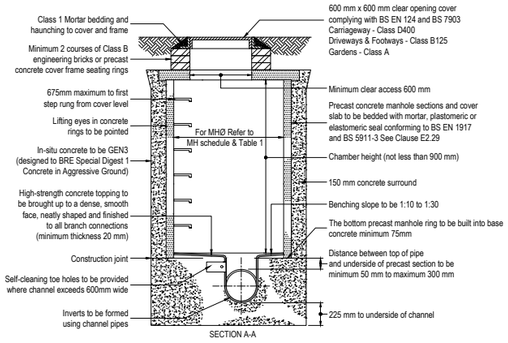
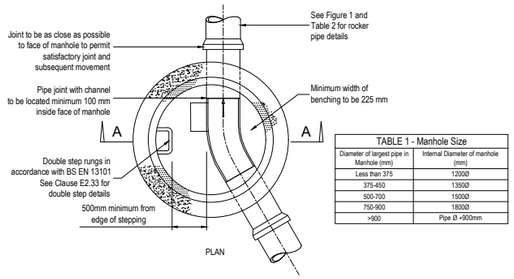
Full Size Drawings - RVW - Structural



SECTION A-A

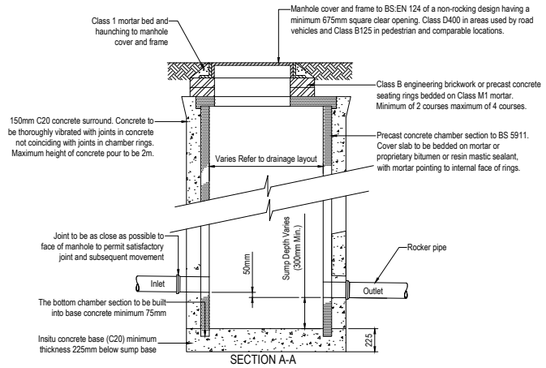


PLAN

TABLE 1 - Manhole Size	
Diameter of largest pipe in Manhole (mm)	Internal Diameter of manhole (mm)
Less than 375	1200Ø
375-450	1350Ø
500-700	1500Ø
750-900	1800Ø
>900	Pipe Ø +900mm

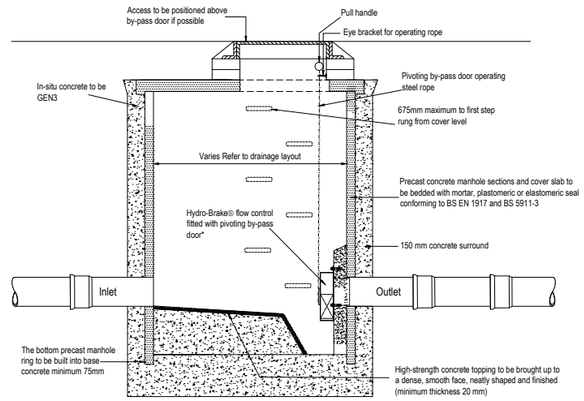
TYPICAL MANHOLE DETAIL - TYPE 2

Maximum depth from cover level to soffit of pipe 3.0m Not to scale



SECTION A-A

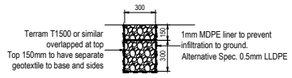
TYPICAL PPC CATCHPIT DETAIL



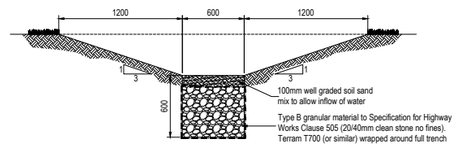
TYPICAL HYDROBRAKE CHAMBER DETAIL

NOTES:-

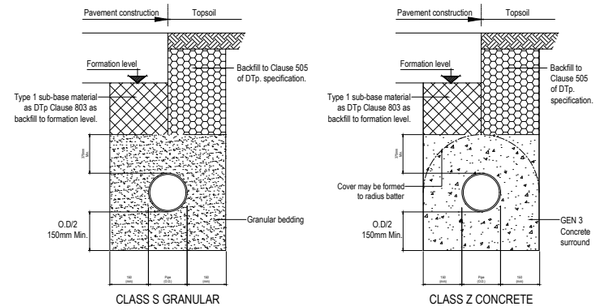
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RVW CONSULTING LIMITED PROJECT DRAWINGS AND SPECIFICATIONS.
2. ALL EXISTING DRAINAGE LEVELS AND OUTFALL POINTS SHALL BE SURVEYED AND VERIFIED BY THE CONTRACTOR PRIOR TO THE COMMENCEMENT OF THE WORKS. ANY DISCREPANCIES SHALL BE REPORTED TO THE ENGINEER IMMEDIATELY.
3. PIPEWORK UNDER ADOPTABLE HIGHWAY WITH LESS THAN 1.2m COVER, AND OTHER TRAFFICKED AREAS WITH LESS THAN 0.9m COVER TO RECEIVE CONCRETE ENCASEMENT.
4. MANHOLE/INSPECTION CHAMBER COVERS SHOULD NOT BRIDGE DIFFERENT SURFACES.
5. WHERE TWO PIPELINES (OTHER THAN PLASTIC PIPES) CROSS WITH LESS THAN 300mm SEPARATION PIPES ARE TO BE SURROUNDED WITH CLASS Z CONCRETE SURROUND FOR NOT LESS THAN 1m CENTERED ON THE CROSSING POINT. CONCRETE SURROUND TO BE EXTENDED AS NECESSARY TO WITHIN 150mm OF NEAREST FLEXIBLE JOINTS.
6. ALL PIPEWORK TO BE LAID WITH SOFFIT TO SOFFIT CONNECTIONS UNLESS NOTED OTHERWISE.
7. ALL CONNECTIONS TO THE PUBLIC SEWERAGE SYSTEM ARE TO BE MADE TO THE SATISFACTION OF THE ADOPTING AUTHORITY AND WILL BE SUBJECT TO A SECTION 106 APPLICATION.



300x450 DEEP FILTER/CARRIER DRAIN DETAIL



TYPICAL SECTION THROUGH SWALE



CLASS S GRANULAR

CLASS Z CONCRETE

NOTES: (CLASS S & CLASS Z)

1. Bedding beneath and at sides of the pipe to be well compacted.
2. The first 300mm of fill above the crown of the pipe is to be lightly compacted by hand. Mechanical compaction may be used only above this level.
3. Concrete cradles and arches may be extended to the sides of the trench.
4. Geotextiles may be used where directed or approved by the Engineer to contain bedding material in certain soils e.g. running sand.
5. In very wet conditions, where directed or approved by the Engineer a temporary land drain may be laid within the granular bed.

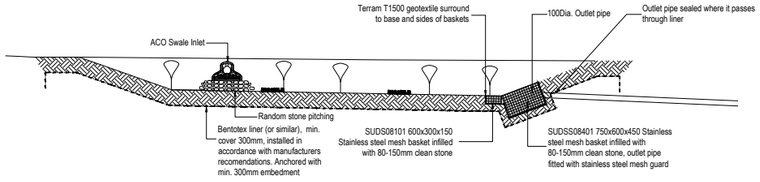
NOTES: (CLASS Z ONLY)

6. Where pipes with flexible joints are used, the concrete protection is to be interrupted over its full cross section at intervals not exceeding 5 metres (or as directed by the Engineer) by a shaped former of bitumen-impregnated insulating board to BS EN622-1 & BS EN 622-4. These interruptions shall coincide with pipe joints. See dimensions on Table 3 for thickness of compressible filler.
7. Concrete to be Class GEN3
8. Where flexible pipes are used, care must be taken to prevent the pipes from floating.

TABLE 3 - Filler Thickness	
Nominal Ø of pipe	Thickness of compressible filler (mm)
Less than 450	18
450-1200	36
>1200	54

Granular Bedding & Sidefill For Rigid & Flexible Pipes		
Pipe Dia.	Class of Bedding	Imported Granular Material (Note 1)
<150mm	S B	10/14mm Single Size or 14 to 5mm Graded
150 to 500mm	S B	10/14/20mm Single Size or 14 to 5mm Graded or 20 to 5mm Graded
>500mm	S B	10/14/20/40mm Single Size or 14 to 5mm Graded or 40 to 5mm Graded

PIPE BEDDING & SURROUND DETAILS



TYPICAL LONG SECTION DETENTION BASIN/POND

This drawing to be read in conjunction with drawing number:
MHPS-RVW-SS6-00-DR-C-000001 SAB Application External Arrangements

"The specification in all respects shall be in accordance with the current Design Manual for Road and Bridges and The Specification for Highway Works and any other construction publication in force in the county at the time of construction."

Rev.	Date.	Details.	By.	Chk.
Amendments				

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Project:
MORRISTON GENERAL HOSPITAL - PHASE 2

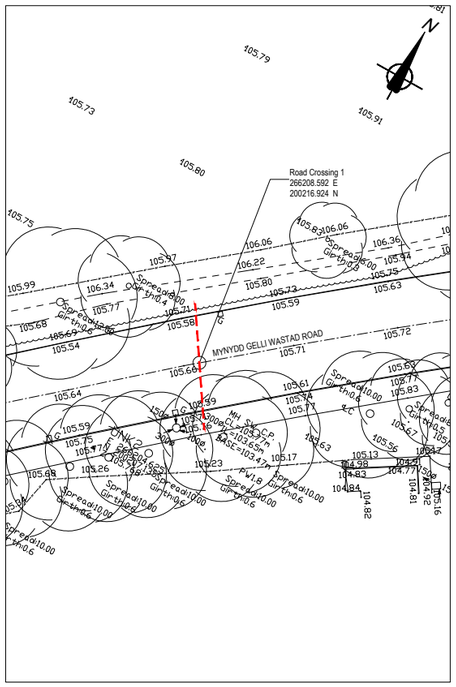
Title:
SAB Application Construction Details

Drawn:	Checked:	Scale(s) at A1:	
KJW	ABP		N.T.S.
Date:	RVW Job N°:	Revision:	Suitability:
11.08.21	**C6986**	**P1**	**S2**

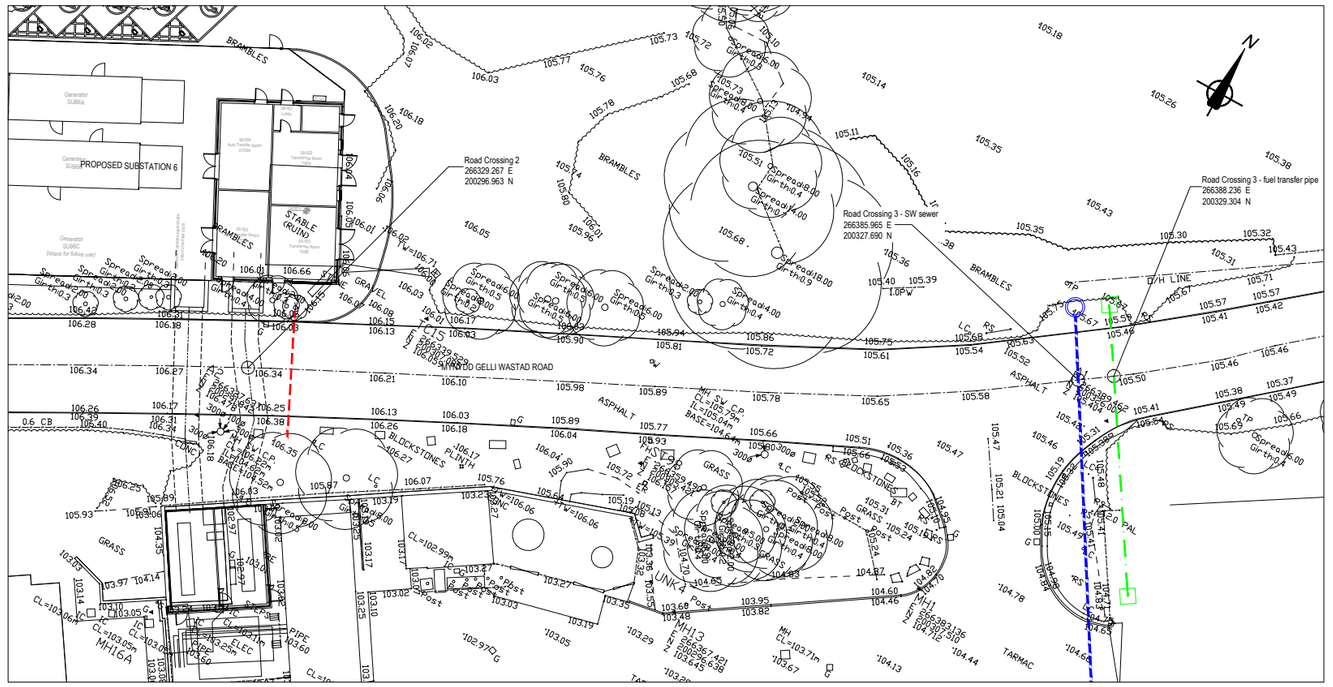
Drawing Status:
STAGE 4 INFORMATION

Drawing N°:
MHP2-RVW-S6-00-DR-C-000003

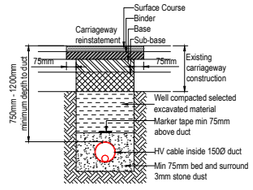
Full Size Drawings - RVW - Structural



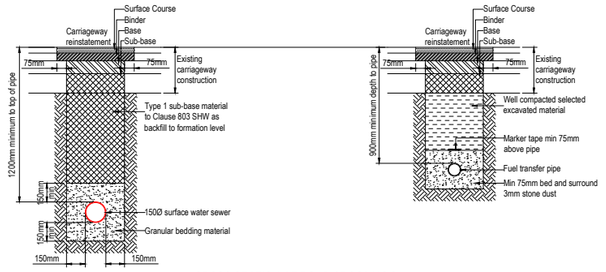
PLAN OF ROAD CROSSING 1
Scale 1:200



PLAN OF ROAD CROSSINGS 2 AND 3
Scale 1:200



CROSS SECTION OF ROAD CROSSING 1
Scale 1:20



CROSS SECTION OF ROAD CROSSING 3
Scale 1:20

SURFACE COURSE
45mm HRA 35/14 F SURF 40/60 H/stone PSV65 to BS EN13108

BINDER
60mm AC 20 Dense Bin 100/150 to BS EN13108

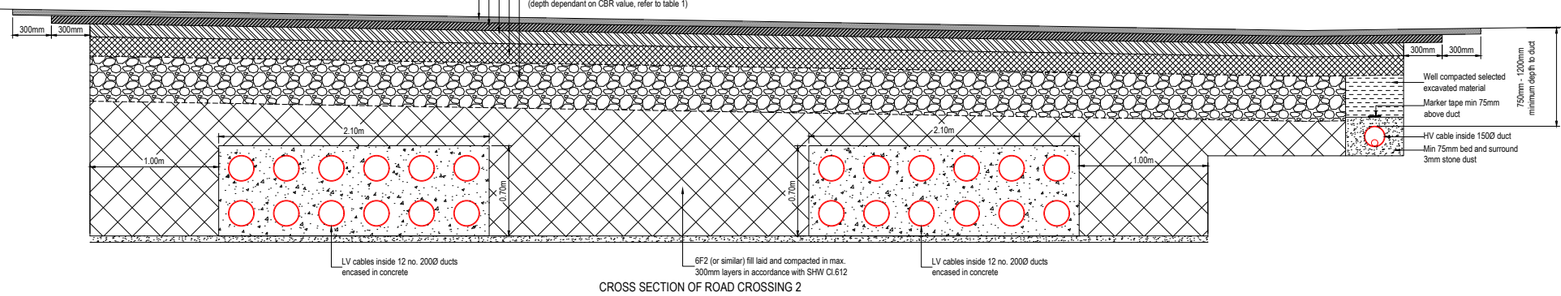
BASE
100mm AC 32 Dense Base 100/150 to BS EN13108

SUB-BASE
Granular sub-base Type 1 to Clause 803 SHW
(depth dependant on CBR value, refer to table 1)

CAPPING LAYER
Capping layer to Clause 613 SHW
(depth dependant on CBR value, refer to table 1)

TABLE 1			
LAYER	CBR VALUE		
	Below 2%	2% - 5%	>5%
Sub-base	150mm	150mm	300mm
Capping layer*	600mm	350mm	0mm

**Capping layer Material to be min. Class 6F1 or 6F2 as specified in Table 6/1 SHW*



CROSS SECTION OF ROAD CROSSING 2
Scale 1:20

NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT RVW CONSULTING LIMITED PROJECT DRAWINGS AND SPECIFICATIONS.

2. DO NOT SCALE FROM THIS DRAWING, USE FIGURED DIMENSIONS ONLY.

3. THIS LAYOUT IS BASED ON THE TOPOGRAPHICAL SURVEY INFORMATION PROVIDED BY THE CLIENT.

Rev.	Date.	Details.	By.	Chk.

Amendments

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Project:
MORRISTON GENERAL HOSPITAL - PHASE 2

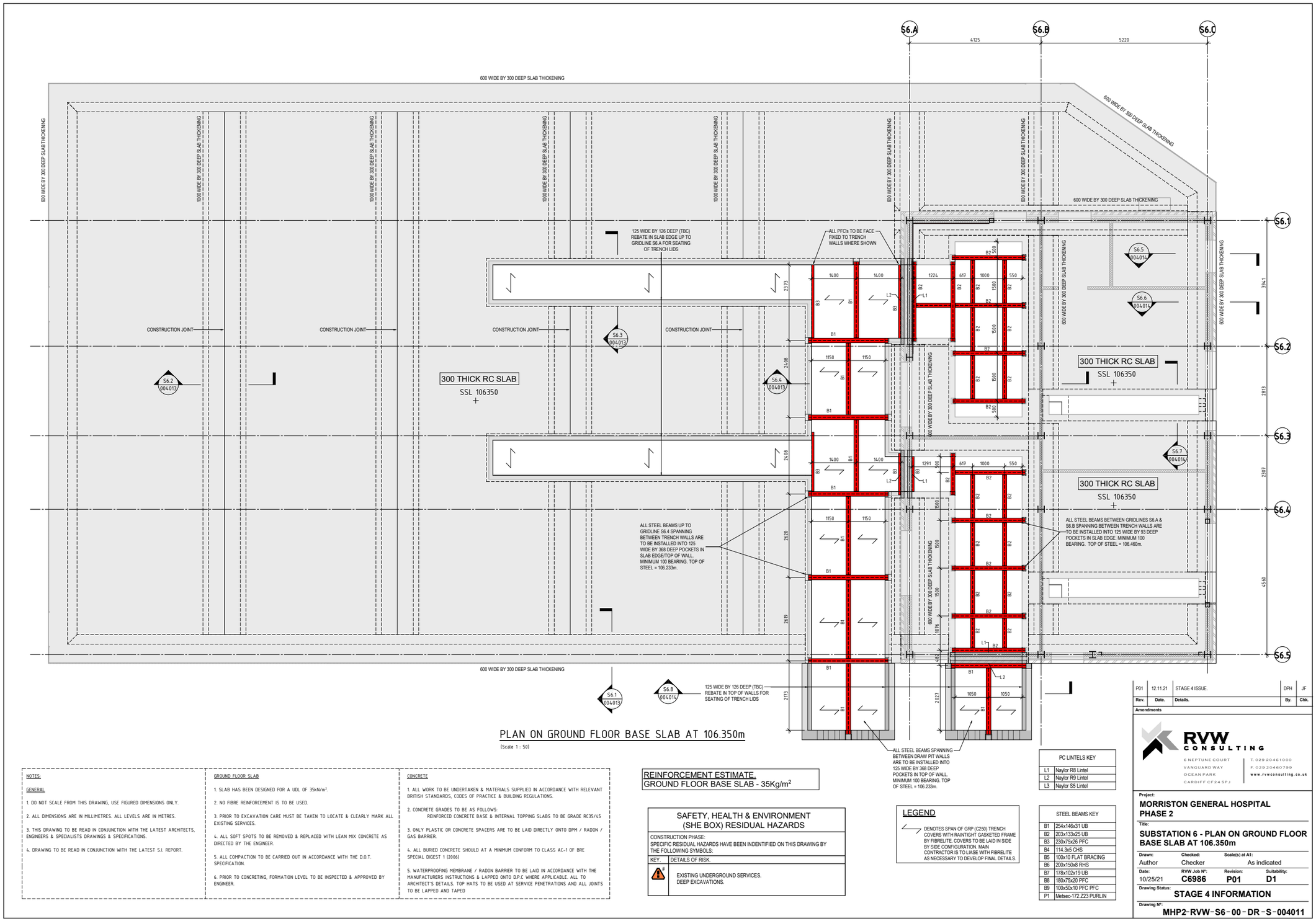
Title:
Section 50 Road Crossing Works

Drawn:	Checked:	Scale(s) at A1:	
KJW	DRW	AS SHOWN	
Date:	RVW Job N°:	Revision:	Suitability:
12.10.21	C6986	P1	S2

Drawing Status:
STAGE 4 INFORMATION

Drawing N°:
MHP2-RVW-S6-00-DR-C-000110

Full Size Drawings - RVW - Structural



PLAN ON GROUND FLOOR BASE SLAB AT 106.350m

(Scale 1 : 50)

NOTES:

GENERAL

1. DO NOT SCALE FROM THIS DRAWING, USE FIGURED DIMENSIONS ONLY.
2. ALL DIMENSIONS ARE IN MILLIMETRES. ALL LEVELS ARE IN METRES.
3. THIS DRAWING TO BE READ IN CONJUNCTION WITH THE LATEST ARCHITECTS, ENGINEERS & SPECIALISTS DRAWINGS & SPECIFICATIONS.
4. DRAWING TO BE READ IN CONJUNCTION WITH THE LATEST S.I. REPORT.

GROUND FLOOR SLAB

1. SLAB HAS BEEN DESIGNED FOR A UDL OF 35kN/m².
2. NO FIBRE REINFORCEMENT IS TO BE USED.
3. PRIOR TO EXCAVATION CARE MUST BE TAKEN TO LOCATE & CLEARLY MARK ALL EXISTING SERVICES.
4. ALL SOFT SPOTS TO BE REMOVED & REPLACED WITH LEAN MIX CONCRETE AS DIRECTED BY THE ENGINEER.
5. ALL COMPACTION TO BE CARRIED OUT IN ACCORDANCE WITH THE D.O.T. SPECIFICATION.
6. PRIOR TO CONCRETING, FORMATION LEVEL TO BE INSPECTED & APPROVED BY ENGINEER.

CONCRETE

1. ALL WORK TO BE UNDERTAKEN & MATERIALS SUPPLIED IN ACCORDANCE WITH RELEVANT BRITISH STANDARDS, CODES OF PRACTICE & BUILDING REGULATIONS.
2. CONCRETE GRADES TO BE AS FOLLOWS:
   REINFORCED CONCRETE BASE & INTERNAL TOPPING SLABS TO BE GRADE RC35/45
3. ONLY PLASTIC OR CONCRETE SPACERS ARE TO BE LAID DIRECTLY ONTO DPM / RADON / GAS BARRIER.
4. ALL BURIED CONCRETE SHOULD AT A MINIMUM CONFORM TO CLASS AC-1 OF BRE SPECIAL DIGEST 1 (2006)
5. WATERPROOFING MEMBRANE / RADON BARRIER TO BE LAID IN ACCORDANCE WITH THE MANUFACTURERS INSTRUCTIONS & LAPPED ONTO D.P.C WHERE APPLICABLE. ALL TO ARCHITECT'S DETAILS. TOP HATS TO BE USED AT SERVICE PENETRATIONS AND ALL JOINTS TO BE LAPPED AND TAPED

REINFORCEMENT ESTIMATE.
GROUND FLOOR BASE SLAB - 35Kg/m²

SAFETY, HEALTH & ENVIRONMENT (SHE BOX) RESIDUAL HAZARDS

CONSTRUCTION PHASE:
SPECIFIC RESIDUAL HAZARDS HAVE BEEN INDENTIFIED ON THIS DRAWING BY THE FOLLOWING SYMBOLS:

KEY.	DETAILS OF RISK.
⚠	EXISTING UNDERGROUND SERVICES. DEEP EXCAVATIONS.

LEGEND

DENOTES SPAN OF GRP (C250) TRENCH COVERS WITH RAINTIGHT GASKETED FRAME BY FIBRELITE. COVERS TO BE LAID IN SIDE BY SIDE CONFIGURATION. MAIN CONTRACTOR IS TO LIASE WITH FIBRELITE AS NECESSARY TO DEVELOP FINAL DETAILS.

PC LINTELS KEY

L1	Naylor R8 Lintel
L2	Naylor R9 Lintel
L3	Naylor S5 Lintel

STEEL BEAMS KEY

B1	254x146x31 UB
B2	203x133x25 UB
B3	230x75x26 PFC
B4	114.3x5 CHS
B5	100x10 FLAT BRACING
B6	200x150x8 RHS
B7	178x102x19 UB
B8	180x75x20 PFC
B9	100x50x10 PFC PFC
P1	Metsec-172.Z23 PURLIN

Rev.	Date.	Details.	By.	Chk.
P01	12.11.21	STAGE 4 ISSUE.	DPH	JF

Amendments

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Project:
MORRISTON GENERAL HOSPITAL PHASE 2

Title:
SUBSTATION 6 - PLAN ON GROUND FLOOR BASE SLAB AT 106.350m

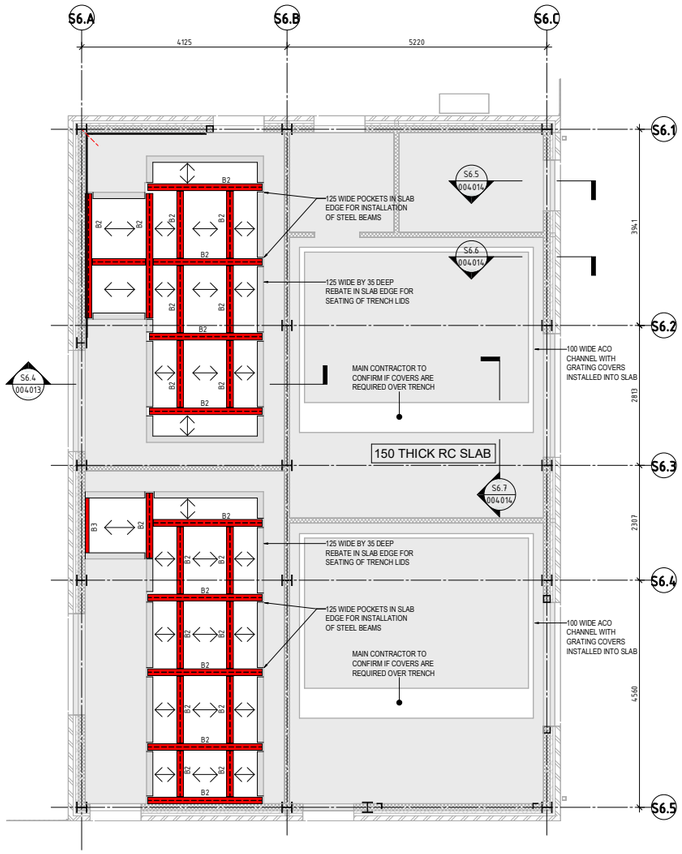
Drawn:	Checked:	Scale(s) at A1:	
Author	Checker	As indicated	
Date:	RVW Job N°:	Revision:	Suitability:
10/25/21	C6986	P01	D1

Drawing Status: **STAGE 4 INFORMATION**

Drawing N°:
MHP2-RVW-S6-00-DR-S-004011

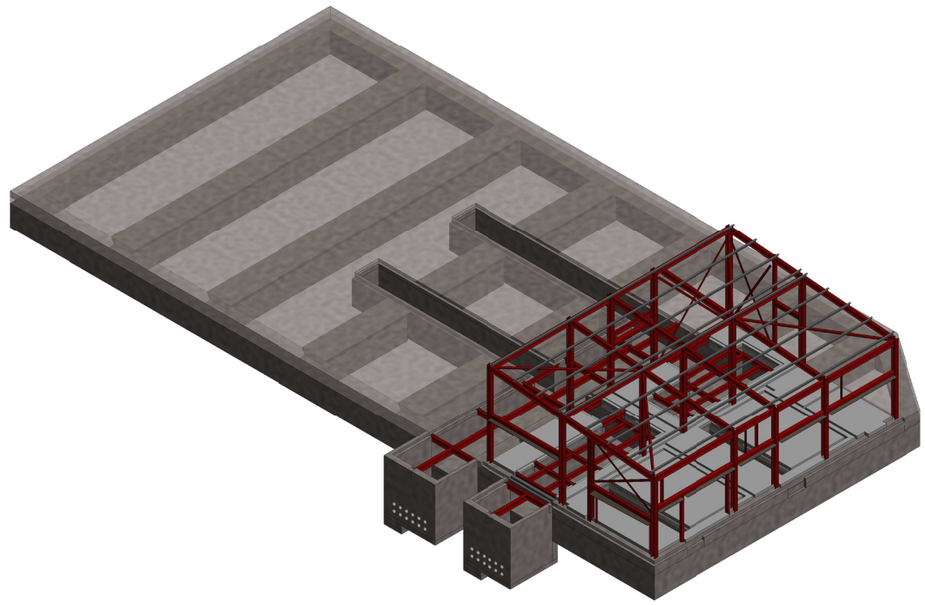
Full Size Drawings - RVW - Structural

SAFETY, HEALTH & ENVIRONMENT (SHE BOX) RESIDUAL HAZARDS	
CONSTRUCTION PHASE: SPECIFIC RESIDUAL HAZARDS HAVE BEEN INDENTIFIED ON THIS DRAWING BY THE FOLLOWING SYMBOLS:	
KEY.	DETAILS OF RISK.
⚠	EXISTING UNDERGROUND SERVICES. DEEP EXCAVATIONS.



PLAN ON GROUND FLOOR INTERNAL SLAB AT 106.500m

(Scale 1 : 50)



SUBSTATION 6 3D VIEW

(Scale)

REINFORCEMENT ESTIMATE.
GROUND FLOOR INTERNAL TOPPING SLAB - 10Kg/m²

LEGEND

⟷ DENOTES SPAN OF 35x5, 34/100 RECTANGULAR PATTERN MILD STEEL OPEN MESH FLOORING BY STEELWAY .

STEEL BEAMS KEY	
B1	254x146x31 UB
B2	203x133x25 UB
B3	230x75x26 PFC
B4	114.3x5 CHS
B5	100x10 FLAT BRACING
B6	200x150x8 RHS
B7	178x102x19 UB
B8	180x75x20 PFC
B9	100x50x10 PFC PFC
P1	Metsec-172.Z23 PURLIN

NOTES:

GENERAL

1. DO NOT SCALE FROM THIS DRAWING, USE FIGURED DIMENSIONS ONLY.
2. ALL DIMENSIONS ARE IN MILLIMETRES. ALL LEVELS ARE IN METRES.
3. THIS DRAWING TO BE READ IN CONJUNCTION WITH THE LATEST ARCHITECTS, ENGINEERS & SPECIALISTS DRAWINGS & SPECIFICATIONS.
4. DRAWING TO BE READ IN CONJUNCTION WITH THE LATEST S.I. REPORT.

GROUND FLOOR SLAB

1. SLAB HAS BEEN DESIGNED FOR A UDL OF 35kN/m².
2. NO FIBRE REINFORCEMENT IS TO BE USED.
3. PRIOR TO EXCAVATION CARE MUST BE TAKEN TO LOCATE & CLEARLY MARK ALL EXISTING SERVICES.
4. ALL SOFT SPOTS TO BE REMOVED & REPLACED WITH LEAN MIX CONCRETE AS DIRECTED BY THE ENGINEER.
5. ALL COMPACTION TO BE CARRIED OUT IN ACCORDANCE WITH THE D.O.T. SPECIFICATION.
6. PRIOR TO CONCRETING, FORMATION LEVEL TO BE INSPECTED & APPROVED BY ENGINEER.

CONCRETE

1. ALL WORK TO BE UNDERTAKEN & MATERIALS SUPPLIED IN ACCORDANCE WITH RELEVANT BRITISH STANDARDS, CODES OF PRACTICE & BUILDING REGULATIONS.
2. CONCRETE GRADES TO BE AS FOLLOWS:
   REINFORCED CONCRETE BASE & INTERNAL TOPPING SLABS TO BE GRADE RC35/45
3. ONLY PLASTIC OR CONCRETE SPACERS ARE TO BE LAID DIRECTLY ONTO DPM / RADON / GAS BARRIER.
4. ALL BURIED CONCRETE SHOULD AT A MINIMUM CONFORM TO CLASS AC-1 OF BRE SPECIAL DIGEST 1 (2006)
5. WATERPROOFING MEMBRANE / RADON BARRIER TO BE LAID IN ACCORDANCE WITH THE MANUFACTURERS INSTRUCTIONS & LAPPED ONTO D.P.C WHERE APPLICABLE ALL TO ARCHITECT'S DETAILS. TOP HATS TO BE USED AT SERVICE PENETRATIONS AND ALL JOINTS TO BE LAPPED AND TAPED

Rev.	Date.	Details.	By.	Chk.
P01	12.11.21	STAGE 4 ISSUE.	DPH	JF

Amendments

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Project:
MORRISTON GENERAL HOSPITAL PHASE 2

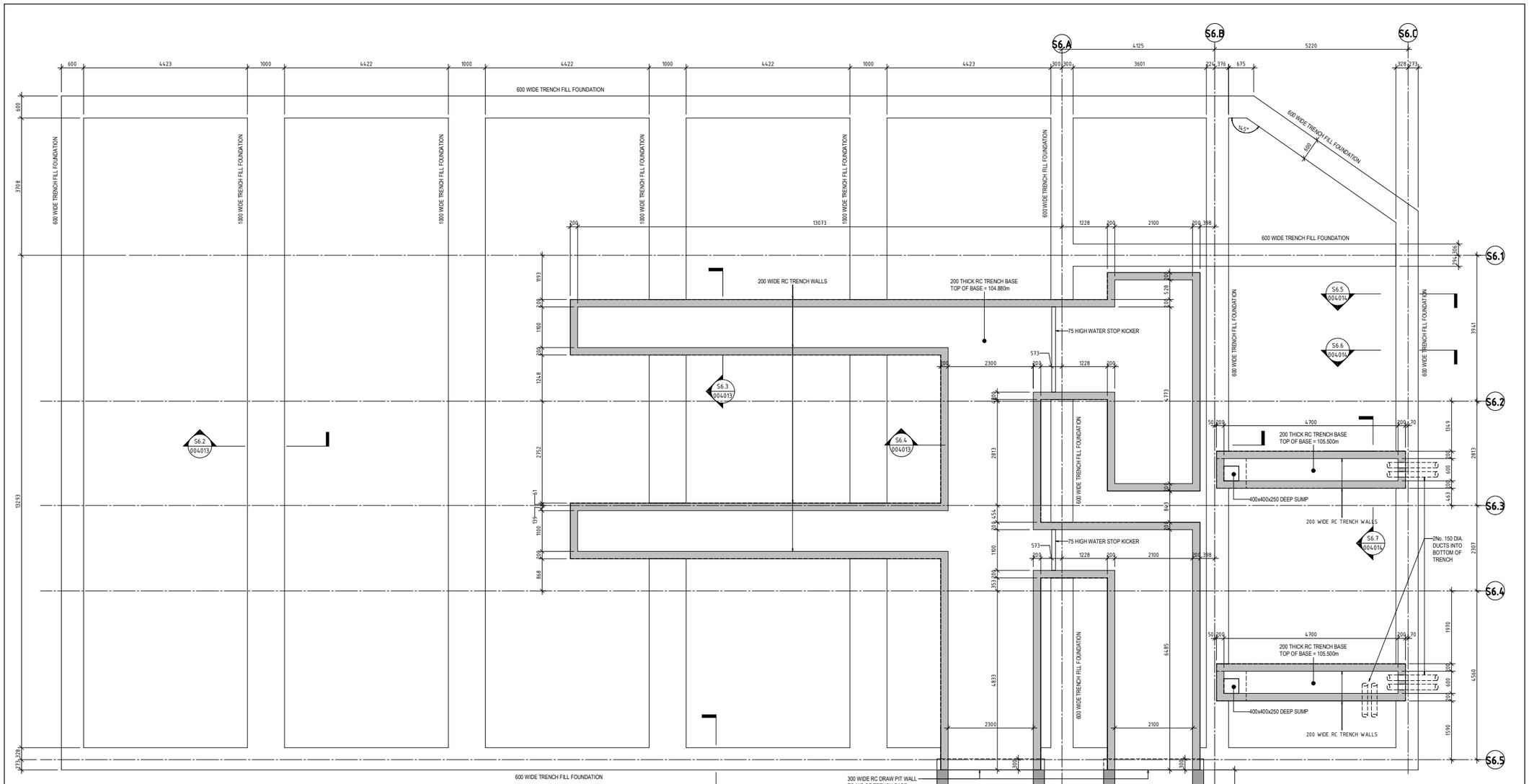
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SUBSTATION 6 - PLAN ON GROUND FLOOR INTERNAL SLAB AT 106.500m

Drawn:	Checked:	Scale(s) at A1:	
DPH	JF	As indicated	
Date:	**RVW Job N°:**	**Revision:**	**Suitability:**
OCT. 2021	C6986	P01	D1

Drawing Status: **STAGE 4 INFORMATION**

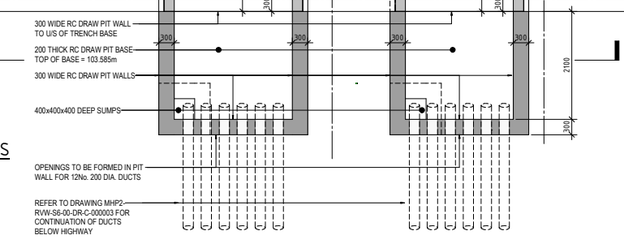
Drawing N°: **MHP2-RVW-S6-00-DR-S-004012**

Full Size Drawings - RVW - Structural



PLAN ON FOUNDATIONS

(Scale 1 : 50)



NOTES:

GENERAL

1. DO NOT SCALE FROM THIS DRAWING, USE FIGURED DIMENSIONS ONLY.
2. ALL DIMENSIONS ARE IN MILLIMETRES. ALL LEVELS ARE IN METRES.
3. THIS DRAWING TO BE READ IN CONJUNCTION WITH THE LATEST ARCHITECTS, ENGINEERS & SPECIALISTS DRAWINGS & SPECIFICATIONS.
4. PRIOR TO SETTING OUT OF FOUNDATIONS ALL PROPOSED SETTING OUT TO BE CO-ORDINATED WITH ARCHITECTS DETAILS & DRAWINGS.
5. DRAWING TO BE READ IN CONJUNCTION WITH THE LATEST S.I. REPORT.

FOUNDATIONS

1. FOUNDATIONS TO BE CO-ORDINATED WITH EXTERNAL WORKS AND DRAINAGE LAYOUTS.
2. THE FOUNDATIONS ARE DESIGNED TO A BEARING PRESSURE OF 100KN/m² AS PER THE RECOMMENDATIONS IN THE SITE INVESTIGATION REPORT. REFERENCE SHOULD BE MADE TO THE REPORT PRIOR TO ANY EXCAVATION WORK BEING UNDERTAKEN.
3. PRIOR TO EXCAVATION CARE MUST BE TAKEN TO LOCATE & CLEARLY MARK ALL EXISTING SERVICES.
4. WHERE APPLICABLE, FOUNDATIONS TO BE TAKEN DOWN TO INVERT LEVEL OF ADJACENT DRAINAGE.
5. ALL SOFT SPOTS TO BE REMOVED & REPLACED WITH LEAN MIX CONCRETE AS DIRECTED BY THE ENGINEER.
6. ALL COMPACTION TO BE CARRIED OUT IN ACCORDANCE WITH THE D.O.T. SPECIFICATION.
7. PRIOR TO CONCRETING, FORMATION LEVEL TO BE INSPECTED & APPROVED BY ENGINEER.
8. ALL FOUNDATIONS TO PENETRATE INTO THE BEARING STRATA AS NOTED ON THE SUBSTRUCTURE DETAILS DRAWINGS.

CONCRETE

1. ALL WORK TO BE UNDERTAKEN & MATERIALS SUPPLIED IN ACCORDANCE WITH RELEVANT BRITISH STANDARDS, CODES OF PRACTICE & BUILDING REGULATIONS.
2. CONCRETE GRADES TO BE AS FOLLOWS:
   MASS CONCRETE TRENCH FILL FOUNDATIONS TO BE GRADE FND2
   REINFORCED CONCRETE M+E TRENCH BASE, WALLS & DRAW PIT TO BE GRADE RC35/45
3. ONLY PLASTIC OR CONCRETE SPACERS ARE TO BE LAID DIRECTLY ONTO DPM / RADON / GAS BARRIER.
4. ALL BURIED CONCRETE SHOULD AT A MINIMUM CONFORM TO CLASS AC-1 OF BRE SPECIAL DIGEST 1 (2006)
5. WATERPROOFING MEMBRANE / RADON BARRIER TO BE LAID IN ACCORDANCE WITH THE MANUFACTURERS INSTRUCTIONS & LAPPED ONTO D.P.C WHERE APPLICABLE. ALL TO ARCHITECT'S DETAILS. TOP HATS TO BE USED AT SERVICE PENETRATIONS AND ALL JOINTS TO BE LAPPED AND TAPED

REINFORCEMENT ESTIMATE.
M+E TRENCHES BASES & WALLS - 60Kg/m²

SAFETY, HEALTH & ENVIRONMENT (SHE BOX) RESIDUAL HAZARDS

CONSTRUCTION PHASE:
SPECIFIC RESIDUAL HAZARDS HAVE BEEN INDENTIFIED ON THIS DRAWING BY THE FOLLOWING SYMBOLS:

KEY.	DETAILS OF RISK.
4	EXISTING UNDERGROUND SERVICES. DEEP EXCAVATIONS.

Rev.	Date.	Details.	By.	Chk.
P01	12.11.21	STAGE 4 ISSUE.	DPH	JF

Amendments

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Project:
MORRISTON GENERAL HOSPITAL PHASE 2

Title:
SUBSTATION 6
PLAN ON FOUNDATIONS

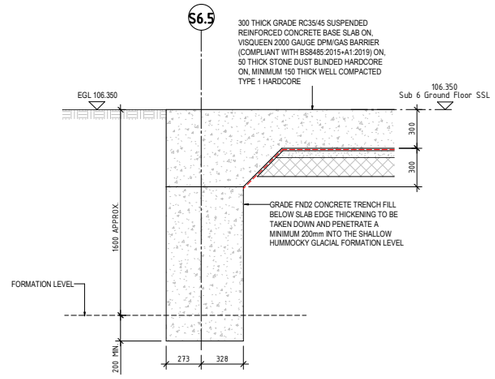
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DPH	JF	As indicated	
Date:	RVW Job N°:	Revision:	Suitability:
OCT. 2021	C6986	P01	D1

Drawing Status: **STAGE 4 INFORMATION**

Drawing N°:
MHP2-RVW-S6-B1-DR-S-004010

Full Size Drawings - RVW - Structural

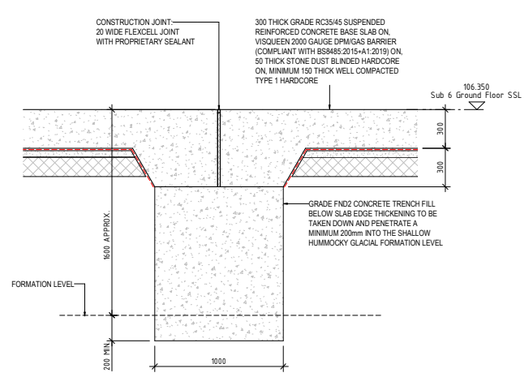
FOR ALL SUBSTRUCTURE NOTES REFER TO DRAWINGS MHP2-RVW-S6-ZZ-DR-S-004016 MPH2-RVW-S6-B1-DR-S-004010, MHP2-RVW-S6--01-DR-S-994011 & MHP2-RVW-S6-00-DR-S-004012.



SECTION S6.1-S6.1

(Scale 1 : 20)

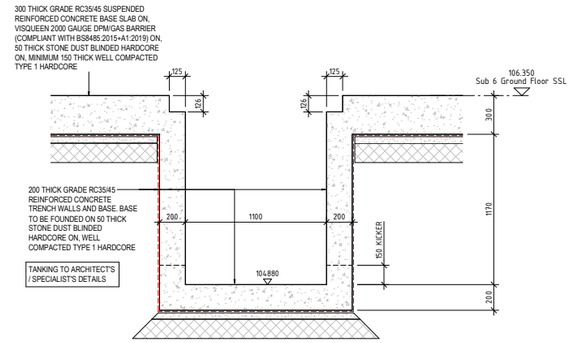
(TYPICAL THROUGH CONCRETE BASE SLAB EDGE)



SECTION S6.2-S6.2

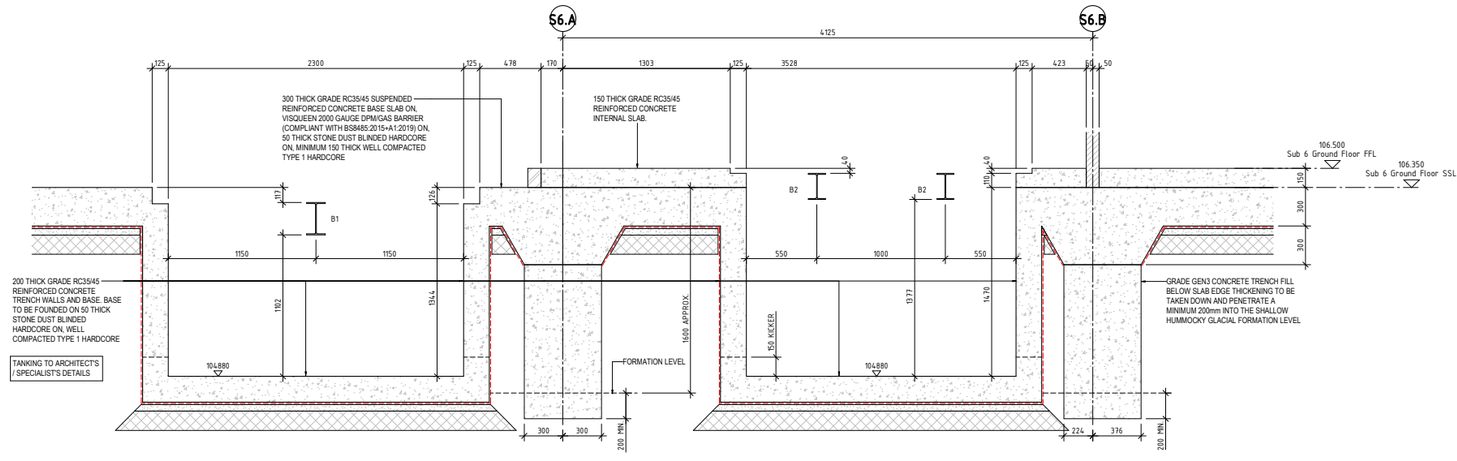
(Scale 1 : 20)

(TYPICAL THROUGH 1000 WIDE BY 300 DEEP BASE SLAB THICKENING)



SECTION S6.3-S6.3

(Scale 1 : 20)



SECTION S6.4-S6.4

(Scale 1 : 20)

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P01	12.11.21	STAGE 4 ISSUE.	DPH	JF

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MORRISTON GENERAL HOSPITAL PHASE 2

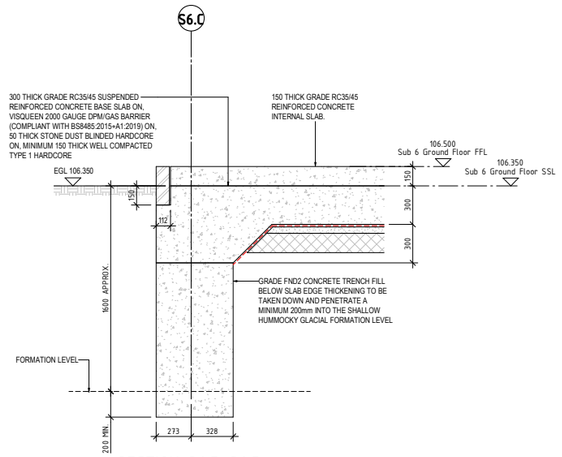
Title:
SUBSTATION 6 - SUBSTRUCTURE SECTIONS & DETAILS (1 of 2)

Drawn:	Checked:	Scale(s) at A1:	
DPH	JF		1 : 20
Date:	RVW Job N°:	Revision:	Suitability:
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Drawing N°:
MHP2-RVW-S6-ZZ-DR-S-004013

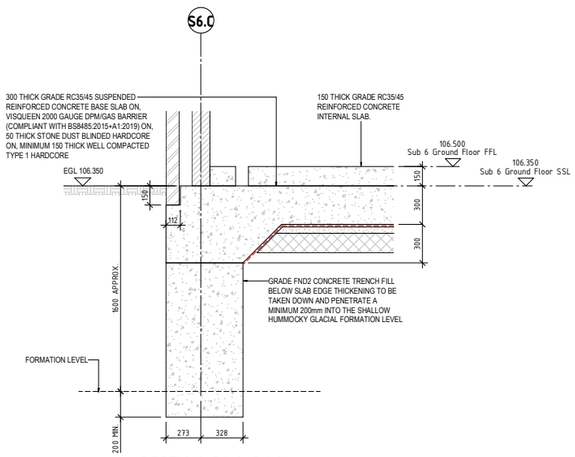
Full Size Drawings - RVW - Structural



SECTION S6.5-S6.5

(Scale 1 : 20)

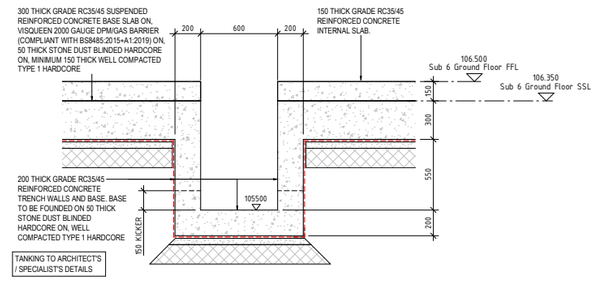
(TYPICAL THROUGH SUB 6 BUILDING SLAB EDGE AT DOOR LOCATIONS)



SECTION S6.6-S6.6

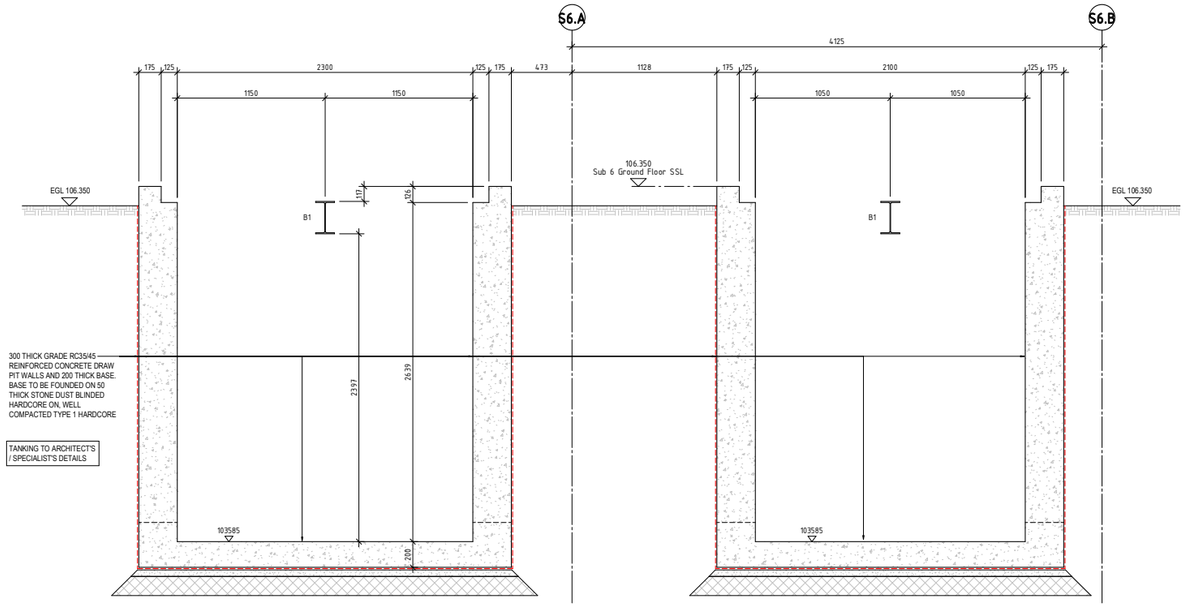
(Scale 1 : 20)

(TYPICAL THROUGH SUB 6 BUILDING SLAB EDGE)



SECTION S6.7-S6.7

(Scale 1 : 20)



SECTION S6.8-S6.8

(Scale 1 : 20)

FOR ALL SUBSTRUCTURE NOTES REFER TO DRAWINGS MHP2-RVW-S6-ZZ-DR-S-004016 MPH2-RVW-S6-B1-DR-S-004010, MHP2-RVW-S6--01-DR-S-994011 & MHP2-RVW-S6-00-DR-S-004012.

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P01	12.11.21	STAGE 4 ISSUE.	DPH	JF

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Project:
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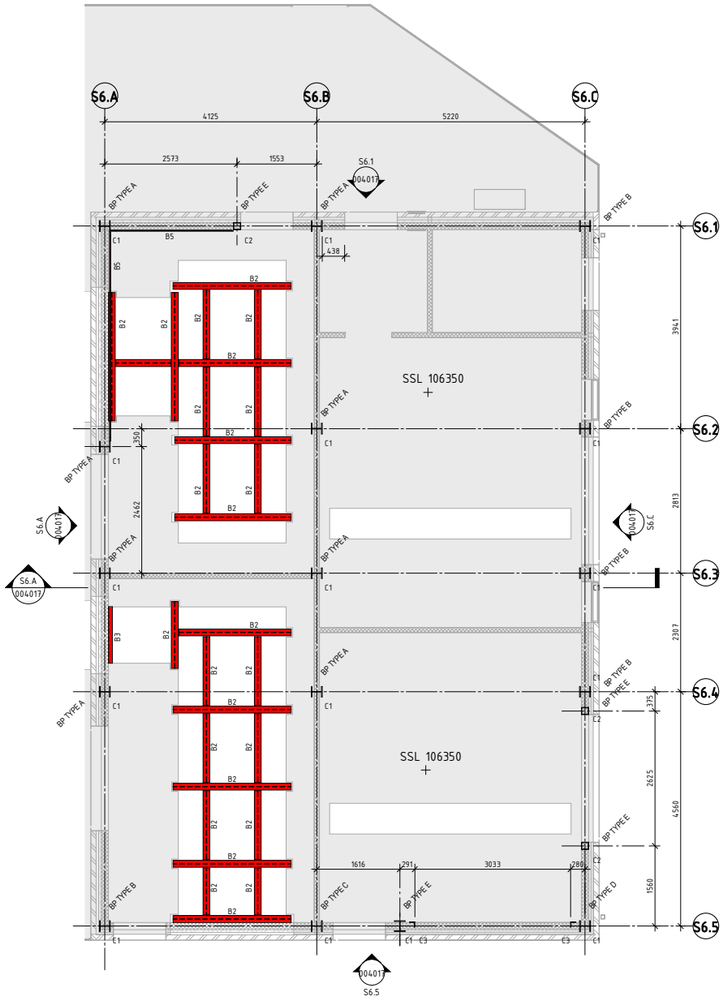
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SUBSTATION 6 - SUBSTRUCTURE SECTIONS & DETAILS (2 of 2)

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Date:	RVW Job N°:	Revision:	Suitability:
OCT. 2021	C6986	P01	D1

Drawing Status:
STAGE 4 INFORMATION

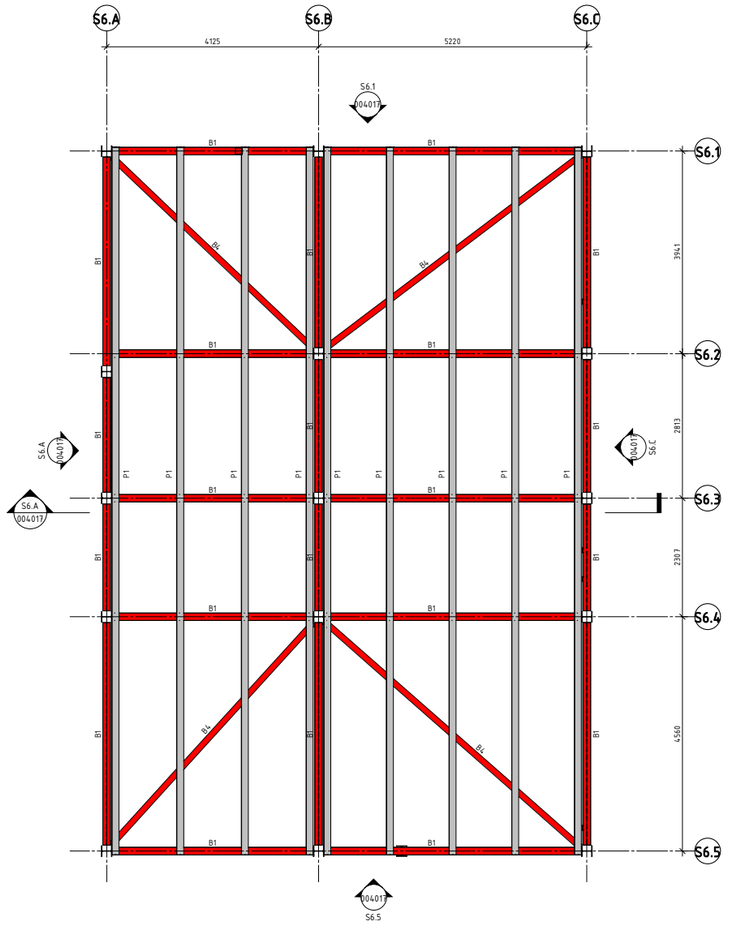
Drawing N°:
MHP2-RVW-S6-ZZ-DR-S-004014

Full Size Drawings - RVW - Structural



PLAN ON STEELWORK AT GROUND FLOOR LEVEL

(Scale 1 : 50)



PLAN ON ROOF STEELWORK

(Scale 1 : 50)

SEONDARY STEELWORK

PURLINS TO BE METSEC 172.Z23 PURLINS AT MAX. 1500c/c (SLEEVED SYSTEM). REQUIREMENTS FOR ANTI-SAG RODS, DIAGONAL TIES WIRES ETC.. TO BE AS MANUFACTURER'S RECOMMENDATIONS.

NOTES :-

GENERAL

DO NOT SCALE FROM THIS DRAWING, USE FIGURED DIMENSIONS ONLY.

ALL DIMENSIONS ARE IN MILLIMETRES. ALL LEVELS ARE IN METRES.

THIS DRAWING TO BE READ IN CONJUNCTION WITH THE LATEST ARCHITECTS, ENGINEERS & SPECIALISTS DRAWINGS & SPECIFICATIONS.

STEELWORK

DESIGN RESPONSIBILITIES:
1. THE STRUCTURE HAS BEEN DESIGNED FOR THE FINAL CONFIGURATION ONLY.
2. THE CONTRACTOR SHALL BE RESONSIBLE FOR DESIGN, FABRICATION, ERECTION AND REMOVAL OF ALL TEMPORARY WORKS AND SHALL PROVIDE ALL TEMPORARY BRACING & BACKPROPPING NECESSARY TO MAINTAIN STABILITY DURING CONSTRUCTION.
3. THE STEEL FABRICATOR SHALL BE RESPONSIBLE FOR THE STEELWORK FABRICATION DRAWINGS AS WELL AS DESIGN OF STEEL TO STEEL CONNECTIONS TO SUIT THEIR METHOD OF ERECTION.

STEELWORK FABRICATOR TO DESIGN & DETAIL ALL CONNECTIONS. LOADS TO BE PROVIDED BY THE ENGINEER. ALL CONNECTIONS TO BE CAPABLE OF RESISTING THE TYING FORCE REQUIRED BY BS. 5950.

PRIOR TO ANY FABRICATION:
A) ALL CALCULATIONS & DETAILS TO BE APPROVED BY THE ENGINEER.
B) FABRICATOR TO PRODUCE A FULL SET OF DETAILED DRAWINGS FOR COMMENT.

SPECIFICATION FOR STRUCTURAL STEELWORK TO BE IN ACCORDANCE WITH THE LATEST EDITION OF THE 'NATIONAL STRUCTURAL STEELWORK SPECIFICATION FOR BUILDING CONSTRUCTION' BY BSCA.

GALVANISING SPECIFICATION:

ALL HOT ROLLED STEEL - 85 MICRONS HOT DIP GALAVNISED TO ENISO14715 EN ISO 1461 STANDARD CODE OF PRACTISE

ALL DAMAGED STEEL TO BE MADE GOOD TO ENGINEERS APPROVAL.

STEELWORK FABRICATOR TO BE SOLELY RESPONSIBLE FOR TEMPORARY WORK & THE ERECTION OF STRUCTURAL STEELWORK.

UNLESS OTHERWISE NOTED:

A) ALL HOT ROLLED STEEL TO BE GRADE S355

B) ALL WELDS TO BE 6mm CONTINUOUS FILLET WELDS.

C) ALL BOLTS FOR HOT ROLLED SECTIONS TO BE GRADE 8.8.

D) ALL BOLTS FOR COLD ROLLED SECTIONS TO BE GRADE 4.6.

IF ANY SPLICES ARE TO BE USED, THEIR LOCATION MUST BE APPROVED BY THE ENGINEER.

ALL COLD FORMED SECTIONS, ROOF PURLINS, SIDE RAILS & TRIMMERS, INCLUDING TRIMMERS TO BE DETAILED TO MANUFACTURERS SPECIFICATION.

ALL WALL RESTRAINING MEMBERS TO HAVE SLOTTED CONNECTIONS & COUNTERSUNK BOLT FIXINGS.

ALL STEELWORK ENCLOSED IN CONCRETE TO RECEIVE ONE COAT OF BITUMINOUS PAINT TO TOP OF BLOCKWORK UP TO DPC

FOR LOCATION OF ALL ROOF & SIDE MOUNTED PLANT REFER TO M&E DRAWINGS.

STEEL COLUMNS KEY	
C1	203x203x60 UC
C2	140x140x8 SHS
C3	100x100x10 RSA
C4	219.1x10 CHS

STEEL BEAMS KEY	
B1	254x146x31 UB
B2	203x133x25 UB
B3	230x75x26 PFC
B4	114.3x5 CHS
B5	100x10 FLAT BRACING
B6	200x150x8 RHS
B7	178x102x19 UB
B8	180x75x20 PFC
B9	100x50x10 PFC PFC
P1	Metsec-172.Z23 PURLIN

SAFETY, HEALTH & ENVIRONMENT (SHE BOX) RESIDUAL HAZARDS

CONSTRUCTION PHASE:
SPECIFIC RESIDUAL HAZARDS HAVE BEEN INDENTIFIED ON THIS DRAWING BY THE FOLLOWING SYMBOLS:

KEY.	DETAILS OF RISK.
	EXISTING UNDERGROUND SERVICES. DEEP EXCAVATIONS. WORKING AT HEIGHT.

Rev.	Date.	Details.	By.	Chk.
P01	12.11.21	STAGE 4 ISSUE.	DPH	JF

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MORRISTON GENERAL HOSPITAL PHASE 2

Title:
SUBSTATION 6 STEELWORK PLANS

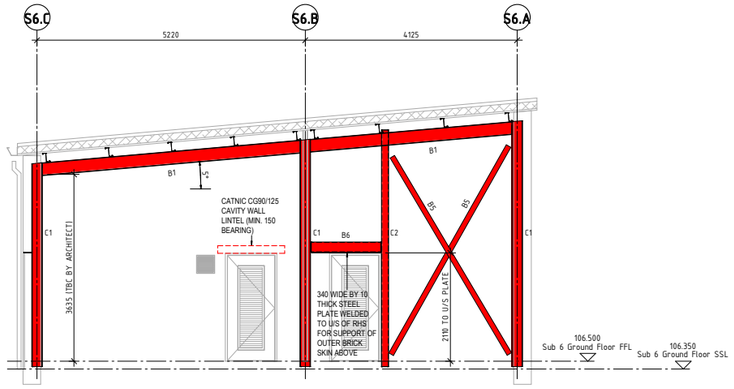
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DPH	JF	As indicated

Date:	RVW Job N°:	Revision:	Suitability:
NOV. 2021	C6986	P01	D1

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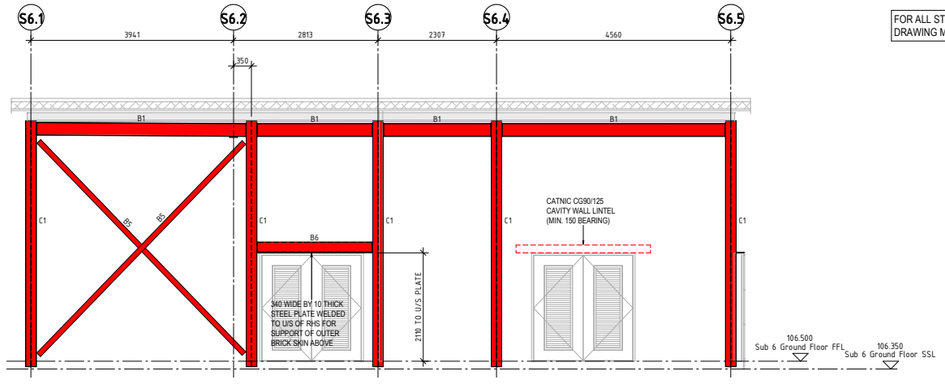
Drawing N°: **MHP2-RVW-S6-ZZ-DR-S-004016**

Full Size Drawings - RVW - Structural



ELEVATION ON GRIDLINE S6.1

(Scale 1 : 50)



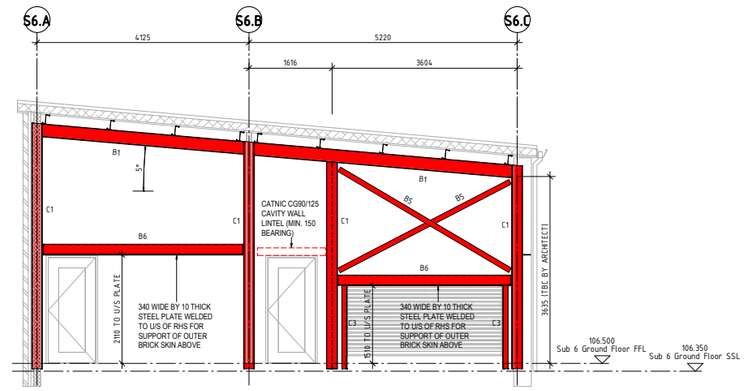
ELEVATION ON GRIDLINE S6.A

(Scale 1 : 50)

FOR ALL STEELWORK NOTES REFER TO DRAWING MHP2-RVW-S6-ZZ-DR-S-004016

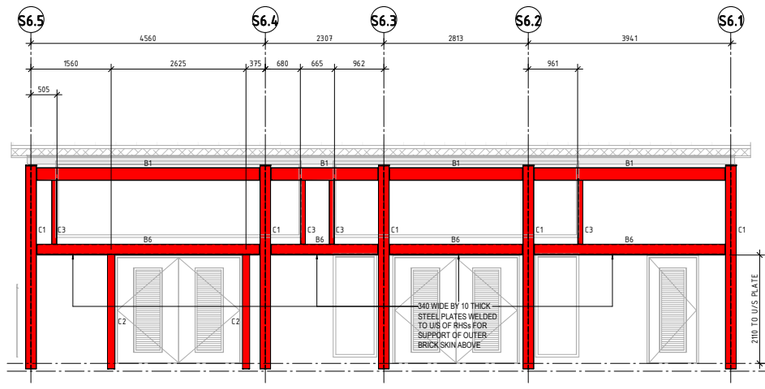
STEEL COLUMNS KEY	
C1	203x203x60 UC
C2	140x140x8 SHS
C3	100x100x10 RSA
C4	219.1x10 CHS

STEEL BEAMS KEY	
B1	254x146x31 UB
B2	203x133x25 UB
B3	230x75x26 PFC
B4	114.3x5 CHS
B5	100x10 FLAT BRACING
B6	200x150x8 RHS
B7	178x102x19 UB
B8	180x75x20 PFC
B9	100x50x10 PFC PFC
P1	Metsec-172.223 PURLIN



ELEVATION ON GRIDLINE S6.5

(Scale 1 : 50)

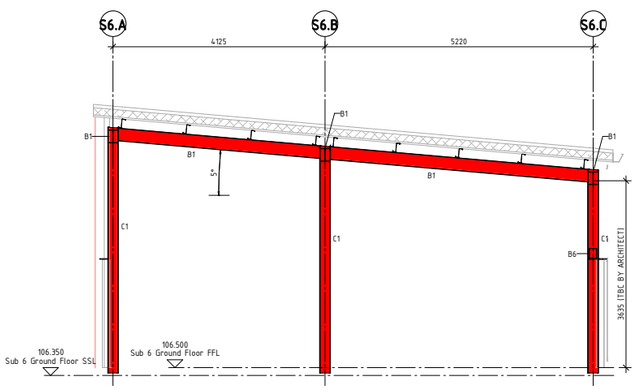


ELEVATION ON GRIDLINE S6.C

(Scale 1 : 50)

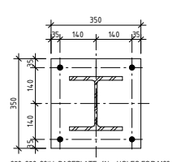
HOLDING DOWN BOLT DETAIL

(Scale 1 : 10)



SECTION S6.A-S6.A

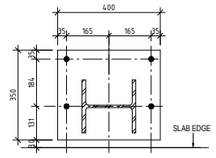
(Scale 1 : 50)



350x350x20thk BASEPLATE. 4No. HOLES FOR M20 375mm LONG GRADE 8.8 HOLDING DOWN BOLTS. 6mm FULL PROFILE WELD TO COLUMN

203x203 UC BASEPLATE DETAIL (TYPE A)

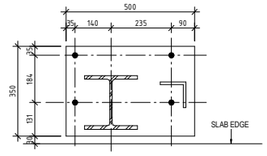
(Scale 1 : 10)



350x400x20thk BASEPLATE. 4No. HOLES FOR M20 375mm LONG GRADE 8.8 HOLDING DOWN BOLTS. 6mm FULL PROFILE WELD TO COLUMN

203x203 UC BASEPLATE DETAIL (TYPE C)

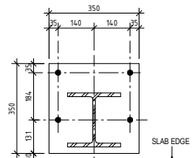
(Scale 1 : 10)



350x500x20thk BASEPLATE. 4No. HOLES FOR M20 375mm LONG GRADE 8.8 HOLDING DOWN BOLTS. 6mm FULL PROFILE WELD TO COLUMN

203x203 UC/100x100 RSA BASEPLATE DETAIL (TYPE E)

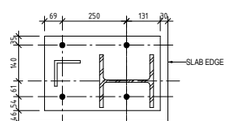
(Scale 1 : 10)



350x350x20thk BASEPLATE. 4No. HOLES FOR M20 375mm LONG GRADE 8.8 HOLDING DOWN BOLTS. 6mm FULL PROFILE WELD TO COLUMN

203x203 UC BASEPLATE DETAIL (TYPE B)

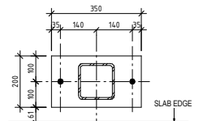
(Scale 1 : 10)



290x450x20thk BASEPLATE. 4No. HOLES FOR M20 375mm LONG GRADE 8.8 HOLDING DOWN BOLTS. 6mm FULL PROFILE WELD TO COLUMN

203x203 UC/100x100 RSA BASEPLATE DETAIL (TYPE D)

(Scale 1 : 10)



200x350x20thk BASEPLATE. 4No. HOLES FOR M20 375mm LONG GRADE 8.8 HOLDING DOWN BOLTS. 6mm FULL PROFILE WELD TO COLUMN

140x140 SHS BASEPLATE DETAIL (TYPE F)

(Scale 1 : 10)

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Project:
MORRISTON GENERAL HOSPITAL PHASE 2

Title:
SUBSTATION 6 STEELWORK SECTIONS & ELEVATIONS

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Date:	**RVW Job N°:**	**Revision:**	**Suitability:**
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Drawing N°: **MHP2-RVW-S6-ZZ-DR-S-004017**

MORRISTON HOSPITAL - INFRASTRUCTURE WORKS

5A: NBS SPECIFICATIONS

NBS Specifications - AECOM

AECOM

Morriston Hospital – HSDU

Swansea Bay University Health Board (SBUHB)

AECOM Engineering Services Specification

MEP Specification

November 2021

Building Engineering

Swansea Bay University Health Board (SBUHB)

Morriston Hospital – HSDU
AECOM Engineering Services Specification
Mechanical Engineering Specification
November 2021

Prepared by:

Jacob Loh
Graduate Engineer

Checked by:

Adam Mleczejewski
Associate Engineer

Revision	Date	Description	Made	Checked	Approved
T1	27/06/2019	Tender Issue	JL	AM	
T2	03/08/2021	Tender Issue	JL	AM	
T3	05/11/2021	Stage 4 Issue	JL	AM	

NOTES FOR TENDERERS

This document has been compiled using text from the National Engineering Specification (NES) which is copyright to Trimble. The format and content of the specification has, however being considerably re-arranged and amended from that provided by Trimble.

The technical content of this specification has been prepared using the Common Arrangement of Work Sections for Building Works and is in four sections. Where any British or other standard referred to in the specification is either out of date or superseded by another standard, the most recent version shall apply.

For reference each work section ends with clause 10000. Here is stated the latest revision of the raw NES on which the AECOM specification work section is based.

SECTION 1 – SCOPE OF WORKS
A summary description of the Works by Work Section.

SECTION 2 – WORK SECTIONS
The specification for each Work Section is generally sub-divided into two parts:

Part 1 System objectives

The system objectives are clauses giving details of the performance and/or design parameters.

Part 3 Clauses specific to the system

These clauses are specific to the Work Section concerned.
Where clauses contain "type" references, these are for cross referencing within the specification and do not necessarily relate to manufacturers types.

NB: (*Part 2 relates to the format used in the raw NES and selection schedules for the Y clauses. Part 2's are not used in AECOM specifications and are replaced by schedules in section 4*)

SECTION 3 – REFERENCE (WORKMANSHIP) SPECIFICATIONS – Y clauses
These clauses specify items that are common to several systems (for example pipework, ductwork and cabling).
The individual clauses are generally arranged in the order of the Common Arrangement "Y" sections from which they originated.
Generally these specifications represent AECOM's standards, contain all contain clauses applicable to each particular category and are not project specific.
Where choices are required, they are made in the Schedules or Scope of Works; otherwise all of the clauses are applicable.

SECTION 4 – SCHEDULES
This section contains schedules of drawings, manufacturers, equipment duties and selections for plant, ancillaries and system components, specific to this project.

ENQUIRIES TO MANUFACTURERS
Enquiries to manufacturers should include all relevant sections as well as any related contractual information. ie the relevant work section and Y clauses pertinent to the plant item in addition to the plant schedule.

NON-NES CLAUSES
Clauses which are structurally different from NES from which they originated, or are AECOM originated clauses, are generally identified by the clause reference being underlined and/or the last digit of the clause number being increased e.g. 300.010 becomes 300.011.

NBS Specifications - AECOM

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Scope of Works

General

Project Description

This project is to carry out a replacement of the existing AHU units and associated MEP services serving the Packing room and General Spaces within the HSDU department.

AECOM's understanding of the existing services is based on record drawings received from Abertawe Bro Morgannwg University Health Board (ABMU) and non-intrusive site visit. It is therefore required that the tenderer visit site to gain a full understanding of the scope of works prior to submitting their tender cost. All site visits shall be arranged with the Estates Department. No claim 'on the grounds of lack of knowledge' in such respect, or otherwise shall be permitted.

The Contractor shall allow for protecting existing access/equipment during works including builders work in connection such as, but not limited to:

- Builders work in connection with service penetrations.

The Mechanical and Electrical Contactors shall liaise with ABMU's Estates Department prior to any services isolation or modification commencing to ensure that any disruption to areas that are to remain operational is minimised.

As part of the works, removal / modifications will be required to existing services within the area of the works. All equipment that has been stripped out shall be offered to ABMU for use as spares or elsewhere on their Estate. Any equipment that is not required shall be removed from site. The removal and disposal of all redundant electrical equipment shall be carried out in accordance with the Waste Electrical and Electronic (WEEE) Directive.

The Mechanical and Electrical Contactors shall co-ordinate with the Project Administrator any disruption to the operation of building and they shall co-ordinate the strip out works to minimise disruption whilst taking due care for the protection of existing plant and equipment.

The Mechanical and Electrical Contactors shall allow for making good any finishes disturbed as part of the removing of redundant services. The sub-contractor shall ensure that other areas of the building remain operational throughout these works where possible. Where disruption to other areas is unavoidable, the Mechanical and Electrical Contractors shall liaise with ABMU's Estate Department prior to any services isolation or modification commencing to ensure that any disruption is minimised.

Unless instructed otherwise, the installation shall be designed and delivered in accordance with:

- The relevant British Standards and/or Codes of Practice.
- Welsh Health Technical Memorandum (WHTMs) & Health Technical Memorandum (HTMs)
- Welsh Health Building Notes (WHBNs) & Health Building Notes (HBNs)

The Contractor shall note that this specification shall be read in conjunction with the following documentation:

- AECOM Engineering Preliminaries
- AECOM Mechanical Engineering Specification (This Document)
- AECOM Electrical Engineering Specification
- AECOM MEP Workmanship Clause Specification
- AECOM Mechanical Engineering Drawings
- AECOM Mechanical Engineering Schedules
- AECOM Electrical Engineering Drawings
- AECOM Electrical Engineering Schedules

In addition, the Contractors shall be deemed to have made full reference to all available Architectural, Structural and Medical equipment drawings / support documentation.

The Mechanical Contractor shall include for all the specialist's designers (e.g. medical gases, BMS systems etc.) ancillary provisions as they have not been incorporated in this RIBA stage 3 design.

Scope of Works

The Mechanical Contractor shall be responsible for the supply and installation of Engineering Services within their discipline, as defined in the above information, into a complete and suitable form of installation.

In general, this specification is for the supply, installation, testing and commissioning of the following building services systems.

Mechanical Engineering Systems

- Primary / Secondary Cooling Distribution
- Primary / Secondary Heating Distribution
- Steam
- Mechanical Supply and Extract Ventilation Systems
- Control System (Performance Specified)
- Wiring Associated with Mechanical Installations (Performance Specified)
- Removal of Existing Services

Public Health Services

- Cold Water Distribution
- Foul Water Drainage (above ground only)
- Removal of Existing Services

The Mechanical Contractor shall note that as detailed under the AECOM Mechanical and Electrical Preliminaries Specification, specific engineering systems have been Performance Specified. As such responsibility for the detailed design of these specific engineering systems rests solely with the Mechanical Contractor. For further details, refer to schedule 'A31sch3 – Schedule of Design Activities' contained within the M&E Preliminaries Specification.

The Mechanical Contractor shall be responsible for developing the design information detailed within the specifications and indicated on the associated drawings into a complete and suitable form of installation.

The Mechanical Contractor shall provide detailed Operation & Maintenance manuals, including record drawings, to the Client upon completion of the project.

Installation Drawings

The Mechanical Services Contractor shall be required to produce a set of fully co-ordinated installation drawings prior to any works commencing on site.

The contractor shall be required to use the interim time between receipt of design drawings and documentation and commencement of works to prepare the installation drawings.

The installation drawings are to be issued to the project team for review and comment and the Mechanical Services Contractor must make due allowances for the drawings to be revised and re-issued following comments. It will be acceptable to issue drawings electronically in AutoCAD format.

The Mechanical Services Contractor shall not be permitted to commence any works until the installation drawings are completed and commented on by the design team.

Strip Out Works

The Mechanical Services Contractor shall allow for making good any finishes disturbed as part of the removing of redundant services.

The Mechanical Services Contractor shall ensure that other areas of the building remain operational throughout these works where possible.

In order to complete the scope of works, appropriate existing plant and equipment shall be isolated and removed.

The Mechanical Services Contractor shall co-ordinate the strip out works to minimise distribution to building users while taking due care for protection of existing plant and equipment.

Scope of Works

The Mechanical Services Contractor shall co-ordinate with the Project Administrator any disruption to the operation of building services.

Builders Work

Provide all builders work associated with the Building Services Works necessary for a functionally complete installation, including openings in structure, holes, penetrations, bases, plinths, support steelwork, pits, trenches, floor ducts, bunds etc.

The Mechanical Services Contractor shall have included in the tender for all builders work and secondary support steelwork and brackelry associated with the mechanical services.

The Mechanical Services Contractor shall provide details of all secondary support work for the approval of the structural engineer prior to any installation.

The Contractor shall provide details of all secondary support work to the Client for acceptance prior to any installation.

Service Holes in Slabs

Generally all mechanical services shall pass vertically through the building within dedicated service risers.

The Mechanical Services Contractor shall note that no holes shall be drilled through the pre-cast slabs without prior agreement of the structural engineer.

Holes cannot be drilled indiscriminately through the slab as they must be through the non-load bearing section and they must not intersect any structural reinforcement within the slab.

Holes required for services shall be co-ordinated with the Electrical Contractor to minimise the number of holes to be drilled.

Fire Stopping

Provide proprietary Fire Stopping where the Building Services Works pass through a fire compartment.

The Mechanical Services Contractor shall ensure that the mechanical services incorporate fire-stopping requirements for all firewalls and fire barriers. These are indicated on the building plans supplied by the architect.

All service penetrations shall be fire stopped as required to satisfy the relevant standards and meet the requirements of the fire officer.

Existing services shall include for fire stopping equipment when passing through a new fire compartment.

Testing

The Mechanical and Electrical Contractors shall undertake a full testing and commissioning procedure as laid down within the current British Standards and as detailed within the specifications. All test and commissioning reports shall be passed to the Engineer for comment.

Defects After Completion

The completed installation shall be guaranteed against defects for a period of twelve months from the date of practical completion certificate. The Sub-Contractor shall also allow at the end of the twelve month period for a complete service of all plant and equipment items with full service report submitted to the Contract Administrator. It shall also be noted that the Sub-Contractor shall be responsible for all responsible for all necessary servicing within the defect period.

Scope of Works

Should the Sub-Contractor fail to carry out repairs or servicing under this guarantee clause within a reasonable period, the Contract Administrator shall be empowered to employ other persons or firms for this purpose and pay for such works from monies due to the Sub-Contractors. The sub-contractor shall revisit the site and carry out seasonal commissioning during the first year following hand over.

Discrepancies

Where discrepancies exist within the design information the M&E Contractor shall inform the Engineer and additional guidance will be provided. Should the M&E Contractor fail to clarify any discrepancy, it shall be deemed that the M&E Contractor has included.

R11 - Foul Drainage Above Ground

The contractor shall be responsible for the supply, installation, testing and commissioning of new fully operational condensate drainage to drain to local foul drainage systems to serve the new IAP and HSDU AHUs of Morriston Hospital linked to the proposed HSDU AHUs Replacement Scheme.

The Contractor shall incorporate all equipment, accessories, controls, supports and ancillaries implicitly or explicitly required either by the specification and drawings, or in accordance with accepted current practice, and procedures, which after assembly, testing and commissioning will enable that section of the Works to function correctly and to achieve the specified performance.

System Description:

The existing installation comprises of condensate drainage routed from the following items of plant to drain to local foul drainage systems:

- AHU condensate in level 2 plantroom
- Humidifier condensate in level 2 plantroom

Strip Out Works

The contractor shall validate all drawings of existing services prior to commencement of works and highlight to the design team any deviations between the drawings and the actual installation on site.

All existing foul drainage shall be inspected and retained if fit for purpose.

Condensate serving redundant stripped out items of plant (as detailed within relevant scope sections) shall be stripped out. This shall include the following:

- AHU condensate in level 2 plantroom
- Humidifier condensate in level 2 plantroom

Proposed Works

The existing redundant steam to the steam lances in the existing IAP AHU and HSDU supply ductwork are being replaced with steam to the new IAP and HSDU AHUs (as detailed within T20/sq), New steam condensate is to be provided and connected to the retained elements of the existing steam condensate system as indicated on the Mechanical Services Layouts.

The following new items of plant shall require condensate to be routed to the nearest suitable foul drainage stack / gulley:

- AHU condensate in level 1 plantroom
- AHU condensate in level 2 plantroom
- Humidifier condensate in level 1 plantroom
- Humidifier condensate in level 2 plantroom

Scope of Works

Unless indicated otherwise pumped pipework from units to be plastic and no longer than 1m up to tundish / air break.

Where condensate drains and traps are susceptible to freezing e.g. roof areas, unheated plant spaces, they shall be fully insulated and trace heated.

Condensate drainage from the AHU shall be installed in compliance with the requirements of HTM 03-01 Condensate shall be gravity drained to connect to the foul drainage system.

Testing & Commissioning

The Contractor shall appoint a Specialist Commissioning contractor to carry out all testing and commissioning in accordance with the requirements of Specification Section Y51.

The final pre-handover quality tests shall be carried out, witnessed and signed off by the Consultant, Client.

On completion of the works, the Contractor & Specialist Commissioning Contractor shall demonstrate that all works function correctly and achieve the specified performance.

S51 - Steam

The contractor shall be responsible for the design, supply, installation, testing and commissioning of a fully operational steam distribution network to serve the refurbished elements of Morriston Hospital linked to the proposed AHU Replacement Scheme.

The Contractor shall incorporate all equipment, accessories, controls, supports and ancillaries implicitly or explicitly required either by the specification and drawings, or in accordance with accepted current practice, and procedures, which after assembly, testing and commissioning will enable that section of the Works to function correctly and to achieve the specified performance.

System Description

Within the level 2 plantroom the existing installation comprises 2 No. steam humidifiers used to provide humidity control to the IAP and HSDU general supply air.

Strip Out Works

The contractor shall validate all drawings of existing services prior to commencement of works and highlight to the design team any deviations between the drawings and the actual installation on site.

Level 1 Plantroom shall be surveyed for existing steam and condensate pipework, and established if there is spare capacity for the replacement IAP AHU. If the existing steam pipework is undersized, the contractor shall strip out the steam pipework to suitable isolation points.

The existing steam and condensate pipes within the Level 2 Plantroom are to be stripped back to where the pipes are rising from below, as indicated on the Plantroom Strip Out Drawing.

The contractor shall ensure strip out works do not affect areas outside the area of works, any strip out works which are likely to impact other areas shall be highlighted and discussed with the design team and client prior to strip out works.

Proposed Works

The Contractor shall establish the capacity on the existing steam generator to supply steam to the replacement IAP AHU and HSDU AHU.

The Contractor is to establish if there is a suitable existing steam pipework within the Level 1 Plantroom that can be connected to the new IAP AHU. The condensate from the AHU shall be connected to the existing condensate pipework within Level 1 Plantroom.

Scope of Works

The steam humidifier within the new HSDU AHU shall be connected to the existing steam pipework within Level 2 Plantroom. Condensate from the humidifier shall be routed to an existing soil stack in the plantroom.

<u>Design Parameters</u>

<u>Steam Conditions</u>
Mains pressure > 5 (TBC) < Barg

<u>Control Requirements</u>
Details of all the controls for this Work Section associated with the central control system are described in Work Section W 60 – Central Controls

T20 - Primary Heat Distribution and Local Heating Units (Incorporating T30, T31 and T42)

The contractor shall be responsible for the supply, installation, testing and commissioning of a new fully operational secondary heat distribution network to serve the refurbished elements of Morriston Hospital linked to the proposed AHU Replacement Scheme.

The Contractor shall incorporate all equipment, accessories, controls, supports and ancillaries implicitly or explicitly required either by the specification and drawings, or in accordance with accepted current practice, and procedures, which after assembly, testing and commissioning will enable that section of the Works to function correctly and to achieve the specified performance.

System Description

Within the Level 1 and Level 2 Plantrooms the existing installation comprises of LTHW F&R pipework serving the existing AHUs. Our design has been based upon the existing LTHW being generated at 82°C with a return temperature of 71°C however this shall be verified by the Contractor.

Within the HSDU general spaces are LTHW CT fed radiators. It is not currently understood what the route of the pipework is through these spaces, however they are outside the scope of works of the proposed scheme.

Strip Out Works

The contractor shall validate all drawings of existing services prior to commencement of works and highlight to the design team any deviations between the drawings and the actual installation on site.

LTHW F&R pipework in the Level 1 Plantroom shall be surveyed, and established if there is spare capacity for the replacement IAP AHU. If the existing pipework is undersized, the contractor shall strip out the existing LTHW F&R pipework to suitable isolation points.

LTHW F&R pipework in the Level 2 Plantroom is to be stripped out to the main run as indicated on the Plantroom Strip Out Drawing, and the contractor shall perform site survey to determine a suitable isolation point.

The contractor shall establish there is spare capacity on the existing pumps to meet the requirements of the replacement AHUs.

The contractor shall ensure strip out works do not affect areas outside the area of works, any strip out works which are likely to impact other areas shall be highlighted and discussed with the design team and client prior to strip out works.

Proposed Works

LTHW flow and return temperatures shall be as existing (design has been based upon 82/71 as detailed above).

New connections shall be provided from the existing secondary LTHW circuits to serve the proposed AHU Replacement Scheme.

Scope of Works

The proposed LTHW GT secondary circuits shall serve the following:
- IAP AHU (Level 1 Plantroom) Frost and reheat coils
- HSDU AHU (Level 2 Plantroom) Frost and reheat coils

IAP Room

Heating to the IAP Room shall be via the IAP air handling unit, the AHU heating off coil temperature shall be set as required to maintain the internal design criteria (as detailed within A13sch) of the space.

Heating controls to coils shall generally be via 3-Port valves.

General Spaces

The general spaces in the HSDU shall be heated from a combination of the HSDU air handling unit and existing radiators within the spaces.

Heating controls to coils shall generally be via 3-Port valves.

General

The Contractor shall make allowance for expansion and contraction of pipework and take the advice of a specialist expansion equipment manufacturer and install in strict compliance with their recommendations.

Prior to commencement of the works, the contractor shall identify the location of exiting central and distributed strainers, and undertake a clean and replacement strainer mesh (filter), to ensure that central plant is protected during the refurbishment . After completion of the works all strainers are to be checked and cleaned.

Prior to commencement of the works, the contractor shall appoint a specialist to undertake an analysis of the existing LTHW water quality for record. The lab report shall be issued to the client prior to strip out works commencing.

The LTHW system shall be pressure tested, cleaned, disinfected, flushed and sample analysed.

Pipes shall be steel as Y10sch.

The heating system shall be tested and commissioned in accordance with section Y51.

The complete heating installation shall be insulated and protected in accordance with this specification, to include pipes, valves and fittings except where specifically mentioned otherwise. Pipework shall be insulated and finish protected in accordance with Y50sch. A protective layer shall be provided between the pipe and any phenolic foam insulation.

Insulation types/thickness is to be fully in compliance with BS5422: 2001 and section Y50 of this specification.

Insulation within the plant room shall be finished with Isogenopak cladding, in other areas foil faced shall be provided.

Pipes shall be titled with direction and identification bands.

<u>Design Parameters</u>

External Conditions
As indicated in 'Schedule of Common Design Criteria'.

Primary Circulation
*Flow 82 °C (assumed, mechanical contractor to confirm)
*Return 71 °C (assumed, mechanical contractor to confirm)

Scope of Works

<u>Control Requirements</u>
Details of all the controls for this Work Section associated with the central control system are described in Work Section W 60 – Central Controls

Testing and Commissioning
As defined in Y51 bt.

T61 – Primary / Secondary Cooling Distribution

The contractor shall be responsible for the supply, installation, testing and commissioning of a new fully operational secondary cooling distribution network to serve the refurbished elements of Morriston Hospital linked to the proposed AHU Replacement Scheme.

The Contractor shall incorporate all equipment, accessories, controls, supports and ancillaries implicitly or explicitly required either by the specification and drawings, or in accordance with accepted current practice, and procedures, which after assembly, testing and commissioning will enable that section of the Works to function correctly and to achieve the specified performance.

System Description

Within the Level 1 and Level 2 Plantrooms the existing installation comprises of CHW F&R pipework serving the existing AHUs. Our design has been based upon the existing CHW being chilled to 6°C with a return temperature of 12°C however this shall be verified by the Contractor.

Strip Out Works

The contractor shall validate all drawings of existing services prior to commencement of works and highlight to the design team any deviations between the drawings and the actual installation on site.

CHW F&R pipework in the Level 1 Plantroom shall be surveyed, and established if there is spare capacity for the replacement IAP AHU. If the existing pipework is undersized, the contractor shall strip out the existing CHW F&R pipework to suitable isolation points.

CHW F&R pipework in the Level 2 Plantroom is to be stripped out to the main run as indicated on the Plantroom Strip Out Drawing, and the contractor shall perform site survey to determine a suitable isolation point.

The existing pumps serving the Level 1 Plantroom is to be stripped out due to the lack of capacity to meet the requirements of the replacement IAP AHU.

The contractor shall establish there is sufficient capacity on the existing pumps serving the Level 2 Plantroom to meet the requirements of the replacement HSDU AHU.

The contractor shall ensure strip out works do not affect areas outside the area of works, any strip out works which are likely to impact other areas shall be highlighted and discussed with the design team and client prior to strip out works.

Proposed Works

CHW flow and return temperatures shall be as existing (design has been based upon 6/12 as detailed above).

New connections shall be provided from the existing secondary CHW circuits to serve the proposed AHU Replacement Scheme.

New CHW distribution pumps shall be provided to serve the Level 1 Plantroom.

The proposed CHW secondary circuits shall serve the following:
- IAP AHU (Level 1 Plantroom) Cooling coil
- HSDU AHU (Level 2 Plantroom) Cooling coil

Scope of Works

IAP Room

The Packing Room is cooled by a chilled water coil within the IAP air handling unit. The supply air temperature from the AHU is to be controlled to maintain required internal design conditions (as detailed within A13sch) of the Packing room.

There is a requirement for humidity control within the Packing room and as such the AHU cooling coil shall have sufficient duty to dehumidify fresh air as required.

Cooling controls to the AHU coil shall be via 3-Port valves.

General Spaces

The general spaces in the HSDU are cooled by a chilled water coil within the HSDU air handling unit. The supply air temperature from the AHU is to be controlled to maintain required internal design conditions (as detailed within A13sch) of the Packing room.

There is a requirement for humidify control within the HSDU general spaces and as such the AHU cooling coil shall have sufficient duty to dehumidify fresh air as required.

Cooling controls to the AHU coil shall be via 3-Port valves.

General

The Contractor shall make allowance for expansion and contraction of pipework and take the advice of a specialist expansion equipment manufacturer and install in strict compliance with their recommendations.

The CHW system shall be pressure tested, cleaned, disinfected, flushed and sample analysed.

Pipes shall be steel as Y10sch.

The CHW system shall be tested and commissioned in accordance with section Y51.

The complete CHW installation shall be insulated and protected in accordance with this specification, to include pipes, valves and fittings except where specifically mentioned otherwise. Pipework shall be insulated and finish protected in accordance with Y50sch. A protective layer shall be provided between the pipe and any phenolic foam insulation.

Insulation types/thickness is to be fully in compliance with BS5422: 2001 and section Y50 of this specification.

Insulation within the plant room shall be finished with Isogenopak cladding, in other areas foil faced shall be provided.

Pipes shall be lilted with direction and identification bands.

Pumps shall be skid/frame mounted, factory assembled and tested, complete with isolating and commissioning valves, strainers, pressure switches, inverters, controls, vibration and inertia mounting.

<u>Design Parameters</u>

External Conditions
As indicated in 'Schedule of Common Design Criteria'.

Primary Circulation
'Flow 6 °C
'Return 12 °C

<u>Control Requirements</u>

Scope of Works

Details of all the controls for this Work Section associated with the central control system are described in Work Section W80—Central Controls

Testing & Commissioning

Refer to Y51bd.

U10 - Ventilation Supply/Extract

The contractor shall be responsible for the supply, installation, testing and commissioning of a new fully operational supply and extract ventilation system to serve the refurbished elements of Morriston Hospital linked to the proposed AHU Replacement Scheme.

The Contractor shall incorporate all equipment, accessories, controls, supports and ancillaries implicitly or explicitly required either by the specification and drawings, or in accordance with accepted current practice, and procedures, which after assembly, testing and commissioning will enable that section of the Works to function correctly and to achieve the specified performance.

System Description

The existing installation comprises a dedicated air handling unit serving the Packing Room with balanced supply ductwork routed directly from the Level 2 Plantroom to ceiling mounted supply grilles.

General Spaces are served by a separate heat recovery air handling unit which is ducted from Level 2 Plantroom to the ceiling void with an existing ductwork network connecting to a number of grilles and diffusers.

Some of the HSDU spaces are served by an extract fan which is ducted from the roof to the ceiling void with an existing ductwork network connecting to a number of grilles within the proposed area of works.

The washer-disinfectors within HSDU are served by an extract fan.

The Manager Office is ventilated via openable windows.

Strip Out Works

The contractor shall validate all drawings of existing services prior to commencement of works and highlight to the design team any deviations between the drawings and the actual installation on site.

Existing ductwork and grilles / diffusers in the Packing Room and HSDU General Areas are generally to be stripped back to a point (as indicated on the Strip Out Drawing) to allow for local modification as required to suit the revised ventilation layout. The contractor is to inspect the retaining existing ductwork to ensure it is fit for purpose and shall appoint a specialist ductwork cleaning company to undertake a deep clean of all systems with retained elements of ductwork prior to system handover.

The existing IAP air handling unit located in Level 2 Plantroom is to be stripped out in its entirety including all associated ductwork, dampers, fittings, louvres, etc., up to where the ductwork enters the Packing room on Level 1. The remaining existing ductwork will then be capped to prevent ingress of dust.

The existing HSDU air handling unit located in Level 2 Plantroom shall be stripped out along with all associated ductwork, dampers and ancillaries up to where the ductwork exits the plantroom where it shall be capped to prevent ingress of dust.

The existing extract fan is to be stripped out in its entirety including all associated ductwork, dampers, fittings, louvres etc., up to where the ductwork drops below to Level 1.

The existing extract fan serving the washer-disinfectors is to be stripped out along with all associated ductwork, dampers and ancillaries up to a suitable point.

NBS Specifications - AECOM

Scope of Works

Existing pressure stabilisers and air transfer grilles shall be shipped out (as indicated on the Strip Out Drawing). Existing elements which are to be retained need to be inspected to ensure it is fit for purpose.

Proposed Works

A new air handling unit shall be provided in the Level 1 Plantroom to serve the Packing area which is currently served from the existing IAP AHU located in the Level 2 Plantroom.

The AHU shall be a full fresh air, supply unit and shall be fully HTM compliant. The unit shall consist of run / standby fans, frost, heating and cooling coils, humidifier, and filters as detailed within Y40sch.

Suitable attenuation shall be provided on the intake and supply ductworks to meet acoustic requirements as detailed within A13sch.

The Contractor shall survey the plantroom and establish if there is sufficient space for the proposed IAP AHU. The Contractor shall also conduct a floor loading assessment to determine if the Level 1 Plantroom would be able to support the new IAP AHU.

The fresh air ductwork of the IAP AHU shall connect to the existing louvre within the Level 1 Plantroom. The Contractor shall establish there is sufficient space for the additional ductwork.

A new central air handling unit (AHU) shall be provided in the Level 2 Plantroom to serve the General Spaces currently served from the existing HSDU AHU and extract fan.

The AHU shall be a full fresh air, supply and extract unit and shall be fully HTM compliant. The unit shall consist of run / standby fans, frost, heating and cooling coils, humidifier, filters and plate heat exchanger type heat recovery device as detailed within Y40sch.

Suitable attenuation shall be provided on the intake, supply, extract, and exhaust ductworks to meet acoustic requirements as detailed within A13sch.

The new HSDU AHU supply ductwork shall connect to the existing supply ductwork which is retained at the plantroom boundary. The new extract ductwork shall be routed to the existing penetration point and connected to the existing extract ductwork dropping to below.

The fresh air and exhaust ductwork shall connect to the existing louvres within the Level 2 Plantroom.

A new extract fan shall be provided to replace the existing extract fan serving the washer-disinfectors in the Washing Area (HSDU06). The existing ductwork is to be cleaned and disinfected. Air sampling points shall be provided above each washer-disinfector.

IAP Room

New supply ductwork shall be routed across the ceiling void from the Level 1 Plantroom to the Packing Area and connect to existing ductwork as indicated in the MEP Services Layout Drawing. Where required, local modifications shall be made to existing ductwork as indicated on the MEP Services Layout Drawing to suit the revised scheme.

New ceiling mounted grilles and diffusers shall be provided as indicated on the drawings.

General Spaces

The existing general supply ductwork shall have new ductwork to serve the General office. The existing extract ductwork previously served by the extract fan shall be connected to the extract ductwork served by the new HSDU AHU, as indicated in the MEP Services Layout Drawing. Where required, local modifications shall be made to existing ductwork as indicated on the MEP Services Layout Drawing to suit the revised scheme.

New low level extract ventilation shall be provided to room Washing Medical Equipment (HSDU07) to protect staff from potential leakage of peracetic acid. A ventilation monitoring system for the space shall be required.

Scope of Works

New ceiling mounted grilles and diffusers shall be provided as indicated on the drawings.

General

All existing fire dampers within the retained ductwork shall require inspection, and retained only if fit for purpose. Fire dampers within stripped out sections of ductwork shall be replaced. The Contractor shall determine if fire dampers are required in sections of new ductwork.

Systems and system components are to be selected to achieve the highest levels of energy efficiency. Air handling units shall be selected to achieve low specific fan powers by increasing AHU cross sectional area and by providing high efficiency fan motors. All fans are to have speed control. Appropriate heat recovery devices (as detailed below) shall also be fitted.

Mechanical ventilation systems shall require acoustic and vibration treatment such as in-duct attenuators, acoustic duct insulation, treatment to AHU casings and anti-vibration measures to suit the limiting noise and vibration levels in the areas served and areas adjacent to plantrooms as well as limiting external noise levels.

All ductwork terminations, where visible, shall be provided with an appropriate grille.

Regulating dampers shall be provided as necessary to ensure the system can be correctly commissioned. A minimum of two regulating dampers shall be provided between all outlets and their associated fan.

V20 – LV Distribution

System Description

It is not envisioned that any of the Main LV infrastructure will be altered or affected by the works proposed. All alterations are proposed to be final circuits from the existing distribution boards in accordance with the requirements of BS 7671.

In general, the installation shall be carried out as indicated on the electrical drawings and detailed within this specification to meet with the agreed requirements of the Client.

Distribution Boards

The distribution board locations are indicated on the electrical drawings issued as part of the Tender Package. The information is based on a non-intrusive survey and existing information provided by the SBUHB Estates. The contractor is to ensure that the information provided is correct and complete a survey of the existing infrastructure.

In instances that there are insufficient ways on the distribution boards specified, the Electrical Contractor shall design and install a relevant solution based on BS7671 and meet with the requirements of the Client.

All new MCB's shall have the following characteristics:

- All MCB types shall be provided to suit the load characteristics (Type B: socket outlets; Type C: lighting; Type D: specific equipment such as welders)
- All MCB breaking capacity shall be selected to give protection from the upstream let-through energy of upstream protective device
- All MCB shall comply with BSEN 60898 of minimum 10kVA rating
- 30mA RCD protection shall be provided as necessary in accordance with BS 7671

V22 – General Power

System Description

The Electrical Contractor shall be responsible for the complete installation and implementation of a new general power installation, as indicated on the electrical drawings and in this specification, to meet with the agreed requirements of the Client.

Scope of Works

The Electrical Contractor shall be fully responsible for the supply and installation of all outlets, switches etc. to complete the installation.

General Criteria

General power shall be provided throughout the development to meet the requirements of the Client. The system shall meet the full requirements of BS 7671. Particular attention shall be given to ensuring that the full requirements of Section 607 (high integrity earthing) are adhered to.

In general, the Electrical Contractor shall be responsible for providing general power outlets, isolators and switches, as necessary, to serve all equipment and / or systems to be installed across the development.

The Electrical Contractor shall be responsible for liaising with the Client, Main Contractor, Mechanical Contractor and each of the Specialist Installers to determine the exact quantities and requirements for the provision of all general power outlets, isolators, and switches.

The final positioning of all general power outlets, isolators and switches shall be to suit the general arrangements. The installation must be fully co-ordinated to suit the Client's requirements.

The Electrical Contractor shall be responsible for ensuring that all primary and secondary containment and cabling is concealed wherever practically possible.

In areas where fair-faced concrete / block / brick is detailed; the Electrical Contractor shall agree the final installation method with the project manager prior to commencing the works.

The Electrical Contractor shall be responsible for ensuring that the final sizing of all secondary containment is in accordance with BS 7671 and that an additional 25% spare capacity has been allowed for.

Works Associated with Mechanical Plant

The Electrical Contractor shall be responsible for the provision of direct power supplies to all mechanical equipment not serviced by the existing MCCP's i.e. local ventilation / extract fans, natural ventilation louvres etc.

Final Accessories

All final accessories within plantrooms shall be of the mounted metal type.

All equipment and accessories shall be selected to provide suitable ingress protection (IP) to suite the environment in which they shall be installed.

All final accessories shall be provided in full accordance with the Disability Discrimination Act (DDA) and Part M of the Building Regulations 2004. The final colour of all final accessories shall be agreed with the Client.

All equipment and accessories shall be fully labelled to identify their use and circuit reference. All accessories serving fixed equipment shall be fully engraved. The final method of presentation shall be agreed with the Client prior to commencing the installation.

General

The Electrical Contractor shall be responsible for ensuring that all accessories are installed in accordance with the respective Manufacturer's recommendations.

All protective device types and ratings shall satisfy the requirements of BS 7671 and the application for which they shall be used. RCDs shall be incorporated to provide additional electrical safety to medical location groups outlined in BS 7671.

W60 - Central Control /Building Management System

Scope of Works

System Description

Building Management System Narratives

This section provides a functional description of the manner in which plant or systems shall be controlled. In general, all control shall be performed by the BMS, however, hardwired control is also described.

Where setpoints, time delays, deadbands, high and low values, proportional bands and similar have been nominated these are indicative only. All these items shall be adjustable and shall be adjusted as required during commissioning.

All items identified within square brackets thus, [20]°C, shall be operator adjustable via the graphics. All items identified within curly brackets thus, {10} secs, shall be adjustable during commissioning and be protected with a high system access level. These items need not be accessed via graphics but can be accessed via system configuration tools i.e. be part of a configuration strategy.

Power supplies for plant and equipment shall be served from separate supplies in order to provide resilience and avoid single point of failure as highlighted on the Electrical Schematics and Controls Concept Power Diagram.

Air Handling Units AHU#01 – IVF AHU

General
The Packing Room of the HSDU department shall be served by Air Handling Unit AHU-01.

The AHU comprises of the following equipment:
- Supply Section:
  - Fresh Air Intake Isolating Damper;
  - LTHW Frost Coil;
  - Supply Panel Filter;
  - Duty Supply Fan;
  - CHW Cooling Coil
  - LTHW Heating Coil;
  - Supply Bag Filter;
  - Humidifier;
  - Supply Isolation Damper.

Motor Control Centre (MCC) Details
Control equipment associated with the ventilation plant shall be housed in a motor control centre located in the Level 1 Plantroom.
Selector switches and indicator lamps shall be incorporated on the fascia of the respective MCCs as follows:

MOTOR CONTROL CENTRE		
TITLE	SWITCH POSITION	INDICATION
AHU-01 SUPPLY FAN No.1	TEST/OFF/AUTO	RUNNING/FAULT
AHU-01 EXCESS PRESSURE	RESET (Pushbutton)	EXCESS POSITIVE PRESSURE/EXCESS NEGATIVE PRESSURE
AHU-01 FROST SAFETY ACTIVATED	RESET (Pushbutton)	FROST SAFETY ACTIVATED

Air Handling Units AHU#02 – HSDU AHU

General
The general areas of the HSDU department shall be served by Air Handling Unit AHU-02.

The AHU comprises of the following equipment:
- Supply Section:
  - Fresh Air Intake Isolating Damper;

Scope of Works

- LTHW Frost Coil;
- Supply Panel Filter;
- Fixed Plate Heat Exchanger;
- Duty Supply Fan;
- CHW Cooling Coil
- LTHW Heating Coil;
- Supply Bag Filter;
- Humidifier;
- Supply Isolation Damper.

- Extract Section:
  - Extract Isolation Damper;
  - Extract Filter;
  - Duty Extract Fan;
  - Fixed Plate Heat Exchanger;
  - Exhaust Air Isolating Damper

Motor Control Centre (MCC) Details
Control equipment associated with the ventilation plant shall be housed in a motor control centre located in the Level 2 Plantroom.
Selector switches and indicator lamps shall be incorporated on the fascia of the respective MCCs as follows:

MOTOR CONTROL CENTRE		
TITLE	SWITCH POSITION	INDICATION
AHU-02 SUPPLY FAN No.1	TEST/OFF/AUTO	RUNNING/FAULT
AHU-02 EXTRACT FAN No.1	TEST/OFF/AUTO	RUNNING/FAULT
AHU-01 EXCESS PRESSURE	RESET (Pushbutton)	EXCESS POSITIVE PRESSURE/EXCESS NEGATIVE PRESSURE
AHU-01 FROST SAFETY ACTIVATED	RESET (Pushbutton)	FROST SAFETY ACTIVATED

Test/Off/Auto Switches
The CE panel fascia switches shall be monitored and configured as per the following BMS Functions:
- MCC/CE Panel Fascia Test/Off/Auto Switches
  - "Test" Switch Position;
  - "Off" Switch Position;
  - "Auto" Switch Position.

Interlocking and Monitoring
The AHU supply and extract fans shall be supplied with a locally mounted direct drive EC/DC motors to aid the commissioning of the fans. The minimum and maximum speeds for the fans shall be determined during commissioning of the system.

Each fan shall:
- Be hardwire interlocked for shutdown on a safety circuit operation (fire alarm detection condition, panic buttons operated);
- Be hardwire interlocked for shutdown via dedicated excess positive or negative pressure duct mounted static pressure switches;
- Be hardwire interlocked to the open end-switch status of the respective supply and extract isolation dampers;
- Have hardwire speed control signal from the BMS;
- Have hardwire enable signal from the BMS;
- Have hardwire running and fault status to the BMS.

Each fan shall:
- Have a differential pressure switch for flow proving and status monitoring.

Refer to the following BMS Functions and Standard Programs in Section 4 for alarm generating:

Scope of Works

- Generation of Mismatch Failure Alarm for Motor Drives.

Refer to the following BMS Functions:
- Inverter Local Mode Monitoring.

System Operation
System Start/Stop
The AHU shall be started by any of the following demands:
- Demand from associated fit-out plant;
- Fixed time programs occupancy demand;
- Optimum start routines;
- Via a manual command from the BMS operator's station.

In the event of loss of communications, the AHU controller shall revert to starting and stopping the AHUs under the dictates of local 'Back-up Time Schedules'. The back-up time schedule shall be available to the BMS operator to set appropriate operating times. Under normal circumstances the back-up time schedule will be ignored.

Manual AHU Starting

On receipt of a manual (software) AHU start signal, the plant shall control as described under 'Normal Start' with the exception of any Pre Warm-up procedures.

Normal Start

Upon a start signal being received, the air handling unit shall be enabled. If the outside air temperature is greater than [15] °C, then no pre-emptive heating demand shall be generated.

The AHU shall start up from the following initial configuration:

- LTHW and CHW temperature control valves fully closed unless in a pre-warm mode;
- The supply, fresh air intake, extract and exhaust isolation dampers shall be commanded to open;
- On receipt of the damper open endswitch status signals, the supply and extract fans shall be enabled at their respective fixed speeds;
- Upon receipt of the supply and extract fan running status signals all control loops shall be enabled.

If the outside air temperature is below [6]°C at the start time, then the AHU CT pumps must be running and AHU CT circuit common flow temperature must be above [50]°C for the AHU to start.

- AHU Low Ambient Temperature Start-up.

On receipt of a start signal, the supply and extract fans shall be started. Upon receipt of a run and flow proven status from both fans, the AHU temperature control loops shall be enabled.

Plant Shutdown

The plant shall be stopped where no occupied signal exists, via its associated time schedule, or via a manual command at the BMS operator's station.

The supply and extract fans shall be disabled. The heating and frost coil control valves shall be driven fully closed to coil and associated isolation dampers commanded to close. All associated control loops shall be disabled.

If the outside air temperature falls to [1]°C or below whilst the plant is shutdown, the heating and frost coil control valves shall be driven to their fully open to coil position. When the outside air temperature rises above [3]°C the control valves shall close.

Control Functions

Scope of Works

Supply Fan Speed Control

The AHU supply fan speed shall be controlled via the supply duct static pressure sensors mounted in the supply ductwork. The duct mounted static pressure sensors shall be wired back to the AHU control panel.

P+I control loops (1 per static pressure sensor) shall be utilised to maintain the supply duct static pressure sensors at [setpoint] pa ± [10] pa. The control setpoint shall be determined during system commissioning.

The supply duct static pressure shall be controlled as described in the following BMS Functions:

- Static and Differential Pressure Control Loops.

Extract Fan Speed Tracking

The extract fan speed control output shall be modulated, via P+I control loop, to maintain the return air volume, as measured on a flow grid installed in the common return air duct, at setpoint. The return air volume setpoint shall be set to (100)% of the measured supply fan volume.

Software filtering shall be used on all air volume values to reduce the amount of flutter on the values to a minimum and it is the filtered values that shall be displayed on the graphics and used in the software.

An alarm shall be raised if the differential volume between supply and return fan volumes remains greater than the high differential alarm value or remains less than the low differential alarm value for a period of (10) minutes whenever the AHU is running.

The BMS signals to the supply and extract fans for speed control shall be reset to zero when the associated fan is off.

AHU Temperature Control

The face/bypass dampers and heating coils shall be modulated in sequence, via a P+I control loop, in order to maintain the extract air temperature at its setpoint of [17]°C ± [0.5] K.

Supply Air Temperature Reset

The AHU supply air temperature setpoint shall be rescheduled via a proportional plus integral action control loop, between the minimum limit of [18]°C and maximum limit of [24]°C, to maintain the return air temperature at [21]°C ± 1K at MR1.

Moisture Content Control

A supply air temperature and humidity sensor shall calculate the water content of the air in the supply duct going to MR1 and modulate the steam control valve in sequence via a proportional plus integral action control loop to maintain a supply air moisture content of (0.0080)Kg/Kg.

AHU Fixed Plate Heat Exchanger Control

The AHU plate heat exchanger shall be controlled as described in the following BMS Functions:

- AHU Fixed Plate Heat Exchanger Control.

Frost Coil Control

Whenever the AHU is running, the frost coil control valve shall be modulated via a proportional plus integral action control loop to maintain its off coil temperature sensor at [5]°C ± 0.5K.

Heating and Cooling Demand Signals

Scope of Works

Heating Demands shall be generated as per the following BMS Functions:

- Heating Demand Signals;
- Cooling Demand Signals.

Control Interlocking and Monitoring

Supply and Extract Fans Monitoring and Failure

Supply and Extract fan monitoring and failure shall be performed as per the following BMS Functions:

- Supply and Extract Fans Monitoring and Failure.

AHU Frost Protection

AHU frost protection shall be performed as per the following BMS Functions:

- AHU Frost Protection.

Fan/Damper Interlocks

The supply and extract fans shall be hard wire interlocked with the end switches on their associated supply and extract isolation dampers, such that a fan shall not operate unless its associated isolation damper is fully open.

A damper failed alarm shall be raised on the BMS if a damper fails to open within a timed period of twice the given travel time of the damper actuator.

Frequency Inverter/Fan Requirements

Frequency inverter/fan requirements are as per the following BMS Functions:

- Frequency Inverter/Fan or Pump Requirements.

Supply and Extract Fans Monitoring and Failure

Supply and Extract fan monitoring and failure shall be performed as per the following BMS Functions:

- Supply and Extract Fans Monitoring and Failure.

Excess Positive and Negative Static Pressure

Excess Positive Static Pressure and Excess Negative Static Pressure shall be monitored as per the following BMS Functions:

- Excess Positive Static Pressure Limit;
- Excess Negative Static Pressure Limit.

System Temperature and Humidity Monitoring

Temperature sensors in the following locations shall be connected to the BMS for monitoring purposes:

- Fresh Air Intake Temperature and Humidity;
- Off Frost Coil Temperature and Humidity;
- Off PHX Temperature and Humidity
- Off Heating Coil Temperature and Humidity;
- Supply Air Temperature and Humidity;
- Extract Air Temperature and Humidity.

Scope of Works

AHU Filters

The AHU Panel, Bag and Extract Filters shall be monitored by differential pressure sensors as per the following BMS Functions:

- **Filter Differential Pressure Sensor.**

Fire Interlock Control

The plant shall be interlocked with the building's automatic Fire Detection and Alarm System and Fireman's Override Control Panel.

Plant Restart Sequence

The plant shall be interlocked, through software, to sequentially restart following:

- **Fire alarm shutdown;**
- **Power Failure;**
- **Frost Shutdown;**
- **Excess Positive or Negative pressure**

"" End of Scope Sections ""

'A' Clauses

Work Sections

R11 – Foul Drainage Above Ground

PART 1 SYSTEM OBJECTIVES

180.010 PERFORMANCE OBJECTIVES
To provide a piped gravity system to collect foul water from normal toilets, sinks and kitchen appliances and connect to the first underground drain connection.

180.020 DESIGN PARAMETERS
In accordance with BS EN 12056-2, BS EN 752, CIBSE Guide G: Public Health Engineering, current Building Regulations and requirements of the Local Authority.

180.022 BREEAM REQUIREMENTS:
On applicable projects and detailed elsewhere, comply with BREEAM requirements below to suit the type of construction and scheme.
BREEAM New Construction 2014 requirement
Comply with Issue ID Pol 03 Surface Water Run-off
Comply with Issue ID Wst 05 Adaptation to Climate Change
BREEAM New Construction 2018 requirement
Comply with Issue ID Pol 03 Flood and Surface Water Management
Comply with Issue ID Wst 05 Adaptation to Climate Change
BREEAM Refurbishment and Fit-out 2014 requirement
Comply with Issue ID Pol 03 Surface Water Run-off
Comply with Issue ID Wst 05 Adaptation to Climate Change

180.030 GENERAL REQUIREMENTS
Refer also to Scope of Works
The system has generally been designed on the one pipe system, using foul waste and vent stacks which take the foul water discharge from the toilet areas, shower areas and cleaners sink etc.
Kitchen areas with appliances discharging grease contaminated waste water connect to a separate waste and vent system which in turn connect to a grease converter (grease trap or separator) before discharging to the below ground drainage.
Anti-syphonage and ventilating pipes (and or anti-syphon traps) protect the traps on the appliances from loss of water/seal.
All soil waste and ventilating pipes shall have minimum falls as defined in BS EN 12056-2, or as shown on the drawings. Anti-syphonage pipework and ventilating pipes must be installed in such a manner as not to create a trap.
Access shall be provided at all changes of direction and above the connection point to the below ground drainage as shown on the drawings.
Main soil/waste ventilation pipes shall rise to roof level and terminate with a vent cowl for discharge to atmosphere.
Where plastic pipework passes through fire compartment floors and walls intumescent fire sleeves to BS 476 shall be fitted.
Thermal expansion shall be included on PVC and polypropylene soil waste and vent pipework.
Where pipes penetrate a floor separating habitable rooms in different flats within residential buildings they shall be enclosed for their full height and full horizontal run in each flat and surrounded with sound absorbent material above and below the floor. The installation shall comply with the requirements of Approved Document E of the Building regulations. "Resistance to the passage of sound".

PART 3 SPECIFICATION CLAUSES SPECIFIC TO R11

380.000 PRODUCTS/MATERIALS

380.005 DRAINAGE SPECIALIST:
On design and build projects engage a drainage specialist to develop the design, install, commission and set to work a gravity drainage system inside the building in accordance with BS EN 12056 as appropriate.

380.011 SOIL WASTE AND VENT PIPEWORK
Refer to Schedule of pipelines Y10 for project particular requirements
Materials standards
Cast iron- BS EN 877

R11 – Foul Drainage Above Ground

Welded stainless steel with spigot and socket – Relevant parts of BS EN 1124
PVC-U – BS EN 1329-1 / BS 4514

380.014 THERMAL EXPANSION ON ALL PVC/POLYPROPYLENE PIPEWORK
Provide expansion joints, thermal movement limiters, anchor points and support/brackets to allow for the correct thermal movement as recommended in the manufacturers installation guide. Alternative forms of thermal expansion arrangements will not be allowed without the prior approval of the CA.

380.015 METAL BANDED FLEXIBLE COUPLINGS ADAPTORS AND BUSHES:
Type as scheduled or described in the particular specification.
Flexible coupling without shear band.
Flexible coupling with shear band.
Flexible adaptor for use with pipes of different outside diameter.
Application
- Repair of damaged pipes
- Connecting pipes of different materials
- Connecting pipes of different diameter
- Jointing short / cut lengths of pipe
- Jointing post-inserted performed junctions

Standard - BS EN 16397-1 and BS EN 16397-2
Materials
- Sleeve – rubber to BS EN 681-1
- Clamping bands 304 stainless steel or316 stainless steel.

380.016 FIRE SLEEVES

Fire sleeves shall be installed on all PVC/Polypropylene pipework 50mm diameter and above, passing through fire break walls, floors and ceilings and subject to approval by the Local Building Control Authority.

380.017 HORIZONTAL BRANCH CONNECTIONS

All 75mm and 100mm branch connections shall connect to the main horizontal runs via a 135 degree branch and a 135 degree bend.

Where possible all smaller branch connections shall connect to the 75mm and 100mm horizontal runs at an angle of 45 degree above the centre line via a 135 degree bend.

380.018 VENT PIPE TERMINALS

All soil waste and vent stacks and waste and vent stacks shall, unless otherwise stated, shall rise through the roof finish with a weathering slate weathering collar and terminate 450 mm above the roof finish (flat or pitched) with a vent cowl.

380.020 FLOOR GULLIES

Standard

Trapped with water seal of at least 50mm – BS EN 1253-1

Without trap – BS EN 1253-2

Gully with light liquid closure to avoid uncontrolled discharge of light liquids such as petrol, diesel and fuel oil into drainage systems in case of emergency to BS EN 1253-5

Material.

Access covers to BS EN 1253-4

Class of gully / cover – as scheduled

R11 – Foul Drainage Above Ground

380.040 FALLS ON SOIL/WASTE PIPEWORK AND VENT PIPEWORK

Unless otherwise stated

All 75mm and 100mm dia. soil and waste pipework shall be installed to a fall of 1:50 all smaller dia. waste pipework shall be installed to a fall of 1:50.

All vent and anti-syphon vent pipework shall be installed to a fall of between 1:50 and 1:100.

380.045 WASTE PIPEWORK DIAMETERS (UNLESS OTHERWISE STATED)

Washhand basin 32mm

Sinks (general)	40mm
Cleaners Sinks	40mm
Shower Tray	40mm
Urinal Bowls	32mm/40mm (as sanitary fitting schedule)
W C Pans	100mm
Bidets	32mm

Specialist equipment waste pipework as per manufacturers requirements.

380.050 SOIL AND WASTE STACKS TAKING THE DISCHARGE FROM PLANTROOM FLOOR GULLIES

Unless otherwise stated soil waste and vent stacks which take the discharge from plantroom floor gullies shall be installed in cast iron and not PVC.

380.130 PLASTICS WC PAN CONNECTOR
Combined solvent weld/push seal socket connector for horizontal outlet WC pans to BS EN 33 or BS EN 997
Use
For horizontal outlet and shrouded pans
BS 5627 for pans to BS EN33 'S' (turned 'P' traps, or 'P' traps new installations, or 'P' traps replacements) or BS EN 997 for WC pans and WC suites with integral trap.

380.140 GRATINGS:
Application
- Vent pipe termination guards

Material
- Galvanised steel wire, plastic coated, PVC or copper.

380.150 SINGLE STACK PLUMBING:
Ensure that there is a change of gradient at stack connections. Use swept branches on small diameter pipes. Use swept inlet or 45 degree branch connections for pipe 75 mm dia. or over.

380.900 WORKMANSHIP

380.905 FOOT OF PIPE STACKS:
Fix cast iron rest bends supported on brick-work or concrete bases where indicated on drawings.

380.910 PERFORMANCE CRITERIA:

R11 – Foul Drainage Above Ground

Install pipework fittings and accessories to ensure that:-
appliances drain quickly, quietly and completely at all times without nuisance or risk to health.

discharge is conveyed without crossflow, backfall, leakage or blockage.
air from drainage system does not enter building.

pressure fluctuations in pipework do not vary by more than plus or minus 38mm water gauge and traps retain a water seal of not less than 25mm.
system can be adequately tested, cleaned and maintained.

310.029 PIPE ROUTES:
Ensure pipe routes are shortest practicable, with as few bends as possible and no bends in wet portion of soil stacks, unless indicated otherwise on drawings.

310.039 COATED PIPES:
Make good damaged coatings and cut ends, or recoat, as recommended by manufacturer.

310.041 INSTALLATION GENERALLY:
Install pipes, fittings and accessories in accordance with BS 8000-0, BS 8000-13, BS EN 12056-2 and manufacturer's recommendations.
Install thermoplastic piping systems in accordance with PD CEN/TR 13801.
Obtain all components for each type of pipework from the same manufacturer, unless otherwise indicated.
Inspect components carefully before fixing and reject any which are defective.
Ensure cut ends of pipes to be clean and square with burrs removed.
Allow for thermal and building movement when jointing and fixing in accordance with the manufacturers recommendations.

Form junctions using fittings intended for the purpose, ensuring that jointing material does not project into bore of pipes, fittings and appliances.
Avoid contact between dissimilar metals and other materials which would result in electrolytic corrosion.
Provide access covers and cleaning eyes as necessary in convenient locations, to permit adequate testing and cleaning of pipework.
Prevent entry of foreign matter into any part of system by sealing openings during construction. Fit all access covers and cleaning eyes as work proceeds.

310.059 CONNECTIONS BETWEEN PIPES OF DIFFERENT MATERIALS:
PLASTIC

PLASTICS
Connect to pipework of other materials using approved connectors and methods in accordance with plastics pipework manufacturer's recommendations, to form a soderfight joint.

CAST IRON
Where possible, connect cast iron pipework to clay pipework using super sleeve adaptors.

COPPER
Connect copper pipework to clay/cast iron using copper to cast iron/clay adaptors whenever possible.

GALVANIZED STEEL
Connect galvanized steel pipework to cast iron sockets with bituminized yarn and molten lead, lead wool or an approved cold caulking compound.

Connect galvanized steel pipework to clay/concrete sockets. A purpose made galvanised steel to clay/cast iron transition piece (to be provided by the rainwater pipe manufacturer) to suit the clay/cast iron adaptor.

310.079 WASTES:
Bed in waterproof jointing compound and fix with resilient washer between appliance and backnut.

310.089 WASTE CONNECTORS:
Join to traps as manufacturer's recommendations.

R11 – Foul Drainage Above Ground

310.091 WC PANS:
Connect to soil pipe spigots with plastic connectors in accordance with connector manufacturer's recommendations.

310.109 TRAP TEST REQUIREMENTS:
Ensure there is a retention of 25mm water seal in every trap, and that no air is blown through the trap seal when performance is tested.

310.119 ACCESS POINTS:
Provide rodding and access points at all changes of direction to enable whole system to be maintained.
Provide square door type access points as indicated on drawings at foot of all soil waste and ventilation pipes and at low level above each floor level. Where practicable, locate access points and horizontal anti-syphon pipes above fitment flood level.
In general make WC connections to drain points and soil pipes via flexible connectors.

10000 Based on NES R11TEXT – Dec 18

S51 – Steam

Incorporating S52, S53, T12, T13 and T33

PART 1 SYSTEM OBJECTIVES

380.010 PERFORMANCE OBJECTIVES
To provide a piped distribution system to user points from a steam source.

380.010 STANDARDS
Supply, install and commission equipment and systems in accordance with the following:

BS 2486 – Recommendations for treatment of Water for Steam Boilers and water Heaters
BS 2790 – Design and Manufacture of shell boilers of welded construction
All relevant parts of BS EN 12953 – Steel shell boilers
BS 1894 – Specification for electrode boilers
Relevant parts of BS EN 12952 – Water tube boilers
Relevant parts of BS EN 12953 – Shell boilers
HSE INDG 436 – Safe management of industrial steam raising boilers
HSE/SAfed/CEA guide BGM1 – Guidance on safe operation of boilers
HSE Guidance Note PM 60 - Steam Boiler blowdown systems
CSA (Commissioning Specialists Association) Technical Memorandum - TM 7 Commissioning of Steam Systems.
BRES TR/20 part 8 – Installation and Testing of Pipework Systems – Steam and Condensate

PART 3 SPECIFICATION CLAUSES SPECIFIC TO S51

380.000 PRODUCTS/MATERIALS

380.001 PRESSURE EQUIPMENT / PRESSURE SYSTEMS SAFETY REGULATIONS
All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 2014/68/EU, implemented in the UK through the Pressure Equipment (Amendment) Regulations 2015 and The Pressure Equipment (Safety) Regulations 2016, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.

Only relevant equipment and assemblies certified as compliant will be permitted under this specification, and any substitution put forward must also be compliant with the Directive.

Comply with all Statutory Regulations, including The Pressure Systems Safety Regulations 2000 and the Approved code of practice (ACOP) L 122 "Safety of Pressure Systems". Provide a "Written Scheme of Examination" for the system.

380.002 STEAM METER
Type
Variable Orifice type
Accuracy
+/- 1% of measured value from 5% to 100% of maximum rated flow
+/- 0.1% FSD from 1% to 5% of maximum rated flow
Repeatability – better than 0.25%
Turndown – 50:1 minimum
Body
Steel
Accessories
To be complete with
Orifice plate assembly
Signal transmitter assembly and transducers with interlinking pipework to the Orifice meter (with IVs)
Integrating control panel with outputs of flow rate and total flow for monitoring by a BEMS and local indication of total flow and flow rate.

380.003 STEAM TRAPS AND TRAP FAILURE INDICATORS
See Y11

380.011 PRESSURE REDUCING VALVES - INTEGRAL SENSOR TYPE:
Components
Copper alloy body
Stainless steel valve and seat and return spring.
Phosphor bronze bellows.
Control spring and handwheel.
Integral sensor with an alphanumeric pressure set-point indicator and locking facility.
Connections
Screwed to BS21 and BS EN 10226-1 or Flanged to BS EN 1092-2 to match pipework

380.021 PRESSURE REDUCING VALVES - PILOT OPERATED TYPE:
Components
Stainless steel valve and seat and return spring.
Control spring.
Single seat design for tight shut off.
Pressure control pipe with stop cock.
Pressure setting handwheel with padlock.
Operation
Phosphor bronze diaphragm.
Material
Cast steel body.

Connections
Steel, flanged to BS EN 1092-1 or screwed to BS21 and BS EN 10226-1

380.031 PRESSURE REDUCING VALVES - DIRECT ACTING TYPE:
Components
Copper alloy in S.G. Iron body
Stainless steel valve and seat and return spring.
Phosphor bronze bellows.
Control spring and handwheel.
Integral sensor with an alphanumeric pressure set-point indicator and locking facility.
Connections
Screwed to BS21 and BS EN 10226-1, or Flanged to BS EN 1092-2 to match pipework

380.032 HOSE AND HOSE ASSEMBLIES FOR STEAM AND CONDENSATE
Hose and hose assemblies for saturated steam and hot water condensate.
Standard - BS EN ISO 6134
Type 1 - low-pressure, maximum working pressure 6 bar
Type 2 - high pressure, maximum working pressure 18 bar
Incorporate an oil-resistant cover.

380.041 PACKAGED CONDENSATE PUMP UNIT - STEAM:
Supply packaged steam powered automatic pump unit capable of handling condensate at 98degC

Components
Cast iron condensate receiver with inlet tappings, outlet IV, vent and overflow
Mild steel steam operated pump with strainer on inlet with trapped condensate drain, and NRV on the inlet and discharge connections
Fit pump bodies with flow counters.
Tubular frame.

380.051 CONDENSATE RECOVERY UNITS - ELECTRIC:
Supply packaged electrically powered condensate recovery units capable of handling condensate at 98oC
Unit
Duplex pump unit. (each pump rated at 110% of the design return rate)
Condensate receivers
Mild steel galvanized after manufacture (unless scheduled otherwise) with mild steel interconnecting pipework to pump inlet.
Receiver connections

S51 – Steam

Screwed inlet.
Screwed outlet.
Vent.
Inspection hatch.
Level control.
Overflow.
Water level gauge.
Drain cock.
High water level alarm.

Pumps

Cast iron body.
Gunmetal impeller.
Gunmetal non-return valve on delivery side
Mount pumps under receiver on galvanized steel frame with suction connected to receiver with IV and resilient coupling in pipework.

Control panel incorporating door interlocked isolator, starters , hand off auto switches per pump and triple pole changeover switch and hours run counter per pump.
Pumps to operate in "cascade" control, ie if the duty pump is unable to cope with peak loads then the control system shall automatically bring in the standby pump.
To be provided with volt free contacts giving indication of any fault condition (ie common fault) for monitoring by a BEMS.

380.861 FLASH VESSELS:
Standard

PD 5500. Or relevant parts of BS EN 13445

Vessel

Steel body.
Flanged condensate inlet.
Flanged condensate outlet.
Screwed pressure gauge boss.
Plugged connection for blow down or inspection.

380.871 SURPLUSSING VALVES:
Fit valves of pilot controlled, diaphragm operated type with single seat.

Components

Steel bodies.
Flanged connections.
Stainless steel pilot.
Stainless steel main diaphragms.
Stainless steel trim.

Allow variation of the set pressure in either direction while valves are in service.

380.881 STEAM SEPARATORS:
Provide baffle type separators.

Material

Steel bodies.

Connections

To match pipework
Screwed bottom drain.

Ancillaries

Separators shall be provided with proprietary insulation jackets, by the separator manufacturer

380.891 STEAM GENERATOR: (T13-310.010)
Type – Gas / oil Fired
Standards

Coil water tube type boiler or generator - BS EN 12952 parts 1-8, and parts 10, 12 and 14 and British Insurance Company requirements.
Shell type boiler or generator – BS EN 12953 / BS 2790 and British Insurance Company requirements

Arrangement

S51 – Steam

Vertical boiler

To be provided as a complete package with feedwater pumps (and all interconnecting pipework), burner unit and controls.

Burner

To be supplied fully wired with its integral control panel, suitable for modulating control, automatic TDS (total dissolved solids) control and blowdown

Mounting

To be provided on factory made base

Provide safety valves for protection against excessive pressure in accordance with BS EN ISO 4126-1
Generator to be provided with volt free contacts giving indication of any fault condition (ie common fault) for monitoring by a BEMS.

380.892 STEAM GENERATOR: (T13-310.010 / T12-310.010)
Type – Electric boiler
Standard:

Supply electric boilers in accordance with BS 1804 and BS EN 12953-8 and British Insurance Company requirements.

Type – Gas or oil fired steam generator of boiler
Standard:
Electrical connection - 3ph, 400Volt, 50Hz
Control
to be provided with all integral controls for load control and blow down
Discharge

Manifold and drain
Discharge unit with fan

Provide safety valves for protection against excessive pressure in accordance with BS EN ISO 4126-1
Mounting -To be provided on factory made base
Generator to be provided with volt free contacts giving indication of any fault condition (i.e. common fault) for monitoring by a BEMS.

380.893 BLOW DOWN VALVES - PARALLEL SLIDE TYPE: (T13-310.020)
Material

Copper alloy flanged body and cover.
Cast steel flanged body and cover.
Locking gland restricting the removal of the operating key unless valve is closed, to requirements of BS 750.

380.894 BLOW DOWN VESSELS (T13-310.030)
Standards

PD 5500.

Comply with the requirements of HSE Guidance Note PM 60 – Steam Boiler blowdown systems and drain and blowdown devices to be designed / installed in accordance with Annex D of BS EN 12953-6.
Provide cooling facilities in vessel if discharge form vessel is likely to exceed 43°C.
Terminate vent pipe with exhaust head and condensate drain facilities.

380.895 SKID MOUNTED PACKAGED STEAM GENERATED PLANT: (T13 310.015)
Duty and detailed requirements as schedule reference S51sch7
Unless scheduled otherwise the following ancillary equipment shall be included in the skid package:

Insulated pre-heated feed water tank
Steam separator
Blowdown vessel
Make-up water treatment plant
Chemical dosing tanks, pumps and pipework for oxygen scavenging and sludge conditioning with pH correction.

Test fire the steam generator for all functionality and safety aspects at the manufacturer's works.
All necessary interconnection pipework, insulation and power and control wiring to be undertaken at the manufacturers works and all pipework pressure tested. Where skid packages require dismantling for transportation / site installation the manufacturer shall undertake all site re-assembly and pressure test the pipework. The manufacturer shall commission the complete skid package.

S51 – Steam

310.005 CHIMNEYS AND FLUES: (T13 310.030)
Ensure chimney heights comply with Clean Air Act Memorandum.
Materials
Provide twin wall flue system, insulated flue. Insulation thickness shall be determined by flue specialist to give a touch temperature of less than 70°C or as scheduled.
Fabricate inner from
316 Stainless steel, tested to a minimum corrosion classification of V2 to BS EN 1856-1. Material thickness dependent on flue diameter and fuel maximum sulphur content (minimum 0.5mm). Oil fired boilers inner to be fully welded.
Fabricate outer from
304 Stainless steel, material thickness dependent on flue diameter (minimum 0.5mm).

A flue specialist shall undertake the detail design and supply and install the boiler flues in accordance with the boiler manufacturer's requirements. Final flue design shall be in accordance with the flue specialist recommendations. The flue specialist shall provide test certification of independent testing to BS EN 1856-1.
The chimney system components should carry a current CE mark showing the classification of the product.
Flues shall carry a relevant fire rating for the application.
Drainage points should be added at the bottom of risers and also on horizontal runs over 6 meters.
Standards:
BS EN 1443
For gas appliances with outputs not exceeding 70kW comply with BS 5854 and BS EN 15287-2
For flue structures serving appliances of 45kW output and above within a space enclosed by a building or which is an integral part of the building comply with BS 5854.
Supply multi wall metal system chimney up to 1200mm diameter in accordance with BS EN 1856-1 and in accordance with the test methodology in BS EN 1859 and BS EN 13216-1.

310.007 STEAM BOILER WATER TREATMENT AND DOSING FACILITIES: (T13 310.035)
Feed-water treatment plant
Duty and requirements – As scheduled in S51 and / or S20.
Provide feed water treatment facilities and chemical dosing facilities as necessary to ensure feed water and steam quality meets the requirements of the following standards:
BS 2486
BS EN 12953-10
Provide the following dosing facilities unless detailed otherwise elsewhere in this specification
Boiler water oxygen scavenging
Boiler water pH control
Scale prevention, sludge control and dispersant
Condensate corrosion inhibition

310.008 WORKMANSHIP

310.001 SITE DIMENSIONS:
Check dimensions on site prior to ordering.

310.002 PERFORMANCE:
Thermal performance of boilers for steam, hot water and high temperature heat transfer fluids in accordance with BS 845 Part 1.

310.003 INSTALLATION:
General
Comply with the requirements of B&ES TR/20 part 8 following the guidance in CIBSE TM 58 and the requirements of this specification.
Install all equipment on purpose made bases or supports, capable of carrying load of equipment. Comply with manufacturer's installation instructions.
Ensure equipment is firmly fixed and level.
Fix supports out of view where possible to give a neat appearance
Install site erected equipment to manufacturer's instructions.
Replace all damaged equipment, lagging and casings.

S51 – Steam

Steam / condensate pipework
Install steam mains to a minimum fall of 1 in 100 in accordance with BS EN 45510 whenever possible and an absolute minimum of 1 in 250 where not practical.
Where a steam main has to rise in the direction of flow, install with a slope not less than 1:40.
Steam trap discharge lines to fall in direction of flow at a minimum fall of 1 in 70.
Take steam connections to plant and Equipment from the top of the steam main.
Connect condense discharge from trap sets into the top of the condensate main.

Incorporate provision for expansion of steam and condensate mains in pipework from trap sets.

Install strainers on their sides when they are part of a steam line to avoid water hammer.

Do not use trap sets to lift condense on equipment with automatic control valves to avoid stall in the heat exchanger.
Install trap sets discharging into condense main at all low points on steam distribution pipework and immediately before all automatic control valves on steam mains and elsewhere where indicated.
Install trap sets at all low points in the distribution system.
On steam mains, provide drain points comprising drain pocket and trap set trap discharging into condensate mains
Locate drain points at all low points on steam mains, at intervals not greater than 40m (but where possible at 30m intervals) and immediately before all automatic control valves on steam mains.
Provide air vents at all high points and at top of collecting legs at the ends of steam mains
Use thermodynamic traps on pipelines which may be subject to freezing conditions
Installation of steam boiler blowdown systems shall be in accordance with HSE Guidance Note PM 60 – "Steam Boiler Blowdown Systems" and drain and blowdown devices to be designed / installed in accordance with Annex D of BS EN 12953-6.

Drain pocket minimum dimensions
Pocket diameter – mains diameter for mains up to 100mm; 100mm diameter for main sizes 125mm - 200mm; for mains 250 diameter and above – 0.5 x mains diameter.
Depth – for mains up to 100mm diameter - 100mm deep; for main sizes 125mm – 200mm diameter - 150mm deep; for mains 250 diameter and above – depth to be equal to mains diameter.

Condensate return lines
Lift pumped condensate from receivers immediately after the pump and wherever possible size and install the return pipe with a gravity fall to the end of the line ensuring the fall is adequate to overcome frictional resistance of the pipe. Install a vacuum breaker at the top of the lift and install automatic air vents whenever the pipe has to drop/rise to avoid clashing with other services/building structure.

310.004 TESTING AND COMMISSIONING:
All items to have been tested at manufacturer's works to appropriate British Standard to suit pressure and temperature conditions of system.
Ensure joints are pressure tested prior to installation of lagging and casings.

Commission steam systems in accordance with The Commissioning Specialists Association (CSA) Technical Memorandum - TM 7 "Commissioning of Steam Systems".

310.005 FLUSHING, CLEANING AND WATER TREATMENT:
Comply with the requirements of B&ES TR/20 part 8
Steam and condensate pipework shall not be hydraulically flushed unless specified in the scope of works or schedules.
Where specified the systems shall be scoured using live steam or compressed air in accordance with a method statement that satisfies the HSE requirements.
The protection of the pipework system from corrosion is a function of the treatment applied to the make up water to the boiler, this shall be in accordance with BS 2486 – Recommendations for treatment of Water for Steam Boilers and water Heaters.

310.006 BUILDERSWORK:
Mark out positions for builders fixed by others, when fixing equipment to stud walling.

S51 – Steam

310.007 CHIMNEY AND FLUE INSTALLATION [T13 320.008]:
Install flues in accordance with BS 5854
Install factory made chimneys to BS EN 1856-2 in accordance with BS EN 15287-1.

10080 Based on NES text as below:
S51 Dec 04
S52 Oct 02
S53 Oct 02
T12 Nov 03
T13 March 18
T33 Dec 04

T20 – Primary Heat Distribution

Incorporating T30 (MTWH) and T31 (LTHW) and T42 (Local heating units)

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide a piped hot water heating distribution system from the plantroom to the heat emitting equipment.
To provide all heat emitting items related specifically to the heating system and comply with BS 6880 Parts 1and 2 - Code of practice for Low temperature Hot Water Heating where applicable.

On applicable projects provide a heat network designed, installed and commissioned following the requirements of CIBSE / CHPA CP1 and to provide heat interface units connected to the heat network or other heat distribution system from a central energy centre or CHP plant. Comply with the guidance in BESA DHC01 for the minimum requirement for space, structural, access and services allowances for a building likely to be connected to a district energy network.
On applicable projects in London follow the guidance in the London Heat Network Manual.

To provide local gas fired radiant or convective heaters.

For pre-insulated underground heating distribution pipework refer to Y10 clauses including 2881, 2882 and 9080 and schedule T20sch3 or Y10sch2.

100.020 DESIGN PARAMETERS
See Schedule of Common Design Criteria.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO T20 (T30, T31, T42)

300.000 GENERAL
Refer to Y10 and Y11 for pipework and pipeline ancillaries installation and workmanship detail requirements.
Refer to Y25 for cleaning and chemical treatment requirements.
Install suitably sized safety valves in all secondary distribution pipework from heat exchangers.

300.001 PRESSURE EQUIPMENT DIRECTIVE/PRESSURE EQUIPMENT REGULATIONS:
All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 2014/68/EU, implemented in the UK through the Pressure Equipment (Amendment) Regulations 2015 and The Pressure Equipment (Safety) Regulations 2016, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.

Only relevant equipment and assemblies certified as compliant will be permitted under this specification, and any substitution put forward must also be compliant with the Directive.

300.011 SITE DIMENSIONS:
Check dimensions on site prior to ordering.

300.012 ECODESIGN REQUIREMENTS FOR LOCAL SPACE HEATERS: (T42)
Equipment to be in accordance with The Energy Related Products Regulations 2010 as amended.
Space heaters up to 120kW to comply with EU Regulation 2015/1188 for seasonal space heating energy efficiency (SHEE), NO_x emissions and product information / instruction manual.

300.020 WATER TREATMENT AND QUALITY:
Refer to scope of works / schedules for water treatment methods / facilities and conditions / properties to be achieved in the circulation water.
Circulation water quality in district heating systems to be in accordance with recommendations in PD CEN/TR 16911. (Recommendations for circulation water in industrial and district heating systems and their operation)

300.021 TESTING:
Test relevant plant equipment at manufacturer's works to appropriate British Standard to suit pressure and temperature conditions of system.

T20 – Primary Heat Distribution

310.825 SAFETY OF WATER BASED HEATING SYSTEMS:
For water based heating systems in buildings with a maximum operating temperature of up to 105°C, provide and install facilities to ensure safety arrangements comply with Section 4.6 in BS EN 12828.
Comply with Annexe E in BS EN 12828 for safety valves in heating systems in addition to the relevant product standards referred to in Y11.

310.830 UNDERFLOOR HEATING INSTALLER SELECTION:
Use a specialist companies to carry out the design, supply, installation, testing and commissioning of the underfloor heating system in accordance with BS EN 1264. The specialist shall advise the size of cupboard, preferred location and access requirements for the manifolds, and associated valves / controls to the Contractor.
Use one of the specialist companies listed in schedule A30M Schedule of Mechanical Manufacturers to carry out the design, supply, installation, testing and commissioning of the under-floor heating system.

310.800 PRODUCTS/MATERIALS

310.821 RADIATORS, CONVECTORS AND TRENCH HEATING GENERALLY: (T31)
Ensure radiators and convectors are manufactured to BS EN 442-1 and tested/rated in accordance with BS EN 442-2.
Ensure fan assisted radiators, convectors and trench heaters are manufactured to BS EN 16430-1 and tested/rated for thermal output in accordance with BS EN 16430-2.
When fan assisted radiators, convectors and trench heaters manufactured to BS EN 16430-1 are to provide cooling they shall be tested / rated for thermal output in accordance with BS EN 16430-3.

Duty and type as scheduled.
Connections
For Steel – Wrought iron bosses welded on at manufacturer's works.
For Cast Iron and Aluminium – Integral screwed
Air cock
Provide return end air cock recessed within unit length.
Finish
Degrease and protect against rusting before application of a high quality stove primer and then powder coat with epoxy polyester, unless otherwise indicated.
Testing
Pressure test not less than 7 bar (gauge) or one and a half times maximum working pressure whichever is greater.
Accessories
Wall/floor brackets or feet as required.

310.862 LOW SURFACE TEMPERATURE RADIATORS / CASING: (T31)
Duty as scheduled, to comply with NHS guidelines.
Manufacture emitter in accordance with BS EN 442-1
Thermal output and pressure drop testing/rating to be in accordance with BS EN 442-2
Material – Mild steel (min thickness 1.5mm) powder coated with antibacterial protection
Casing
- To have fully radiused corners, and be a one-piece construction which does not require assembly. Cut-outs for pipework, skirting and vinyl flooring etc to be provided during manufacture to eliminate site cutting.
- Front panel to be hinged for cleaning.
- Grilles to be pencil proof and designed to prevent fingers being trapped. For secure environments the unit shall be tested as being anti-ligature.

LST types in secure environments to have heavy duty cases and be tested as being "anti-ligature" design including providing mesh behind grilles.
Ensure all hot surfaces are concealed and exposed surfaces remain at a temperature of no more than 43°C.
Accessories – unless scheduled otherwise provide:
- Air vent and drain cock.
- Front panel to be hinged for deep cleaning.
- Welded feet and top stay.
- Wall brackets.
- Plinth for floor mounting to accommodate pipework

310.864 FAN ASSISTED RADIATORS / CONVECTORS: (T31)

T20 – Primary Heat Distribution

Duty and type as scheduled.
Standards
- Sound power levels to be measured in accordance with BS EN ISO 3744
- Ensure heat emitters are manufactured to BS EN 16430-1 and tested/rated for thermal output in accordance with BS EN 16430-2 and BS EN 442-2

Details – unless scheduled otherwise
- Fans / motors
  - Multiple axial type, fixed to the finned connector using manufacturer's mounting kit complete with modulating speed control or single centrifugal crossflow fan with EC motor and modulating speed control as scheduled.
- Controls
  - Integral temperature sensor and controls to automatically start and modulate fans for morning boost.
  - Boost switch integrated into radiator to override normal temperature control.
- Connections
  - Brass.
- Finish
  - Degrease and protect against rusting before providing corrosion protection by phosphating followed by powder coating with epoxy polyester unless scheduled otherwise .
- Testing
  - Pressure test at not less than 7 bar (gauge) or one and a half times maximum working pressure, whichever is greater.
  - Thermal output and pressure drop testing/rating to be in accordance with BS EN 442-2
- Accessories / options
  - Air vent and drain cock.
  - Wall brackets.

310.866 VENTILATION RADIATORS / CONVECTORS: (T31)
Duty and type as scheduled.
Standards
- Sound power levels to be measured in accordance with BS EN ISO 3744
- Ensure heat emitters are manufactured to BS EN 16430-1 and tested/rated for thermal output in accordance with BS EN 16430-2 and BS EN 442-2

Details – unless scheduled otherwise
- Controls
  - Integral temperature sensor and controls to automatically start and modulate fans for morning boost.
  - Boost switch integrated into radiator to override normal temperature control.
  - CO_2 sensor to control outside ventilation and room exhaust ventilation.
- Connections
  - Brass.
- Finish
  - Degrease and protect against rusting before providing corrosion protection by phosphating followed by powder coating with epoxy polyester.
  - Colour as scheduled
- Testing
  - Pressure test at not less than 7 bar (gauge) or one and a half times maximum working pressure, whichever is greater.
  - Pressure drop testing to be in accordance with BS EN 442-2
- Accessories / ancillaries
  - Air vent and drain cock.
  - Wall brackets.
  - Outside air inlet louvre – details as scheduled

310.870 NATURAL CONVECTOR HEATERS: (T31)
Duty as scheduled.
Type - Wall mounted low water content convector unless scheduled otherwise
Standards
Ensure natural convector heaters are rated in manufactured accordance with BS EN 442-1.
Thermal output and pressure drop testing/rating to be in accordance with BS EN 442-2
Arrangement as scheduled

T20 – Primary Heat Distribution

Casing
Construct casing from rigid heavy gauge sheet steel, strengthened to prevent drumming, with no sharp edges for safety. Support heating element from casing and ensure casing prevents air by-passing.
Fit foam plastic strips to flanges at rear of casing.
Provide back panels.
Access
Ensure front covers are easily removed for cleaning and access to control and isolating valves.
Finish
Degrease and protect against rusting and provide corrosion protection by phosphating followed by powder coating with epoxy polyester unless otherwise indicated.
Heating elements
Materials
Finned tubes
Copper.
Fins
Aluminium.
Headers
Copper
Connections
Screwed female to relevant part of BS EN 10226 terminating within casing.
Air cock
Fit an air cock on flow connection with the air cock terminating through side of the casing, or behind front grille.
Grilles
Linear grilles to manufacturers' standard, unless otherwise indicated Ensure grilles are pencil proof.
Control Damper
Provide a control damper regulated by a knob on outside of casing with damper position clearly marked.
Testing
Pressure test at not less than 7 bar (gauge) or one and a half times maximum working pressure whichever is greater.
Thermal output and pressure drop testing / rating to be in accordance with BS EN 442-2.
Accessories
Feet to conceal rising pipes when unit fed from below.

310.880 FAN CONVECTOR HEATERS: (T31)
Duty as scheduled.
Standards
Ensure fan assisted convectors equipped with fans to increase the convective thermal output are manufactured in accordance with BS EN 16430-1 and tested/rated for thermal output in accordance with BS EN 16430-2
Ensure fan convector heaters (fan coil units) are rated in accordance with all relevant parts of BS 4856 depending on type specified.
Arrangement
As scheduled
Casing
Construct casing from rigid heavy gauge sheet steel, strengthened to prevent drumming, with no sharp edges for

safety. Support heating element from casing and ensure casing prevents air by-passing. Fit foam plastic strips to

flanges at rear of casing. Provide back panels.

Internal lining
Line internal casing surfaces with the standard acoustic absorption material, free from surface erosion.

Access
Provide an easily removable panel to give access to fan, motor and filter.
Finish
Degrease and protect against rusting and provide corrosion protection by phosphating followed by powder coating with epoxy polyester unless otherwise indicated.
Heating elements
Materials
Finned tubes

Copper.
Fins
Aluminium.
Headers
Copper
Connections
Screwed female to relevant part of BS EN 10226, terminating within casing.
Air cock
Fit an air cock on flow connection with the air cock terminating through side of casing, or behind front grille.
Fan
Crossflow centrifugal with EC motor or double inlet, double width centrifugal type, dynamically and statically balanced, suitable for high efficiency and quiet running as scheduled.
Motor
Electronically commutated (EC) with infinitely variable speed control unless scheduled otherwise.
Vibration isolation
Isolate motor/fan assembly from casing by anti-vibration mountings.
Filter
Removable, washable type.
Grilles
Linear grilles to manufacturer's standard, unless otherwise indicated. Ensure grilles are pencil proof.
Controls
Pre-wired sensor / controls arranged as described in the controls drawings and scheduled in W80
Testing
Pressure test at not less than 7 bar (gauge) or one and a half times maximum working pressure whichever is greater.
Accessories
Mounting brackets

310.882 TRENCH HEATING: (T31)
Duty and type as scheduled.
Standards
Ensure trench heaters (convectors) are manufactured to BS EN 16430-1 and tested/rated for thermal output in accordance with BS EN 16430-2.
Sound power levels to be measured in accordance with BS EN ISO 3744
Electrical supply to BS EN 60038
Details – unless scheduled otherwise
Fan / motor type
Crossflow with electrically commutated (EU) motor with infinitely variable speed control unless scheduled otherwise.
Casing
Construct casing from rigid heavy gauge galvanised sheet steel, strengthened to prevent drumming, with no sharp edges for safety. Support heat exchanger from casing and ensure casing prevents air by-passing.
Casing minimum thickness - 1.2mm
Finish -Manufacturer's standard unless scheduled otherwise.
Grilles
Anodised aluminium roll-up linear grille to manufacturer's standard.
Stainless steel roll-up linear grille to manufacturer's standard.
Linear grilles to manufacturer's standard.
Ensure grilles are pencil proof.
Filter - fresh module for facade ventilation unit
Removable, washable type.
Connections
Brass compression fittings for connecting to valves terminating in casing.
Controls - fan assisted types
Provide manufacturer's standard wall-mounted digital controller with integral room temperature sensor suitable for interfacing with a BMS for alarm outputs.
Control requirements unless scheduled otherwise.
Provide facility for digital input for remote on/off control.
Unit to operate in natural convection mode with automatic operation of fan to increase output.

T20 – Primary Heat Distribution

Electronically commutated (EC) motor with infinitely variable fan speed control to automatically adjust the fan speed depending on the room temperature.
Integrated timer program for programming day and week switching functions.
Provide manufacturer's standard wall-mounted electromechanical room thermostat and fan speed controller.
Controls - natural convection types
Provide and install in the convector casing a lock shield valve and thermostatic radiator valve with remote sensing bulb and adjuster.
Testing
Pressure test at not less than 7 bar (gauge) or one and a half times maximum working pressure, whichever is greater.
Accessories – unless scheduled otherwise provide the following:
Air vent and drain cock.
Two port LTHW control valve and actuator for on/off control.
Lockshield valve for return shut off / regulation.
Floor mounting brackets with height adjustment.

310.085 UNIT HEATERS: (T31)
Duty as schedule
Standard - Rate unit heaters in accordance with BS 4856.
Electrical details to BS 7697, single or 3 phase as scheduled
Arrangement – as schedule
Casing
Manufacturer's standard. Construct casing from rigid heavy gauge sheet steel.
Provide access to fan and motor
Extend casing to cover motor and fan.
Position suspension steals so that the heater will be suspended level before pipework is connected.
Fit spigot for ductwork connection as required.
Finish
Degrease and protect against rusting before application of a high quality stove primer and Stove enamel paint
Colour
Manufacturer's standard.
Heating elements
Finned tubes
Copper.
Fins
Aluminium.
Headers
Steel.
Connections
Screwed female to relevant part of BS EN 10226 or Flanged to BS EN 1092 parts 1, 2, 3 or 4 - PN to suit fluid and working pressure.
Fan
Propeller type dynamically and statically balanced.
Motor
Totally enclosed, with sealed for life bearings requiring no
Vibration isolation
Isolate motor/fan assembly from casing by anti- vibration mountings.
Louvres
Provide adjustable discharge louvers as indicated.
Testing
Test to BS 4856, not less than 20 bar (gauge) or twice the maximum working pressure whichever is greater.

310.090 CONTINUOUS NATURAL CONVECTORS: (T31)
Standard - Ensure natural convectors are manufactured in accordance with BS EN 442-1,
thermal output and pressure drop testing/rating to be in accordance with BS EN 442-2
Duty as scheduled.
Type
Sill line convector.
Skirting convector.
Handrail convector.
as scheduled

T20 – Primary Heat Distribution

Materials
Finned tubes
Copper.
Fins
Aluminium.
Casing
Provide back plates complete with brackets to support finned tube.

Manufacture back plates from aluminium, or mild steel.
Provide front plates manufactured from aluminium, or mild steel.
Finish
Degrease and protect against rusting before application of a high quality stove primer, unless otherwise indicated.
Outlet
As scheduled
Grille
Aluminium grille, unless otherwise indicated
Testing
Pressure test at not less than 7 bar (gauge) or one and a half times maximum working pressure whichever is greater.
Accessories
Support brackets

310.100 RADIANT PANELS (heating or heating / cooling): (T31)
Duty as scheduled.
Standards
BS EN 14037-1 - technical specification and requirements.
BS EN 14037-2 - test methods for thermal output.
BS EN 14037-3 - rating method and evaluation of radiant thermal output.
If panels used in a changeover system to provide summer cooling, test panels constructed in accordance with BS EN 14037-1 for cooling capacity in accordance with BS EN 14037-4 and BS EN 14037-2.
Panels for security applications to be anti-ligature design and National Offender Management Service approved.
Material
Coil and Header, coil minimum diameter 20mm and header minimum diameter 32mm. Copper.
Front panel, minimum thickness 2mm. Aluminium, or Mild Steel.
All cover plates shall be manufactured of the same materials as the Radiant Panels and of the identical profile in order that when fitted they provide a smooth continuous face with the minimum gap to accommodate expansion between the panels and the cover plate, these being fixed with spring clips, magnets or set screws as necessary.
Finish
Degrease and protect against rusting before application of a high quality stove primer, unless otherwise indicated.

Insulation
Insulate back of panel with 40mm minimum thickness material with reinforced aluminium foil finish, and all edges taped to prevent fibre migration. Insulation shall be held in place by purpose made clips/fixings.
Air venting
Provide air cock for venting in unit heater.
Access
Provide access panel to match front plate.
Support
Provide adjustable hangers for ceiling units and brackets for wall hung units.

310.111 RADIANT STRIP HEATING: (T31)
The radiant Strip Panels shall be aluminium construction having a 18 minimum gauge smooth aluminium face plate to the back of which shall be attached mechanically a special extrusion of such profile as to give at least 50% surface contact to the heating water copper tube. This extension shall be designed specifically for the purpose with the fixing arrangements such that it will allow differential thermal movement between the face plate movement between the face plate and extrusion without facial distortion.
A copper tube grid shall be held into the extrusion such that the tube is held in very close contact but at the same time allowing thermal movement.

T20 – Primary Heat Distribution

The rear of the Strip Panel shall be provided with a 400mm thick fibre glass blanket which shall have all edges taped to prevent fibre migration.
The panels shall be provided with a factory finish.
Junctions between panels shall be by means of purpose made strips in order to allow expansion naturally.
Standards
BS EN 14037-1 - technical specification and requirements
BS EN 14037-2 – test methods for thermal output
BS EN 14037-3 – Rating method and evaluation of thermal output
BS EN 14037-4 – Test method for cooling capacity if used in a changeover system to provide summer cooling

310.120 TOWEL RAILS: (T31)
Duty as schedule
Arrangement
Floor mounted, Wall mounted or including radiator panel as scheduled
Connections
Integral screwed.
Air cock
Provide flush return end air cock.
Finish
Chromium plated.
Testing
Pressure test at not less than 7 bar (gauge) or one and a half times maximum working pressure whichever is greater.
Thermal output and pressure drop testing to be in accordance with BS EN 442-2.
Accessories
Wall /floor brackets.

310.130 EMBEDDED PIPE COILS :(T31)
Duty as scheduled
Supply pipe for installation in screed.
Material
Copper - BS EN 1057, R250 with brazed joints or
Steel – BSEN 10244, heavy, with welded joints or
Plastic to manufacturer's specification.
as indicated.

310.140 HEATED CEILING PANELS :(T31)
Duty as equipment schedule
Provide heated ceiling panels installed by specialist to manufacturer's instructions.

310.150 UNDERFLOOR HEATING :(T31)
Duty and details as equipment schedule
Standards
Design, proving of thermal output, testing and installation in accordance with relevant parts of BS EN 1264
Comply with relevant parts of BS EN ISO 11855.
Pipe and fittings system
WRAS listed.
All underfloor pipework to incorporate an oxygen diffusion barrier.
Material
Crosslinked polyethylene (PE-X) BS 7291-3 or all parts of BS EN ISO 15875, Ends plain, and finish – natural
or Polybutylene (PB) BS 7291 Part 2 or all parts of BS EN ISO 15876 Ends - plain, and finish – grey
or Proprietary plastic multilayer composite system to BS EN ISO 21003
Two layers of PE-Xc to all parts of BS EN ISO 15875 with EVOH oxygen barrier to DIN 4726.
or Metal / plastic multilayer composite system to BS EN ISO 21003.
Welded aluminium forming oxygen barrier between inner and outer layers of PE-X to BS EN ISO 15875-2 or PE-RT to BS EN ISO 22391-2, oxygen barrier to DIN 4726.

310.151 HEAT INTERFACE UNIT (HIU) (Y22 2015)
General

T20 – Primary Heat Distribution

Design, install, test and commission the units and systems into which they are installed following the guidance / recommendations in BSRIA BG62/2015 and CIBSE / CHPA CP1 for heat networks. The extent of design work is outlined in the scope of works / system description.
The HIU shall be CE marked.
Duty and detailed requirements – as scheduled
Electrical details
BSEN 60038, single phase or as scheduled
Arrangement
As scheduled
Standards
Equipment associated with hot and cold water services to comply with Water supply Regulations and have relevant WRAS approvals.
Materials / jointing
Internal interconnecting pipework in the HIU to be copper or 316 stainless steel connections shall be brazed or welded wherever possible, compression or other mechanical fittings will only be acceptable where it can be demonstrated that brazing or welding is not possible. Wherever practical, internal pipework and heat exchangers to be insulated to minimize heat losses.
Casing
Construct casing from rigid heavy gauge sheet steel. Provide label on unit to enable user to isolate the primary supplies in an emergency. Provide access to all components from the front of the unit, side access panel will not be acceptable. Ventilation openings to be provided to prevent overheating of pump motor or control components.
Finish
Degrease and protect against corrosion before application of high quality stove primer and stove enamel paint or powder coating, colour to be manufacturer's standard unless scheduled otherwise.
Connections
Screwed female to BS EN 10226 to suit fluid maximum working pressure.
Heat Exchangers
Plates to be 316 stainless steel and fouling factor of 10% to be used in sizing. Units to be pre-insulated at the manufacturers works.
Pump / Control
Glandless circulator to be Class A with variable speed control. Motors shall have a maximum Energy Efficiency Index (EEI) of 0.2, in accordance with EC directive 641/2009 and the amendment 622/2012. Pump motor to be permanent magnet type, with integral stepless control of pump speed to a minimum flow in response to closing of Thermostatic radiator or other 2 port control valves in the system. Pumps to comply with BS EN 60335-2-51 and relevant parts of BS EN 16297 for calculation of Energy Efficiency Index (EEI).
Circulators having a rated input of up to 200W to be tested in accordance with BS EN 16644 for structure and fluid borne noise.
Testing and Commissioning
HIU to be tested in accordance with BSRIA BTS 2/2015 to provide the following:
Product identification
Space heating circuit capacity
Domestic hot water production
Fluid side pressure drop on both circuits
Plate deflection in Heat exchangers
Heat loss
Hydraulic pressure testing at manufacturers works 1.5 times the maximum working pressure on primary and secondary side as scheduled.
Undertake commissioning and proving of capacity accordance with the relevant CIBSE / BSRIA codes and recommendations of the HIU manufacturer.
Where scheduled provide test data for testing to BESA UK HIU Test Regime Technical Specification to establish how the HIU will interact with a "Heat Network".
Temperature Control
Control of Domestic Hot Water flow temperature to have accuracy no greater than +/- 3°C.
The controls shall ensure that the heat exchanger surfaces do not reach temperatures that could cause rapid scaling of the heat exchange surfaces.
Heat meter
To be part of units and record and display cumulative energy used (kWhrs), flow and return primary temperatures, instantaneous flow rate / kW. Heat meters to comply with relevant parts of BS EN 1434.
Flow sensor accuracy class as BS EN 1434-1 and Annex MI-004 of the EU Measuring Instruments Directive (MID 2014/32/EU) – class 2.
Cold water meter
To relevant parts of BS EN ISO 4064

T20 – Primary Heat Distribution

To BS EN 14154-4 (if AFD's associated with Smart Metering required)

Accessories

Wall or floor brackets and items as scheduled.

Fixed full bore bypass in the primary heat network connections with tender points for measurement of differential pressure across the HIU.

310.150 PRESSURIZATION PLANT:

Standard

Manufacture pressure vessels for sealed hot water systems in accordance with BS EN 13831, and BS 7074 Part 1 (Domestic heating and hot water supply) or Part 2. (Low and medium temperature hot water heating systems) as applicable.

Manufacture pressure vessels for unvented hot water systems in accordance with BS 6144, and BS 7074 Part 1 (Domestic heating and hot water supply) or Part 2. (Low and medium temperature hot water heating systems) as applicable.

Duty as scheduled.

Accessories

100mm OD minimum system pressure gauge (calibrated in bar & psig)
High pressure switch.
Low pressure switch.
Safety valve
Water meter - integrating total system make-up quantity
Automatic pump changeover, with lead pump selector switch
Power 'on' indicating lamp
High pressure indicating lamp
Low pressure indicating lamp
Power isolating switch
Hand/off/auto switch
Hours run counter
Pump start frequency counter
Control equipment to comply with Health & Safety Executive Guidance Note PM5 - Hot water boilers, category 'B'

Alarms

High system pressure
Low system pressure
Excessive pump start
Facility for remote monitoring of a common alarm condition

310.170 GAS / OIL FIRED HEATING PLANT – LOCAL HEATING UNITS (T42):

Refer to schedules / scope of work for project specific type / details and duties.

Direct and indirect fired self-contained heating units standards

BS EN 525 - direct gas fired heaters, with rated input not exceeding 300kW.
BS 5990 - direct gas fired heaters rated from 330 kW up to 2 MW.
BS 5991 - indirect gas fired heaters rated up to 2 MW.
BS EN 1266 - gas-fired with nominal heat input up to 70kW based on net calorific value.
BS EN 1020 - non-domestic gas-fired forced convection air heaters not exceeding net heat input of 300kW, incorporating fan to assist combustion air and/or combustion products.
BS EN 778 - domestic gas-fired forced convection air heaters not exceeding net heat input of 70kW.
BS EN 1319 - gas-fired forced convection air heaters with fan-assisted burners not exceeding net heat input of 70kW.
BS EN 1196 - gas-fired air heater, supplementary requirements for condensing air heaters.
BS EN 13842 - oil fired forced convection air heaters.
Heat recovery
Type - Plate heat exchanger performance tested in accordance with BS EN 308

Gas fired space heaters standards

BS EN 14829 - independent gas-fired flueless space heaters for nominal heat input not exceeding 6kW.
BS EN 1266 - gas fired convection heaters up to 20kW.
BS EN 449 - LPG domestic flueless space heaters for nominal heat input not exceeding 4.2kW.

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BS 5871-1 - gas fires, convector heaters and heating stoves.
BS 5871-2 - inset live fuel effect gas fires of heat input not exceeding 15kW, and fire/back boilers.
BS 5871-3 - decorative fuel effect gas appliances of heat input not exceeding 20kW.
BS 5871-4 - independent gas-fired flueless fires, convector heaters and heating stoves of nominal input not exceeding 6kW.

Gas radiant heater standards

BS EN 416-1 and BS EN 416-2 - Types A, B and C single-burner overhead heaters single-burner overhead heaters.
Multi-burner overhead heaters
BS EN 777-1 - Type B individual units without fans connected to a common duct with a fan. Only one burner unit is situated in each branch tube.
BS EN 777-2 - Type B individual units with a fan connected to a common duct without a fan.
BS EN 777-3 - Type B individual units with a fan connected to a common duct with a fan.
BS EN 777-4 - Type B individual units without fans connected to a common duct with a fan. One or more burner units are situated in each branch tube.
BS EN 419-1 - luminous overhead heaters. Type A appliances without a fan.
BS EN 14543 - LPG flueless radiant parasol patio heaters.

Flues to BS EN 1856-1 (tested to BS EN 1859) installed in accordance with BS EN 15287-1 and the unit manufacturers recommendations

320.000 WORKMANSHIP (T31 / T42)

320.010 INSTALLATION (T31 320.010 & T42 320.030, 310.010, 310.020, and 310.030):

Install in accordance with manufacturer's recommendations to give a neat appearance, with supports out of view where possible.

Ensure equipment is firmly fixed and level.

Install domestic systems with heat requirements up to a total of 50kW to BS EN 14336.

Installation / ventilation requirements for local gas / oil fired heaters

Install space heaters in accordance with manufacturer's recommendations.
Install gas radiant heaters in accordance with BS 6896
Install and commission gas fired air heaters of rated heat input not exceeding 2MW in accordance with BS 6230 and manufacturer's instructions.
Install and commission gas-fired air heaters of rated heat input not exceeding 70kW in accordance with BS 5864 and manufacturer's instructions.
Install and commission oil fired air heaters of rated output not exceeding 45kW in accordance with BS 5410-1 and manufacturer's instructions.
Install and commission air heaters for liquid fuel firing installations for non-domestic buildings and buildings containing multiple separate dwellings in accordance with BS 5410-2 and manufacturer's instructions.

Install unit flue and flue connection from unit in accordance with manufacturer's instructions and recommendations.
The heater manufacturers shall install and commission the flues.
Install flue in accordance with BS EN 15287-1.
Minimise the number of joints, do not locate joints in depth of floors. Install with any sockets facing upwards.
Fill joints with approved jointing compound to give gas tight seal.

Install oil storage tank in accordance with BS 5410-2 and BS 799-5

Comply with BS 6896, BS EN 13410, BS 6230 or relevant part of BS 5410 depending on heater type, application and fuel, for ventilation / supply of combustion air.

320.020 BUILDERSWORK:

Mark out positions for battens fixed by others, when fixing equipment to stud walling.

320.030 SECOND FIX:

Allow for removal and second fix of all radiators.

T20 – Primary Heat Distribution

320.040 ISOLATION:
Fit an isolating valve on flow and a regulating valve on return unless otherwise indicated.

320.051 EMBEDDED PIPE COILS & UNDERFLOOR HEATING INSTALLATION:
For plastic pipe coils embedded in screed, comply with manufacturer's instructions for installation. Lay insulation and pipework on floor slab and test prior to screeding. Protect against damage to pipework before screeding is carried out. Install panels at depth and in position shown on drawings.
Install in accordance with manufacturer's instructions and BS EN 1264-4 or BS EN ISO 11855-5, the piping system manufacturer's recommendations and comply with BSRIA BG 4/2011 for the general installation process, commissioning, balancing and start-up.

320.070 PRESSURISATION UNIT INSTALLATION:
Install pressurization unit and ancillary equipment in accordance with manufacturer's recommendations including safety valves if not part of the packaged equipment. .
Install expansion vessels and ancillary equipment for low and medium temperature hot water heating systems in accordance with BS 7074 Part 2.
Install expansion vessels and ancillary equipment for domestic heating in accordance with BS 7074 Part 1.
Install double check valves on quick fill connections.

10080 Based on NES:
T20 March 18
T30 Dec 04
T31 March 18
T42 Dec 18

T61 – Primary / Secondary Cooling Distribution

PART 1 SYSTEM OBJECTIVES

160.010 PERFORMANCE OBJECTIVES
To provide a piped chilled water distribution system from the plantroom to the cooling emitters and cooling coils.
For pre-insulated underground distribution pipework refer to Y10 clauses including 2881, 2882 and 9080 and schedule Y10sch2.

160.021 STANDARDS
See Schedule of Common Design Criteria.

All components of the system to be designed installed tested commissioned and decommissioned to the requirements of the following:

Standards/Approved codes of practice
The Pressure Systems Safety Regulations 2000
The Approved code of practice to the Pressure Systems Safety Regulations (ACOP) L 122 "Safety of Pressure Systems".
CIBSE TM 13 - Minimising the risk of Legionnaires' disease
Where evaporative cooling systems are to be installed, assess the system against the notification requirements defined in NICTEC Notification of Cooling Towers and Evaporative Condensers Regulations 1992 and liaise with the employer to ensure a notification has been made to the Local Authority if required. Comply with HSC ACOP L8 and associated technical guidance HSG 274 Part 1 as appropriate. Provide sample points in the cooling system pipework to enable sampling to be undertaken in accordance with BS 7592.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO T61

380.000 GENERAL
Refer to Y10 and Y11 for pipework and pipeline ancillaries installation and workmanship detail requirements.
Refer to Y25 for cleaning and chemical treatment requirements.
Install suitably sized safety valves in all secondary distribution pipework from heat exchangers.

380.001 PRESSURE EQUIPMENT DIRECTIVE/PRESSURE EQUIPMENT REGULATIONS:
All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 2014/68/EU, implemented in the UK through the Pressure Equipment (Amendment) Regulations 2015 and The Pressure Equipment (Safety) Regulations 2016, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.

Only relevant equipment and assemblies certified as compliant will be permitted under this specification, and any substitution put forward must also be compliant with the Directive.

380.011 SITE DIMENSIONS:
Check dimensions on site prior to ordering.

380.051 MAINTENANCE:
Ensure that major components are readily accessible for maintenance without dismantling or removing other components.

380.060 SAFETY:
Comply with BS EN ISO 12100 and relevant parts of BS EN 378. Ensure noise precautions are in accordance with the Health and Safety Executive Noise at Work regulations.

380.071 EQUIPMENT:
Comply with the following standards .
Pressure vessels
BS 7005 or relevant parts of BS EN 13445 and BS EN 14276-1 for general requirements for material, design, manufacturing, testing and documentation.
Materials
Generally - Manufacturer's standard.

T61 – Primary / Secondary Cooling Distribution

Pipework – BS EN 10216-1 to BS EN 10216-4 and BS EN 10217-1 to BS EN 10217-6
Steels for pressure vessels – BS EN 10028-7, BS EN 10028, BS EN 10273.

Provide noise and vibration isolation equipment to meet the scheduled performance criteria.

Minimum efficiency of single speed three phase cage induction motors from 0.75kW to 500 kW shall be IE3 or IE2 with VSD unless scheduled otherwise in accordance with BS EN 60034-30-1.

310.000 PRODUCTS/MATERIALS

310.002 HEAT EXCHANGER INSULATION:
Insulate chilled water heat exchangers as specified in section Y50.

310.105 CHILLED WATER BUFFER VESSEL
See schedule for capacity, working pressure and fittings
Standards: PD 5500 or BS EN 13445 ; BS EN ISO 16433, BS EN 10028; BS EN 1011
Insulation
Vessel to be insulated and finished with hammer clad aluminum complete with vapour sealing, thickness in accordance with Y50 reference specification,
Fittings
Temperature gauge.
Pressure gauge.
Drain cock.

310.121 PRESSURISATION AND EXPANSION PLANT:
Standards
Comply with the recommendations in BS 7074-3 for the selection, application, installation, testing and commissioning of expansion vessels and ancillary equipment including safety valve for sealed chilled water systems.
Closed expansion vessel with built in diaphragm to BS EN 13831. For applications where the vessel water temperature is normally outside the range of 5 °C to 70 °C the test methods in this standard shall be adapted in such a way that the test temperature corresponds to the
Provide duty and standby pumps with auto changeover on failure; duty pump selector switch; volt free contacts for common fault.
Include break tank with type AF air gap in packaged unit to BS EN 14622.

Duty as scheduled.

Accessories – unless scheduled otherwise provide the following:
100mm OD minimum system pressure gauge (calibrated in bar & psig)
High pressure switch.
Low pressure switch.
Safety valve
Water meter – integrating total system make-up quantity
Automatic pump changeover, with lead pump selector switch (on units with duty and standby pumps)
Power 'on' indicating lamp
High pressure indicating lamp
Low pressure indicating lamp
Power isolating switch
Hand/off/auto switch
Hours run counter
Pump start frequency counter

Alarms
High system pressure
Low system pressure
Excessive pump start
Facility for remote monitoring of a common alarm condition
Electrical details to BS EN 60038

T61 – Primary / Secondary Cooling Distribution

320.000 WORKMANSHIP

320.010 GENERAL:
Install equipment in accordance with equipment manufacturer's requirements. Comply with statutory and local authority requirements and by-laws.

320.021 CONNECTIONS:
Observe manufacturer's requirements and instructions. Where the connections on a machine are closer than would allow the fitting of two adjacent flanges, fit 45° flanges to space the connections to the distance required. No not use cut flanges.

320.030 ACCESS:
Ensure plant is located to allow access for operation and maintenance as required by manufacturer.

320.040 CLEANSING:
Observe manufacturer's requirements and instructions. Provide valved flushing connections adjacent to plant.

320.051 PRESSURISATION UNIT INSTALLATION:
Install pressurization unit and ancillary equipment in accordance with manufacturer's recommendations and install expansion vessels and ancillary equipment for chilled water and condenser systems including safety valve in accordance with BS 7074 Part 3 in chilled water distribution pipework.
Install double check valves on quick fill connections.

320.052 WORKMANSHIP UNDERGROUND/BURIED PIPEWORK: (NES 320.040)
Install pre-insulated bonded steel pipelines to BS EN 253, BS EN 448, BS EN 488 and BS EN 489 in accordance with manufacturer's instructions and BS EN 13941 or BS EN 15698-1 for twin pipe systems.
Install pre-insulated bonded flexible pipe system to BS EN 15632-1 and BS EN 15632-2, with plastic service pipes, in accordance with manufacturer's instructions.
Install pre-insulated non bonded flexible pipe system with plastic service pipes to BS EN 15632-1 and BS EN 15632-3 in accordance with manufacturer's instructions.
Install pre-insulated bonded flexible pipe system with metal service pipes to BS EN 15632-1 and BS EN 15632-4 in accordance with manufacturer's instructions.

10000 Based on NES T60 TEXT March 18

U10 – Ventilation Supply/Extract

Incorporating U11 (toilet ventilation), U12 (kitchen ventilation), U13 (car park ventilation) T40 (Warm air heating from central ventilation plant)

PART 1 SYSTEM OBJECTIVES

380.010 PERFORMANCE OBJECTIVES AND REGULATIONS / STANDARDS
To provide an air movement system to ventilate the spaces listed and to remove vitiated air where indicated.

To temper and filter the air where indicated or provide space heating from central ventilation plant (refer to Y40 for air handling units details)
Refer to clause W80 320.100 for control panel design and construction.

Comply with Building Regulations Approved Document F1 (England and Wales) or Building Standards Domestic or Non Domestic Technical Handbooks, Section 3.14 (Scotland) or Building Regulations Technical Booklet K (Northern Ireland).

Comply, as detailed in the scope of works and / or A13sch, with the requirements of BS EN 16798-3 and additional guidance in PD CEN/TR 16798-4 to achieve the specified category of supply air (SUP) with defined category of outdoor air (ODA)

Comply with BS EN 15423 for fire precautions for air distribution systems in buildings.

Naturally ventilated / mixed mode buildings.
Comply with the following unless detailed otherwise in the project specific scope of works.
Any design work detailed in the project specific scope of works for natural / mixed mode ventilation to comply with Code of Practice BS 5925.
Calculations for determination of air flow rates including infiltration to be in accordance with BS EN 16798-7 and energy losses due to ventilation to be in accordance with BS EN 16798-5-1 and BS En 16798-5-2.
Use Computational Fluid Dynamics (CFD) to predict airflows and temperatures in 3-dimensions in the building and within the natural ventilation devices.
Predict by dynamic simulation whether summertime overheating is likely to occur.
Unless detailed otherwise in the scope of works, the building shall conform to Category II in BS EN 15251 for maximum acceptable temperature above the comfort (or operative) temperature.
Employ a specialist or the ventilation terminal unit manufacturer to develop the concept design and the tender stage thermal model and undertake dynamic thermal modelling calculations using manufacturer's data for the selected ventilation terminals in order to ascertain the optimum size, location and number of terminals required.

Kitchen ventilation (U12)
Comply with the design, construction, testing and commissioning requirements of BESA DW172 appropriate to the scope of works / system description or relevant parts of BS EN 16282 appropriate to the scope of works / system description and schedules.

Car park ventilation systems (U13)
Comply with the requirements of BS 8899, BS 7346-4 or BS 7346-5, BS 7346-7 and BS 7364-8 and Building Regulations Approved Document B (Fire Safety) for car park ventilation in order to limit concentrations of carbon monoxide (CO) and other vehicle emissions in the day-to-day use of car parks and to remove smoke and heat in the event of a fire.
Ensure wiring is suitable for high temperatures to provide a maintained supply.
Comply with BS 7671 (IET Wiring Regulations) and provide power supplies in accordance with BS EN 12101-10.
The cables selected for power and control wiring for the installation shall be fire-resistant meeting the requirements of BS 8519.

Schools
Where applicable, comply with the requirements of the latest version of Building Bulletin 101 Ventilation of School Buildings for school ventilation and baseline designs and strategies for schools, including for the Priority School Building Programme (PSBP) where appropriate

U10 – Ventilation Supply/Extract

Offices
Where applicable, comply with the top of the range recommended in the British Council for Offices Guide to Best Practice in the Specification of Offices.

Healthcare buildings
Where applicable, comply with the requirements of HTM 03-01 Specialised ventilation for healthcare premises (England, Wales and Northern Ireland) SHTM 03-01 Ventilation for Healthcare premises Part A: Design and Validation (Scotland) for Clinical areas with controlled environmental conditions.

General

Undertake checks and tests in order to verify the fitness for purpose of the installed systems prior to handover in accordance with BS EN 12599.

Refer to Y30sch1 for each ventilation systems cleanliness quality class to BS EN 15780 and PDI level to BESA TR/19

For residential ventilation comply with BS EN 13142 for performance characteristics. Performance test ventilation components/products in accordance with relevant parts of BS EN 13141.

380.020 DESIGN PARAMETERS / REQUIREMENTS
General
See Schedule of Common Design Criteria / clause 100.010.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO U10

380.011 TOILET EXTRACT UNIT (U11 toilet ventilation)
Electrical safety to BS EN 60335-2-80.
Motor
Electrical supply to BS EN 60038
Access - provide access via removable panel.
Controls - On/off with auto changeover.
Accessories
Backdraught dampers.
Anti-vibration mounts.
Testing
Where fans approved under CAME scheme are used provide certified data for type.
Where fans are not approved under CAME scheme provide results of aerodynamic performance tests in accordance with BS EN ISO, BS 848-1; noise tests in accordance with BS EN ISO 5136, BS ISO 13347 parts 1-4; and fan vibration tests in accordance with BS ISO 14695.

380.015 ECODESIGN REQUIREMENTS FOR AIR HEATING PLANT: (T40)
Equipment to be in accordance with The Energy Related Products Regulations 2010 as amended.
Plant to comply with EU Regulation 2016/2281, including Seasonal Space Heating Energy Efficiency (SHEE) and product information / instruction manuals information on disassembly, recycling and/or disposal.

380.020 NATURAL VENTILATION TERMINAL UNIT MANUFACTURER:
Use ventilation terminal units from a single manufacturer.
The selected ventilation terminal unit manufacturer shall undertake the following
Provide structural loadings and installation details.
Produce installation and record drawings for all ventilation terminals, co-ordinated with the architect and structural engineers' details.
The supply, installation, testing and initial commissioning of all ventilation terminals and all associated controls that make up the ventilation systems in the building.
Seasonal commissioning to prove the installed system and facilities meet the design criteria and users' requirements.

380.040 INTEGRATION, CONTROL AND MONITORING: (U13 car park ventilation)
Provide an integrated system as detailed in the scope of works / schedules.

U10 – Ventilation Supply/Extract

Equipment to be controlled / monitored should interface with BMS and fire alarm system as described in the scope of works viz:
- Local outstations / control panels

Supervisory control and data acquisition system via:
- Local outstations / control panels

Fire detection and alarm system:
- Ensure interfaces to fire detection and alarm system comply with the requirements of BS 5839.
- Ensure relevant equipment complies with BS EN 50130-4.

310.850 SOFTWARE: (U13 car park ventilation)
Obtain on behalf of the end users all appropriate licences, permissions, copyright waivers, rights of use and the like from the owners of the software rights. Ensure that the end user is properly registered with the software supplier for support and appropriate updating. Provide documentation for application software in accordance with BS ISO/IEC 26513 and BS ISO/IEC 26514.
Ensure that, as far as practicable, all software is commercially available off-the-shelf.
Ensure that any programmable configuration, customisation, and bespoke software, is developed, tested and commissioned using relevant processes and procedures complying with BS ISO/IEC/IEEE 12207 or BS ISO/IEC/IEEE 15288 supported by a quality management system meeting the requirements of BS EN ISO 9001.

310.900 PRODUCTS/MATERIALS
Provide system components as indicated on drawings and schedules

Natural ventilation
- Where natural ventilation terminal units include automatic controls, a manual override should be fitted to allow short-term adjustment during unexpected weather conditions.
- All natural ventilation terminals to include insect screen and weather protection.
- Louvres to comply with Y48 and be tested in accordance with BS EN 13030.
- Air transfer devices and trickle ventilators to comply with BS EN 13141-1 for performance testing of air transfer devices and BS 8375-1 for performance for weather tightness.
- Test local wall ventilators and trickle ventilators in accordance with BS EN 1026 and BS EN 1027 for air permeability and water tightness.

310.905 MAIN CAR PARK EXTRACT FANS (U13 310.005):
The facilities shall be designed in accordance with code of practice BS 7346-7.
Details of fans are given in work section Y41 and schedules.
Details of controls and BMS requirements and interfaces with main car park extract fans and impulse fans (where installed) are given in the scope of works or work section W60.
Testing
- Test aerodynamic performance to BS EN ISO 5801
- Temperature/time classification to BS EN 12101-3
  - 300°C for not less than 60 minutes unless scheduled otherwise

Power supplies
- Comply with BS 7671 and BS EN 12101-10

Where fans are not approved under CAME scheme provide results of aerodynamic performance tests in accordance with BS ISO 14695, BS 848-6

310.906 CAR PARK MAKE UP AIR HANDLING SYSTEM (U13.310.006):
Refer to scope of works / schedules and work section Y40 for details of air handling units.
Control and BMS requirements and interfaces with main car park extract fans and impulse fans (where installed) are given in the scope of works or work section W60.

310.912 CAR PARK VENTILATION SYSTEM AND IMPULSE JET CAR PARK VENTILATION UNITS (U13 300.001, 300.015 & 310. 910)
Refer to schedules for duties / details.
Use a specialist to manufacture, supply and install and commission the car parking ventilation equipment and associated control system to operate the jet fans and associated main car park extract fans.
Where scheduled use a specialist to undertake the detailed design of the system and carry out a detailed CFD study of the car park ventilation system and prepare and submit the CFD analysis to the approving authority, in accordance with the Smoke Control Association / HEVAC Guide - CFD Modelling Guide for Car Park Ventilation

U10 – Ventilation Supply/Extract

Systems. The system shall be designed in accordance with the functional and calculation methods described in BS 7346-7 and BS 7346-8.
Standards
- Comply with BS 9999, BS 7346-7 and BS 7346-8
- Comply with BS 7671 and provide power supplies in accordance with BS EN 12101-10.
- The cables selected for power and control wiring for the installation shall be fire-resistant meeting the requirements of BS 8519.

Operation
- Sequential impulse fan and main extract fan operation on demand from bespoke control system.

Materials
- Polyester powder coated or Manufacturer's standard.

Electrical safety to BS EN 60335-2-80.
Motor
- Electrical supply to BS EN 60038

Accessories
- Directional outlet diffuser.
- Safety inlet guard

Controls - Provide speed controller to match fan.
Testing
- Jet fans performance test data in accordance with BS EN ISO 13350.
- Temperature/Time classification to BS EN 12101-3: 300°C for not less than 60 minutes unless scheduled otherwise.
- Provide results of fan vibration tests in accordance with BS ISO 14695, BS 848-6.

310.915 DUCTWORK SYSTEM FOR CAR PARK VENTILATION (U13 310.015):
All smoke control duct sections should comply with BS EN 12101-7, tested to the requirements of the relevant parts of BS EN 1366 and classified in accordance with BS EN 13501-4.
Smoke control dampers should comply with BS EN 12101-8, tested to BS EN 1366-10 and classified in accordance with BS EN 13501-4.
Provide test classification report using BS EN 13501-4 nomenclature from a UKAS accredited certification body.
The design and selection of the system shall comply with the recommendations of BS 7346-7: Annex A.
Refer to schedule Y30 schedules for project specific details

310.916 KITCHEN VENTILATION CEILINGS (U12 310.030):
Type – refer to scope of works / drawings
Standards
BESA DW172 and BS EN 16282-3 for design, construction and safety requirements
Details – refer to scope of works / drawings

310.917 TREATMENT OF AEROSOLS/POLLUTION IN KITCHEN EXHAUST SYSTEMS (U12 310.032):
Type – refer to scope of works / drawings
Standards
BS EN 16282-5 for design, construction and safety requirements
Details – refer to scope of works / drawings

310.931 DUCTWORK FOR KITCHEN VENTILATION SYSTEMS (U12 310.030)
For normal applications supply and install ductwork associated with kitchen canopies in accordance with DW144 as detailed in DW 172 and clause Y30.2065
Kitchen extract ductwork to be fire resisting as schedule Y30sch5 and clauses Y30.2110G and 2110D or Y30.2110E or as described in the scope of works.
Where existing systems require inspection and cleaning prior to modification, employ a specialist to undertake the following works approved in accordance with Loss Prevention Standard LPS 2084:
- Inspect and clean ductwork that may be contaminated with combustible deposits.
- Make recommendations for access improvements to any areas where there is currently limited access making cleaning / maintenance impractical.

When total grease tightness is required Supply and install grease tight ductwork in accordance withDW172
Access doors for cleaning (with grease tight gaskets) shall be installed at every bend and connection and at every 3m on straight lengths of ductwork on all kitchen extract systems.
- Material
- 1.2mm stainless steel.

U10 – Ventilation Supply/Extract

or 1.0mm zintec.
Supply and install ductwork to extract steam from dishwasher and potwashing machines in accordance with DW172.
Refer to Y30 schedules and/or U10 scope of work for project specific requirements.

310.032 GROUND –AIR HEAT EXCHANGE SYSTEM - PIPEWORK / DUCTS
Refer to schedule U10sch3 for project specific requirements.
Material
Polypropylene to BS EN 1852 and DIN 16962 or HDPE to DIN 16961 or DIN 8074 and 8075 with ring stiffness to BS EN ISO 9969
Or Concrete to DIN 4032 and DIN 4035

All materials installed in the ground to be non-toxic and non-corroding in accordance with VDI 4640 Parts 1 and 4.
The materials shall have a smooth – surface interior, not attract dust, be non-hygroscopic and air tight. Corrugated pipes are not acceptable.
The complete system including all joints to be radon proof.
Installation
Install at a minimum fall of 1:50 towards the building / condensate removal facility

310.041 KITCHEN VENTILATION GAS SAFETY INTERLOCK FACILITIES (U12)
Provide an interlock between all kitchen gas appliances supply and extract ventilation to kitchens, such that the ventilation system operation must be proved before the gas appliance can be used in accordance with BS 6173. If an automatic electric isolation valve system is installed in the gas supply to the kitchen then the ventilation system shall also be interlocked with this system.
Comply with IGEM/UP/19 for the design, and application of interlock devices used within commercial and industrial applications including catering.
Scope to include control panel, pressure switch or sensing device, gas isolation control valve and all interconnecting power and control wiring.
Install interlock system in accordance with the manufacturer's recommendations.
Provide the following interlocks unless detailed otherwise in the scope of works or schedules:

- Primary interlock between ventilation system and appliances using differential pressure switch to shut gas isolation valve and lock out appliance on low pressure failure.
- Primary interlock between ventilation system and appliances by monitoring power used by fans to shut automatic gas isolation valve and lock out appliance on low absorbed power.
- Secondary interlock to shut gas isolation valve and lock out appliance on sensing high CO2.
- Secondary interlock to shut gas isolation valve and lock out appliances on fan failure or trip.
- Interlock with fire detection system
- Interlock with gas detection system
- BMS interface

Where appliances do not have flame failure devices provide a pipework integrity system (formerly referred to as weep by-pass system) in accordance with Appendix 12 in IGEM/UP/2 Edition 3.

320.000 WORKMANSHIP

320.010A INSTALLATION AND COMMISSIONING (NATURAL / MIXED MODE BUILDINGS):
Provide a method statement for the installation and commissioning of the ventilation facilities and controls.
The installer shall undertake a pre-installation survey prior to delivery of ventilation terminals to check all site dimensions and access facilities. A report shall be produced with results of survey and any remedial work required to the terminals shall be carried out before delivery to site.
The ventilation terminal unit manufacturer shall install and commission the ventilation terminal units and all associated controls or employ a certified, trained and vetted installer to undertake the work on behalf of the manufacturer.
Weathering details for all terminals to be agreed with the architect prior to installation.
Installation of all equipment to be installed in accordance with the manufacturer's instructions.
Commissioning should be undertaken by a control specialist to set the natural ventilation system up to recognise seasonal conditions. These should be set to meet the requirements of the building and its location.

320.011 EQUIPMENT INSTALLATION
Install equipment in accordance with manufacturer's recommendations.

U10 – Ventilation Supply/Extract

Install and commission LEV systems in accordance with the latest edition of Health and Safety Executive HSG258.

320.012 PROTECTION (U13)
Protect all car park duct droppers with 6mm bands 50mm wide. These shall be positioned at 300mm, 800mm and 1200mm aff, and shall be GAM. There shall be a 25mm air gap between the outside of the duct and the protective band.

320.020 KITCHEN CANOPY AND INSTALLATION (U12)
Design, manufacture, supply and install kitchen canopies in accordance with DW 172
Electricity safety of commercial electric hoods to BS EN 60335-2-80.

320.020A SYSTEM PROVING / POST COMMISSIONING (NATURAL / MIXED MODE BUILDINGS):
Revisit site 3 months after handover and check all terminal units and associated controls for operation in accordance with the design intent.
Undertake seasonal commissioning as defined elsewhere in this specification.
Visit site 12 months after handover to obtain user feedback from periods of high/low occupancy and during all seasons and adjust controls/fine tune the systems as necessary to improve performance if required. Report findings to the designer and building owner/operator and amend the O&M manuals, Building Log Book and Building User Manual.
Where required comply with the 3 year aftercare requirements of Soft Landings.

320.022 INSTALLATION OF CAR PARK SMOKE CONTROL SYSTEM (U13 320.010):
Install, commission and test the car park smoke control equipment in accordance with manufacturer's instructions, the requirements of the approving authority and BS 7346 Parts 7&8.
In addition to the general requirements for operation and maintenance documentation elsewhere in this specification comply with the requirements of BS 7346 Parts 7&8.

320.023 QUALITY CONTROL (U13 320.020):
Record all commissioning measurements and tests and site modifications to hardware or software, and revise operating and maintenance instructions accordingly.
Manage configuration of software settings, data and design, in accordance with an appropriate Configuration Management Plan (CMP), complying as necessary with BS EN ISO 9001, BS ISO 10007, BS ISO/IEC/IEEE12207 and BS ISO/IEC/IEEE 15288.
Provide configuration details along with the operation and maintenance manual on hand-over.
Manage information security of systems, software and data during design, implementation and commissioning in line with BS EN ISO/IEC 27001.

M0000 Based on NES U10 TEXT Sept 18
U11 TEXT June 17
U12 TEXT Dec 18
U13 TEXT June 18

V20 – LV Distribution

Incorporates V12 (public utility supply)

PART 1 SYSTEM OBJECTIVES

V20.011 PERFORMANCE OBJECTIVES
To provide the distribution of low voltage electricity from the supply authority's source to the building main switchboard and from the building main switchgear panel to and including the area distribution boards, sub-distribution board, motor control centres and specific items of mechanical plant.

On healthcare projects comply with all HTM's and HBN's pertinent to the nature of the project. In particular, compliance with HTM 06-01 and HTM 06-02 is required. In particular, compliance with HTM 06-01 Electrical services supply and distribution and HTM 06-02 Electrical safety guidance for low voltage systems is required.
To provide three phase power supplies to user points.
Refer to scope of works for primary and secondary sources of power.

V20.021 DESIGN PARAMETERS FOR HEALTHCARE PREMISES:
Design and supply the LV distribution in accordance with HTM 06-01 Electrical services supply and distribution and HTM 06-02 Electrical safety guidance for low voltage systems.
- Locate all HV-LV or LV-HV transformers as close as possible to any respective LV switchgear.
- Locate the principal LV switchboard as close as possible to the HV substation, considering harmonic interference, fault level and protection.
- Comply with HTM 05-02 (Firecode) – Fire safety in the design of healthcare premises, considering the location of HV and LV switchgear.
- Do not locate HV substations and LV switchrooms below bulk water or other fluid storage, or wet distribution systems.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO V20

V20.060 PRODUCTS/MATERIALS

V20.062 SWITCHBOARDS, DISTRIBUTION BOARDS
Refer to Y71

V20.063 CABLES and SUPPORTS
Refer to Y61 and Y63

V20.064 EARTHING
Refer to W51, which incorporates Y60 clauses for earthing and bonding components.

V20.065 BUSBAR TRUNKING
Refer to Y62

V20.070 LV OVERHEAD LINES AND ARIEL CABLES (V12.300.020)
Provide erected poles and accessories for supporting aerial/catenary low voltage distribution cables, to suit application.

Poles
- Standard BS 1990-1

Insulator fittings and pins for bare conductors
- Standard BS 3288 parts 1&2. BS EN 61466 parts 1&2, BS EN 61284 and BS EN 60372

Overhead line conductors
- Standard BS 7884 Copper
- BS EN 61232 Aluminium clad steel
- BS 215-1 Aluminium stranded
- BS 215-2 Aluminium - steel reinforced
- BS EN 50183 Aluminium Alloy

BS 6485 Covered conductors

V20.081 CO-ORDINATION STUDY

V20 – LV Distribution

Where required in the scope of works, carry out a complete protection grading and setting calculation of the complete electrical distribution system, including all connected equipment. Engage an independent Chartered Engineer specialising in electrical installation design to:
Undertake and verify the calculation.
Provide fault (short circuit) calculations for the distribution system as indicated on the drawings and a protective device co-ordination study to ensure that all protective devices are co-ordinated, to achieve full discrimination (unless specified otherwise). Base the study on the actual devices and cable lengths installed.
Prepare the fault calculations in accordance with BS EN 60909 and protective device study with an approved proprietary software package, by prior approval written calculations may be used for simple networks, include complete fault calculations for each proposed source and combinations thereof including motor, generator and UPS contributions.
Present the fault calculations including the following:
- General description of calculations methods, assumptions and base per unit quantities selected.
- Evaluation of grading margins used.
- Single line diagrams, source and electrical equipment characteristics (impedance data including X/R ratios, zero sequence impedances, inrush current characteristics, rated currents, design loads).
- Calculation of peak and three phase symmetrical / asymmetrical prospective fault currents (short circuit and earth fault) at each switchboard, motor control centre and distribution board.
- Typical calculations, tabulations of calculation quantities and results, verification of electrical equipment fault ratings.
- Conclusions and recommendations

Carry out the protective device co-ordination study including the following:
- Consideration of:
  - Short-circuits
  - Overloads
  - Residual currents
  - Possible fault currents in systems with semiconductors in accordance with Figure A53.1 of BS 7671 (IET Wiring Regulations)
- Time-current co-ordination curves graphically indicating the proposed co-ordination for the system on log-log graph transparencies. Include on each sheet, a complete title and single-line diagram identifying the specific portion of the system covered.
- A detailed description of each protective device (overcurrent and/or residual current) identifying its type, function, manufacturer and time current characteristics and tabulation of recommended settings.
- Carry out adjustments of the protection settings to confirm that the requirements of the report, ensure that;
  - Selectivity is achieved throughout the network and select protective devices and settings accordingly.
  - electrical equipment is protected.
  - maximum disconnection times are achieved.
- Time-current co-ordination curves graphically indicating the proposed co-ordination for the system on log-log graphs for short circuit and earth fault conditions. Include on each sheet, a complete title and single line diagram identifying the specific portion of the system covered.
- A detailed description of each protective device identifying its type, function, manufacturer and time current characteristics.
- Tabulation of recommended settings and operating values for each function of each device.

Include on the graphs, relay characteristics, pertinent transformer, motor and generator characteristics from the downstream HV device and including up to the largest outgoing LV circuit breaker/fuse for each final distribution board. Indicate manufacturing tolerances clearly showing the final grading margin.
The co-ordination study should demonstrate that all low voltage switchgear and controlgear assemblies to relevant parts of BS EN 61439 are compatible with the ratings of circuits to which they are connected, and with the installation conditions.
- Ensure that the relevant fault current (short-circuit) rating of each switchgear and controlgear assembly is greater than or equal to the maximum prospective fault current at the point of connection to the system.
- Ensure that the relevant design current does not exceed the rated current of the assembly, or rated current of a circuit of the associated assembly, taking into account applicable diversity and loading factors.

Submit the study as a bound report for approval by the CA. Upon approval by the CA, submit copies of the approved report together with soft copies of the project fault level calculations and discrimination study files in the approved software native format.

V20 – LV Distribution

310.000 WORKMANSHIP

310.011 INSTALLATION:
Install equipment in accordance with manufacturer's recommendations.

310.012 TESTING and COMMISSIONING
Refer to Y81

10000 NES Version V20 Dec 18

V22 – General Power

PART 1 SYSTEM OBJECTIVES

160.010 PERFORMANCE OBJECTIVES
To provide sub-circuit power installations from the sub-distribution boards terminating with socket outlets, fuse connection units and other outlet accessories.

160.020 DESIGN PARAMETERS
Unless otherwise indicated all final circuits for general LV power circuits shall comprise:

	Protective device and rating (A)						
	MCB	20A		32A		20A	
Circuit type		Ring				Radial	
Cable size (mm²)		2.5	4.0	2.5	4.0	2.5	4.0	6.0
Maximum circuit length (metres)		35	60	20	35	25	40	60

(Cable sizes are based upon a maximum volt drop of 2% with the circuit loaded to 80% of the cpd rating. For ring circuits a 0.67 current diversity has been used.)
Circuit lengths are taken to the furthest point of utilisation of the circuit for radial circuits or for the route length of the circuit for ring circuits.

On healthcare projects the electrical installation shall meet the requirements of BS 7671 IET Wiring Regulations and HTM 06-01 as applicable (note for Scotland the title HTM 06-01 shall be replaced by SHTM 06-01).
The performance requirements of BS EN 60601-1 shall be considered in so far as how the electrical installation will affect any medical equipment compliant with that standard.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO V22

300.000 GENERAL

300.010 SYSTEM REQUIREMENTS
Select equipment suitable to meet system objectives and as indicated on the drawings and schedules.

300.030 ELECTROMAGNETIC COMPATIBILITY
Ensure all equipment and systems are installed to provide electromagnetic compatibility within the systems and with any other systems installed in the same location.

310.000 PRODUCTS/MATERIALS

310.005 WIRING AND CONTAINMENT SYSTEM
Wiring to be carried out in single core insulated cable enclosed in conduit and or trunking as scheduled.
Trunking routes shown on drawings are primary routes only and all subsidiary trunking and conduits to be provided to form a complete containment system.

310.006 POWER USING EQUIPMENT AND FIXTURES
Provide equipment as scheduled complete with means of fixing or supporting.

310.007 POWER TO MECHANICAL PLANT
Refer to W80 for details.
Provide fused connection unit adjacent to each item of local plant that is not fed from an MCC, final connection to be by the Controls Specialist.
Provide power to all MCC's, distribution boards etc supplied by the Controls Specialist.

320.000 WORKMANSHIP

320.010 WORK ON SITE:
Ensure all building works are complete and service connections provided.

320.021 INSTALLATION:
Install, commission and to set to work equipment in accordance with manufacturer's recommendations and BS 7671 IET Wiring Regulations.

V22 – General Power

320.031 QUALITY CONTROL:
Handle, store and install equipment and components in accordance with manufacturers' recommendations. Obtain all equipment and components from a single source.
Inspect all equipment and components on delivery, before fixing and after installation, and reject and replace any that are defective. Record all commissioning, measurements and tests.

18080 NES VERSION V22 Test Dec 19

W60 – Central Control / Building Management System

PART 1 SYSTEM OBJECTIVES

This work section is derived from the BSRIA Standard Specification for BMS – Application Guide AG 8/2001. It must be read in conjunction with all the appropriate work sections, schedules, controls drawings and Y reference specifications. Particular attention should be made to A 37 for Operation and Maintenance Manuals / training requirements and to Y51 for Commissioning and handover requirements.
Refer to Y60 for conduit and cable trunking
Refer to Y61 for cables and wiring
Refer to Y63 for support components – cables
Refer to Y71 for switchgear and distribution boards
Refer to Y72 for contactors starters and drives
Refer to Y92 for motors

Controls drawings
The Controls tender drawings show schematic details of all main plant items and associated control components. They indicate the conceptual arrangement of the plant with each item identified together with a description of the controls operation and details of the associated interlocking. Where terminal units are included on the controls diagrams they show the "typical" control requirements for each unit. The Controls Specialist shall establish actual quantities of terminal units and associated control components from the detail design drawings and/or equipment schedules before production of Controls Logic diagrams as defined in work section A31 or A04 or A04D of this specification.

160.011 PERFORMANCE OBJECTIVES:
To provide a control system for the operation of services and equipment, the collection of information on operational settings and status, and where appropriate, process data for the management and operation of the building.

To provide all power wiring and containment to mechanical plant from main distribution boards or MCC's, all power wiring and containment to lighting in packaged mechanical plant such as air handling units, all control wiring / containment (including local controls serving plant not controlled by the BMS – eg local extract fans) and all interlocks between plant and safety systems including automatic shut off valves in gas supplies.

To install final power supply wiring / containment between local mechanical plant and fused spurs provided by the electrical contractor (including fan coil units, local fans, window mounted fans, local heaters etc)

To make all digital and analogue control interfaces between the BMS and packaged plant, energy / utility services meters and motor inverter drives as detailed on the Controls diagrams and individual plant schedules and elsewhere in the specification. Any apparent discrepancy between the specification / plant schedules and drawings shall be drawn to the attention of the Contract Administrator before or with the tender submission. Otherwise the Contractor shall be deemed to have made the maximum allowance within their tender.

For all buildings with a total usable floor area greater than 1000m² and as described in the scope of works, provide all necessary software and hardware for automatic readings of all energy and utility supply meters. The software shall be capable of real time analysis of the data. The consumption data shall presented as profiles and reports to enable consumption data to be audited against targets and consumption profiles.

To hard wire interlocked chilled water primary pumps with chiller controls to prevent operation of the chiller if the pumps are not operating.

160.020 DESIGN PARAMETERS:
Controls/BMS supplier/installer shall provide a schedule of site conditions including security, cleanliness, weather protection etc. that must be maintained before equipment is delivered.

160.023 OPERATING CONDITIONS:

Unless otherwise indicated equipment shall be suitable for operating within the following environmental ranges:-
Operator facilities – located in general office areas
Temperature – 10ºC to 35ºC

	Humidity	– 20% RH to 80% RH
Operator facilities	located in plant areas, and Outstations	
	Temperature	– 0°C to 50°C
	Humidity	– 10% RH to 80% RH
Electrical environment	as associated with building services plant room areas. protected against effects of conducted and radiated interference to IEC 801 Part 3 (1984) and Part 4 (1988)	
Dust and dirt	as associated with the indicated location of the equipment.	

The overall installation shall be capable of maintaining conditions within the following accuracies:

Temperature	+/- 0.5 °C
Humidity	+/- 5% RH

380.024 POWER SUPPLIES:
The supply to the distribution boards/MCC's shall be 400 Volts, 3 phase, 50 Hertz, 4 wire, TN-S.
Unless otherwise indicated ensure all control equipment operates normally from a power supply of:
Voltage - 230V +10%/-6%
Frequency - 50Hz +/- 1%

380.025 EXPANSION
Arrange system to allow 25% expansion without redundancy.(ie: by addition rather than replacement of hardware), without compromising the BMS system's functionality or speed of operation.

380.026 COMMISSIONING
Commissioning requirements for the automatic controls systems / BMS are given in clause 350.000 and work section Y51. (also refer to A33 or A64 or A64D).

PART 3 SPECIFICATION CLAUSES SPECIFIC TO W60

380.000 GENERAL

380.010 SYSTEM REQUIREMENTS:
Select control components and equipment, suitable to meet system objective requirements. Ensure that system safety complies with:
- BS EN 61508-series for control of systems where an assessed safety integrity level is required.
- BS EN ISO 13849-1 and BS EN ISO 13849-2 for safety-related components of control systems.
- BS EN 13850 for design of emergency stop functions.
- BS EN 61511-1 for functional safety of programmable controllers.

Comply with BS EN 15500-1 for electronic individual zone control equipment.
Comply with relevant parts of BS EN 60730 for automatic electric controls.
Comply with the following standards for building automation and control systems (BACS) components:
- BS EN ISO 16484-2 for hardware
- BS EN ISO 16484-3 for functions

Comply with the requirements of the relevant parts of BS EN 50491, BS EN 63044-1 and BS EN IEC 63044-3 appropriate to the project, for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS).
Install all switches, controls, outlets and meters in accordance with BS 8300: Design of buildings and approaches to meet the needs of disabled people. (to meet the requirements of the Disability Discrimination Act)

380.020 CONTROL SYSTEM:
Provide a Building Management System (BMS) to meet the particular requirements detailed in the scope of works and / or control strategy diagrams and schedules. Scope to include, equipment design, development of design, supply, installation, commissioning, selling to work, operator training, fine tuning and seasonal commissioning during the defects period.
Supply and install control equipment to provide a means of controlling and indicating the performance of other systems within set criteria and varying their criteria as required from a central location.

380.030 CONTROLS SPECIALIST:
Use a controls specialist to design, supply, install, test and commission complete controls / BMS installation.

380.051 COMPRESSED AIR:
Where required the compressed air plant is specified in work section S30. Ensure the compressed air is available to pressure, quantity and cleanliness requirements to suit the control devices.

380.060 CONTROL COMPONENTS MANUFACTURER:
Unless otherwise indicated use control components and equipment from one manufacturer throughout.

380.091 FINISHES:
Ensure all equipment is designed to common installation practices. Provide all equipment as a matching suite.

380.100 ELECTROMAGNETIC COMPATIBILITY:
Ensure all monitoring system equipment is compatible, and does not adversely affect any other equipment installed in the same location.
Ensure all systems are designed and installed with due consideration to good electromagnetic compatibility (EMC) practice, and in line with EMC requirements of relevant standards including:
- BS 7671 (IET Wiring Regulations)
- BS EN 50310 for earthing and bonding in relation to communications system components
- BS EN 50174-series for communications and control cabling
- BS EN 61000-6-7 and BS EN 61000-1-2 as relevant for EMC in relation to functional safety

Ensure all equipment complies with BS EN 50130-4 where relevant.
Ensure fire alarm interface equipment complies with BS EN 50130-4 where relevant.

380.130 INTEGRATED SYSTEM:
Provide integrated system combining the sub-systems as scheduled or described in the scope of works into the BMS.

W60 – Central Control / Building Management System

310.132 BREEAM / WELL REQUIREMENTS:
On applicable projects and as detailed elsewhere, comply with BREEAM requirements below to suit the type of construction and scheme.
Provide the following unless detailed otherwise elsewhere.
A plasma screen for wall mounting installation in the building reception.
Software within BMS, to give as a minimum, a real-time display of
How much energy is being generated from all renewable energy systems and how much non-renewable energy is being consumed. Information to be gathered from all pulsed output energy usage over the same period.
Energy usage/generation of past year or month.
If a rainwater collection or grey water collection system is installed, how much water has been collected over a previous time period and what contribution this makes to the building overall usage over the same period.
BREEAM New Construction 2018 requirements
Comply with Issue ID Man 04 Commissioning and handover
Comply with Issue ID Man 05 Aftercare
Comply with Issue ID Ene 02 Energy monitoring
Comply with Issue ID Wat 02 Water monitoring
Comply with Issue ID Wat 03 Water leak detection
Comply with Issue ID Pol 01 Impact of refrigerants
BREEAM Refurbishment and Fit-out 2014 requirements
Comply with Issue ID Man 04 Commissioning and handover
Comply with Issue ID Man 05 Aftercare
Comply with Issue ID Ene 02 Energy monitoring
Comply with Issue ID Wat 02 Water monitoring
Comply with Issue ID Wat 03 Water leak detection
Comply with Issue ID Pol 01 Impact of refrigerants
Where the building is being assessed to the WELL Building Standard v1 comply with feature
Comply with feature 18 Air Quality Monitoring and Feedback
Comply with feature 23 Advanced Air Purification

310.820 GENERAL REQUIREMENTS - ELECTRICAL SAFETY:
Ensure that the BMS complies with the following legislation:
The Electrical Equipment (Safety) Regulations 2016
The Construction Products Regulations 2013
The General Product Safety Regulation 2005
Ensure that the BMS installation complies with BS 7671.
Ensure that control panels comply with:
Relevant parts of BS EN 61439-series.
BS EN 60204-1 where the control panel is classed as Machinery in accordance with the Supply of Machinery (Safety) Regulations 2008.

310.829 GENERAL REQUIREMENTS - ELECTRICAL SAFETY:
Ensure that the BMS complies with the following EC Directives
Low Voltage Directive 73/23/EEC and amendments 93/68/EEC.
Construction Products Directive 89/106/EEC.
General Product Safety Directive 92/59/EEC.
Ensure that the BMS installation complies with BS 7671 Electrical installations in buildings.
Ensure that control panels comply with BS EN 61439-1 Low-voltage switchgear and control assemblies.

310.839 GENERAL REQUIREMENTS - ELECTRICAL SUPPLY:
Ensure that the BMS can be supplied with electricity conforming to:
The Electricity Safety, Quality and Continuity Regulations 2002 (as amended); and
BS EN 50160 Voltage characteristics of electricity supplied by public distribution systems; and
Additional voltage drop within the consumer's electrical installation according to BS 7671 (IET Wiring Regulations).

310.851 GENERAL REQUIREMENTS - EMERGENCY RESTORATION PROCEDURES
Ensure that the BMS fully restores all control and monitoring functions following an emergency shut down period.

W60 – Central Control / Building Management System

Ensure that the start delay times can be adjusted according to the magnitude of the load.
Ensure that the system restart does not cause unsafe operating states.

310.861 GENERAL REQUIREMENTS - UNINTERRUPTIBLE POWER SUPPLY FACILITY:
Uninterruptible power supply facility requirements - As work section V32 or detailed in scope of works.
310.870 GENERAL REQUIREMENTS - TIME SYNCHRONISATION:
Ensure that all time-dependent BMS components are time synchronized.
Ensure that the BMS can automatically handle daylight saving adjustments including changes between British Summer Time (BST) and Greenwich Mean Time (GMT)
Ensure that the BMS can accommodate time adjustments such as leap years and leap seconds.
Refer to scope of works for any project specific detailed requirements.

310.880 GENERAL REQUIREMENTS - SYSTEM SECURITY:
Standard - IET Code of Practice for Cyber Security in the Built Environment.
Provide, as a minimum, operator access for the following levels based on user's login credentials
Level 1 - Ability to display all point data.
Level 2 - Ability to display all point data and to initiate data logging functions.
Level 3 - Ability to display all point data; to initiate data logging functions; and to change set points and time schedules.
Level 4 - Ability to display all point data; to initiate data logging functions; to change set points and time schedules; and to change control strategies and schematic/graphics functions and password assignment.
Ensure that appropriate credential-based operator and maintenance technician access is set up for clients, servers and field controllers.
Login access type to be via password unless detailed otherwise in the scope of works
Manage information security of systems, software and data during design, implementation and commissioning in line with BS EN ISO/IEC 27001.
Ensure that the BMS software is protected from unauthorised entry.
Ensure that the BMS can be maintained by a service provider with BS EN ISO/IEC 27001 and BS ISO/IEC 20000-1.

310.891 GENERAL REQUIREMENTS - SYSTEM SOFTWARE:

SOFTWARE DEVELOPMENT:
Prior to commencing the development of project specific software confirm the following information

: operating system, revision and issue number
: other packaged software to be provided, revision and issue number
: availability and cost of any further appropriate packaged software not specifically specified.
: functional description of any software needed to be written for "The Works", procedure for its preparation and development period. Provide summary of previous experience of writing similar software.
: details of software support service available to client, where future software would be written and how charged.

Demonstrate the operation of all software for conformity with the specification prior to installation.
Procedures for modifying the configuration, graphics pages and parameters shall allow alterations and additions to be made systematically without the need to shut down the BMS or any Engineering Systems.
All software shall support, without modification, the future addition or removal of outstations or points up to the practical limit of the installed software.

Obtain on behalf of the end users all appropriate licences, permissions, copyright waivers, rights of use and the like from the owners of the software rights. Ensure that the end user is properly registered with the software supplier for support and appropriate updating. Provide documentation for application software in accordance with BS ISO/IEC 26513 and BS ISO/IEC 26514.
Ensure that, as far as practicable, all software is commercially available off-the-shelf.
Ensure that any programmable configuration, customisation, and bespoke software, is developed, tested and commissioned using relevant processes and procedures complying with BS ISO/IEC/IEEE 12207 or BS ISO/IEC/IEEE 15288, supported by a quality management system meeting the requirements of BS EN ISO 9001.Ensure that IT industry standard operating systems are used.

W60 – Central Control / Building Management System

Ensure that copies of all BMS vendor-specific software are held by an independent third party and that this software can be released to the client.
Ensure that the ESCROW Agreement is completed and signed.
Use communications protocol to relevant parts of BE EN 14908.

310.093 GENERAL REQUIREMENTS - CHOICE OF CONTROL STRATEGY:
Where detailed control strategies are not provided or where design development of the control strategies provided in the tender documents is required, ensure that the selected control strategies are appropriate for the building services systems and their intended application.
Ensure that selected control strategies are robust and not over complex.
Where a novel control strategy is to be implemented, ensure that testing/evaluation is performed to confirm its suitability.
Ensure that on project where a detailed control strategy is not provided, wherever possible selected control strategies are based on those provided in the BSRIA Library of System Control Strategies: AG 7/96.

310.095 GENERAL REQUIREMENTS - DESIGN FOR COMMISSIONABILITY:
Ensure that the BMS specification details required for commissioning are made available to the BMS commissioning engineer.
Ensure that all field controllers, sensors and controlled devices are easily accessible and can be removed for testing and future maintenance.
liaise with the mechanical contractor to ensure that air handling units are provided with appropriate access doors.
Ensure that access is available to all control devices. Comply as appropriate with:
BS EN 547-series.
BS 7671 (IET Wiring Regulations) requirements for maintenance gangways
Ensure that the requirements of the following documents are met:
Space and Weight Allowances for Building Services Plant - Inception Stage Design. BSRIA. TN 9/92.
Space Allowances for Building Services Distribution Systems - Detailed Design Stage. BSRIA. TN 10/92.
Ensure that sensors are installed correctly in order to give representative readings.
Ensure that reference labels are attached to each control device.

310.097 GENERAL REQUIREMENTS - DESIGN FOR MAINTAINABILITY:
Ensure that a full O&M manual is prepared which reflects any system changes made during the installation and commissioning stages.
Ensure that adequate access to BMS equipment and components is provided.
Ensure that all components and wiring are identified by a consistent numbering system

310.100 GENERAL REQUIREMENTS - SYSTEM SUPPORT:
Ensure that a viable strategy is in place to fully support the BMS for a minimum of 10 years from the date of practical completion.

310.110 OPERATOR CLIENT / SERVER - OPERATIONAL CHARACTERISTICS:
Ensure that the control of plant is independent of the operator workstation.
Ensure that no data of a control nature is transferred between field controllers via the client / server, i.e. data relating to control strategies.
Ensure that the client / server can communicate with all addressable field controllers.
Provide complete system integrity such that the network of field controllers will continue to fully operate following a failure of the client / server.
Ensure that the appropriate control strategy configuration data can be downloaded to all addressable field controllers.
Provide a means of displaying and modifying each addressable field controller's control strategy, time schedules and set-points via the client / server.
Allow the operator to re-schedule plant operation times. Ensure that re-scheduling can be applied globally to a number of items of plant at one or more sites (or one or more controllers on one site) as selected by the operator.
Ensure that the client / server incorporates a data storage management system that warns against impending on-line storage overflow and allows for data archiving to, and retrieval from, off-line non-volatile media. Ensure that the operator is prompted at pre-defined intervals to carry out the data archiving procedure.
Ensure that it is possible to perform a complete backup of the plant comprising control strategies, set-points and logged data to the server.

W60 – Central Control / Building Management System

Where neither network-attached storage (NAS) storage area network (SAN) or cloud storage are utilised to backup purposes by the system, provide an electronic data archival device that uses readily available non-volatile media that is appropriate for long term storage of system software, configuration data and logged data (including alarm data).
Allow the transfer of data from the system memory and other storage devices to the archive mediums, and vice versa for the preparation of reports.
Ensure that the system can be fully restored from backup data..

310.115 BMS SERVER EQUIPMENT:
Refer to scope of works for detailed requirements.
Standards
BS EN ISO 16484-3
BS EN 60950-1
BS EN 62368-1
Approach - Physical server unless detailed otherwise in scope of works
Administrator interface by Remote desktop, or Local user interface or UK QWERTY keyboard.
Ensure that the processor speed of each server (or server farm) meets the data processing requirements.

310.121 CLIENT DISPLAY EQUIPMENT:
Supply and install a head end PC or PC's as specified in the scope of works and in the locations described in the scope of works or as indicated on the drawings.
Standard - BS EN ISO 16484-2, BS EN 60950-1, BS EN 62368-1
Client
PC, or Laptop or mobile device as detailed in the scope of work / system description.
Processor
Ensure that the processor speed of each client meets the data processing requirements.
Ensure that the processor speed is such that any significant delays in processing system are eliminated.
User Access
Provide a UK QWERTY keyboard with full upper/lower case ASCII key-set, numeric keys and mouse.
Where required incorporate a touch-screen facility in place of a keyboard. Where this is the case also provide a keyboard connection and associated functionality.

Tenderers to confirm with tender make and specification of equipment they are proposing for each of the operator facilities.

310.125 PRINTER(S):
Standard
BS EN 60950-1
BS EN 62368-1
Ensure that the printer can print all monitored and logged data (including graphs of logged data); all point data (hard and soft); control logic and plant/building schematics in colour; alarm data/text; and system help text.
Ensure that the automatic printing of alarm data can be switched on/off.
Ensure that alarm data can be routed to specific clients and/or individual operators as identified by their specific logon information.
Ensure that the printer has a minimum output of four pages per minute.

310.131 SYSTEM MONITORING AND LOGGING FUNCTIONS:
Ensure that all monitored point data can be displayed at the client. Ensure that analogue, digital and soft-points can be displayed simultaneously.
Ensure that all changes made by the operator (eg set-point changes) can be logged and identified by both operator and date/time stamp.
Provide a facility to allow the display, at the client, of 'real time' data superimposed on plant schematics with a refresh rate not exceeding 20 seconds.
Ensure that a minimum of six 'real time' data points can be displayed simultaneously, in the form of data plots, with a time delay not exceeding 20 seconds.
Provide a facility to allow the monitoring and display, on the same 'page', of common criteria/plant functions.
Ensure that any hard or soft-point log can be displayed and stored on the client.
Ensure that logs can be set up from the client and that logging times and logging intervals are user adjustable between 1 second and 24 hours or when the value changes by an amount greater than an adjustable hysteresis

threshold.
Provide central operator facility with the ability to select points to be logged by the system.
Total number of logging channels available for each outstation not to be less that 20% of the total physical points on that outstation or as indicated.
Outstation memory shall be sufficient to log the equivalent of 5 days data at 15 minute intervals for 20% of the total number of physical points on the outstation.
Flexibly allocate logging memory to the points selected including to "soft" or "virtual" points.
When a log is set up allow for the following
: error indication if the maximum logging channels are exceeded
: the ability to specify the frequency and duration for which the data value is to be stored.
Each logged value shall be associated with
: point reference
: unit of measurement
: date and time measured
The system shall be able to export this information to other software packages including Microsoft Excel and Word format.
Provide a facility to allow the simultaneous display of different logged data. Ensure that this function is operator adjustable.

310.141 GRAPHICAL USER INTERFACES:
Comply with relevant standards including the following where appropriate.
BS EN 61082-1 for general schematic and information presentation
BS EN 60073 for indications and actuator states
ISO 7000/IEC 60417-series, IEC 60617 and ISO 14617-series for symbols in general.
BS 1553-1 for piping systems and plant symbols and schematics
BS 1553-2 for power generating plant symbols and schematics
BS 1553-3 for compressing plant symbols and schematics
BS 1635 for fire protection system symbols and schematics
BS 4737-5.2 for intruder alarm system symbols and schematics
BS EN 1861 for refrigerating system and heat pump symbols and schematics
Provide graphics as defined in the scope of works. The graphics shall be dynamic, and to show the following as a minimum.
Water and air temperature set points, and actual values, valve and damper positions, filter status, minimum and maximum air flows in VAV systems, plant operational status (ie on/off/alarm), metering actual data.
Provide a software library of plant schematics and symbols, the format/contents of which should be confirmed with the specifier based on samples.
Provide a facility to allow the operator to generate additional schematics and symbols using readily available drawing formats.
Ensure that the system can accommodate the addition of 20% extra graphics 'pages'.
Provide a facility to allow the operator to modify plant schematics and to generate new ones. New elements for schematics to be available on a Tool Palette and the association with data points in controller outstations to be made using drag-and-drop.
Ensure that graphics can be displayed in a layered approach (building layout graphics down to plant subsystems and components). Ensure that the operator can modify the structure of the layered approach.

310.150 USER INTERFACE - HELP AND ASSISTANCE:
Provide a facility to allow the display of help text covering all operator functions and system fault conditions.
Provide a facility to allow the display (including a hard copy) of points list (hard and soft-points) and control strategy logic schematics.

310.160 INTEGRATION WITH THIRD PARTY MANAGEMENT SOFTWARE:
Energy monitoring and targeting software
Provide a facility to allow the direct transfer of recorded energy consumption and external air temperature readings from the BMS to the monitoring and targeting software. Ensure that real time data is available in a standard database format (e.g. SQL, ODBC, etc).

Maintenance management software
Provide a facility to allow the direct transfer between the BMS and the maintenance management software of plant run hours; number and frequency of plant starts; critical alarms requiring immediate

attention; and maintenance (non-critical) alarms.
Ensure that real time data is available in a standard database format (e.g. SQL, ODBC, etc).

310.170 SYSTEM ALARMS:
Standards
BS EN 62682
Engineering Equipment and Materials Users Association publication No. 191 "Alarm Systems: A Guide to Design, Management and Procurement".
Ensure that alarms are displayed on a rolling basis in chronological order.
Ensure that the operator can acknowledge alarms, including muting of audible or flashing annunciators.
Provide a facility to silence audible alarms or inhibit flashing annunciators without performing alarm acknowledgement.
Ensure that alarms can be inhibited for reasons of time and/or priority as selected by the operator.
Ensure that the BMS can be configured to avoid fleeting alarms, i.e. ensure that alarms can accommodate start-up and shutdown delays.
Ensure that the operator can alter the limits at which the measured values cause alarms to be triggered.
Ensure that alarms can be limited to the source items(s) of plant.
Ensure that alarm limits can accommodate sliding limits, e.g. set-point changes.
Ensure that alarms can be differentiated by means of alarm type and identification.
Ensure that alarms can be prioritised (including a high priority that will be annunciated regardless of other activity) and a low priority or information status that is only annunciated on demand.
Ensure that the time taken to receive alarms does not exceed 5 seconds
Ensure that visual, audible and printed annunciation of alarms, or any combination of these, can be selected by the operator.
Ensure that the reception and acknowledgement of alarms can take precedence over other operations. However, ensure that the reception of alarms does not hinder user log-in.
Allow the user to acknowledge alarms individually and on a group basis. Acknowledgement should include muting or flashing annunciators.
Provide distinction between active alarms whose conditions are not cleared and unacknowledged alarms.
Provide an alarm-latching facility with manual reset.
Ensure that alarm data provides condition identity; condition value; alarm source; alarm time and date; and acknowledgement status.
Ensure that the alarm file can be sorted by the above criteria.
Allow alarms to be automatically redirected to other user interfaces.
Provide sufficient data storage capability for the storage of alarms.
Ensure that any stored alarm data can be analysed in conjunction with other monitored conditions or stored logged data.
Ensure that an alarm review facility is available.
Allow the display of stored alarm data based on user definable selection criteria.
Ensure that the operator can define the requirement for acknowledgement of alarms; a time programme for annunciation of alarms to different destinations; and text messages associated with alarm conditions.
Ensure that critical alarms can be relayed by SMS text message and/or email to a distribution list of operators. The definition of a 'critical alarm' is to be wholly adjustable by the administrator.

310.175 FIELD CONTROLLERS - GENERAL:
Standard
BS EN ISO 16484-2 for hardware
BS EN 15500-1 for electronic individual zone equipment
Casing material – rigid plastic

310.180 FIELD CONTROLLERS - MODES OF OPERATION:
Ensure that the field controllers perform all control actions independently of the operator workstation.
Ensure that all field controllers can operate independently and in real time following a failure of the BMS communication network.
Ensure that field controllers can operate with the loss of shared data through the use of default values and final data reading before the loss of network communications.
Provide operator interfaces

310.190 FIELD CONTROLLERS - PHYSICAL CONSTRUCTION:

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For internal plant room applications, construct field controller enclosures to give a minimum degree of protection to IP54 in accordance with BS EN 60529. Where the field controller is fitted inside a control panel that is protected to IP54 then the field controller protection can be reduced to IP41. For external applications, construct field controller enclosures to IP65.
Where an enclosure is to be provided ensure that field controller enclosures are lockable.
Ensure that modular construction is used for field controllers. Ensure that this allows the removal and replacement of devices without the need for rewiring of field wiring.
Ensure that I/O modules can be removed and replaced without the need to power down the entire modular system (i.e. I/O modules are hot-swappable).

310.200 FIELD CONTROLLERS TERMINATIONS:
Use terminals of the screw down clamp-type fixed to purpose made mountings.
Segregate into groups terminals of different voltage bands (in accordance with BS 7671).

310.220 FIELD CONTROLLERS - CONTROLLER INPUTS:
Ensure that the interfaces for the field controllers are appropriate for gathering data from sensors and devices.
Ensure that the following requirements are met.

Universal inputs
- Variable currents (4-20 mA), variable voltages (0-10V), variable resistances or volt-free contacts.
- Ensure that the scaling tables, necessary to process inputs configured as type analogue, are resident at the field controller.
- Ensure that a minimum and maximum limit value can be defined for each analogue input. Ensure that each limit is associated with a configured response.
- Ensure that the field controller can detect open or closed circuit faults and raise an alarm on the operator workstation.
- Ensure that the configuration tables necessary to process inputs configured as type digital are resident at the field controller.
- Ensure that the configuration tables necessary to process inputs configured as type multi-state are resident at the field controller

Digital inputs
- As derived from volt-free contacts (max 24 volts/20mA). Allow the interface to be selected to monitor a normally open or normally closed circuit.
- Ensure that the routines necessary to process the digital inputs are resident at the field controller.

Pulsed inputs
- As derived from volt-free contacts (max 24 volts/20mA) at a pulse frequency of up to 32Hz.
- Ensure that the routines necessary to process pulsed inputs are resident at the field controller.
- Ensure that the field controller has the following capabilities.
  - Storage of cumulative totals daily; weekly; monthly; yearly; and continuously.
  - Operator re-set facility of cumulative totals via the operator workstation.
  - Facility to combine counts from separate pulsed inputs.
  - Ability to calculate the number of pulses per unit time through addition and/or subtraction.
  - Ability to compare the number of pulses with preset limits on the basis of total number of pulses per unit time and the time required for a total number of pulses.
  - Ability to convert pulsed readings into quantifiable values.
  - Alarm facility based on a user-defined limit being exceeded.
- Ensure that the inputs which are used to monitor fluctuating pulse rate (eg maximum demand meter for electricity) have operator adjustable limits.
- Ensure that when data for pulsed inputs is recorded, the record includes both the pulse count and logging intervals for cumulative counts.

Run-time totals
- Include run-time totalling routines to enable the operator to record cumulative run-time for each item of plant selected.
- Provide the operator with the option to set a different maximum run-time for each item of plant selected.
- Ensure that when the maximum run-time has been reached an alarm is signalled to the operator.
- Ensure that the operator workstation can be used to interrogate field controllers for a point-by- point summary of run-time totals and run-time limits.
- Ensure that it is possible for the user to set an initial value of hours run other than zero.

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- Ensure that all inputs can be scanned at intervals not exceeding 1 second.
- Refer to the scope of works / schedules for any special requirements for time-critical control applications.
- Ensure that all inputs are protected against spurious out-of-range signals including those caused by contact noise or bounce.
- Ensure that errors introduced by the analogue to digital conversion of inputs do not exceed 0.1% of the analogue value.

310.230 FIELD CONTROLLERS - CONTROLLER OUTPUTS:
Ensure that isolation between controllers and networks meet the requirements of BS EN 63044 – series.
Ensure that the field controllers' interfaces are capable of providing control signals to actuators and switching devices.
Ensure that routines are configurable, such that one or more events may be enabled in direct response to any defined logical relationship between the status of a number of physical or soft-points.
Ensure that in the event of power failure, output devices can be driven to their preset, fully open/closed position.
Provide the following interface characteristics:
- Analogue output. As variable currents (4-20mA) or as variable voltages (0-10V). Ensure that it is possible to characterise analogue outputs in order to obtain a near linear response from the controlled items of plant.
- Digital output. Ensure that digital outputs can be selected as 'normally closed' or 'normally open'.

Ensure that errors introduced by the digital to analogue conversion of outputs do not exceed 1 LSB.
Ensure that the field controller is capable of receiving feedback signals which allow the comparison between an output signal to a controlled device and its actual condition.

310.240 FIELD CONTROLLERS - POSITIVE FEEDBACK:
Ensure that the field controllers can include routines necessary to confirm that specific items of plant are functioning correctly. Ensure that this can be performed by monitoring physically separate but functionally related sensors, switches or transducers.
Ensure that an alarm is raised if the expected response has not been established by a pre-set time following switching on of plant. Ensure that it is possible to operate any specified standby plant. Provide the operator with a facility to adjust the pre-set time delay.
Ensure that the field controllers are capable of using measured feedback from an actuator position to give a percentage open reading.

310.250 FIELD CONTROLLERS - DATA MONITORING AND LOGGING:
Ensure that hard and soft-points associated with a field controller can be logged.
Ensure that the BMS operator can set the start/stop times and logging frequency at the operator workstation.
Ensure that logging is selectable between fixed periods or on a rolling basis.
Ensure that each log can be defined in terms of log identification (point identification); units; and date/time stamp.
Ensure that the operator can select all physical and soft-points for logging.
Ensure that the field controller has sufficient memory to log the equivalent of seven days data at 15 minute intervals for 50% of the total number of physical points on the field controller.
Ensure that the log data is to be automatically uploaded to the operator workstation / system server and stored in a standard database format (e.g.SQL, ODBC).

310.260 FIELD CONTROLLERS - ENVIRONMENTAL CONDITIONS:
Ensure that field controllers are suitable for operating normally within the following environmental ranges:
- Temperature 0 to 50°C
- Relative humidity 10% to 90% non-condensing.

Ensure that the field controllers will operate in the electrical environment associated with building services plant rooms.
Ensure that the field controllers are protected against the effects of moisture, dust, dirt and gases.

310.271 FIELD CONTROLLERS - INTERNAL POWER BACKUP:
Provide internal power backup
Ensure that a rechargeable battery or capacitor, if specified, can hold the controller's volatile memory for a minimum period of 72 hours.
Ensure that a non-rechargeable battery, if specified, can maintain the controller's clock function for a period of two years.
Ensure that the battery is easily replaceable.
Ensure that the interval between battery maintenance inspections is not less than 12 months.

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310.289 FIELD CONTROLLERS - MEANS OF CONFIGURATION:
Ensure that the field controllers can be fully configured directly via a laptop type computer and via the operator workstation.
Ensure that the field controllers can be configured through the use of a configuration interface with full upload and download capability.
Ensure that configuration details can be easily altered by system operators.
Ensure that access to make configuration alterations is restricted to operators with access authority through the use of passwords.
Ensure that any battery monitoring functions defined in the Particular Inspection can be met.

310.291 FIELD CONTROLLERS - USER INTERFACES:
Ensure that all field controllers can be accessed through the use of portable computers.
Ensure that access allows the display of all configuration details associated with the field controller along with:
- Password protection for access with a minimum of two access levels.
- Ability to display all point data (both hard and soft).
- Ability to initiate and display logged data.
- Ability to display and alter set-points and time schedules.
- Ability to make alterations to control strategies.

As defined in the scope of works or schedules provide a panel-mounted operator interface to interrogate the field controllers. Ensure that the interface includes the ability to:
- Provide password protection for access with a minimum of two access levels.
- Display all physical point data.
- Display and alter set-points and time schedules.
- Display the current date and time.
- Review and acknowledge alarms.
- Display logged data in graphical format, with overlaying of up to 8 logs on a single graph.

310.295 DEDICATED CONTROLS - OPTIMISERS:
Standard - BS EN 12098-2.

310.296 DEDICATED CONTROLS - COMPENSATORS:
Standard - BS EN 12098-1, BS EN 12098-3

310.297 DEDICATED CONTROLS - TIME SWITCHES:
Standard BS EN 60730-2-7.
Provide time switches with minimum of 24 hours mains failure reserve facility.

310.301 OCCUPANT CONTROLS - GENERAL:
Ensure that the specified occupant controls can be linked to, and communicate over, the BMS communications network.
Ensure that the occupant controls can control the relevant items of plant.
Ensure that the status of each occupant controller can be viewed and overridden via the operator workstation.
Ensure that each occupant controller has a service port available that allows a laptop type computer to be connected using a suitable wired service tool. It shall be possible to disable the service port function via the password protected configuration settings for the occupant control.
When connected using the service port all controllers in the entire BMS network are to be accessible via the laptop type computer.
Ensure that the occupant controls allow:
- Adjustment by the occupants of the set-points.
- Definition, and adjustment by the BMS operator, of high and low limits for each set-point control.

Provide a facility to allow the global alteration of set-point and high/low limits via the operator workstation.
Provide an override facility to allow plant operation during out of hours occupation.
Ensure that the occupant controls are intuitive to use and clearly labelled.
For temperature control ensure that hot/cold and/or red/blue indication is used for the occupant interface.
For fan speed control ensure that fan fast/slow indicators are used.
Ensure the +/- symbols are not used without clarification of the controlled function.
Wall/desk mounted

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310.329 OCCUPANT CONTROLS - OFFICE IT/INTRANET BASED:
Ensure that the occupant controls are TCP/IP compatible.

310.339 CONTROL FUNCTIONS AND ROUTINES - GENERAL:
Provide a facility to automatically cycle selected actuators through their full range of movement outside normal operating periods with a periodicity set by the operator (in addition to normal automatic or manual control). Ensure that the cycle finishes as one complete operation. Ensure that any alarm conditions raised during the operation are inhibited as necessary.
Provide a facility to drive actuators to their open or closed positions at the end of plant operating periods.

310.349 CONTROL FUNCTIONS AND ROUTINES - BASIC CONTROL FUNCTIONS:
Ensure that configuration routines necessary for direct digital control (DDC) are resident at the field controllers.
Provide DDC of plant through algorithms giving proportional plus integral plus derivative control (PID).
Provide two-position control.
Provide raise-lower or three-point control.
Allow the selection of either proportional control (P) or proportional and integral control (P+I) or proportional and integral plus derivative control (P+I+D) modes independently for each relevant item of plant. Ensure that proportional, integral and derivative action times can be adjusted by the user.
Allow the combination of more than one control loop by 'cascading', i.e. using the output signal from one control loop as the input signal to another control loop.
Ensure control routines provide for bumpless transfer capability when switching from manual mode to automatic mode.
Ensure that the control routines are capable of controlling the individual plant items listed
Provide a comprehensive programmable facility using a simple and easy to use program strategy tool that allows comprehensive debugging and live editing of control strategies.
If a comprehensive programmable facility is not available then a micro function block based tool may be supplied providing the following requirements are met:
Provide logic modules covering
- Logical combination of digital variables.
- Logic timer module.
- Logic readback module.
- Logic counter module.
- Logic delay module.
- Logic hours run module.

Provide the following logic functions:
- AND.
- NOT AND (NAND).
- NOT OR (NOR).
- OR.

Provide the following function modules as a minimum:
- Filter (applies exponential filter with gain to input signal).
- Rescale from (rescales an input of 0 to 100 to a user defined output and limits at these values).
- Rescale to (rescales the input to the output of 0 to 100 and limits at 0 and 100).
- Limit al (limits the output al user specified values).
- Limit to (limits the output to 0 or 100 percent at values specified by the user).
- Logarithm of input; Square root of input; Add to input; Multiply by input; Divide by input.
- Minimum (to select the minimum value from two or more inputs);
- Maximum (to select the maximum value from two or more inputs);
- Average (to calculate the average value from two or more inputs).
- Analogue gate (digital signal switches output between two analogue input signals).
- Comparator (to compare two inputs, when input X is greater than input Y output of one is produced otherwise the output is zero).
- Enthalpy (to calculate the enthalpy value from a temperature input and humidity input).
- Hysteresis (changes a digital state if the input changes outside a defined band).
- Analogue to digital converter (to change analogue value to binary).
- Provide comprehensive debugging and live editing of control strategies.

Ensure that the program strategy tool (whether comprehensive or Macro function block based) is not restricted to the use of the systems integrator but is available for suitable trained administrators via the operator workstation.

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310.350 CONTROL FUNCTIONS AND ROUTINES AND CONTROL INTERLOCKS:
Ensure that the BMS is capable of providing all control functions, routines and interlocks detailed in the scope of works, schedules and controls drawings.

Where the following standard control routines are required (as detailed in the schedules, scope of works or controls drawings) the BMS shall be capable of providing the functions detailed in BSRIA Application Guide AG 9/2001. (Part A clauses 5.3 to 5.11 inclusive)
- Frost protection (see clause 310.351)
- Building/plant protection
- Safety interlocks
- Time schedules
- Plant start/stop control
- Sequence control
- Plant rotation control
- Optimum start for heating and cooling systems
- Weather compensation
- Lighting control

Safety interlocks
Ensure that all safety interlocks are hardwired and have precedence over all other control functions.
Ensure that safety interlocks can only be reset manually and locally (not from the operator workstation).
Ensure that all hardwired safety interlocks have corresponding software interlocks to prevent cascading nuisance alarms.
Ensure safety interlocks operate when plant selector switches are in 'Hand' or 'Auto' mode.
Ensure safety interlocks operate when frequency inverters are selected in 'Local' or 'Auto' mode at the inverter keypad.
Ensure safety interlocks comply as appropriate with:
- BS EN 61508-series for control of systems where an assessed safety integrity level is required.
- BS EN 13850 for design of emergency stop functions.

Variable volume pumped systems
Control strategy to include regime to fully open and close all 2 port valves in the system on a timed basis to ensure water treatment chemicals are circulated through all terminal units on a regular basis.

310.351 FROST PROTECTION OF BUILDING SERVICES SYSTEMS AND BUILDING FABRIC
Provide frost protection routines to operate plant, pumps and / or fans and necessary control valves in order to protect building services systems and their components from frost damage.

Provide the following two stages of protection:
- When the outside temperature falls to the operator set minimum frost-protection temperature, the selected pumps start and circulation is established through pipework systems and their components including all air handling unit coils in locations where the outside air temperature could be below the minimum frost protection temperature. This shall include fully opening two port control valves and motorising 3 port control valves to flow to the coil. Allow the operator to pre-select which plant is to be started. The automatic standby plant is to operate on failure of the duty plant.

- Ensure that when the return temperature falls below the operator pre-set minimum, the full frost-protection facility is initiated. Ensure that for heating systems, the heat source is turned on and operated to maintain the return flow temperature above the pre-set minimum. Ensure that specified protective devices activate for other liquid systems.

Provide a facility to allow frost protection to be logged together with date and time.

Provide protection routines to operate the plant in order to protect the building fabric and its contents against the effects of low internal temperatures and of condensation.
Ensure that if the internal air temperature falls below the pre-set protection temperature, the heating system and related plant is turned on and heat supplied to maintain the air temperature at or above the protection set-point temperature.

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Ensure that the building/plant protection routine overrides other control functions unless otherwise specified.
Ensure that protection operates whenever the normal heating is switched off.

310.440 SYSTEM COMMUNICATIONS - GENERAL:
Ensure that the system communications allows the full transfer of monitored, logged, alarm, backup and configuration data between the operator workstation and addressable field controllers.
Ensure that the communication protocol selected seeks to achieve error-free data transfer. Ensure that the protocol includes an error detection check; includes an error correction and/or re-try technique; limits re-transmission; and raises an alarm condition on failure.
Ensure that the available bandwidth is sufficient to avoid excessive delays in transmitting data

310.450 SYSTEM COMMUNICATIONS - COMMUNICATION DEVICES:
Ensure that connections to telecommunication systems complies with BS 6701.
Provide an ADSL link.

310.460 SYSTEM COMMUNICATIONS - COMMUNICATIONS PROTOCOLS:
Arrange the digital data interchange systems using open system protocol.
Possible applicable standards – refer to scope of works for details
- BS EN 61158-2 (fieldbus).
- Profibus (BS EN 62769-series)
- Profinet (BS EN 62769-series)
- Modbus
- Modbus over Ethernet
- KNX (BS ISO/IEC 14543-series)
- BS EN ISO 16484-5 (BACnet)
- BS EN 14908-1, BS EN 14908-2, BS EN 14908-3 and BS EN 14908-4 (LonWorks).
- Metering data exchange:
  - Smart metering:
    - BS EN 62056-series Electricity metering data exchange
    - BS EN 50491-11 HBES smart metering user display
    - PD CEN/TR 16061 smart gas meters
    - PD CEN/CLC/ETSI TR 50572 Functional reference architecture for communications in smart metering systems
  - PD CLC/TS 50568-4 and PD CLC/TS 50568-8 Electricity metering data exchange
  - BS EN 61968-9 system interfaces for utility metering interface and control

Ensure that the selected field level protocol can:
- Run on the required communications media.
- Provide a communications throughput sufficient for the intended application.

Provide appropriate network topology options.
- Allow sufficient maximum physical segment length.
- Allow sufficient maximum number of nodes for each physical segment and the logical network.
- Provide sufficient maximum distance between nodes.
- Make use of off-the-shelf network devices such as repeaters, bridges and routers.

Allow control devices to be powered from the network if defined in the scope of works
Ensure that the protocol is compatible with fully developed network configuration and management tools.

310.470 SYSTEM COMMUNICATIONS - DIRECT INTEROPERABILITY:
Ensure that each of the protocol's objects and attributes are consistent with the achievement of the specified level of direct interoperability.
Ensure that each of the protocol's arrangements for physical connection, data packaging, network management and error detection/correction are the same.

310.480 SYSTEM COMMUNICATIONS - GATEWAYS:
Ensure that the gateway can:
- Transfer the specified maximum number of points.
- Limit loss of functionality to the level specified.
- Add functionality where specified.

Ensure that the specified contingency and alarm measures in response to a failure of the gateway are met.
Ensure that the gateway can be modified in response to any future changes relating to the type and amount of

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data transferred over it.
Clearly define who has contractual responsibility for the implementation of the gateway.

310.490 SENSORS AND DETECTORS - GENERAL:
Ensure that all signals are compatible with interfaces fitted to associated field control devices.
Ensure that the performance of the sensors and detectors are not adversely affected by variations in power supply conditions in accordance with BS EN 50160 (with additional voltage drop in the electrical installation defined in BS 7671), or by anticipated conducted and radiated electromagnetic disturbances for the electromagnetic environment in which the sensors and detectors are to be used.
Ensure that connections to sensors and detectors are of a screw down clamp type or self-locking connectors.
Ensure that senses, detectors and meters are installed in accordance with the manufacturer's instructions and recommendations.
Ensure that calibration conditions for meters are fully documented in the O&M manuals and clearly marked on or adjacent to the meters.
Ensure that any calibration and maintenance requirements for sensors, detectors and meters are documented in the O&M manuals.
Interface detectors and sensors with controllers and indicators via amplifiers or transmitters, where necessary.
Provide calibration certificates for all sensors used on projects where there is a validation requirement.

310.500 SENSORS AND DETECTORS - TEMPERATURE SENSORS:
Standard BS EN 60730-2-9 and BS EN 14597 where appropriate.
Sensors shall not drift by more than 0.1 °C per year, and have a hysteresis value of less than 0.05%.
Off/On thermostats for general applications shall be metal with sensor accuracy of +/- 0.5 °C and volt free contacts for derivation of low voltage status signals
Time constant
Space/outside air temperature - 300s still air.
Duct air temperature - 120s @ 1m/s.
Water - 30s @ 1m/s.

Ensure that temperature sensors comply with the minimum requirements of the following table.

Temperature sensors - minimum requirements

Fluid	*Temperature range °C*	*Sensor accuracy °C*
Air	-10 to +40	+/- 0.5
Flue gas	+30 to + 850	+/- 3.0 (0.75% of FSD above 450°C)
Chilled Water	-10 to + 30	+/- 0.25
Water	-10 to +150	+/- 0.5

310.501 AIR THERMOSTATS - ROOM TYPE:
Standard - BS EN 60730-2-9.

310.505 AIR SENSOR - INSERTION TYPE:
Use proportional type insertion sensor.
Sensor

Averaging type temperature sensor for mounting overface of air flow in an air-handling unit or in ductwork adjacent to a heating coil.
Thermistor type temperature sensor, minimum stem length 200mm for mounting in the air flow or distribution ductlines.

310.510 SENSORS AND DETECTORS - HUMIDITY SENSORS:
Standards - BS EN IEC 60730-2-13
Provide humidity sensors as follows:

no need to recalibrate within a period of at least 12 months
response time of less than 30 seconds
hysteresis value of less than 3% of the measurement range
drift not exceeding 5% of the measurement range per year
useful life span of not less than 3 years

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Ensure that humidity sensors comply with the minimum requirements of the following table.

Humidity sensors - minimum requirements

Sensor	*Humidity range*	*Sensor accuracy*
Humidity	10 to 90%	+/- 5% RH

310.520 SENSORS AND DETECTORS - AIR VELOCITY SENSORS:
Standard - BS EN 60730-2-15.
Ensure that air velocity sensors comply with the minimum requirement of the following table.

Air velocity sensors - minimum requirements

Sensor	*Sensor range*	*Sensor accuracy*
Pitot static tube	3 to 80 m/s	+/- 2% of reading
Thermo-electric anemometer	0 to 20 m/s	+/- 3% of reading or +/- 0.1 m/s whichever is greatest

310.530 SENSORS AND DETECTORS - AIR PRESSURE SENSORS:
Ensure that air pressure senses are manufactured from stainless steel and comply with the minimum requirements of the following table.
Air pressure sensors - minimum requirements

Sensor	*Sensor range*	*Sensor accuracy*
Air pressure	-	+/- 2% of reading

310.535 SENSOR AND DETECTORS - FLOW SENSORS:
Standard - BS EN 60730-2-15.

310.540 SENSORS AND DETECTORS - FLOW METERS:
Ensure that meters comply with the minimum requirements of the following table.
Flow meters - minimum requirements unless scheduled otherwise.

Meter	*Meter range*	*Meter accuracy*
Fuel flow meter	0 to 10 Hz	3% of reading
Water flow meter	less than 5:1	2% of reading
Electricity meter	-	1.5% of reading

Where a meter is used to measure the amount of energy supplied for billing purposes, the meter must be approved and stamped by NMO (National Measurement Office) or approved under the European Measuring Instruments Directive (MID 2004/22/EC).

310.545 SENSORS AND DETECTORS - LEVEL DETECTORS
Provide level detectors as indicated.
Use stainless steel capacitance electrodes with PTFE insulation for liquids with minimum conductivity of 0.01 S/m.
Use stainless steel conductivity electrodes.
Use float type to BS EN 60730-2-15
Provide indicator showing measured value at sensor. Calibrate indicators.

310.545 SENSORS AND DETECTORS – OTHER SENSORS:
CO sensors
BS EN 50291-1 for manufacture and testing of detectors designed for domestic premises.
BS EN 50292 for selection and installation of detectors in domestic premises.
CO_2 sensors.

Compliance – EMC Directive 89/336/EEC – relevant parts of BS EN 61000
Operating principle – NDIR (non dispersive infra red)
Measurement range – 0-2000 ppm, numerical resolution 1ppm
Accuracy - +/- 1% measurement range; +/- 5% of reading (within +/- 10°C calibration temp)
Annual zero drift - <+/- 0.3% measurable range
Response time – 20s with tube connection at 0.1l/min
Operating temperature 0-50°C

Combustible gases and oxygen

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BS EN 50271 - requirements and tests for apparatus using software and/or digital technologies.
Equipment for use in explosive atmospheres to be in accordance with BS EN 60079-29-1 and installed in accordance with BS EN 60079-29-2.

310.550 SENSORS AND DETECTORS - SENSOR TIME CONSTANTS:
Ensure that the following sensor time constants are met.

Table 6 BSRIA AG9 Sensor time constants

Measure medium	Time constant
Space/outside air temperature	300s still air
Duct air temp	120s @ 1m/s
Water	30s @ 1m/s
Relative humidity	300s @ 1m/s
Light	Instantaneous
Flow - water	5s
Flow - liquid fuel or gas	5s

310.555 TRANSMITTERS:
Use transmitters to interface between sensor and controller, utilizing only one sensor.
Resistance thermal device (RTD) to BS 1041-3
Resistance thermal device (RTD) to BS EN 60751.
Thermocouple to BS EN 60584-series type .

310.561 AIR FLOW VELOCITY SENSORS / DETECTORS
Where indicated, provide multi - point, integrating measuring devices in ductwork.
The units shall be suitable for the level of filtration to be provided and complete, comprising as a minimum,
a frame work to allow it to be built into the ductwork system,
all transducers, signal processors etc, to enable it to produce a signal in a form required by the BEMS (0-10 V, 4-20mA).
in-built calibration equipment for any on board electronics
display of the sensed flow at the grid
The number of sensing points shall be capable of measuring the flow to an accuracy of +/- 5% of the sensed system volume (over the full range of operating volumes on variable volume systems) to a minimum velocity of 1.5m/s.

310.610 AIR THERMOSTATS – ROOM TYPE
Standards BS EN 60730-2-9; Type as indicated and to suit application.

310.640 AIR THERMOSTATS - FROST PROTECTION TYPE:
BS EN 60730-2-9.
BS EN 14597
For space mounting use frost protection thermostats with temperature range of 0-20ºC and with SPST switching action and electrical rating of 20 amps resistive.
For heater battery protection use frost protection thermostats consisting of a gas filled sensing element and a bulb, a directly adjustable set point and switching differential.
For compensated systems use external frost type thermostats with proportional type sensor, the whole unit being weather-proofed.
Ancillaries
Start up switching and indication
Manual or automatic reset facility as detailed in the scope of works or control strategy diagrams.

310.645 WATER IMMERSION THERMOSTATS:
Standards - BS EN 60730-2-9, BS EN 14597
Use proportional type immersion thermostats with rigid sensing elements ensuring 50mm minimum length is immersed. Use separable pockets, screwed 15mm BSP.
Install pockets in positions indicated.

310.650 HUMIDISTATS:
Differential – 4% RH

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Accuracy – 3% RH

310.700 ACTUATORS:
Include position feedback devices suitable for connection to the BMS.
Ensure that actuators incorporate a disconnection device to allow manual operation of the valve or damper in the event of actuator failure.
Where line voltage actuators are used, provide local means of isolation by manual isolator or plug and socket connection.

310.705 ACTUATORS - SOLENOID TYPE:
Standard - BS EN 60730-2-8.

310.710 ACTUATORS - ELECTRONIC TYPE:
Standard -BS EN 60730-2-8
Use low voltage, high torque, electronic type actuators, including mounting brackets, adjustable linkages and necessary attachment devices.
Control mode – as described in controls narratives
Actuators, together with linkages, shall operate smoothly from fully open to fully closed positions without binding and with adequate torque to overcome resistances of bearings and fluid flow.

Clearly mark linkages with clamping position so that after maintenance or replacement the mechanism can be easily restored to its correct operating position.
Fit visual position indicators.
Electrically and mechanically protect actuators against the effects valve or damper seizure.
Incorporate disconnection device to allow manual operation in the event of actuator failure.
Where indicated or necessary for correct system operation provide a position feedback device connected to Controls/BMS.

310.715 ACTUATORS - ELECTRIC MOTOR:
Provide thermal overload protection with manual reset option.
Electrical requirements - Integral terminal strip or DIN plug and socket connections C/W two end of travel limit switches, with adjustable cam operation for motor de-energisation.
Mechanical requirements - Manual override, geared to prevent backdrop, position indicator.
Enclose to IP65 minimum.

310.805 MOTORISED VALVES / ACTUATORS:
Type – As described in controls narratives
Standards - BS EN 60730-2-8, relevant parts of BS EN 60534
Pressure Independent Control Valve (PICV) - tested in accordance with BSRIA BTS 1/2012.
Ancillaries
Position indicator, Locking device, Control device and linkage mechanisms, and as required to match control function
Actuating motive power - to match control system
Valve/actuator combinations shall be capable of closing off fully. In the case of 2 port control, this shall be against the full closed head of the installed pump.
Ancillaries- Positioners, locking device and lever for manual operation / control failures

The failure position of control valves shall be as follows:
Humidifiers, heating to HWS calorifiers, and items fed by steam- closed to load (i.e. spring return)
Heating and cooling coil and frost protection – open to the load or mid-position
Others – mid-position

310.905 MOTORISED DAMPERS AND SHUTTERS:
Use motorised control dampers manufactured and installed in accordance with DW/144.

310.906 RELAYS:
Use demountable relays of the totally enclosed type having at least one spare set of changeover contacts.
Electrical terminals to be shrouded and screw down clamp
Provide indicator tags/LEDs to indicate energised state. Provide manual actuation for test purposes.

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320.000 INSTALLATION

320.050 FIXING AND CONNECTION - CABLING

Plan and install all building management monitoring systems cables in accordance with the cable manufacturer's recommendations.

Label and record all monitoring cables.

General

This part of the specification covers extra-low voltage wiring (as defined by BS 7671), i.e. signal and data communications wiring. For power wiring refer to relevant "Y" sections of this specification.

Install all cabling in accordance with BS EN 50173-series, BS EN 50174-series and BS EN 7671 (IET Wiring Regulations).

All cabling must be adequately protected from the environment through which it passes to avoid the possibility of mechanical damage and electromagnetic interference.

Install cabling and conduits associated with sensors in a manner that prevents spurious transfer of moisture and heat etc from external sources to sensing devices.

Ensure that all wiring is carried out in a neat manner by skilled operatives. Clip wiring to form a loom and route it to avoid interference with the correct operation or maintenance of other components.

Cable type and application

Ensure that the types of cable installed do not prejudice satisfactory operation of the BMS.

Ensure that the type of cables, installation and planning comply with the BMS manufacturers recommendations and the project's electrical specification.

Ensure that the cross-sectional area of cables is sufficient to ensure that sensor circuit resistance limits are not exceeded.

Ensure that the method of installation and routing of cables does not compromise the satisfactory operation of the BMS.

Ensure that the minimum separation distances between data/analogue signal cables and cables of other services (including) power cables comply as relevant with BS 7671 and BS EN 50147 series.

Identification

Ensure that all cables have identification sleeves at their terminations which combine the requirements of BS 7671 with those for specific circuit identification. Ensure that the identification is consistent with the relevant wiring diagrams.

320.060 FIXING AND CONNECTION - USE OF EXISTING CABLE AND WIREWAYS:

Confirm by testing or obtain appropriate certificates from original suppliers that any existing means of network communication is of a suitable standard for satisfactory operation of the BMS.

Ensure that any tests performed comply with relevant parts of BS EN 50174.

Ensure that the potential corruption of data cannot arise from:

Other installations not connected to, but in close proximity to, the route of existing cabling

Other electrical services using existing cabling

Other adjacent cabling.

State in writing at the time of tender whether or not existing cabling is suitable.

320.070 FIXING AND CONNECTION - CONNECTION TO PLANT AND CONTROL EQUIPMENT:

General

Provide all devices and terminals necessary to connect the BMS to items of plant and control equipment.

Take account of any existing services that have to remain in continuous operation. Provide for approval, an installation and commissioning plan that identifies how the BMS equipment can be installed an commissioned without disrupting the operation of the existing building services.

Where plant and control equipment are supplied by others, provide the adequate interface and integration (physical and functional) needs for installation and commissioning requirements. Provide this information in time and in sufficient detail to enable any other installers and their suppliers to incorporate the BMS connection facilities before delivering their equipment to site.

Where plant is subject to warranty by others, obtain clearances in writing from those concerned that the proposed modifications do not invalidate the warranties.

Ensure that modifications carried out as a result of the contract are fully documented and do not affect the satisfactory operation of safety devices connected to any plant or systems affected directly or indirectly by the BMS works. Carry out proving tests to the satisfaction of the Project Supervisor.

Ensure that the use of existing relays, contactors, starters and switches as part of the BMS installation is fully documented.

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Safety interlocks

Provide interlocks as scheduled to establish and maintain safe/pre-determined plant conditions under all modes of operation including loss, reduction and restoration of power.

Ensure that all safety hard-wired interlocks are wired to failsafe on loss of power, or on relay coil failure, or on open circuit, eg cable breakage.

Ensure that all interlocks use voltage-free contacts and AC or DC 24V relays and field wiring.

Complete all wiring and testing of all hard-wired safety interlocks to ensure safe and/or sequenced operation of the plant before the BMS is set to work. Arrange interlocks to prevent unsafe or out of sequence operation of the plant by the BMS.

Ensure that plant does not operate using the BMS until all interlocks have been tested to the satisfaction of the Project Supervisor.

Manual control

Provide manual control facilities to enable plant maintenance/facilities staff to operate essential plant in the event of BMS failure and for routine test purposes. Ensure that the facilities include:

Start/stop operation of the plant.

Automatic operation of motorised control devices such as valves and dampers, etc if the BMS is operating.

Manual setting of motorised control devices such as valves and dampers, etc if the BMS has failed.

Ensure that the manual control facilities do not override safety devices or hard-wired interlocks.

Volt-free contacts

Ensure that the contact materials are suitable for use in the installation and at the required voltages and currents.

Use screw down or locking spade terminals for electrical connections to volt-free contacts.

Relays

Use demountable relays of the totally enclosed type.

Use relays with circuit arrangement printed on top.

Use screw down clamp or locking spade-terminals, and ensure they are shrouded.

Use relays with LED or flag indication of coil status.

Signalling from starters

Provide additional contacts for signalling and remote operation purposes as scheduled

Control equipment

Obtain advice from the relevant supplier when additional facilities are to be fitted to control equipment supplied by others.

Use the knockouts, cable routes and terminals, etc incorporated into the design of control devices.

Packaged plant

Ensure that connections to packaged plant are made within the packaged plant control panel. Fit an additional enclosure where this is not possible. Ensure that all connections between the BMS and packaged plant are 24V maximum.

320.080 FIXING AND CONNECTION - ADDITIONAL PROVISIONS FOR RETROFIT INSTALLATIONS:

Arrange for any necessary control modifications to existing plant to be carried out by the original supplier (with the exception of starter panels). Give the supplier details of the requirements for connection of equipment to the BMS. State the name of the supplier in the Tender together with a priced schedule for the necessary work.

Where details of existing plant are not available from the original supplier or from record documents, provide a specialist conversant with the particular type of plant to carry out any necessary modifications. Provide the specialist with the details of the BMS connections required. State the name of the specialist in the Tender together with a priced schedule for this work. Advise the Project Supervisor of any difficulties with connections.

Advise in writing at the time of tender of any potential delay to the contract arising from the difficulty of providing the necessary BMS connections to the plant.

Use existing relays and volt-free contacts where feasible.

Fit auxiliary contacts to contactors, etc where adequate space is available. Install additional relays if the space is not adequate.

Obtain advice from the original supplier when additional facilities are to be fitted to existing control equipment.

Use the control manufacturer's standard accessories to provide any additional contacts, limit switches and potentiometers, etc.

Use the knockouts, cable routes and terminals, etc incorporated into the design of control devices wherever possible. Obtain approval from the Project Supervisor for ad hoc fixings and modifications to control devices before action is taken on site.

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320.891 CABINETS FOR BMS EQUIPMENT DESIGN AND CONSTRUCTION:

Construct BMS equipment enclosures to give the minimum degree of protection to IP54 and IP 55 in wet plant rooms, unless scheduled otherwise, in accordance with BS EN 60529. Where the enclosure is fitted inside another panel (eg a motor control centre to IP 54 or 55) the protection can be reduced to IP41. For external applications, construct enclosures to IP 65 unless scheduled otherwise.

Ensure that access doors are of a rigid construction and mounted on stout metal hinges capable of supporting the full weight of the open door. Ensure that doors will not sag or drop when open. Fit doors with stout locking handles to prevent access by unauthorised personnel.

Allow safe access to the BMS equipment where the BMS equipment is incorporated into another control panel without having to isolate the panel.

320.191 CONTROL PANELS - DESIGN, CONSTRUCTION & INSTALLATION:

Refer to schedules or scope of works for control panel type, internal separation, input power supply and electrical ratings.

Standards

BS EN 61044-series for controllers

Relevant parts of BS EN 61439-series where the control panel forms part of switchgear and/or controlgear as defined in the standard

BS EN 60204-1 where the control panel may be considered to form part of machinery as defined in the Supply of Machinery (Safety) Regulation 2008

BS EN 60529 for ingress protection

BS 7671 (IET Wiring Regulations)

BS EN 62208 for enclosures

Control panel design

Ensure that the layout of control panels reflects the layout of the plant being served. Ensure that indicators and controls for associated plant are grouped.

Ensure that all doors on panels containing exposed dangerous voltages are provided with interlocked isolators such that the door cannot be opened except with the isolator in the 'off' position. Ensure that isolation complies with BS 7671.

Ensure that equipment that requires on-line adjustment and testing by non-electrically qualified personnel is accessible and usable without interrupting the supply or overriding safety interlocks. Ensure that in general, field controllers are not located within control panels where isolation is necessary to gain access.

Design panels to maintain all components within their environmental tolerance limits taking into account ambient environmental conditions. Install fans with thermostatic control and air extract grilles and air intake grilles with replaceable filters where mechanical ventilation is required to control the environmental conditions.

Ensure that the specified ingress protection (IP) ratings are maintained.

Service conditions

Ambient air temperature to relevant parts of BS EN 61439.

Suitable for ambient air temperature for outdoor installations where required.

Altitude to relevant parts of BS EN 61439.

Suitable for use at altitudes above 1000m where required.

Electromagnetic compatibility

Environment A to BS EN 61439-1 (industrial)

Environment B to BS EN 61439-1 (domestic and light industrial)

Control panel construction

Construct control panels to IP54 and IP 55 in wet plant rooms. For external applications, construct enclosures to IP65 unless scheduled otherwise.

Where the enclosure is fitted inside another panel (eg a motor control centre to IP 54 or 55) the protection can be reduced to IP41.

Construct the panels using sheet steel, folded and seam welded to form a rigid self-supporting structure. Ensure that bracing and stiffening is used as necessary to take the weight of internal components and control assemblies. Ensure that no sharp corners are present.

Ensure that control panels weighing more than 50 kg including installed components are fitted with eyebolts to facilitate delivery and installation.

Ensure that panels are provided with adequate undrilled and/or detachable gland plates of sufficient size and strength to accept glands for all types of cable conduits and cable trunking intended for termination within the panel.

Arrange all wiring within the panel in looms and/or perforated trunking. Ensure that all cables are run continuously from terminal to terminal without intervening joints.

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Ensure that all terminations are fully shrouded, recessed or otherwise protected against accidental contact to at least IP 2x / IP xxD

Ensure that where live equipment cannot be isolated it is covered with a perspex shield carrying appropriate warning labels in addition to specified shrouding.

Ensure sufficient spare capacity in cable ways and trunking to comply with BS 7671.

Ensure that flexible looms are used to connect door mounted to interior-mounted components such that wires will not weaken or break with repeated door openings. Arrange the loom to avoid pinching or looping when the door is closed and ensure that it is fully supported at each end.

Locks to be multipoint locking system with T-handle / key unless scheduled or described otherwise in the scope of works.

Internal wiring

Standard

BS 6231 polyvinyl chloride (PVC) insulated or BS EN 50525-3-41 low smoke zero halogen (LSZH)

BS 6701, BS EN 50173-series and BS EN 50174-series for telecommunications cables

Identification of conductors - Comply with the following standards, as relevant:

BS EN 60445 core standard for identification of conductors

BS 7671 for wiring forming part of the electrical installation

BS EN 60204-1 for control panels that are classed as a component of machinery in accordance with Supply of Machinery (Safety) Regulations 2008

BS EN 61439-series for switchgear and controlgear assemblies

BS 6701, BS EN 50173-series and BS EN 50174-series for telecommunications cables

Identification of earthing and bonding conductors

Ensure protective conductors are coloured cream and labelled in accordance with and BS 7671 and BS EN 60445.

Ensure dedicated telecommunication functional earth conductors are identified and labelled in accordance with BS 6701.

Ensure combined protective earthing and functional earthing conductors are identified primarily as protective conductors.

Control wiring

Segregate control and auxiliary contact wiring from power circuits and data communications circuits.

Provide electrical separation for voltages of different bands in accordance with BS 7671, BS EN 60204-1 and BS EN 61439- series as relevant.

Contain control wiring in slotted plastic trunking

Take account of thermal effects of grouping when routing power wiring.

Wire termination practice

Identify every wire at each end with a unique wire number according to the control panel drawings and cable schedule. Wire numbers may be formed from numbers and uppercase letters. Ensure the system used cannot be confused with alphanumeric conductor function identification requirements of BS EN 60445 and BS 7671.

Terminate wiring intended for screw terminals with ferrules to prevent damage to conductors, and facilitate fault finding and maintenance replacement of components.

Arrange all wiring within the panel in looms and/or perforated trunking. Ensure that all cables are run continuously from terminal to terminal without intervening joints.

Ensure sufficient spare capacity in cable ways and trunking to comply with BS 7671 (IET Wiring Regulations).

Ensure that flexible looms are used to connect door mounted to interior-mounted components such that wires will not weaken or break with repeated door openings. Arrange the loom to avoid pinching or looping when the door is closed and ensure that it is fully supported at each end.

Provide DIN-rail mounting for equipment and terminate to.

BS EN 60715 dimensional type designation as agreed by the designer.

Ensure steel DIN-rails are manufactured and finished in accordance with Appendix A to BS EN 60715.

Location

Do not locate outstations within control panel compartments where isolation is necessary to gain access.

Control panel labelling

Ensure that all panels and individual panel sections are provided with exterior labels to BS EN ISO 7010 and BS 7671 (IET Wiring Regulations) indicating the voltage within the panel along with clear warnings of risk and instructions for isolation. Display requirements for informing the BMS supervisor and/or disabling alarms prior to isolation of control circuits.

Label all switches, controls and indicators on control panels as to function and associated plant.

Fix a notice to the front of the panel warning of the need for isolation elsewhere if the panel does not totally control the electricity supply to associated plant.

Identify all cables with permanently fixed alphanumeric labelling system. Ensure that the numbering corresponds to the numbers fixed to the terminals. Ensure that identification and coding matches that used on the design drawings, schematics and schedules.

Lights
Use LEDs
Use lens colours in accordance with BS EN 60073.
Audible alarms
Ensure that operation of any starter trip lamp, safety circuit lamp or alarm lamp operates a common audible alarm with mute and test facilities and terminals for remote alarm signal.
When an alarm condition has had the audible alarm muted, ensure that terminals for a remote 'alarm accepted' light are energized. The audible alarm circuit and terminals for remote alarm signal must still be capable of indicating another fault occurring even though original fault has not been cleared. The test facilities are to test momentarily both the audible alarm and alarm indicator lamps, whilst the push button is depressed.
Use alarms that interface with a sensor or controller to sense set-point and measured value. Provide adjustable upper and lower limits on face of unit. Provide unit with indicating lamps to show which limit has been exceeded. Provide each unit with connections for remote alarm.
Surge and transient suppression
Ensure surge arrestors are fitted for star-connected and star-delta started motors to limit peak voltage to 1200 V.
Ensure transient suppressors in the form of resistor and capacitor networks are fitted across starter contactor coils.
Controlgear
Terminals for external conductors
For main power circuits, accommodate cross-sectional area of copper cables in accordance with BS EN 61439-1, Appendix A.
Size neutrals on 3-phase supplies to take account of harmonic content (triple-n's) where relevant, with a minimum of the full current-capacity of the corresponding phase conductors.
For control and auxiliary circuits, provide terminal blocks suitable for DIN rail mounting on top-hat rails dimensional type TH 37-7,5 to BS EN 60715.
Accessibility for inspection
Arrange for following operations to be performed when assembly is in service and under voltage.
Visual inspection of switching devices and other apparatus, settings and indicators of relays and releases, conductor connections and markings.
Adjusting and re-setting of relays, releases and electronic devices.
Replacement of fuse links and indicating lamps.
Fault location by voltage and current measuring.
Accessibility for maintenance
Provide space between functional unit or group and adjacent functional units or groups. Provide retainable fastening means for parts likely to be removed for maintenance.
Use barrier protected sub-sections for each functional unit or group.
Use compartments for each functional unit or group.
Removable parts and withdrawable parts
Degree of protection of assembly after removal or withdrawable of part as manufacturer's standard.
Mounting – As scheduled or detailed in the scope of works
Site modification
Do not make site alterations unless authorised. Where site modifications to assemblies are authorised make in accordance with manufacturer's certified drawings and instructions. Ensure that modifications made comply with type test certificate obtained for arrangement of components.
Provide document pocket inside the control panel, complete with full control panel schematic and wiring schedule.

320.102 FIREMAN'S OVERRIDE FAN CONTROL PANEL
Supply and install a fireman's override fan control panel as specified in the scope of works or as indicated on the drawings.
Provide plant switches required are located under a breakglass panel which has a budget lock (ie one which accepts the keyed base of a firemans axe).
Switches shall be configured by plant as Override On/Normal/Override Off. An indicator lamp shall be provided for each position. The colour of the panel shall be agreed with the CA. Allow for stainless steel panel with all text etched and coloured. Panel to be recessed. Size / finish to match fire alarm panel as Architect's details.

320.110 SENSORS - GENERAL:
Ensure that sensors can be removed for testing and maintenance.
Ensure that a tight-sealing test hole is provided adjacent to every duct sensor. Ensure that Binder test points, or

similar, are provided for pipe sensors.
Provide a sufficient length of spare cable so that the sensor can be removed without disconnecting the wiring.
Mark and record the location of concealed sensors (e.g. in false ceilings and shafts, etc).
Provide a labelling plate for each sensor.
Take account of the active and inactive sections of a sensor probe.
Take into account the effects of orientation on the functioning of the sensor.
Take into account:
Minimum/maximum ambient temperature.
Ambient humidity.
Vulnerability to spray water and/or vibration.
Explosion protection.
External influences.

320.120 TEMPERATURE SENSORS:
Pipe-mounted immersion sensors
Ensure that the full active length of the sensor is immersed in water.
Install sensors against the direction of flow.
Install at the correct angle.
The sensor should be installed diagonally in a bypass pipe or in a bend if the active length of the sensor probe is longer than the diameter of the pipe.
Allow an adequate space between the sensor and the obstruction so that the sensor can be removed from the immersion pocket.
Ensure that immersion pockets are made from stainless steel of the appropriate pressure rating.
Ensure that immersion pockets are filled with a heat conducting compound.
A test point or an additional immersion pocket, adjacent to the sensor, should be provided for test purposes.
An adequate distance (10 x pipe OD) between the mixing point and the sensor should be provided when mixing water at different temperatures to take account of stratification.
Surface temperature sensor - water
Ensure a smooth clean contact surface and fill the space between the sensor and the pipe with a heat conductive compound to improve thermal conductivity.
Immersion sensors for air (ducts)
The full active portion of the sensor probe should be exposed to the air flow.
Ensure that the active portion of the probe is located central to the airflow.
A test hole should be provided adjacent to every sensor with plug when not in use.
Probe-type sensors should not be used in areas where stratification can occur, eg downstream of heating and cooling coils, etc (see averaging sensors).
Sensors which are positioned near to coils should be shielded against the radiative heat transfer.
Return air duct sensors should be located near to the occupied space to avoid heat gain or loss and radiant effects influencing readings.
Sensors must be positioned in an area of representative air flow. This applies to all duct sensors but particularly the return air sensor which may be located in the ceiling plenum.
The likely cleanliness of the air should be considered when selecting sensors.
Sensors representing zone temperature should be offset to account for heat gains e.g. space temperature stratification or if light fixtures are used as the return air path.
Sensors should only be used in return air ducts where air is continuously extracted.
Capillary sensors with probes
The device head must be higher than the sensor probe.
The sensor probe should be tilted downwards.
The ambient temperature at the device head must always be higher than the temperature to which the sensor probe is exposed.
The sensor element must always point downwards. The capillary should not form a U-shape.
The capillary should not be bent too tightly (radius of bend 50mm).
Averaging sensor (for use in ducts/AHU)
Allow a distance of at least 50 mm between any heat exchanger and the sensor.
The entire length of an averaging sensor must be fully inside the air-duct.
The sensor element must be evenly distributed over the full cross-section and adequately secured to prevent vibration.
The sensor element should be installed in the air flow, downstream of the eliminator plate when air

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washers are used for humidification.

Frost protection thermostat

Leave a spare capillary loop of 20 cm to enable sensor testing outside the duct/unit.

The measuring head and the test loop of the thermostat must be located inside the ductwork and downstream of the heat exchanger if the ductwork is outdoors or in an unheated space.

The capillary should be installed in the air flow, downstream of the first heating coil exposed to frost. The capillary must be installed diagonal to the heat exchanger pipes or in a serpentine manner at right angles to the pipes.

Room sensor

Sensors should be installed at a height of 1.5 m in occupied spaces and at least 50 cm from any adjacent walls.

Where room sensors have an adjustable dial they shall be mounted at 1.2m

The sensor should be located in an area representative of the entire control zone.

The sensor should be located away from heat sources, e.g. office IT equipment.

The sensor should be located in the area it controls.

Sensor locations near air currents generated by diffusers or openable windows, for example, should be avoided.

The sensor must not be exposed to direct solar radiation.

Avoid external walls except were unavoidable. Use insulated backplates.

Avoid recesses and alcoves.

The conduit entry points to the sensor wall box should be sealed where there is a risk of air from another zone flowing over the sensor element.

Do not install near or under lamps or above radiators.

Avoid chimney walls.

Do not install directly adjacent to doors.

Do not install behind curtains.

Do not fit to walls concealing hot-water pipes.

Outdoor air temperature sensors

Do not install on facades affected by significant rising heat, or facades which will be heated by solar radiation (fix sensors to a north-facing wall or use solar shields).

Avoid chimney walls and other walls subject to high internal heat gains.

Do not install under eaves.

Do not install above windows.

Do not install above ventilation extracts.

Ensure accessibility for inspection/verification

An alternative to an external mounting is to locate the sensor in the AHU intake duct. This should ideally be upstream of the intake damper and on AHU plant which run continuously (24/7). Where this is not possible it must be a suitable distance before re-circulated air and mechanical devices to avoid their effects.

320.130 HUMIDITY SENSORS:

Humidity sensor/stat. - duct

The air velocity in the vicinity of the sensor must not exceed 10 m/s (a perforated steel plate cover can be used).

The sensor must not be located in deadlegs (super-saturation can occur in areas where there is no air flow).

A test hole must be provided downstream of the sensor, plugged off when not in use.

The sensor should be positioned beyond the spray distance of humidifiers.

Humidity sensor/stat. - room

The sensor should be installed at a height of approximately 1.5 m in the occupied space and at least 50 cm from the adjacent wall.

Avoid locations where the sensor will be exposed to direct solar radiation.

Avoid external walls except were unavoidable. Use insulated backplates.

Avoid alcoves and recesses.

Do not install near lamps or above radiators.

Do not fit to chimney walls.

Do not fit directly adjacent to doors.

320.140 PRESSURE SENSORS:

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Pressure - general

Pressure sensors are affected by orientation.

The pressure tubes must be provided with a binder point near the device head for test purposes.

The connection must be fitted with a bypass with a stop valve to avoid overload on one side when manipulating the sensors and to enable zero calibration. Isolating valves should also be fitted.

The sensor should be installed on a vibration-free surface or vibration-proof base.

The pressure-tapping point must not be located in turbulent air flow. Provide 5 x OD upstream and 5 x OD downstream of straight duct or pipe without obstructions.

Pressure - air

Probes for measuring static pressure should be installed parallel to the flow.

The differential pressure measuring tube should be correctly sized.

The tapping point should not be located where it will be affected by obstructions to the flow.

Pressure - liquids

Use a damping coil to avoid transferring vibrations (horizontal loops to avoid trapped air bubbles and condensate).

The device must always be installed in a location which is lower than the sensing point.

Do not measure at the top of a pipe (trapped air, bubbles) or at the bottom (dirt).

Pressure - gases

When measuring vapour gases the device must always be installed in a location which is higher than the sensing point.

Measure at the top of the pipe to prevent condensate from entering the pressure tube.

320.150 FLOW VELOCITY/FLOW RATE SENSORS:

Differential pressure for flow monitoring - liquids

There should be no stop valves or balancing valves between the sensing points on the pipework.

Differential pressure for flow monitoring - air

Ensure a steadying zone upstream and downstream of the orifice plate/flow grid, etc.

The flow or differential pressure must not be monitored where there is a variable resistance such as a filter or fan, etc.

Velocity sensors

Sensors should be positioned at an adequate distance from bends, tees, fans and coils such that the centre line velocity is representative of the average velocity.

A single point sensor should be located at a distance from the centre of the duct equal to 0.25 x the duct radius.

Wilson flow grid

Averaging velocity sensors across the duct, e.g. Wilson flow grid or multi-point averaging pilot tubes, should be used where the minimum separation distance from a flow disruption is not available. Ensure that the Wilson flow grid is sized correctly for each duct size.

320.160 INDOOR AIR QUALITY SENSORS:

CO_2 and mixed-gas sensors - room mounted

Ensure that the sensor is located in a representative location, e.g. on an open wall 1.5 to 3 m above the floor.

Ensure that the sensor is not mounted in niches or bookshelves or behind curtains.

Ensure that the sensor is not located where people are continuously present (within 1 or 2 metres).

CO_2 and mixed-gas sensors - duct mounted

Ensure that the sensor is located in the return air duct as close as possible to the room extract point(s).

Ensure that the sensor is located in the vertical position.

Ensure the correct orientation of the duct probe with respect to the airflow.

Ensure that the sensor is not installed in a vertical position with the head at the bottom.

320.170 ACTUATORS:

Securely mount actuators to rigid members, free from vibration or distortion in accordance with manufacturer's recommendations. Select mounting positions to require minimum linkages, and to avoid angular drive to operating levers. Allow access for servicing and replacement.

Ensure that actuators and linkages for valves and dampers operate smoothly from fully open to fully closed without binding and with adequate torque to overcome the resistance of the actuator mechanism and the flow and to provide the specified close off ratings.

Ensure that linkages are clearly marked with the clamping position such that after maintenance or replacement the mechanism is able to operate correctly.
Fit actuators with visual position indication.
Actuators shall have tamperproof reversible clockwise and anti-clockwise mode selection.
Ensure that there is sufficient space above the actuator so that it may be removed for testing or maintenance.
Include position feedback devices suitable for connection to the BMS.
Ensure that actuators incorporate a disconnection device to allow manual operation of the valve or damper in the event of actuator failure.
Ensure that actuators are electrically and mechanically protected from the effects of valve or damper seizure.
Use 24v actuators wherever possible. Where line voltage actuators are used, provide local means of isolation by manual isolator or plug and socket connection.
Ensure that, during commissioning, valve actuators are fitted in a fully closed/bypass position where they are being fitted to valves which push against a spring.

320.180 VALVES:

General

Ensure that valves have the correct authority without excessive pressure drop.
Ensure that valve bodies are suitable for the medium, the temperature and the pressure of the fluid system.
Ensure control valves have a close-off pressure rating higher than the circuit pressure design.
Ensure that valves will pass the required flow at a pressure drop within the maximum differential pressure rating of the valve.
Check for out-of-balance forces, particularly during operation of a three-port valve.
Where possible ensure that valves are not installed with their spindles in the horizontal position. If valves cannot be installed with their spindles in the vertical position ensure that they are as near as possible to the vertical.
Ensure that valves are not installed with the actuator at the bottom.

Modulating valves

The following additional considerations apply for modulating valves:
Ensure system operating pressures, test pressures, pump heads and pressure drops through heat exchangers and associated pipework are known before control valves are selected.
Select 3 port valves to provide a minimum authority of 0.5 for diverting applications and 0.3 for mixing applications.
Select 2 port valves to provide a minimum authority of 0.3
Select valves with port characteristics appropriate for the intended function.
Ensure that all modulating control valves are selected for equal percentage or linear characteristics according to system type, to provide near linear characteristics between the valve position and heating/cooling power as delivered to the air or water-based system.
Ensure that the rangeability of the selected valves is large enough to provide stable control under low load conditions.

Combined pressure independent 2 port control valves (PICV)

Select, install and commission valves to provide the functions of flow limitation, modulating control and differential pressure control within a single valve body.
The valve manufacturer shall provide test results for each type and size of PICV to be used on the project in accordance with BSRIA Test Method for Pressure Independent Control Valves BTS 1/2012.
Limiting minimum operating pressure – 20Kpa.
For PICVs with a k_v value less than 0.4, a flushing drain should be incorporated in the pipework between the terminal unit and the PICV.
All PICVs' shall have an equal percentage control characteristic, be sized such that the design flow is within the setting range of the valve and be capable of closing against a maximum differential pressure that is greater than the pump head.
Type – Full stroke where the control and flow setting functions are separated within the valve and the full stroke of the valve is available for control (unless scheduled otherwise)
Valve characteristic/control - Equal percentage modulating (unless scheduled or described otherwise elsewhere in this specification).
Duties - To suit terminal unit design flow rates as detailed in equipment schedules.
Standard

Relevant parts of BS EN 60534
Valve leakage class to BS EN 60534-4 when shut off - IV.

Materials:

Body - DZR brass.
Globe or ball - brass.
Stem - brass.
O-Ring/diagram - EPDM rubber.
Springs - stainless steel.
Features - Facility to measure pressure drop across valves at commissioning.
Actuator - 0-10V proportional electric for modulating control or 3 point floating control.

320.190 VALVE SIZING REQUIREMENTS:

All types of valves and applications
Parameter - Body pressure rating.
Requirements - To exceed system test pressure.
All 2-port valves
Parameter - Close-off pressure rating.
Requirements - To exceed pump or system full differential pressure.
All 3-port valves
Parameters - Close-off pressure rating.
Requirements - To exceed out of balance pressures
All types of valves and applications
Parameters - Maximum leakage coefficient.
Requirements - 0.05% kv.
2-port isolation valves
Parameters - Pressure drop at full flow.
Requirements - Select at line size for minimal pressure drop.
2-port modulating valves
Parameters - Pressure drop at full flow.
Requirements - Select kv value for a minimum authority of 0.3, not to exceed 50 kPa.
3-port modulating valves
Parameters - Pressure drop at full flow.
Requirements - Select kv value for 30% - 50% authority against coil or circuit pressure drop.
Isolation valve
Parameter - Characteristic.
Modulating valves (plant valves and zone reheater coil valves)
Parameters - Characteristic.
Requirements - Equal percentage.
Modulating valve (fan coil units)
Parameters - Characteristic.
Requirements - Equal percentage (preferred) or linear.
Modulating valves (independently pumped mixing and injection circuits)
Parameter - Characteristic.
Requirements - Linear.
PICV's – refer to clause 320.180.

320.200 DAMPERS:

Provide visual position indicators on all damper actuators installed so that they can be seen from the plantroom floor.
Ensure that damper characteristics are as linear as possible.
Ensure that modulating dampers are sized correctly to give adequate authority.

320.210 COMMUNICATION NETWORKS - GENERAL:

Ensure that all addressable control devices can be addressed over the communications network.
Ensure that the bandwidth and subsequent speed of communications is sufficient to meet the requirements of the selected manufacturer's BMS equipment.
Ensure that no cross corruption of data occurs when the BMS shares a communication network with other IT-based systems. Ensure that permission has been given by the IT manager to connect BMS components onto the IT network. Comply with the organisation's IT strategy for connection of devices to the IT data network, including allocation of IP addresses.
Ensure that network testing, identification and documentation comply with BS EN 50173-services and BS EN 50174-series.

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Ensure that all network devices such as routers and bridges are compatible with the network and are capable of operating such that the required throughput of data is achieved.
Install communication networks in accordance with BS EN 61918.
Assess the network performance for business-critical functions in accordance with BS EN 61907.

320.220 COMMUNICATION NETWORKS - STRUCTURED CABLING:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Ensure that the selected BMS components are suitable for operating on the structured cabling system.
Ensure that the selected BMS topology (star wired, chained or bus-based) is appropriate for the structured cabling system.
Ensure that each addressable BMS device can be addressed over the structured cabling system.
Where BMS components are specified to be powered from the structured cabling system ensure that the power available is sufficient. Ensure that overheating of the structured cabling system will not occur.
Ensure that any changes to the structured cabling system are reflected in updated documentation.

320.230 COMMUNICATION NETWORKS - INTRANET AND INTERNET APPLICATIONS:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Ensure that the BMS is compatible with relevant security techniques in accordance with BS ISO/IEC 27032
Ensure that the BMS devices to be directly connected onto the Intranet/Internet are TCP/IP compatible.

320.240 COMMUNICATION NETWORKS - MAINS-BORNE SIGNALLING:
Comply with the requirements of BS EN 50065-1.
Provide the necessary equipment to ensure that there is no mutual interference between the signaling system of the electricity utility and mains-borne signaling of the BMS.

320.250 COMMUNICATION NETWORKS - RADIO COMMUNICATIONS:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Ensure that the radio transmitter/receiver and the BMS components are adequately powered.
Ensure that radio communications devices and associated BMS components are easily accessible to allow the change of batteries.
Ensure that the attenuation of radio signals does not hinder effective data communications.

320.260 INTEGRATION WITH FIRE DETECTION SYSTEMS - GENERAL:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Ensure approval from the relevant Fire Prevention Officer or Building Control Officer.
Ensure that the requirements of BS 5839-1 are not compromised.
Ensure that the fire detection system can operate autonomously and will not be affected by any failure of the BMS.
Ensure that the BMS will not be affected by any failure of the fire detection system or fails safe as appropriate.
Ensure that the loss of electrical power to the BMS will have no adverse effects on the fire detection system.
Ensure that a full cause and effect testing programme is developed in conjunction with the fire alarm company.
Ensure that the integrated system is fully commissioned.
Ensure that the contractual responsibilities of the various parties responsible for the integrated system are fully defined.

320.270 INTEGRATION WITH FIRE SYSTEMS - INTEGRATION DETECTION FOR MONITORING:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Uni-directional systems
- Provide the display of fire alarm detector status information on the BMS operator client indicating the location of fire detector heads or zones, along with their respective status
- Ensure that a fire alarm condition automatically displays the appropriate building graphic/schematic along with relevant detector head status or zone status.

320.280 INTEGRATION WITH FIRE DETECTION SYSTEMS - INTEGRATION FOR CONTROLS:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Provide fail-safe, hard-wired interlocks using volt-free contacts between the BMS field controllers and items of plant listed in schedules.
Use volt-free contacts and AC or DC 24V interlocks.
Use relay logic and/or microprocessor-based logic.
Ensure that building services control actions operate correctly in response to the status of the fire detection

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system.

320.290 INTEGRATION WITH SECURITY DETECTION SYSTEMS - INTRUDER ALARM SYSTEMS:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Provide the display of security sensor/detector or zone status information on the BMS operator client.
Provide any building graphics/schematics on the BMS operator workstation indicating the location of security sensors/detectors or zones along with their respective status.
Ensure that a security alarm condition can automatically display an appropriate building graphic/schematic along with the relevant sensor/detector status.
Ensure that any time delay in receiving security alarm data at the operator workstation client does not exceed the manufacturer's recommendations.

320.300 INTEGRATION WITH SECURITY DETECTION SYSTEMS - ACCESS CONTROL SYSTEMS:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Provide the display of access control status on the BMS operator client.
Provide on the BMS operator workstation building graphics/schematics indicating the location of access control devices along with their respective status.
Ensure that an alarm condition or an access control system can automatically display the appropriate building graphic/schematic along with the relevant sensor/detector status.
Ensure that no configuration of access cards is possible via the BMS.
Ensure that building services control actions operate correctly in response to the status of the access control system.

320.310 INTEGRATION WITH LIGHTING CONTROL SYSTEMS:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Ensure that the following functionality is provided:
- Switching of lighting zones in accordance with zone occupation times as set on the BMS.
- Switching of lighting zones in accordance with occupancy sensing and light level sensing where this is provided by the BMS.
- Monitoring of lighting zones.
- Monitoring of lamp run hours.
- Raising of an alarm on lamp run hours exceeding the specified maximum.
- The ability to override zones.

Ensure that re-definition of zones cannot be performed via the BMS.
Direct interoperability – Ensure that the requirements of clause 310.470 are met.
Gateway link - Ensure that the requirements of clause 310.480 are met.

330.330 CONTROLS CIRCUITS:
Supply Voltage – Ensure control circuits are DC (negative-earth) or AC 230 V sourced from common single-phase supply. Control circuits from single-phase supplies derived from different phases shall not be used in the same enclosure.

330.340 CONTROL CIRCUITS TRANSFORMERS:
Provide control circuit transformers to supply power at voltages to suit control components.
Standard - Use transformers in accordance with BS EN 61558-2-6, BS EN 61558-2-23 or BS EN 61558-1 and provide an external label of approved type and size.
Protection – Primary and secondary fuses

340.000 WORKMANSHIP:

340.010 GENERAL:
Install pipeline control components in accordance with manufacturer's instructions.
Install ductline control components in accordance with DW/144 and manufacturer's instructions.
Install control components in accordance with manufacturer's recommendations, in positions indicated.

340.020 APPEARANCE:
Arrange, support and clip all control wiring, pneumatic tubes and capillaries to present a neat appearance, with other services and the building structure.

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340.030 INSULATION:
Where control components are incorporated in insulated pipelines, ductlines or equipment, provide details for approval of method proposed to insulate component.

340.040 SUPPORTS:
Arrange supports for control components to ensure no strain is imposed on components.

340.050 ACCESS:
Arrange control components to ensure adequate access for operation and maintenance.
Comply as relevant with BS EN 547-series and BS 7671 (IET Wiring Regulations) requirements for maintenance gangways.

340.080 POWER OPERATED CONTROLS:
Install power operated controls in accordance with manufacturer's instructions and relevant standards.

340.090 ELECTRIC MOTOR ACTUATORS:
Securely mount actuators to rigid members, free from vibration or distortion in accordance with manufacturer's recommendations. Select mounting positions to require minimum linkages, and to avoid angular drive to operating levers. Allow access for servicing and replacement.

340.100 SENSORS/CONTROLLERS:
Install sensors/controllers in accordance with manufacturer's instructions, in accessible locations. Install wall mounted components, where indicated.

340.105 TEMPERATURE SENSOR LOCATION:
Internal

Install temperature sensors: out of sources of draughts; away from doors and sources of heat or cooling; away from sources of water / sinks; out of the reach of direct sunlight; not in partitioned alleys; approximately 1500 mm above floor; in a position which will not be covered.
They should also be coordinated with the Architect's furniture drawings to ensure they are not blocked or covered.
The Contractor shall ensure that the conduit to the back of the sensor is completely sealed.

External

Out of the reach of direct sunlight; away from any heat sources, exhaust, open windows; in a safe, tamperproof location.

340.110 ANCILLARIES:
Install ancillaries in accordance with manufacturer's instructions.

340.120 ENCLOSURES:
Install enclosures where indicated, providing space for access and maintenance.

340.121 PACKAGED PLANT:
Make all digital and analogue control interfaces between the BMS and packaged plant as detailed on the Controls diagrams and individual plant schedules and elsewhere in the specification.
Make connections to packaged plant within the plant control panel. Where insufficient space within such panels fit a further enclosure to the plant to accommodate the connections.

340.122 PANELS, WIRING AND WIRE WAYS:
Install all Panels, wiring and wire ways as described in the appropriate reference specifications.

Other than in individual starters and the interlocks from local isolators, the control circuit voltage shall not exceed 110 Volts ac (55-0-55). Where control circuits are taken outside the enclosure to remote equipment use 24 Volts maximum.
Where modifying existing installations, agree the detail of the above with the S.O.

340.130 BUILDING MANAGEMENT SYSTEM INSTALLATION:
Install commission and set to work building management system in accordance with the manufacturer's recommendations.

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340.140 BUILDING MANAGEMENT SYSTEM CABLE INSTALLATION:
Plan and install all building management monitoring systems cables in accordance with the cable manufacturer's recommendations.
Label and record all monitoring cables

340.150 BUILDING MANAGEMENT SYSTEM QUALITY CONTROL:
Handle, store and install equipment and components of the building management system in accordance with the manufacturer's recommendations.
Inspect all equipment and components on delivery, before fixing and after installation and reject and replace any which are defective.
Record all commissioning tests and site modifications to hardware or software, and revise operating and maintenance instructions accordingly.
Inspect installed and operational functions of Building Automation, Controls and Technical Building Management System including its configuration in accordance with BS EN 16946-1.
Manage configuration of software, settings, data and design, in accordance with an appropriate Configuration Management Plan complying as necessary with BS EN ISO 9001, BS ISO 10007, BS ISO/IEC 12207 and BS ISO/IEC/IEEE 15288.
Provide configuration details along with the operation and maintenance manual on handover.
Manage information security systems, software and data during design, implementation and commissioning in line with BS EN ISO/IEC 27001.

340.160 CONTROL SYSTEM FUNCTION CHARTS:
Prepare function charts for the control system in accordance with BS EN 60848. Obtain approval for function chart before design of system hardware or writing control software.

350.000 COMMISSIONING:
Commission in accordance with CIBSE Commissioning Code C. Refer to section Y51 for BMS commissioning and seasonal commissioning requirements.
Undertake and manage integrated commissioning in accordance with CIBSE Commissioning Code M: Commissioning Management
- Perform interface testing with all other logically-connected systems
- Perform whole building integrated testing as scheduled or described in the scope of works.
- Perform black building integrated testing as scheduled or described in the scope of works.

The BMS / controls specialist shall assist with seasonal commissioning during four separate occasions with three monthly intervals during the defects liability period in the first year after handover unless scheduled or detailed otherwise elsewhere in this specification.

360.000 DEMONSTRATION AND HANDOVER:
Refer to General scope of works for project particular requirements and section Y51 and "A" sections of the specification for standard clauses for BMS witnessing requirements, operator training and post-handover checks.
Refer to work section A37 or A84 or A84D for requirements for BMS O&M manual.

360.040 SOFTWARE:
Ensure that a copy of the configuration software is securely held both on and off-site.
Ensure that, as alterations are made to the configuration software, all previous versions of the software are securely archived.
Ensure that all credentials are transitioned to the operation and maintenance organisation(s) at handover.

10000 Ref NES Text Sept 18

Common Workmanship Clauses

Y11 – Pipeline Ancillaries

M01 GENERAL [based on NES 211.016]
The tender drawings show the design intent and do not necessarily show all facilities for filling, draining, flushing, cleaning, draining and chemical cleaning of the water systems.
The Contractor shall include in the installation all necessary facilities, including sample coolers (if required) , to enable a Specialist to successfully fill, flush, clean, and chemically treat the systems listed in schedule Y25 in accordance with the latest edition of BSRIA Guide BG29 "Pre-commissioning cleaning of pipework systems. Where 2 port control valves and PICV's are installed and the a orifice of the control valve is too small to allow adequate flow for back flushing a drain point shall be located between the two-port valve and the coil connection.
The Contractor shall review all designs to ensure that systems are commissionable in accordance with the CIBSE commissioning code W and BSRIA Guide BG2/2010 as detailed in Y51. If additional facilities are required the Contractor shall advise the designer prior to commencing work on site.
All pressure equipment shall be designed, manufactured and certified in accordance with the Pressure Equipment Regulations 1999 as amended and The Approved code of practice (ACOP) L 122 "Safety of Pressure Systems"
All fittings, pipe joints and flanges PN rating shall be suitable for hydraulic test pressure of the system (ie minimum of 1.5 times the maximum operating pressure).
For applicable valves comply with BS EN 16668 for all essential safety requirements of the Pressure Equipment (Safety) Regulations. Valves excluded from conformance to this standard in the Regulations shall meet "sound engineering practice" by conformity to the relevant product standard.
Face to face and centre to face dimension of PN and Class designated flanged metal valves to be in accordance with BS EN 558.
Valves and components of valves specified are as defined in BS EN 736-1 (types of valves) and BS EN 736-2 (components).
In addition to the particular valve type standard, valves to be used in, or connected to, water supply pipe systems, above or below ground carrying water intended for human consumption to comply with the relevant parts of BS EN 1074 and BS 5163 as appropriate to the application.

M10 SAFETY DEVICES AND RELIEF VALVES - SELF OPERATED - APPLICATION:
Safety
To discharge with rapid opening action to prevent predetermined safe pressure being exceeded.
Relief
To discharge with opening action proportional to increase in pressure above set pressure.

Select, supply and install safety devices in accordance with relevant parts of BS EN ISO 4126 to suit the project particular requirements.

M20 EXPOSED VALVES:
Fit easy-clean covers over glands and bonnets to small copper alloy valves exposed in areas other than plant rooms. Fit thermoplastic valve wheels. Fit dust caps to lockshield valves.

M30 TESTING [based on NES 211.016]:
Ensure that valves and cocks are pressure tested at manufacturer's works, in accordance with specific requirements of the valve product or performance standard. Pressure test valves in accordance with BS EN 12266-1 or BS ISO 5208. Undertake supplementary tests as necessary in accordance with BS EN 12266-2.
Pressure test thermoplastic valves at manufacturer's works, in accordance with BS ISO 9393-1 in conjunction with given specific requirements of the valve product or performance standard.
For valves used for volatile air pollutants and hazardous fluids, test for external leakage in accordance with relevant parts of BS EN 15848.

M40 VALVE REMOVAL
All valves used on water services installations shall be provided with means of disconnection. Screwed or capillary valves shall be fitted with unions either side. Compression ended valves shall only be used for final isolation or where easily accessible.

2000 PRODUCTS/MATERIALS

2005 VALVE ENDS
Ends of valves shall suit the pipelines into which they are installed.

Y11 – Pipeline Ancillaries

2007 **STOP VALVES - SLUICE TYPE TO BS 5163:**
Valve type (as BS) - A
Application – Waterworks purposes
Ends
Flanged to BS EN 1092
Seat
Metal seated.
Stem seal
Stuffing box and gland.
Operation
Handwheel.
Materials
Manufacturer's standard.
or As otherwise indicated.
Options
Stem cap.

2015 **STOP VALVES (STOP COCK) TO BS EN 1213 FOR POTABLE WATER SUPPLIES:**
Material - copper alloy.
Flow rate class
VA (straight and angle pattern stop valves).
VB (oblique pattern stop valves).
End connections
Compression to BS EN 1254-2 or Compression to BS EN 1254-3 or Capillary to BS EN 1254-1.
or Threaded to Relevant parts of BS EN 10226 .

2016 **MANUALLY OPERATED VALVES FOR GAS:**
Comply with the requirements of IGEM/UP/2 edition 3 for the selection and installation of manual valves for pipe section / plant isolation, buried below ground, by-pass and AECV applications in accordance with the following standards.
BS EN 331 – ball and taper plug valves.
BS EN 593 – butterfly valves
BS EN 1984 – steel gate valves
BS EN ISO 15761 – steel gate, globe and check valves not exceeding 100mm NB
BS EN 12266 parts 1&2 – testing and test procedures for valves
BS EN 13774 – gas valves for distribution systems up to 16 bar
Threaded to Relevant parts of BS EN 10226 or Flanged to BS EN 1092-1

2021 **STOP VALVES – COPPER ALLOY GATE TYPE TO BS EN 12288:**
Gate valve type
Solid or split wedge
Ends
Threaded to Relevant parts of BS EN 10226 or Flanged to BS EN 1092
Stem
Inside screw non rising stem or Outside screw non rising stem.
Trim material
Suitable for potable water supply.
Operation
Handwheel
Options
Position indicator.
Locking device.

2031 **STOP VALVES – CAST IRON GATE TYPE TO BS EN 1171:**
Valve type
Solid or split wedge.
Inside screw stem (non-rising).
Stem sealing
Stuffing box and gland.
Ends

Y11 – Pipeline Ancillaries

Flanged to BS EN 1092-2. PN as indicated
Body and bonnet material
Grey cast iron or SG iron as scheduled or to suit the pressure/temperature application
Trim category
Copper alloy faced.
Operation
Handwheel.
Suitable for use with potable water.
Options
Position Indicator.
Locking device.

2061 **PARALLEL SLIDE VALVES TO BS EN 1984:**
Material – Steel
Application – Steam and HTHW
Ends - Flanged BS EN 1092-2 or butt-weld with dimensions of ends to BS EN 12627 as indicated.
Stem - Rising stem.
Valve faces - Stainless steel disc and seat.

2081 **STOP VALVES - BALL TYPE:**
Standards
BS EN 13547 for general use including heating and cooling systems.
BS EN 13828 for potable water supply in buildings up PN 10 and a distribution temperature of 65 °C with occasional excursions up to 90 °C permitted for a period of 1 h maximum
Materials - Bronze or DZR copper alloy body.
Ends - Threaded to Relevant parts of BS EN 10226 or grooved or flanged as scheduled.
Chrome or nickel plated DZR sphere with full bore flow aperture. PTFE seats and stem seals.
Anti-blowout stem.
Operation - lever operated or screw driver operated or key operated.
For hot and cold water applications to BS EN 13828, incorporate a flow regulator within the isolation valve where the static pressure exceeds 1 bar.

2085z **SERVICING VALVES TO BS 6675**
Material - copper alloy.
End connections
Compression to BS EN 1254-2 or Compression to BS EN 1254-3 or Capillary to BS EN 1254-1 or Threaded to Relevant parts of BS EN 10226 .
Operation – as indicated on drawings.

2085z **STOP VALVES - BUTTERFLY TYPE TO BS EN 593:**
Construction
Provide controlled elastomer compression on flange faces.
Semi-lugged, I wafer type design or grooved type capable of dead end service and bi-directional service, with disc offset from stem. Grooves for 350mm and larger to be wedge shaped, for example, Victaulic advanced groove system (AGS).
For installation between flanged pipework connections, body to suit BS EN 1092.
Provide lever-operated valves with long body neck for lagging clearance.
Seat - bonded, pressure responsive elastomer in sizes up to 300mm, disc mounted seal for 350mm and larger.
Materials
Ductile iron or Carbon Steel or stainless steel body to suit application and operating pressure / temperature conditions.
Stainless steel shaft.
Disc material suitable for service fluid and operating temperature.
EPDM seat
Body lining material suitable for service fluid and operating temperature. For potable services the linings shall be arranged such that the fluid is not in contact with any ferrous parts.
Operation
Lever and graduated notch plate up to 150mm. Gear box operator above 150mm. Unless otherwise indicated.

2121 **STOP VALVES TO BS 5433**
Application

Underground stop valves for water services
Material
Bronze or DZR copper alloy body threaded to Relevant parts of BS EN 10226
Washer material suitable for service fluid and operating temperature Material

2125 POLYETHYLENE VALVES
For water supply and drainage to BS EN 12201-4
For gas supply to BS EN 1555-4

2130 STOP VALVES – LUBRICATED PLUG COCK TYPE TO BS 5158:
Materials
Cast Iron
Pattern
Short or regular.
Ends
Flanged to BS EN 1092-1 or BS EN 1092 -2 as indicated or screwed to Relevant parts of BS EN 10226
Body seat
Tapered or Parallel, or Plug fitted with injection facility for lubrication or sealing compound.
Operation
Wrench, but with wheel and gearbox where indicated.
Options
Provide manufacturer's charge of lubrication/ sealant suitable for service fluid and operating temperature.

2161 STOP VALVES – BALL TYPE TO BS ISO 7121:
Material
Carbon Steel or stainless steel body as scheduled
Pattern
Full bore.
Ends - threaded to relevant parts of BS EN 10226 unless detailed otherwise elsewhere.
(Socket weld ends to be to BS ISO 7121 or BS EN 12627 & butt welding ends to BS ISO 7121).
Operation
Wrench.
Trim material
Manufacturer's standard.
Options
Wrench.

2170 STOP VALVES – DIAPHRAGM TYPE TO BS EN 13397:
Pattern – Weir.
Ends -Flanged to BS EN 1092-1 or BS EN 1092-2 or BS EN 1092-4 PN as indicated or Threaded to Relevant parts of BS EN 10226
Materials
Suitable for service fluid and operating temperature.
Operation
Hand wheel.
Options
Sealed bonnet.

2210 REGULATING VALVES - BUTTERFLY TYPE:
Standard - BS EN 593.
Construction
Provide controlled elastomer compression on flange faces.
Fully lugged wafer type design or grooved type capable of dead end service and bi-directional service, with disc offset from stem.
For installation between flanged pipework
Body flanged to suit BS EN 1092
Provide lever and gear operated valves with long body neck for lagging clearance.
Seat
Bonded.
Materials

Cast iron body.
Stainless steel shaft.
Aluminium bronze disc.
Disc material suitable for service fluid and operating temperature.
EPDM seat.
Body lining material suitable for service fluid and operating temperature.
Operation
Infinitely variable setting with travel stops and position indicator.
Gear box operation.

2221 DOUBLE REGULATING VALVES - GLOBE TYPE TO BS 7350:
Series (as BS) - B.
Material
Copper Alloy to BS 5154
or cast iron to BS EN 13789 as scheduled
Pattern
Oblique or Y. Flanged to BS EN 1092 – 2 or BS EN 1092-3 or screwed to Relevant parts of BS EN 10226 or grooved
Stem
Inside screw rising stem.
or Outside screw rising stem.
Trim material
Suitable for potable water supply.
Operation
Lockshield.
Options
Regulating locking device to
Provide double regulating facility.

2230A FLOW MEASUREMENT DEVICES TO BS 7350 TYPE 3, COPPER ALLOY:
BS 7350, section 3.2 - type 3
A fixed orifice either integral with or as a fixed orifice fitting close coupled to a double regulating globe valve.
Ends
Threaded to Relevant parts of BS EN 10226 or flanged to BS EN 1092-2 to match pipework as indicated.
Material
Double regulating globe valve, bronze or DZR copper alloy to BS 5154 series B and close coupled fixed orifice fitting to BS 7350 table 6.
Options
Independent means for positive isolation on pressure tapping or adapter.

2230C FLOW MEASUREMENT DEVICE TO BS 7350 CAST IRON, TYPE 3:
BS 7350, section 3.2 - type 3
A fixed orifice either integral with or as a fixed orifice fitting close coupled to a double regulating globe or butterfly valve.
Ends - Flanged to BS EN 1092-2.
Material
Double regulating globe valve, cast iron to BS EN 13789 and close coupled fixed orifice fitting to BS 7350, table 6.
Options
Independent means for positive isolation on pressure tapping or adapter.

2240 ORIFICE PLATE:
Material
Stainless steel.
Carrier ring to fit inside bolt circle of flange.
or Carrier ring full faced for installation between copper alloy flanges.

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Pressure tappings with self-sealing test plugs, suitable for operating conditions, for connection to manometer to provide measuring facility

2261 **TERMINAL UNIT MANIFOLD COMMISSIONING MODULES:**
A multi terminal commissioning system for controlling up to 6 terminal units served by either 15mm or 20mm flow measuring stations / pipework. For duties refer to drawings and terminal unit schedules.
All components to be assembled and installed in an insulated painted galvanised sheet steel box having a minimum thickness of 1.2mm incorporating handles, a clamped lid for access and external hanging points. Insulation to be a minimum thickness of 20mm and ensure the box is completely vapour sealed.
Modules are to incorporate a flushing bypass, isolation valves, and strainer with integral drain cock, pressure test points, flow isolating valves and return flow measuring / regulation valves as clause 2230A.
When used on variable volume systems an adjustable differential pressure control valve or PICV shall also be installed within the box, as indicted on the drawings.
Connections to flow & return pipes are to be BSP Threaded Female and accessible on the outside of the box to prevent disturbing the insulation.
Each module to be supplied with an identification label, identifying each manifold with flow/return designation, terminal numbers and flow rates.

2268A **RADIATOR VALVES TO BS 2767**
Type – Use type 4 or type 10 as required to meet system temperature and pressure
Material – Bronze or DZR copper alloy body.
Pattern – Angle or straight to suit application.
Pipework Connections – Straight
Threaded to Relevant parts of BS EN 10226
or compression to BS EN 1254-2 to suit pipework as indicated.
Angle
Threaded to Relevant parts of BS EN 10226 with one end internal and other end external with union nut and tail pipe; or compression joint to BS EN 1254-2 one end and other end externally threaded to BS 21 with union nut and tail pipe to suit pipework as indicated.

Connections
Fit wheel valves on flow connections to radiators, and other heat emitters, without thermostatic radiator valves. Fit lockshield valves on return connections.

2270 **THERMOSTATIC RADIATOR VALVES to BS EN 215:**
Materials and connections as radiator valves.
Pattern – Angle or straight to suit application, valves to be tamper proof.
Ancillaries
Position indicator.
Locking device.
Temperature sensor
Integral sensor with an alpha/numeric set-point indicator and locking facility,
or Remote sensor with an integral alpha/numeric/temperature set-point indicator; integral locking facility, and capillary connections between sensor and valve, or remote sensor incorporating the selector.

2298A **FLOAT OPERATED VALVES, BALANCED EQUILIBRIUM:**
Bronze or DZR copper alloy body.
Inlet
Threaded to Relevant parts of BS EN 10226 or flanged to BS EN 1092 as indicated.
Spindle and head effectively guided and arranged with stops to engage with valve body and prevent over travel. Linkage fulcrum adjustable relative to vertical plane, securely locked to body tapping when set.
Screwed plug from access cover.
Float and lever arm.
Spun copper float, halves brazed or welded together, with centre sleeve connecting to lever arm.
For feed and expansion application use long arm type arranged to close when tank contains 150mm depth.
WRAS approved.

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2308z **FLOAT OPERATED VALVES - DELAYED ACTION TYPE:**
Incorporating
: Float operated valve.
: Canister – copper.
: Secondary float – gunmetal.
: Support bracket – galvanized steel.

2324z **SWING CHECK VALVES TO BS 5154**
Material
Copper Alloy
Series B; horizontal pattern.
Ends
Threaded to relevant parts of BS EN 10226 or flanged to BS EN 1092 to suit pipework as indicated.
Trim material – Manufacturer's standard.
To be suitable for potable water where required

2336z **SWING CHECK VALVES TO BS EN 16767**
Type – As defined in BS EN 736-1
Material
Cast iron unless scheduled otherwise
Pattern – Straight pattern, horizontal.
Valve face – Copper or nickel alloy.
Ends - Flanged to BS EN 1092-2 or grooved.
Material – Manufacturer's standard.
To be suitable for potable water where required.

2371 **CHECK VALVES GLOBE STOP AND CHECK TYPE:**
Standard - Steel - BS EN 13709.
Pattern – Straight or Angle as indicated.
Ends -Flanged to BS EN 1092-1 PN to suit system operating temperature / pressure.
Materials - Manufacturer's standard to suit fluid and operating conditions.

2385 **DEVICES TO PREVENT CONTAMINATION OF WATER BY BACKFLOW:**
BS EN 13959 – check valves.
BS EN 14451 – terminal anti-vacuum valves.
BS EN 14451 – in-line anti-vacuum valves.
BS EN 14451 –combined check and anti-vacuum valves.
WRAS approval.
Ends Compression connections to BS EN 1254-2 or Threaded to Relevant parts of BS EN 10226

2394A **COMBINED CHECK AND ANTI-VACUUM TYPE ANTI BACK SYPHONAGE VALVES:**
Bronze or DZR copper alloy body assembly with compression connections to BS EN 1254-2. or threaded to relevant parts of BS EN 10226 (horizontal or vertical)
WRAS approval
Pattern : In-line pattern or side inlet bottom outlet or bottom inlet side outlet as indicated.
Components
Stainless steel domed air inlet. Non-return valve with plastic body, rubber actuator and stainless steel to plastic seal.

2381A **HOSE UNION ANTI-VACUUM TYPE ANTI BACK SYPHONAGE VALVES:**
Bronze or DZR copper alloy body assembly with fittings to BS EN ISO 228-1.
Pattern – In line pattern.
Sizes – DN15 to DN25.
WRAS Approval

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2355A VERIFIABLE BACKFLOW PREVENTER WITH REDUCED PRESSURE ZONE (RPZ) VALVE GENERAL REQUIREMENTS:
Provide an application to the local water supplier using the WRAS "RPZ Valve Assembly - Application for Installation" form.
Obtain Water Supplier agreement that a Type BA device is a suitable means of backflow protection in the water supply system under consideration.
Test methods and maintenance regimes shall be in accordance with the Water Suppliers requirements and any failure to comply may result in termination of supply or removal of the device. These maintenance requirements must be detailed within the project Operation & Maintenance documentation.
The fitting must be included in the WRAS "Water Fittings and Materials Directory" and satisfy the requirements of the Regulations.
The installer must obtain formal Water Supplier agreement that a Type BA device is a suitable means of backflow protection in the plumbing system under consideration before installation.
Confirm that any Type BA device installed provides protection against back pressure and back siphonage at the point of use from fluids up to and including Category 4 as defined in:
England and Wales - The Water Supply (Water Fittings) Regulations 1999, the Water Act 2014 and the Construction Products Regulations 2013.
Scotland - The Water Supply (Water Fittings) Byelaws 2014.
Northern Ireland - The Water Supply (Water Fittings) Regulations (Northern Ireland) 2009.
Comply with the stipulations and requirements set out in WRAS Approved installation method Document AIM-03-1.

2355B VERIFIABLE BACKFLOW PREVENTER WITH REDUCED PRESSURE ZONE (RPZ) VALVE INSTALLATION:
The Type BA device shall not be installed in a place or position which is:
Liable to flooding
Above electrical equipment
Exposed to freezing - unless measures are taken to prevent the assembly from freezing
The assembly shall be:
Installed horizontally with the relief valve discharging downwards. Inline strainers shall be fitted downstream of the inlet isolating valve and immediately upstream of the device - to prevent fouling of elements of the assembly.
The valve shall be installed not less than 300mm above ground or floor level or the base of any cabinet to the underside of the exit port of the relief valve and no more than 1500mm above ground or floor level. An air break shall be provided between the relief outlet port and the top of the allied tundish.
Following installation the assembly shall be flushed and disinfected in accordance with BS EN 806-4 and complimentary guidance in BS 8558.
Following flushing and prior to commissioning and site test, the assembly shall be checked by the installer to ensure that the relief valve functions correctly - in accordance with the guidelines in WRAS Approved installation method Document AIM-03-1.

2355C VERIFIABLE BACKFLOW PREVENTER WITH REDUCED PRESSURE ZONE (RPZ) VALVE ON SITE INSPECTION AND TESTING:
Site testing must only be carried out by an accredited tester approved by the Water Supplier.
Testing shall be carried out at intervals not exceeding 12 months.
Test data during the commissioning of the assembly and at subsequent intervals shall be entered on the "RPZ Valve Test Report Form" produced by the WRAS.
The inspections and testing shall be in accordance with WRAS Approved installation method Document AIM-03-1.
On completion of site tests, a certificate must be completed by the tester in accordance with WRAS Guidance Note and copies submitted to the water supplier and the person responsible for the device.
Copies shall be included in the Operation and Maintenance Manuals, including interval periods for subsequent testing.

2355D VERIFIABLE BACKFLOW PREVENTER WITH REDUCED PRESSURE ZONE (RPZ) VALVE RECORD OF INSTALLATION AND TEST DATA:
Provide records for each assembly.
In general, the record shall indicate the following:
Precise location of the assembly
Purpose of the assembly
Data pertaining to prescribed tests

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Frequency of tests
Defects found and measures taken to remedy these defects
Details of the person who carried out the test
The installation, commissioning and subsequent test data shall be forwarded to the Water Supplier and copies retained by the Tester and the Water Supplier's customer for a period of at least five years.

2400 PRESSURE REDUCING VALVES - INTEGRAL SENSOR TYPE:
Material
Bronze or DZR copper alloy body threaded to relevant parts of BS EN 10226
Stainless steel valve and seat and return spring.
Phosphor bronze bellows.
unless otherwise indicated
Components
Control spring and handwheel.
Integral sensor with an alphanumeric pressure set-point indicator and locking facility.

2422 IN LINE DIFFERENTIAL PRESSURE CONTROL VALVES - DIRECT ACTING TYPE:
Provide valves to maintain a constant differential pressure downstream of the valve across a specific zone, mounted in the return pipeline.
Material
Cast iron Malleable iron body, brass or bronzebody.
Stainless steel seat, cone and return spring.
Phosphor bronze bellows.
Components
Control spring and actuator.
Valve body and bellows.
Connections
Threaded to relevant parts of BS EN 10226.
Or Flanged to BS EN 1092 parts 1,2 or as appropriate

2423 PRESSURE INDEPENDENT CONTROL VALVE (PICV): [NBS 211.855]
Select, install and commission valves to provide the functions of flow limitation, modulating control and differential pressure control within a single valve body.
Commission valves in accordance with the manufacturer's recommendations and Commissioning Specialists Association TM18.
The valve manufacturer shall provide test results for each type and size of PICV to be used on the project in accordance with BSRIA Test Method for Pressure Independent Control Valves BTS 1/2012.
Limiting minimum operating pressure – 20Kpa.
For PICVs with a k_v value less than 0.4, a flushing drain should be incorporated in the pipework between the terminal unit and the PICV.
All PICVs' shall have an equal percentage control characteristic, be sized such that the design flow is within the setting range of the valve and be capable of closing against a maximum differential pressure that is greater than the pump head.
Type – Full stroke where the control and flow setting functions are separated within the valve and the full stroke of the valve is available for control (unless scheduled otherwise)
Valve characteristic/control - Equal percentage modulating (unless scheduled or described otherwise elsewhere in this specification).
Duties – To suit terminal unit design flow rates as detailed in equipment schedules.
Standard
Relevant parts of BS EN 60534
Valve leakage class to BS EN 60534-4 when shut off - IV.
Materials:
Body - DZR brass.
Globe or ball - brass.
Stem - brass.
O-Ring/diagram - EPDM rubber.
Springs - stainless steel.
Features - Facility to measure pressure drop across valves at commissioning.
Actuator - 0-10V proportional electric for modulating control or 3 point floating control.

2424 BYPASS DIFFERENTIAL PRESSURE CONTROL VALVES - DIRECT ACTING TYPE:

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Provide valves to maintain a minimum circuit flow rate as system loads change.
Material
Cast iron Malleable iron body, brass or bronzebody.
Stainless steel seat, cone and return spring.
Phosphor bronze bellows.
Components
Control spring and actuator.
Valve body and bellows.
Connections
Threaded to Relevant parts of BS EN 10226.
Or Flanged to BS EN 1092 parts 1,2 or as appropriate

2C08A **DIRECT ACTING SAFETY VALVES COPPER ALLOY, SINGLE SPRING:**
Material - Bronze or DZR copper alloy body.
Standard
BS EN ISO 4126-1, BS EN ISO 4126-7
Ends - Threaded to relevant parts of BS EN 10226.
Spring type - Single spring loaded, high lift type.
Protection from unauthorised adjustment
Fit a ferrule under adjusting screw.
or Fit compression ring under adjusting screw.
or Lock adjusting screw.

2C08B **DIRECT ACTING SAFETY VALVES COPPER ALLOY, DOUBLE SPRING:**
Material - Bronze or DZR copper alloy body.
Standard
BS EN ISO 4126-1, BS EN ISO 4126-7
Ends - Threaded to relevant parts of BS EN 10226.
Spring type - Double spring loaded, high lift type.
Protection from unauthorised adjustment
Fit a ferrule under adjusting screw.
or Fit compression ring under adjusting screw.
or Lock adjusting screw.

2C08C DIRECT ACTING SAFETY VALVES CAST IRON, SINGLE SPRING:
Material - Cast iron body.
Standard
BS EN ISO 4126-1, BS EN ISO 4126-7
Ends - Flanged to BS EN 1092-2
Spring type - Single spring loaded, high lift type.
Protection from unauthorised adjustment
Fit a ferrule under adjusting screw.
or Fit compression ring under adjusting screw.
or Lock adjusting screw.

2C08D DIRECT ACTING SAFETY VALVES TO BS 6759, CAST IRON, DOUBLE SPRING:
Material - Cast iron body.
Ends - Flanged to BS EN 1092-2
Spring type - Double spring loaded, high lift type.
Protection from unauthorised adjustment
Fit a ferrule under adjusting screw.
or Fit compression ring under adjusting screw.
or Lock adjusting screw.

2A08A DRAIN COCKS, THROUGHWAY GLAND COCK:
Standard – BS 2879

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Bronze body with capillary ends. Tapered plug with square shank for loose lever; bolted gland; strap and blank cap screwed on hand fight. Outlet to accept hose union. Locate at all low points

2A60 **DRAIN COCKS, BALL TYPE**

Bronze or DZR copper alloy body; chrome-plated DZR ball; PTFE seats and stem seals; blow-out proof stem; strap and blank cap screwed on hand fight; serrated outlet to accept hose pipe. Lockshield key operated.

2A70 **TWO WAY GLAND TYPE VENT COCK:**
Bronze body threaded to relevant parts of BS EN 10226.
Tapered plug with square shank for loose lever.
Plug position indicator.
Bolted gland.

2A50 **THREE WAY GLAND TYPE VENT COCK:**
Components
Bronze body threaded to relevant parts of BS EN 10226.
Tapered plug with square shank for loose lever.
Plug position indicator.
Port markings to indicate inlet, vent, waste.
Bolted gland.
Port configuration, T port with slops.

2S08A **THREE WAY PLUG VALVE VENT COCKS:**
Cast iron body, plug and bottom cover. PTFE thrust washer.
Ends - Flanged to BS EN 1092-2
T port configuration with slops. Wrench operation.

2S11 **AUTOMATIC AIR VENTS - FLOAT TYPE:**
Construction
Bronze or DZR copper alloy body with threaded inlet to Relevant parts of BS EN 10226.
Provide a solid polypropylene float and air release valve. Ensure valve is self closing.
Provide
Connection to air vent for piping away released air.
Isolating valve.
Integral non-return valve.
Operating conditions
Maximum temperature, 130°C.
Maximum pressure 10 bar.

2S16 **DEAERATION UNITS - MICROBUBBLE TYPE:**
For systems with less than 15m static head on heating and 5m on Chilled water
Type
Inline Temperature Differential Deaerator

Construction
Vertical mild steel housing, fitted with non-clogging helicoidal separation tubes and mesh / packing manufactured from copper tube, stainless steel or other proprietary material to create a the correct environment at the top of the unit to deaerate efficiently by separating the smallest microbubbles.
Maximum operating temperature and pressure of 110°C and 10 bar.g.
Units to be compliant with The Pressure Equipment Regulations 1999.
For Chilled Water systems, the Deaerator shall be suitably insulated to prevent condensation
Provide air release mechanism comprising a solid polypropylene float not rigidly coupled to the air release valve. The air release valve shall be self closing. The AAV shall incorporate a 3-way valve allowing positive shut off to the AAV for servicing and protection from dirt during filling / flushing.
Ends
Screwed or flanged to BS EN 1092- 1, PN to match pipework

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All Deaeration equipment must be manufactured and supplied by companies complying with the requirements of "Lloyds register quality assurance ISO9001". A Certificate of Compliance must be issued by this company for approval prior to orders being placed.

2521 **DEAERATION UNITS - PRESSURE –STEP or VACUUM DEGASSER TYPE**
For systems with greater than 15m static head on heating and 5 m on Chilled water
Type
Packaged Pressure Step Differential Deaerator complete with pump, casing and all necessary electronic controls.
The unit shall incorporate the following controls: air monitoring – auto start/shutdown; re-start every day by time clock; pump "anti-stick" start every three days; volt-free contacts for connection to BMS for fault indication.
The Deaerator shall have a vessel, where a volume of water from the main system is exposed to a vacuum and an automatic air vent.
For Chilled Water systems, the Deaerator shall be suitably insulated to prevent condensation.
Maximum operating temperature – 99oC.
Operating pressure range shall be selected to suit the system requirements.
The Deaerator shall be commissioned by the manufacturers representative.
The Pressure Differential Deaerator shall be electronically controlled
All Deaeration equipment must be manufactured and supplied by companies complying with the requirements of "Lloyds register quality assurance ISO9001". A Certificate of compliance must be issued for approval by the engineer prior to orders being placed.

2523 **DIRT SEPARATOR UNITS:**
Construction
Vertical mild steel housing. To ensure Deaeration and Dirt Separation are achieved the unit shall be fitted with a non-clogging cluster of spiral tubes manufactured from copper tube and wire to create an the correct environment at the bottom of the unit for dirt separation to occur.
The Dirt Separator unit shall have a standard maximum operating temperature and pressure of 110oC and 10 bar.g. respectively.
Units to be compliant with The Pressure Equipment Regulations 1999.
The pressure drop across the Dirt separator shall remain constant regardless of the amount of dirt trapped.
Ends -Screwed or flanged to BS EN 1092- 1, PN to match pipework
Dirt separation equipment must be manufactured and supplied by companies complying with the requirements of "Lloyds register quality assurance ISO9001". A Certificate of compliance must be issued for approval by the engineer prior to orders being placed.

2524 **COMBINED DEAERATOR & DIRT SEPARATOR:**
For systems with less than 15 m static head on heating and 5 m on Chilled water
Type
Inline Combined Temperature Differential (microbubble) Deaerator & Dirt Separator .
Construction
Vertical mild steel housing, fitted with non-clogging helicoidal separation tubes and mesh / packing manufactured from copper tube, stainless steel or other proprietary material to create a the correct environment at the top of the unit to deaerate efficiently by separating the smallest microbubbles.
Maximum operating temperature and pressure of 110ºC and 10 bar.g.
Units to be compliant with The Pressure Equipment Regulations.
For Chilled Water systems, the Deaerator shall be suitably insulated to prevent condensation
Provide air release mechanism comprising a solid polypropylene float and air release valve. Ensure valve is self-closing.
Provide dirt drain valve at its lowest point.
Ends
Line size with flanges to BS EN 1092-1, PN to match pipework
All Deaeration & Dirt separation equipment must be manufactured and supplied by companies complying with the requirements of "Lloyds register quality assurance ISO9001". A Certificate of compliance must be issued for approval by the engineer prior to orders being placed.

2538 **STEAM TRAPS TRAP SETS AND ANCILLARIES:** (NES 211,259)

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Conform to BS EN ISO 6553 for marking of steam traps and, where appropriate, BS EN 558 for dimensions.
Rubber hoses and hose assemblies for saturated steam to comply with BS EN ISO 6134.
Comply with BS EN 26948, ISO 6948 for production and performance characteristic tests for automatic steam traps.
Determine discharge capacity of automatic steam traps in accordance with BS EN 27842, ISO 7842.
Determine steam loss of automatic steam traps in accordance with BS EN 27841, ISO 7841
Unless indicated otherwise steam trap set assemblies to comprises
- Dirt pocket with removable end cap or flange.
- Steam stop valve.
- Union.
- Strainer (if not integral with trap).
- Trap failure sensor chamber (if steam trap not provided with integral sensor)
- Steam trap (with integral sensor if separate sensor chamber not installed).
- Union.
- Sight glass.
- Non-return valve.
- Stop valve.

Steam trap monitoring to be automatic, continuous, monitoring steam leak and water logging detection unless indicated or scheduled otherwise.

2548 **STEAM TRAPS - THERMOSTATIC TYPE, BALANCED PRESSURE:**
Bronze or DZR copper alloy body with threaded ends to Relevant parts of BS EN 10226
Seamless stainless steel capsular element.
Stainless steel internal components with renewable seat.

2558 **STEAM TRAPS - THERMOSTATIC TYPE, BI-METALLIC:**
Steel body and cover with threaded ends to relevant parts of BS EN 10226 suitable for horizontal in-line mounting.
Thermostatic element in corrosion resistant multiple cross disc type bimetal stainless steel.
Integral stainless steel strainer.

2568 **STEAM TRAPS - FLOAT TYPE:**
Material
- SG iron body.
- Stainless steel float, air vent and internal components.

Ends – Threaded ends to relevant parts of BS EN 10226
Mounting
- Horizontal in-line.

Options as indicated
Steam lock release facility.
Combined thermostatic air vent and steam lock release facilities.

2578 **STEAM TRAPS - THERMODYNAMIC TYPE:**
Material
- Stainless steel body.
- Stainless steel disc with screwed cap.

Ends
Threaded ends to relevant parts of BS EN 10226
Integral strainer with access plug and stainless steel screw.
Options as indicated.
Blowdown cock fitted to strainer cap.
Air venting disc.

2588 **STEAM TRAPS - INVERTED BUCKET TYPE:**
Cast iron body with threaded ends to relevant parts of BS EN 10226
Stainless steel bucket and internal components.
Integral strainer with access plug and stainless steel element.
Bolted cover with gasket

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2288 **STEAM TRAP FAILURE INDICATORS:**
Materials
Cast iron sensing chamber body.
or Cast steel sensing chamber body.
Stainless steel internal sensor and sensor gasket.
Ends
Threaded ends to relevant parts of BS EN 10226.
Connect into assembly upstream of steam trap, as indicated.
Provide plug-in solid state electronic indicators complete with batteries, number as indicated (minimum 2No).
Provide central indicator panels as indicated and all interface wiring.

2508 **SIGHT GLASSES:**
Bronze or DZR copper alloy body threaded female to Relevant parts of BS EN 10226
Glass window.
Double window type.
Locate remote from fluid discharges to avoid damage by thermal or pressure shock conditions.

2511 **EXPANSION LOOPS - STEEL:**
Where indicated provide expansion loop in material and finish of associated pipeline. Forge bend from a single length of pipe or join by welding fittings if expansion loops are too large to manufacture in one piece.
Where a grooved steel pipework system is used the loops shall be designed by the system manufacturer.
Loop sizes shall be calculated using the CIBSE guidance. Calculations shall be undertaken to establish stress contained in the loop
Finish – to match pipework system

2520 **EXPANSION LOOPS - COPPER:**
Where indicated provide expansion loop in material and finish of associated pipeline. Forge bend from a single length of pipe.
Where a grooved steel pipework system is used the loops shall be designed by the system manufacturer.
Loop sizes shall be calculated using the CIBSE guidance. Calculations shall be undertaken to establish stress contained in the loop.

2531 **EXPANSION COMPENSATORS:**
Type
Unrestrained - Axial.
Restrained – Lateral, Angular gimbal
Ends
Threaded to relevant parts of BS EN 10226.
or Flanged to BS EN 1092-1 PN to match pipework.

Standards
Joints shall comply with the requirements of the Expansion Joints Manufacturers Association standard 1999 (EMJA). Expansion joints may be of the restrained or unrestrained type.
Design, manufacture and install metal bellows expansion joints in accordance with BS EN 14917.

General
Expansion joint convolutions shall be of a thick wall spirally wound, multi-ply construction with a corrosion resistant inner ply in AISI 316L stainless steel. Units shall be fitted with stainless steel inner sleeves.
For critical services such as MTHW, HTHW and steam, the bellows shall have a weep hole as a fail-safe device.
Expansion joints shall be capable of not less than 5000 complete reversals of movement at the given working conditions and the manufacturer shall be able to produce calculations to that effect.
Expansion joints shall be capable of withstanding a test pressure 1.5 times their design pressure without deformation.
The Contractor shall ensure the expansion joints are installed in accordance with the manufacturer guidelines for selection and installation. The manufacturer shall issue a Certificate of Compliance and appropriate expansion / anchor load calculations as part of the handover documentation.

Where a grooved system is used, liaise with the system manufacturer and ensure that the complete system (which may incorporate a combination of proprietary expansion devices and standard grooved couplings / fittings) is in accordance with their recommendations.

Unrestrained expansion joints
Axial expansion joints shall only be used in positions where pressure thrust can be contained by adequate anchor points contained by the building fabric. The expansion joint manufacturer shall submit calculations for anchor loadings for onward transmission to the Structural Engineer.

Restrained expansion joints
Restrained expansion joints shall be used as an offset type either by using lateral or angular expansion joints to compensate for thermal expansion or building movement. The expansion joint restraints shall be designed to absorb the full pressure thrust of the expansion joint convolutions.
Lateral expansion joints shall be of the thick wall spirally wound multi-ply construction and fitted with threaded tie bars and low friction self-lubricating hemispherical nuts, allowing movement in two planes.
Angular expansion joints shall be of the thick wall spirally wound multi-ply construction and be used in pairs or threes. All hinge pins shall be PTFE coated to reduce friction and prevent corrosion.
For movement in two planes Gimbal Expansion joints shall be used in pairs or in combination with one Angular Expansion joint. All hinge pins shall be PTFE coated to reduce friction and prevent corrosion.
All expansion joints must be manufactured and supplied by companies complying with the requirements of Lloyds register quality assurance ISO9001. A Certificate of compliance must be issued for approval by the engineer prior to orders being placed.

2531A **SLIP TYPE GROOVED END EXPANSION COMPENSATORS:**
Material – ductile cast iron to ASTM A536, grade 65-45-12.
Ends – grooved for mechanical joints.
Operation – supply expansion joints capable of not less than 2000 complete reversals of movement at the given working conditions; and of withstanding a pressure test of 1.5 times the design pressure without deformation.
Type – slip-type expansion compensation device, gasketed, with grooved coupling ends and 'telescoping' body.
Size – 50mm to 150mm.
Maximum axial end movement - 70mm.
Limiting test pressure – 24bar pressure rated.
Gasket – grade 'E' EPDM for water services to 110°C.
Installation to be strictly in accordance with the manufacturer's instructions.

2531B **GROOVED END MULTIPLE FLEXIBLE COUPLINGS TYPE COMPENSATORS:**
Coupling material – ductile cast iron to ASTM A536, grade 65-45-12.
Ends – grooved for mechanical joints.
Operation – supply expansion joints capable of not less than 2000 complete reversals of movement at the given working conditions; and of withstanding a pressure test of 1.5 times the design pressure without deformation.
Type - multiple standard flexible grooved couplings joined by grooved end nipples.
Axial movement – dependent on number of couplings in the compensator, refer to schedule/particular specification.
Gasket - grade 'E' EPDM for water services to 110°C

2551 **FLEXIBLE CONNECTIONS AND NOISE AND VIBRATION ABSORBERS**
Generally

Flexible connections shall be fitted to all pump suction and discharge connections, chillers condensers and other centrifugal, reciprocating or vibrating plant

Flexible Connections must have certification to demonstrate they have been tested for Noise and Vibration reduction capabilities

Flexible Connections are to be fitted as close to the source of vibration as practicable. The pipework and flexible connections shall be installed to prevent any stresses in the pipework from being transmitted to the

pump or vibrating equipment. To ensure correct alignment, a spool piece is to be employed during installation.

Rubber Flexible Connections shall be single convolution of hand laid multi ply reinforced EPDM rubber with wire reinforced cuffs. Flanges shall be removable and suitably profiled to control the convolution shape; plate flanges must not be used under any circumstances.

Threaded and adjustable tie bars with rubber top hat washers shall be used where the working pressure exceeds 1.5 bar.g. When unified flexible connections are used, the manufacturers recommendations for anchors and guides shall be followed to prevent forces being exerted on to the pump casing and AV mounts.

All flexible connections must be manufactured and supplied by companies complying with the requirements of "Lloyds register quality assurance ISO9001". A Certificate of compliance must be issued for approval by the engineer prior to orders being placed.

Comply with the requirements of DIN 4809

Marking

The flexible Connections must be fully traceable: and moulded into the Flexible carcass shall be the manufacturer, country of origin, type and batch number, serial number, easily recognisable colour flashes and the date of manufacture.
Ends
Flanges to BS EN 1092 - 1 that can swivel and are removable; or threaded to relevant parts of BS EN 10226 with one union end to suit pipework as indicated.

Working temperatures up to 70°C
Flexible carcass can be reinforced using high tensile synthetic fibre reinforcement.

Working temperatures between 70°C and 100°C
Flexible carcass must be steel wire mesh reinforced throughout. Connections are to have a minimum design life of 10 years, continuously operating at 100°C and a minimum burst pressure of 30 bar.g, in compliance with the minimum requirements of DIN4809: Part 1.

Working temperatures above 100°C
Flexible Connections must be of thick wall spirally wound multi-ply construction stainless steel, all welded construction with tie rods.
Ends Flanges to BS EN 1092 - 1

2661 **FLEXIBLE HOSES / TERMINAL UNIT CONNECTIONS**
Application
Sealed LTHW and chilled water systems only
Standards
Flexible hose assemblies (up to 25mm nominal bore) for use in closed circuit heating and cooling systems shall be manufactured in accordance with BSRIA Guide BG 4/2004
Flexible hoses shall be installed in accordance with BSRIA Code of Practise 11/2002. (Flexible hoses a code of practice for services installers)
Material
EPDM inner liner with stainless steel wire braid. Nickel plated brass fittings with stainless steel ferrules.
Or corrugated metal in accordance with BS EN 14585-1 and PD CEN/TR 14585-3
Operation
Minimum length 300mm.
Ensure hose is capable of resisting kinking when bent through 180 deg.
Working pressure 15 - 20 bar and temperature 110 °C

or as otherwise indicated.
Other features
Supply chilled water connections fully insulated with end caps. The insulation shall form a vapour tight seal on the hose ferrules.
The hoses shall be colour-coded red and blue to indicate its suitability for LTHW and Chilled water.

Chilled water hoses shall be fully insulated and the insulation fitted with end caps.
The hoses shall have been thermal cycle tested from 0°C to 80°C for at least 5000 cycles, carried out by an independent test authority.
All Hoses shall have a minimum 10 year warranty.

High temperature and critical applications

Where the operating temperature exceeds 100°C, flexible connections shall be constructed from convoluted stainless steel flexible hose, with a stainless steel wire braid, all welded construction.
The hoses shall be of annular corrugated construction and manufactured from AISI 321 Stainless Steel.

The hose shall be braided or unbraided to suit the temperatures and pressures.

Fitting shall be welded or brazed to suit the application. All hoses shall be 100% leak tested by the manufacturer.

The manufacturer shall be consulted to determine minimum flexible length and installation configuration.

All terminal connections must be manufactured and supplied by companies complying with the requirements of Lloyds register quality assurance ISO9001.

2662 **FLEXIBLE HOSES FOR DRINKING WATER INSTALLATIONS & HOSES AS INTEGRAL PARTS OF APPLIANCES**
Standards
Flexible hose assemblies for drinking water installations to connect sanitary tap ware, heaters and similar appliances operating temperature 70 °C to be in accordance with BS EN 13618.
Flexible hose assemblies intended to be used as integral parts of appliances, to be in accordance with BS EN 61770.

2663 **HOSE AND HOSE ASSEMBLIES FOR STEAM AND CONDENSATE**
Hose and hose assemblies for saturated steam and hot water condensate.
Standard - BS EN ISO 6134
Type 1 - low-pressure, maximum working pressure 6 bar
Type 2 - high pressure, maximum working pressure 18 bar
Incorporate an oil-resistant cover.

2670A **TEST PLUGS, SELF SEALING:**
Provide self-sealing test plugs with integral means of isolation, for measurement of temperature and pressure, complete with captive cap for sealing when not in use. Ensure test plugs are suitable for system operating temperature and pressure.
Provide one thermometer and pressure gauge for each range of conditions, for use with test plugs.
Install test plugs:
Either side of each strainer (unless integral with strainer)
Either side of each pump set
On the flow and return connection to each calorifier/heat exchanger/boiler/chiller/condenser
On the flow and return connection to each coil
Across the ports of each control valve
Elsewhere as necessary to allow the system to be commissioned in accordance with the CIBSE Commissioning Codes
Elsewhere as indicated

Y11 – Pipeline Ancillaries

2571z TEST PLUGS, VALVE CONTROLLED:
On MTHW and HTHW provide self valve controlled test plugs for measurement of temperature and pressure, complete with captive cap for sealing when not in use. Ensure test plugs are suitable for system operating temperature and pressure.
Provide one thermometer and pressure gauge for each range of conditions, for use with test plugs. Install as 2870A.

2581 PIPELINE STRAINERS:
Ends
To match pipework. Screwed to relevant parts of BS EN 10226 or flanged to BS EN 1092-1 or BS EN 1092 – 2 or BS EN 1092 – 4 or grooved.
Pattern
Simplex basket, Duplex basket or Y pattern as indicated on schematic drawings or as scheduled
Screen free area
Not less than 250% of pipe bore or as indicated.
Screen perforations
15 - 50mm, within range 0.7 - 0.9mm diameter.
65mm and above, within range 1.5 - 1.8mm diameter.
unless otherwise indicated.
Internal to external flow through screen.
Provide plugged connections for drain, air vent and differential pressure monitoring, threaded to BS 21.
At commissioning allow for the installation of temporary fine mesh screens in main system strainers.

2582 PIPELINE SUCTION GUIDE/STRAINERS:
Application – to provide a flow straightener to achieve optimum flow conditions
Body material - cast iron or ductile iron for water services to 110°C
Ends - flanged to PN16 or PN25 to suit system maximum working pressure.
Stainless steel strainer and fine mesh (start-up) strainer.
Unit to be complete with flow stabilising vanes to allow connection direct to pump suction.
Unit to be complete with removable stainless steel fine mesh sleeve start-up pre-filter.
Provide plugged connections for drain, air vent and differential pressure monitoring.
Installation to be strictly in accordance with the manufacturer's instructions.

2586C TUNDISHES:
Provide tundishes for all drains from equipment, located adjacent to equipment, or as indicated, in material to suit piping.
Material
Copper sheet nominally minimum 3mm thick.
or Mild steel galvanized after manufacture.
Construction
Form sheet into a tapered reducing cone with a minor diameter to suit drain line.
Major diameter nominally 50 mm larger than minor diameter, tapering at approximately 30 degrees.

2708z GAUGES:
Use dial type gauges of robust construction, enclosed in dust tight metal cases. Retain dial glass with bezels screwed to case. Finish with chromium plating.
Dial cases
In plant rooms
150mm diameter, heavy pattern, finished in black stove enamel.
In other areas
100mm diameter, finish chrome plated unless otherwise indicated
Use white dial scales indelibly and clearly marked with black lettering to indicate measured values. Select scale ranges which indicate 'Normal' when pointer is vertical or central on scale.
Mount gauges with dial face in vertical plane and locate as follows
Direct

Y11 – Pipeline Ancillaries

Support casing by connection to instrument, unless otherwise indicated.

2716z TEMPERATURE GAUGES:
Use temperature gauges with pocket and provided with gland attachment on thermometer stem.
Type
Mercury in steel, mounted direct in pocket.
or Vapour pressure to BS EN 13190, mounted direct in pocket with horizontal or vertical stem as appropriate.
or Vapour pressure to BS EN 13190, for remote mounting with capillary tube of sufficient length to allow slack run to immersion bulb. Protect capillary along full length by a flexible sheath jointed to dial case and bulb.
Use separable type pockets, threaded 15/19mm BSP and manufactured from stainless steel unless otherwise indicated.
Screw pockets into tapped bosses or stools set in pipelines or vessels. Fill pockets with oil to ensure contact with thermometer bulb.
Provide gauges with dial graduation in degrees Celsius marked on a logarithmic scale. Ensure pointer movement is clockwise for increase in temperature.
Provide sensing elements for air and gas systems, where indicated, and fix to provide airtight joints.
Provide with metal shielding around sensing element to prevent effects of local radiation from equipment.

2720 PRESSURE AND ALTITUDE GAUGES:
Use vapour pressure type gauges to BS EN 837-1. Connect to pipeline systems via matched gauge cocks and cock connectors.
Ensure dial graduation is from zero to between 1.5 and 3.0 times normal working pressure. Graduate in bar (gauge) on gauges reading head or working pressure, or in Pascals where pressure differences across plant items are to be established. Where fitted on boilers and pressure vessels, clearly mark with operating and maximum permissible working heads in accordance BS 759. Elsewhere provide gauges with normal working pressure. Ensure dial movement is clockwise for an increasing in head.
Fit pig tail siphons and double isolation valves on steam, MTHW and HTHW systems. Use "U" siphons on all other services.
Provide flexible piping where gauge is subject to noticeable vibration.
Fit gauge cocks preceding all connections to altitude and pressure gauges. Copper alloy, tapered ground plug, with ebonite lever. Unless flanged joints are required, screw inlet ends female and fit outlet ends with union connections allowing removal of gauges.

2730 VACUUM GAUGES:
Use vacuum gauges complying with BS EN 837-1. Calibrate in mm of mercury.

2735 DIFFERENTIAL PRESSURE GAUGES:
Supply where indicated.

2748z GAUGE MOUNTING BOARDS:
Mount on walls or purpose made steel frames at a height approximately 1.3m above floor level as indicated
Manufacture from 12mm thick hardwood, and polish.
or Manufacture from 3mm mild steel plate, finished black stove enamel and trimmed with chromium plated strips approximately 10mm wide.

3000 ACCESSORIES

3010z LOOSE ITEMS:
Provide 5 no. tee handled short shank keys suitable for each size of valve spindle shank.
Provide one lever pattern key suitable for each drain cock.
Provide loose hose unions each for drain cock.

3020z VALVE SEAT REPLACEMENT
Provide a seat replacement tool for the TRV's, where fitted.

Y11 – Pipeline Ancillaries

4030 WORKMANSHIP APPROVAL
Ensure all valves used on potable services have WRAS approval, and are so marked.

4010 INSTALLATION:
Install pipeline ancillaries in accordance with manufacturer's recommendations and BS 6683.

4021 LOCATION OF VALVES AND ANCILLARIES:
Install valves, cocks, traps, strainers, test plugs, tundishes and other ancillary equipment in positions indicated and as a minimum as follows:

Mains to isolate major sections of distribution.
The base of all risers and drops except in cases where one item of apparatus only is served which has its own local valve or stop tap.
Points of pipe connection of all items of apparatus and equipment except where the item could conveniently be isolated or regulated by valves provided for other adjacent items.
At all terminal units. (For hot and cold water services incorporate a flow regulator within the fitting isolation valve where the static pressure exceeds 1 bar).
Draw-off fittings except where ranges of fittings are served by a common float, the isolator then being fitted with the float.
At all sanitary fittings.
At all main branch connections

Locate drain valves at all low points

4025 LOCATION OF THERMOSTATIC RADIATOR VALVES:
Install thermostatic radiator valves in an area which reflects the space temperature. Ensure that they are not behind curtains or enclosed in heating or radiator panels.

4030 POSITIONING OF COMPONENTS:
Locate flow and pressure measurement and control valves to ensure manufacturer's recommended straight length of pipe upstream and downstream of valve is provided.

4040 POSITIONING OF DOUBLE REGULATING VARIABLE ORIFICE VALVE:
Install double regulating variable orifice valve to ensure equivalent of 10 diameters of straight pipe upstream and 5 diameters downstream of double regulating valve or in accordance with the manufacturers recommendations. .

4041 POSITIONING OF MEASURING STATION/COMMISSIONING SETS:
Install station to ensure equivalent of 10 diameters of straight pipe upstream of metering station and 5 diameters downstream of double regulating valve or in accordance with the manufacturers recommendations. .

4050 POSITIONING OF CONTROL COMPONENTS:
Install pipeline control components in accordance with manufacturer's instructions and in positions indicated.
Insulation
Where control components are incorporated in insulated pipelines
Provide details for approval of method proposed to insulate component.
Supports
Arrange supports for control components to ensure no strain is imposed on components.
Access
Arrange control components to ensure adequate access for operation and maintenance.

4060 VENT COCKS:
Provide outlets of vent cocks with discharge pipes terminated in a safe, visible & accessible location.

4070 VALVE STUFFING BOXES:
Adjust glands of all stuffing boxes at normal plant operating temperature and pressure in accordance with manufacturer's instructions. Ensure that valve action is not impaired by over tightening.

Y11 – Pipeline Ancillaries

4080z DISCHARGE CONNECTIONS:
Fit pipework connections, where indicated, to
Provide
Discharge connection to Safety and Relief valves terminating at a safe discharge point.
Discharge connection to vent cocks terminating 150mm above floor level.
Bleed connection from air bottles terminating with air cock or needle valve in a convenient position.
Discharge pipe to automatic air vents terminating over a suitable gully or drain line in a visible location.

4090 EXPANSION DEVICES:
Arrange supports and fixings to accommodate pipe movement caused by the thermal changes, generally allow the flexure at changes in direction. Allow for movement at branch connections.
On drainage pipework use purpose designed fittings at changes of direction to accommodate movement, and to avoid stresses on connections to stacks.
Where possible provision for movement due to thermal expansion and contraction shall be made by natural changes in the direction of pipework.
Anchors and guides shall be positioned to contain all movement and resist the maximum loads imposed.
Anchors and guides are to be located at points which prevent excess stresses on pipework, joints and equipment connections. Similar provisions shall be made for building movement or building settlement.
Any provisions for expansion, anchors and guides shown on the drawings are for guidance, the actual requirements shall be determined by the Contractor.
The contractor shall utilize one of the named specialists and confirm in their tender submission that all provisions for pipework expansion have been included.
All loads on the building structure shall be advised to the Structural Engineer prior to the installation commencing.

4100 EXPANSION COMPENSATORS INSTALLATION:
Provide anchors and guides to contain all movement and resist maximum loads imposed. Install expansion compensators strictly in accordance with manufacturer's instructions.
Select and install metallic bellows expansion joints, test/inspect the systems after installation of the expansion joints and 1st full movement and provide certification in accordance with BS 6129-1.

4110 FLEXIBLE CONNECTIONS INSTALLATION:
Fit rubber bellows as close to source of vibration as practicable. Ensure the pipe at other end of bellows is a fixed point. Install flexible connections strictly in accordance with manufacturer's instructions.
Ensure flexible connections are fixed when the plant is on vibration isolation mountings.

4120 TERMINAL UNIT CONNECTIONS INSTALLATION:
Install hose connections strictly in accordance with manufacturer's instructions.

4132 GAUGE MOUNTING LOCATIONS:
Mount gauges in the following locations:-
: Primary heating and cooling source – inlet and outlet pipeline temperature gauges.
: Pipelines leaving and entering plantrooms – temperature gauges.
: Main system pipeline headers – temperature gauge.
: Heat exchangers – primary and secondary pipelines inlet and outlet temperature gauges.
: Air handling plant – supply air temperature gauge.
: Pumps – suction and discharge connections pressure gauges mounted on a gauge board.
: Plant items - specified sensing points.
: Packaged plant, control panel mounted, gauges as specified.
: Elsewhere as indicated on the drawings.

10000 Based on NES TEXT Sept 18

Y20 – Pumps

1810 **PUMPS:**
Provide pumps manufactured and tested in accordance with appropriate British Standard as defined in clause 2201. Comply with safety requirements as BS EN 809, and BS EN 60335-2-51 where applicable.

1815 **POTABLE WATER SERVICE PUMPS:**
To be WRAS approved.

1820 **PUMP SELECTION AND EFFICIENCY:**
Select pump at or near most efficient part of performance curve for duty required.

Centrifugal glanded pumps
Comply with EU Regulation 547/2012 on Eco Design requirements of glanded centrifugal water pumps.
Do not select pumps on flat part of performance curve.
Pump efficiency
Pump efficiency tests shall be carried out in accordance with BS EN 16480.
Determine Energy Efficiency Index (EEI) in accordance with BS EN 17038-1 and BS EN 17038-2
Whenever possible select single stage glanded centrifugal pumps to achieve minimum pump efficiency (after correcting for pump head) equal to or better than defined by the upper efficiency line in figs 3 – 6 of the "European Guide to Pump Efficiency for Single Stage Centrifugal Pumps" as published by Europump 2003. (ie "Optimum efficiency selections). Pumps with a corrected efficiency between the upper and lower efficiency lines in this guide (ie efficient selections) will only be considered if it can be shown that an "Optimum efficiency" pump is not available.
Limiting Efficiency Index (MEI) to be as scheduled.

Motor / drive – Provide packaged pumps with motor and VSD integrated as part of the package unless scheduled otherwise.

Glandless Circulators.
Comply with EC Regulation 641/2009 and the amendment EU Regulation 622/2012 for glandless circulators.
Pump efficiency
Comply with BS EN 16297-1 and BS EN 16297-2 for general requirements and procedures for testing and calculation of the Energy Efficiency Index (EEI) for stand-alone circulators.
Comply with BS EN 16297-1 and BS EN 16297-3 for general requirements and procedures for testing and calculation of the Energy Efficiency Index (EEI) for circulators integrated into products.
Include EEI of pump on name plate together with an indication of which part of BS EN 16297 was applied for the determination of the EEI.
Limiting Energy Efficiency Index (EEI) to be as scheduled.

Motor – Provide electronically controlled permanent magnet type or EC motor.

1822 **DESIGN DUTIES:**
Pump Volume: Ensure scheduled volume is provided when operating against resistance of system corrected for changes between specified and selected component resistances.
Quoted pump duties are based on component pressure losses as scheduled in Y20sch. Adjust scheduled pump resistances to compensate for actual resistance of selected components.
Adjust pump heads if changes are made to pipework routing or arrangement in preparation of installation drawings or details.
Commissioning Allowance: Quoted pump duties include the following commissioning allowances:
Flow Rate 10%
Head 15%
These allowances are on top of the calculated design duty to allow for system regulation and additional fittings, unforeseen at the design stage and are not intended as "future spare capacity".
Pump Speed: Refer to schedule for maximum pump operating speed.

1824 **BELT DRIVEN PUMPS**
For each belt driven pump provide a change of belts and drives (to be sized after balancing the system). Allow for changing belts and drives and recommissioning pump and then rechecking system as necessary to achieve the specified duty.

Y20 – Pumps

1825 **DIRECT DRIVE PUMPS**
For each direct driven pump (both single pumps and twin headed pumps) without inverter or other speed control, allow for a change of impeller (to be sized after balancing the system). Allow for changing impeller and recommissioning pump and then rechecking system as necessary to achieve the specified duty.
All inline direct drive pumps for floor mounting shall be supplied with a proprietary support foot.

1826 **TWIN HEADED CENTRIFUGAL PUMPS**
Pumps shall be selected as duty and standby. All twin headed pumps shall be supplied with a matching blanking plate to enable the pump to be operated with a single head fitted during maintenance or replacement of standby head / impeller.
All pumps for floor mounting shall be supplied with proprietary support foot.

1830 **SAFETY GUARDS:**
Fit safety guards around revolving parts on close coupled and belt drive pumps.

1840 **PUMP TESTING:**
Hydraulic performance tests at manufacturer's test facilities
Ensure pumps comply with BS EN ISO 9906 or BS EN ISO 5198 where an extremely high accuracy of measurement is required.

Comply with reference section Y92 clauses for motors.
Ensure all pumps do not have any distinguishable, discrete continuous noise or give rise to distinct impulses.
Noise testing
When specified in the scope of works or schedules, undertake noise measurements in accordance with BS EN ISO 20361.
Glandless circulators having a rated input of up to 200W to be tested in accordance with BS EN 16644 for structure and fluid borne noise.

1845 **PUMP MOTORS / STARTERS:**
Refer to Controls / Monitoring section W60 and Y20 schedule for detailed requirements.
Comply with reference section Y72 clauses for starters.
Comply with reference section Y92 clauses for motors.
Variable speed drives specified as integrated with the pump shall be isolated from any vibration from the pump / motor and have a life expectancy no shorter than the motor life expectancy. Facility to connect to a BMS shall be incorporated into drives supplied by the pump manufacturer.

2000 **PRODUCTS/MATERIALS**

2011 **CASING:**
Provide casing with drain connection fitted with plug.
Provide threaded connections in accordance with BS EN 10226 for drains, vents, water jackets, cooling lines, etc.
Provide pump with split casing to allow access to the impeller for service and maintenance.

2015 **VARIABLE FLOW CONTROL:**
For variable volume systems, pumps shall be selected with a steep curve in the anticipated range of the system. This will ensure that a significant change in differential pressure occurs at the sensor as the flow varies, resulting in a significant change in pump speed and subsequent energy saving. Do not select pumps with flat curves; this will cause the pressure at the pump to stay roughly the same as the system resistance changes.
Where variable speed drives are fitted to direct drive pumps, ensure the drive meets the safety requirements of BS EN 61800-5-1.
Also comply with Y72 clauses for details of variable speed drives.

2016 **IMPELLER:**
Ensure impellers are accurately machined and finished smooth, free from blowholes and other defects and designed to be in dynamic balance at all speeds.
Provide open or semi-open type impellers for removal of sludge or other foreign material to prevent clogging.

Y20 – Pumps

Fix impellers to shafts to ensure that they remain firm if direction of rotation is reversed.
Indicate direction of rotation on pump casing.

2017 **SHAFTS:**
Ensure shaft is of adequate diameter to withstand all imposed loading and has a critical speed when assembled with its impeller at least 10% above normal operating speed.

2018 **BEARINGS**
Grease Points (where specified)
Provide bearings with lubrication line extended to grease nipple at convenient position with protection against over filling.

2019 **SUCTION AND DELIVERY CONNECTIONS:**
Flanged to BS EN 1092-2 or screwed to BS EN 10226 to match pipework.

2201 **PUMPS (MATERIALS)**

Type		A	C	E	E1	G
Description		Centrifugal	Centrifugal	Centrifugal	Centrifugal	Centrifugal Multistage
Configuration		Motor mounted vertically above casing on a common baseplate (belt driven)	Pump casing and motor mounted on a baseplate in line (close coupled)	Direct driven unit with pump body incorporating inlet and outlet connections in line, to allow pump to be mounted in pipework or floor mounted	Direct driven 'tele head unit with pump body incorporating inlet and outlet connections in line, to allow pump to be mounted in pipework or floor mounted	Motor mounted vertically above casing on a common pedestal (close coupled)
Pump Standards		BS EN ISO 9906 BS EN ISO 3661 BS EN 12756 BS EN 733	BS EN ISO 9906 BS EN ISO 3661 BS EN 12756 BS EN 733	BS EN ISO 9906 BS EN 12756 BS EN 733	BS EN ISO 9906 BS EN 12756 BS EN 733	BS EN ISO 9906 BS EN 12756
Material	Casing	Cast iron to BS EN 1561	Cast iron to BS EN 1562	Cast iron to BS EN 1561	Cast iron to BS EN 1561	Cast iron to BS EN 1561
	Impeller	Gunmetal to BS EN 1982	Cast iron to BS EN 1562	Cast iron to BS EN 1561	Cast iron to BS EN 1561	Cast iron to BS EN 1561
	Shaft	Stainless steel to BS EN 10088	Stainless steel to BS EN 10088	Stainless steel to BS EN 10088	Stainless steel to BS EN 10088	Stainless steel to BS EN 10088
Bearings		Ball Sealed-for-life	Sleeve	Ball Sealed-for-life	Ball Sealed-for-life	Sleeve
Glands		Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Seal Housing		Cast iron to BS EN 1561	Cast iron to BS EN1452	Cast iron to BS EN 1561	Cast iron to BS EN 1561	Cast iron to BS EN 1561
Drive		Belt	Close coupled	Direct coupled	Direct coupled	Direct coupled

Type		G1	I	I1	I2
Description		Centrifugal	Centrifugal	Centrifugal	Centrifugal
Configuration		Motor mounted vertically above casing on a common pedestal (close coupled)	Sealed unit with immersed rotor with pump body incorporating inlet and outlet connections in line, to allow pump to be mounted in pipework	Sealed unit with immersed rotor with pump body incorporating inlet and outlet connections in line, to allow pump to be mounted in pipework	Sealed unit with immersed rotor with pump body incorporating inlet and outlet connections in line, to allow pump to be mounted in pipework
Pump Standards		BS EN 12756	BS EN 16297 Parts 1&2	BS EN 16297 Parts 1&2	BS EN 16297 Parts 1&2
Material	Casing	Cast iron to BS EN 1561 Stainless steel to BS 1449 Part 2	Cast gunmetal to BS EN 1982	Cast iron to BS EN 1561	Cast iron to BS EN 1561
	Impeller	Stainless steel to . BS EN 10088	Stainless steel to . BS EN 10088	Noryl	Noryl

Y20 – Pumps

	Shaft	Stainless steel to BS EN 10088	Ceramic	Stainless steel to BS EN 10088	Stainless steel to BS EN 10088
Bearings		Sleeve	Pre-packed type requiring no maintenance (In-line pumps)	Sleeve	Sleeve
Glands		Mechanical			
Seal Housing		Cast iron to BS EN 1561	Gunmetal to BS EN 1982	Cast iron to BS EN 1561	Gunmetal to BS EN 1982
Drive		Direct coupled	Direct coupled	Direct coupled	Direct coupled

Type		J3	K1	K	M
Description		Centrifugal	Centrifugal	Centrifugal	Centrifugal
Configuration		Sealed unit with immersed rotor with pump body incorporating inlet and outlet connections in line, to allow pump to be mounted in pipework	Pump casing and motor in line (close coupled) sealed vertical assembly	Pump casing and motor in line (close coupled) sealed vertical assembly	Motor mounted vertically above casing on a common pedestal (close coupled)
Pump Standards		BS EN 16297 Parts 1&2	BS EN ISO 9906 BS EN 12756	BS EN ISO 9906 BS EN 12756	BS EN ISO 9906 BS EN 12756
Material	Casing	Cast iron to BS EN 1561	Stainless steel to and BS EN 10088	Cast iron to BS EN 1561or Cast gunmetal to BS EN 1982 or Cast steel to BS EN 10213 or SG iron to BS EN 1563 or Stainless steel to BS EN 10088	Cast iron to BS EN 1561
	Impeller	Stainless steel to and BS EN 10088	Stainless steel to BS EN 10088	Cast iron to BS 1452 or Gunmetal to BS 1400 or Stainless steel to BS EN 10088 or Ni-resist to BS EN 13835	Monanyl
	Shaft	Stainless steel to BS EN 10088	Stainless steel to BS EN 10088	Stainless steel to BS EN 10088 or High tensile carbon steel	Stainless steel to BS EN 10088
Bearings		Pre-packed type requiring no maintenance (In-line pumps)	Sleeve or Ball or Sealed-for-life or Spherical roller or Pre-packed type requiring no maintenance (In-line pumps) or Water lubricated (sealed unit in-line pump) or grease point	Sleeve or Ball or Sealed-for-life or Spherical roller or Pre-packed type requiring no maintenance (In-line pumps) or Water lubricated (sealed unit in-line pump) or grease point	Sleeve
Glands			Mechanical	Mechanical	Mechanical
Seal Housing		Cast iron to BS EN 1561		Cast iron to BS EN 1561 Gunmetal to BS EN 1982	
Drive		Direct coupled	Direct coupled	Direct coupled or Close coupled	Direct coupled

Type		S	S1	V
Description		Positive displacement	Positive displacement	Positive displacement
Pattern		Helical	Helical	Rotary
Material	Casing	Cast iron to BS EN 1561 or SG iron to BS EN 1563 and BS EN	Cast iron to BS 1452 or SG iron to BS EN 1563	Cast iron to BS EN 1561

Y20 – Pumps

		1564		
	Impeller			
	Shaft			High tensile carbon steel
Bearings		Spherical roller	Sleeve or Ball or Sealed-for-life or Spherical roller or Pre-packed type requiring no maintenance (in-line pumps) or Water lubricated (pedal unit in-line pump) or Grease point	Sleeve
Glands		Mechanical	Mechanical	Packed
Shaft Housing		Cast iron to BS EN 1561	Cast iron to BS EN 1561	Cast iron to BS EN 1561
Drive		Direct coupled	Direct coupled	Direct coupled

3000 ACCESSORIES

3010 DRIVE BELTS:
Provide belt driven pumps with two or more belts.

3020z MATCHING FLANGES:
Provide flanged pumps with matching flanges to relevant part of BS EN 1092, pressure/temperature to match pipework.

3031 DRAIN LINES FROM PACKED AND WATER-COOLED GLANDS:
Provide copper drain lines complete with tundish from glands to nearest drain. To facilitate cleaning use plugged tees instead of elbows.

4000 WORKMANSHIP

4010 GENERAL:
Comply with manufacturer's recommendations for installation of pumps. For in-line pumps ensure that motor is positioned in accordance with manufacturer's requirements. Do not install glandless pumps with the shaft in the vertical.

4020z PIPELINE CONNECTIONS:
On other than small in-line circulators, support pumps independently from connecting pipework to ensure no load is transmitted from pipework to pump casing on pump suction and discharge.

4030z MOUNTINGS:
Mount motors and pumps for belt drive pumps resiliently. Comply with reference section Y52 clauses.

4050 ALIGNMENT:
Align pump to prevent undue restraint and thrust on interconnecting pipework.
Align drives to prevent undue wear and restraint on pump shaft.
For belt drives, align pulleys and tension belts to prevent undue wear and out of balance forces.

4060 ACCESS:
Locate pump within the system with adequate space around it for service and maintenance.

4070 MAINTENANCE REQUIREMENTS FOR SEWAGE PUMPS:
For ease of service and maintenance, install submersible sewage pumps on guide rails or with lifting cables. Fit pumps with automatic discharge connections, which
Locate on to permanent pipework at low level in chamber.

10000 BASED ON NES Y20TEXT Dec 19

Y30 – Air Ductlines

1000 GENERAL

1005 DEFINITION
The materials, apparatus and methods detailed throughout the ductwork component schedules and specification clauses apply to all enclosures for conveying air, and their ancillaries, whether as ducting runs or casings for equipment and accessories.

1007 DESIGN
Ensure that the design velocities and pressure conditions comply with the values and tests specified.

1010 DUCTWORK AND ANCILLARIES INSTALLATION STANDARDS:
Carry out construction and installation of ductwork in accordance with BESA DW144, DW145, DW154, DW172 and DW191 and BS 8999 as appropriate.
Comply with BS EN 1507, BS EN 12237, and BS EN 13403 (Ductwork made from insulation ductboards) as appropriate.
Where builders work ducts are used they shall be thoroughly cleaned and sealed prior to plant operation.
Where ducts penetrate a floor separating habitable rooms in different flats within residential buildings they shall be enclosed for their full height and full horizontal run in each flat and surrounded with sound absorbent material above and below the floor. The installation shall comply with the requirements of Approved Document E of the Building regulations. "Resistance to the passage of sound".
Install and inspect fire resisting duct systems in accordance with Building Regulations and ASFP Code of Practice TGD 18.

1021 DUCTWORK DIMENSIONS:
Sizes of ductwork are internal airway dimensions. Where applicable make allowance for any internal lining.

1022 DUCTWORK LAYOUT
Set out ductwork as indicated on the drawings, making due allowance for any diagrammatic presentation.
Provide all necessary offsets, bends, tapers, transformation pieces etc. required whether or not these are detailed. Make due allowance for any thermal movement on long runs.

1031 ELECTRICAL BONDING TERMINAL:
Ensure an electrical bonding terminal suitable for connection of 6mm² maximum conductor is provided where required by BS 7671 Requirements for Electrical Installations clause 544.1

1041 INSTALLER SELECTION: (NBS Z20.220)
Use a member of the BESA (Building Engineering Services Association) specialising in manufacturing and installing ductwork.
Where post installation cleaning is specified, appoint a specialist cleaning contractor to undertake the work in accordance with BESA TR/19, and supply and install any additional cleaning openings to suit their selected specific methods of cleaning and to suit the practical site conditions relative to the fabric of the building and position of other services.

For existing systems that require inspection and cleaning prior to modification or re-commissioning (including kitchen extract systems):
Use a specialist, approved in accordance with Loss Prevention Standard LPS 2084, to undertake the following:
- Inspect and clean ductwork that may be contaminated with combustible deposits.
- Make recommendations for access improvements to any areas where there is currently limited access making cleaning / maintenance impractical.

2000 DUCTWORK FABRICATION/MATERIALS

2011 DESIGN INFORMATION:
General
All ductwork and associated materials shall be manufactured, installed and tested, in accordance with the current editions of BESA Specification DW/144 and DW/154 for sheet metal ductwork and plastic

ductwork respectively, for low, medium and high pressure/velocity air systems, and as qualified in this specification.
Ductwork Classification
Ductwork to be used on this project shall be as scheduled.
The ductwork pressure classifications scheduled are in accordance with the limits for positive/negative static pressure, air velocity and air leakage defined in table 1 in DW144.
Fabricate ductwork to meet pressure classification in accordance with DW144 Table 1 and DW154 table 1. Fabricate ductwork to meet leakage classification in accordance with DW144 Table 1 and DW154 table 1. Where indicated ensure ductwork is suitable for a variable air volume system.
For special installations where contaminants are indicated, ensure materials and construction of ductwork are suitable for contaminants in the airstream.

2024 DUCTWORK AIR LEAKAGE TESTING - GENERAL:
Carry out ductwork air leakage testing on those sections of systems with a design flow rate greater than 1m³/s where the pressure class is such that DW/143 recommends testing and where the BER calculation assumes a leakage rate lower than the standard in DW144.
Test to be in accordance with the requirements of the latest version of Building Regulations ADL2 A&B and DW144 or appendix A in DW154 as appropriate and as procedures set out in DW143. Use portable fan and test equipment and apply to erected sections of the ductwork complete with access doors at the test pressure and flow rates as scheduled.
Test before insulation is applied to ductwork.
Achieve leakage rates indicated or better.
Test ductwork components with the ductwork, where they are able to withstand the test pressure, otherwise isolate.

If the test fails, pressure test four further sections. If the further tests fail apply remedial action to the complete ductwork system.

The results to be recorded on test sheets based on DW/44 or DW/154 and DW/143 examples and compared to acceptable leakage rate specified or better.

Sections, which need unacceptable levels of remedial work on seams or joints, shall be replaced by new sections. This requirement shall be identified during the preliminary test to DW 143.

Provide documented evidence of the calculations used to arrive at the allowable loss for the section to be tested and ensure the client or their representative witness and sign the results of the tests.

All "in duct" plant shall be factory tested to the same leakage classification by the Manufacturer.

Builders work ducts used as part of a ductwork supply system shall be sealed in accordance with the Architect's specification by the Contractor. The ducts / shafts shall be leakage tested to demonstrate that leakage is no greater than the requirements for sheet metal ductwork class A as defined in DW/143 at the design pressure at that part of the system.

For pressure and leakage testing - builder's work shafts, voids, enclosures and floor voids / plenums refer to clause Y51 2015.

2025z SPARK TESTING ON PLASTICS DUCTWORK:
Where specified in the scope of works or schedule of air ductlines, carry out spark testing in accordance with DW/154 at land marks identified in the contract programme.

2031A HIGH PRESSURE DUCTWORK AIR LEAKAGE TESTING:
Carry out ductwork air leakage testing on all high-pressure ductwork in accordance with DW/144 as procedures set out in DW/143.
Testing of plant items, as DW/144.

2031B MEDIUM PRESSURE DUCTWORK AIR LEAKAGE TESTING:
Test medium pressure ductwork in accordance with DW 144 and DW143.

Test the specified proportion of sections of duct system (as scheduled) for air leakage. Test at the pressure recommended in DW144 for the classification of the selected ductwork. Carry out the tests as the work proceeds and prior to application of thermal insulation.
If the test on a section fails, pressure test four further sections (to be selected by the Designer). If the further tests fail, apply remedial action to the complete ductwork system.
Provide documented evidence of the calculations used to arrive at the allowable loss for the section to be tested and ensure the client or their agent witnesses and signs the results of the tests.
Testing of plant items as DW 144.

2031C LOW PRESSURE DUCTWORK AIR LEAKAGE TESTING:
Test low-pressure ductwork in accordance with DW 144 and DW143 as scheduled.
Test the specified proportion of sections of duct system for air leakage. Test at the pressure recommended in DW144 for the classification of the selected ductwork. Carry out the tests as the work proceeds and prior to application of thermal insulation.
If the test on a section fails, pressure test two further sections (to be selected by the Designer). If the further tests fail, apply remedial action to the complete ductwork system.
Provide documented evidence of the calculations used to arrive at the allowable loss for the section to be tested and ensure the client or their agent witnesses and signs the results of the tests.
Testing of plant items as DW 144.

2035 STRENGTH AND LEAKAGE TESTING OF CIRCULAR SHEET METAL DUCTWORK:
Where scheduled carry out ductwork strength and air leakage testing on circular sheet metal ductwork in accordance with BS EN 12237.
Test procedure shall be as detailed in BS EN 12237, Section 7.
Produce a test report as detailed in BS EN 12237, Section 8.

2036 STRENGTH AND LEAKAGE TESTING OF RECTANGULAR SHEET METAL DUCTWORK
Where scheduled complete systems shall be leakage tested. Tests shall be carried out when the fan has been first set to work and a visual/audible inspection has been made of all connections from plant to ductwork. This shall include any untested joints between tested sections and all joints and seams not previously subjected to leakage pressure tests, including plant casings, grille joints, dampers etc.
Carry out ductwork strength and air leakage testing on rectangular sheet metal ductwork in accordance with BS EN 1507

2041 DUCTWORK MATERIALS STEEL
Ductwork shall be zinc-coated steel to DW144 Part 2 unless otherwise specified. Where scheduled, external ductwork to be hot-dip galvanized to BS EN 10346

2051A STEEL DUCTWORK TO DW 144 - RECTANGULAR:
Duct
Comply with DW 144 Part 3 for construction of rectangular ductwork.
Additional requirements
Any duct with an aspect ratio greater than 4:1 shall be supplied complete with a central spitter.
Longitudinal seams: Fig Nos. 5, 6 and 7 shall be avoided. Fig No 8 may be used on large duct components with the Designer's approval.
For all side-on flange systems (mezz etc) with bolted corners, joints on all systems shall be further secured with intermediate fastenings to the manufacturer's recommendation.
Full girth stiffeners shall be used in all instances.
Dimpling is not acceptable as a method of fastening.
Plant connection shall be constructed at Tables 2, 3 and 4, but one gauge thicker. Tie bars shall be provided on all plant connections with a side longer than 1500mm.
Turning vanes shall be fitted on square bends. Square branches shall not be used.
Cross-joints
Use cross-joints in accordance with DW 144 or use cross-joints tested in accordance with DW/TM1, unless otherwise indicated.
Finish
Zinc coated steel – hot dip galvanised, or Zinc coated steel - electroplated, or pre-coated steel in accordance with DW 144

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2851B STEEL DUCTWORK TO DW 144 - CIRCULAR:

Dust

Comply with DW 144 Part 4 for construction of circular ductwork. Use spirally wound ducts unless otherwise indicated.

Additional requirements

Fig Nos. 34 and 41 in DW 144 will only be acceptable as a means of jointing provided the manufacturers of the proprietary system inspect a minimum of 25% of the joints after installation to verify the installation has been carried out in accordance with their instructions and size limitations.

Components

Square branches shall not be used. On high and medium pressure systems use only conical branches

Fittings

Comply with DW 144 Part 4 for manufacture of fittings for circular ductwork.

Cross-joints

Use cross-joints in accordance with DW 144 or use cross-joints tested in accordance with DW/TM1, unless otherwise indicated.

Finish

Zinc coated steel - hot dip galvanised, or Zinc coated steel - electroplated, or pre-coated steel in accordance with DW 144 Appendix H unless otherwise indicated.

2851C STEEL DUCTWORK TO DW 144 - FLAT OVAL:

Dust

Comply with DW 144 Part 5 for construction of flat oval ducts. Use spirally wound ducts unless otherwise indicated.

Cross Joint

Submit for approval details of any cross-joints not in accordance with DW

Components

Square branches shall not be used; on low-pressure systems use shoe branches in lieu. On high and medium pressure systems use only conical branches.

Fittings

Comply with DW 144 Part 5 for manufacture of fittings for flat oval ductwork.

Finish

Zinc coated steel - hot dip galvanised, or Zinc coated steel - electroplated, or pre-coated steel in accordance with DW 144 unless otherwise indicated.

2852 HIGH PRESSURE SHEET METAL DUCTWORK

Where high-pressure ductwork is specified, the following shall apply otherwise stated in writing:

Bends and offsets shall have a minimum throat radius equal to the width or diameter of the duct.

On rectangular duct over 1 metre wide or where space is restricted, splitters may be introduced with the prior written approval of the Designer. Locations for dampers for volume control shall be agreed with the Designer.

Requirements of the relevant Clauses in DW 144 must be adhered to.

2853 KITCHEN EXTRACT SYSTEMS

Refer also to clause 310.I131 in U10 (U12)

Kitchen extract ductwork to be fire resisting as scheduled.

Comply with BESA "Specification for Kitchen Ventilation Systems DW172. Appendix D and DW/144

As a minimum, all ductwork shall be constructed to Class "A" specification and tested to Class "B" requirements and be increased at least one size in metal thickness above the standard requirement. Access doors for cleaning (with grease tight gaskets) shall be installed at every bend and connection and at every 3m on straight lengths of ductwork. All joints shall be grease-tight. Horizontal ductwork shall be installed to provide a fall to a drain point. A drain connection shall be provided at all low points.

Comply with Section 7 of BESA TR/19 for facilities and specific requirements for cleaning.

Comply with the requirements of the Building Control Officer for fully welded ductwork, fire cladding and minimum metal thickness.

The entire system installation shall comply with the requirements of the Building Control and Fire Officer.

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2871 MAN ACCESS AND SAFETY BARS:

Where man access is provided, ensure that duct floor is of sufficient strength to comply with safety standards. Provide safety bars at the top of all risers unless alternative means of protection are provided.

2872 FLANGED CONNECTIONS:

Provide bolted flanged joints for connecting ductwork to flanged items of plant, builder's work frames and where removable sections of ductwork are required.

2874 PLANT CONNECTIONS:

Make connection between air handling assembly and ductwork system in accordance with DW 144 and manufacturers recommendations.

2101 PLASTICS DUCTWORK TO DW 154:

Manufacture and install plastic ductwork in accordance with DW 154.

Material

PVC-U (Unplasticized polyvinyl chloride).

PPS (Self extinguishing polypropylene).

FBPP (Fabric backed polypropylene sheet).

PVC-U/GRP (Composite laminate of unplasticised polyvinylchloride and glass reinforced plastic).

PVC-U/FOAM/GRP (Composite laminate of unplasticised polyvinylchloride, rigid polyurethane self extinguishing foam and glass reinforced plastic).

FBPP/FOAM/GRP (Composite laminate of fabric backed polypropylene sheet, rigid polyurethane self extinguishing foam and glass reinforced plastic).

Construction

Rectangular ducts DW 154 Part 3.

Provide internal stiffeners.

Circular ducts DW 154 Part 4.

2110A FIRE PROTECTION WITH FIRE DAMPERS:

Method of protection where ventilation ducts pass through fire-separating elements

BS 9999 Method 1 and Method 4 protection using fire dampers and / or automatically actuated fire and smoke dampers triggered by smoke detectors.

Installation to comply with:

BESA DW / 144 and DW/145

Building Regulations Approved Document B

BS EN 15650 – Ventilation for buildings. Fire dampers

Relevant parts of BS EN 1366, BS EN 13501 and BS EN 12101

2110B FIRE PROTECTION WITH FIRE RESISTING ENCLOSURES:

Method of protection where ventilation ducts pass through fore-separating elements –

BS 9999 Method 2 using fire resisting enclosures.

Installation to comply with:

BESA DW / 144

Building Regulations Approved Document B

Relevant parts of BS EN 1366, BS EN 13501 and BS EN 12101

2110C FIRE RESISTING AND SMOKE AND HEAT CONTROL DUCTWORK GENERALLY:

Supply and install fire resisting ductwork using either fire protection cladding on-site, factory applied fire resisting finish or factory manufactured fire rated ductwork, as detailed elsewhere in this specification. Ductwork to be in accordance with BESA DW/144.

Duct constructed to BESA DW/144 has no tested fire resistance, therefore when using protective cladding materials, construction of base duct must comply with the actual construction of the tested duct specimen and cladding material.

Y30 – Air Ductlines

Method of protection where ventilation ducts pass through fire-separating elements
BS 9999 method 3: protection using fire-resisting ductwork.
Ensure complete ductwork system complies with EN testing requirements to relevant parts of BS EN 1366, be tested by a UKAS accredited notified body and comply with Building Regulations Approved Document B or equivalent in devolved nations in UK.

The ductwork shall be constructed in accordance with the ASFP (Association of Specialist Fire Protection) Guide to Fire Rated and Smoke Extract Ductwork to provide the Fire Rating for Integrity & Insulation (BS EN EI nomenclature) when tested to the requirements of BS EN 1366 Parts 1, 8 or 9 depending on system function by a UKAS accredited notified body. The ductwork providing either duct type A (fire outside), Duct Type B (fire inside) or Duct Type C (fire inside smoke control duct) and, under normal non-fire operating conditions, shall conform to the scheduled pressure classification of the current BESA DW/144 specification for sheet metal ductwork.
All smoke extract ductwork shall be capable of retaining a cross sectional area of 80% under fire conditions in accordance with BS EN 1366 Part 8 for multi compartment smoke extract systems. Comply with BS EN 12101-7 for this purpose.

Projects in Non EU markets only
The ductwork shall be constructed in accordance with the ASFP (Association of Specialist Fire Protection) Guide to Fire Rated and Smoke Extract Ductwork to provide the Fire Rating for "Stability", "Integrity" and "Insulation" as scheduled or indicated in the particular specification or on the drawings, when tested to the requirements of BS 476: Part 24 by a UKAS approved laboratory.

2110D **FIRE RESISTING AND SMOKE AND HEAT CONTROL DUCTWORK WITH FIRE PROTECTION CLADDING:**
Ensure complete system complies with testing requirements to BS EN 1366 Parts 1, 8 or 9 depending on system function. In the case of smoke extract ducts to conform to the requirements of BS EN 12101-7.
Classification documents to be in accordance with BS EN 13501-3 for ventilation ducts and BS EN 13501-4 for smoke control ducts sections.
Ducts to be fire protected with the correct thickness of high density single layer mineral wool fire rated ductwork slab in accordance with the manufacturer's recommendations and instructions. Insulation to be independently tested and carry valid classification documents to BS EN 13501-3 Parts 1,8 or 9 depending on system function by a UKAS accredited body. The ductwork providing either duct type A (fire outside), Duct Type B (fire inside) or Duct Type C (fire inside smoke control duct). All smoke extract ductwork shall be capable of retaining a cross sectional area of 80% under fire conditions in accordance with BS EN 1366 Part 8 for multi compartment smoke extract systems. Comply with BS EN 12101-7 for smoke and heat control duct systems which are manufactured off site as such and then placed on the market for this purpose.

General
Ductwork to be in accordance with BESA Specification DW/144. Ducts constructed to this specification has no tested fire resistance therefore when using protective cladding materials construction of base duct must comply with the actual construction of the tested duct specimen and cladding material.
Drop rods and exposed bearers to be insulated in accordance with manufactures recommendations and instructions.
Where a vapour barrier is required, all exposed edges and penetrations through the foil should be sealed using soft self-adhesive aluminium foil tape.
Refer to clause Y60L2185 for further details of fire protection cladding.

Projects in Non EU markets only
Ensure complete ductwork system complies with the requirements of BS 476-24 and BS 9999.
Supply and install fire rated ductwork. Ducts to be fire protected with the correct thickness of high density single layer mineral wool fire rated ductwork slab in accordance with manufacturers recommendations and instructions. Insulation system to be independently tested and carry current valid certification to provide fire protection duty in accordance with the requirements of duct 'Type A' and duct 'Type B' of BS 476-24 and BS 9999.
Testing to be by a UKAS accredited notified body

2110E **FIRE RESISTING AND SMOKE AND HEAT CONTROL DUCTWORK – FACTORY APPLIED FIRE RESISTING FINISH**
Comply with BS EN 12101-7 for Smoke and heat control duct systems.

The design manufacture, installation and testing of the complete fire rated ductwork system shall be undertaken by a specialist.
Ductwork must be capable of resisting the anticipated temperature generated during the development of a fire and the required degree of fire resistance for Integrity & Insulation (BS EN EI nomenclature) as indicated on the tender drawings when tested to the requirements of BS EN 1366 Parts 1, 8 or 9 depending on system function. The ductwork providing either duct type A (fire outside), Duct Type B (fire inside) or Duct Type C (fire inside smoke control duct). All smoke extract ductwork shall be capable of retaining a cross sectional area of 80% under fire conditions in accordance with BS EN 1366- 8 for multi compartment smoke extract systems.
The fire rated ductwork shall be constructed from Galvanised Sheet Steel manufactured to an enhanced standard, then degreased and factory sprayed with the proprietary coating. The coating shall contain selected mineral fillers in a low permeability electrometric binder, to give a finished product which has been successfully tested for international use under Cellulosic Fire Conditions in excess of 4 hours duration.
The ductwork shall be composite fire rated ductwork manufactured to method 3 of BS 9999. The ductwork shall be factory produced in flanged sections and assembled on site utilising tested fireproof gaskets. All fire insulation, sealants, gaskets and flexible joints must be non-flammable when tested in accordance with BS EN 1366 Parts 1, 8 & 9. Classification Documents to BS EN 13501-3 & 4 and relevant test documentation to be provided.
After installation the ductwork shall be leakage tested in accordance with DW/143. (to suit pressure classification scheduled)
On kitchen extract systems access doors shall be installed at a minimum distance between doors of 3m.
Where the ductwork passes between fire compartments fire stopping shall be carried out by the specialist in accordance with the ductwork manufacturers recommendations and the ductwork shall be reinforced in line with that used within actual fire test and be relevant to flexible or rigid wall/floor constructions to prevent deformation of the duct in a fire to maintain the cross-sectional area of the duct and ensure that the fire rated penetration seal around the duct is not compromised.
The specialist ductwork contractor shall be responsible for the design and sizing of the drop rods and bearers (and their centres) for the fire rated ductwork to suit the fire duration scheduled.
The internal surface of the ductwork shall be smooth in order to impose no more pressure loss than DW 144 ductwork.
Test holes which are cut in after installation must be suitably sealed by the specialist to ensure that the system integrity is maintained.
The completed system shall be tested to BS EN 1366 Parts 1,8 & 9. Classification Documents required to confirm that systems are suitable for horizontal and vertical applications and in both rectangular and circular profiles
At completion of the project a certificate of conformity shall be issued by the specialist confirming that the system has been manufactured and installed in accordance with the manufacturer's recommendations.

Projects in Non EU markets
Ductwork must be capable of resisting the anticipated temperature generated during the development of a fire and must be tested to BS 476-24, ISO 6944 Fire Rated Ductwork Systems shall be manufactured to provide the required degree of fire resistance (up to 4 hours for stability, integrity and insulation fire ratings) and the type of fire exposure, type A or B.

2120 **INTERNAL THERMAL/ACOUSTIC LININGS:**
Where indicated line internal surfaces of ducts. Internal lining to be as described in DW/144
Standard: tested and rated in accordance with BS EN ISO 717-1 and relevant parts of BS EN ISO 10140.
Lining
Provide lining that is inert, fire proof, inorganic, vermin proof, non-hygroscopic. Fire rated to Building Control Officers and Fire Officer approval
Material
Class "O" fire rated open cell acoustic foam (minimum 25mm thick required) which shall not emit toxic fumes in the event of a fire.
Performance
Minimum random incidence absorption coefficients in accordance with BS EN ISO 354, as follows:

Frequency (Hz)	125	250	500	1000	2000	4000	8000
		0.12	0.21	0.42	0.62	0.88	0.72

Protection of Lining
Protect lining against product migration and erosion.
Fire resistance: Class O Building Regulations when tested to BS476: Part 6 and Part 7.

2121 EXTERNAL THERMAL/ACOUSTIC INSULATION:
Install required layers of acoustic insulation, as detailed below, where indicated. (Unless described otherwise in the particular specification)
Material
Duct wrap lamellae glass or mineral wool acoustic insulation.
Polymeric mass layer - 10 kg/m^2
Acoustic performance – Minimum Sound Reduction Index (SRI) – as indicated in particular specification.
Standards: Tested to BS EN ISO 717-1, and relevant parts of BS EN ISO 10140.
Insulation thickness – 50mm
Insulation thermal conductivity – 0.033 – 0.039W/mK at mean temperature of 10°C
Fire resistance - Class 0 Building Regulations when tested to BS 476-6 and BS 476-7
Finish – Reinforced aluminium foil (outer)
Continuous quilted mineral fibre mat .The polymeric mass layer should be positioned outermost from the sound source and overlapped at all joints. The product must be designed to maintain its original thickness subsequent to installation. The lagging should be cut 25mm oversize and a 25mm strip of the inner resilient element removed to create an overlap. The mass layer must not come in contact with the duct.
Overlap and seal all joints with adhesive and external reinforcing tape.
Overlap and seal all joints with adhesive and suitable external reinforcing tape.
Installation -To manufacturer's standard.

2122 ACOUSTIC PLENUMS:
Where indicated
Provide plenums constructed using acoustic panels in positions indicated. Joint panels with seals to match performance of panels. The plenums shall be suitable for the relevant air pressures.
Infill
Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic. Fire rated to Building Control Officers and Fire Officers approval.
Material
Class "0" fire rated open cell acoustic foam (25mm thick required minimum) which shall not give off toxic fumes in the event of fire, unless otherwise indicated.
Performance
Minimum random incidence absorption coefficients in accordance with BS EN 20354, as follows:

Frequency (Hz)	125	250	500	1000	2000	4000	8000
		0.12	0.21	0.42	0.62	0.88	0.72

2130A PRE-INSULATED THERMAL DUCTWORK [RECT 21000021300]
Supply pre-insulated ductwork where indicated or as scheduled.
Material – CFC & HCFC free, closed cell phenolic foam boards
Standards
BS EN 13403
The insulation materials and facings shall be rated as Class 1 when tested to BS 476 Part 7
Class "O" finish
The boards shall be tested for optical density of smoke generated to BS 6401
DW 144
Thickness - to meet maximum permissible heat loss (warm air ducts) - 10.34 W/m2 and heat gain (chilled/dual-purpose air ducts) - 6.45 W/m2 in accordance with BS 5422 and Non-Domestic Heating, Cooling and Ventilation Compliance Guide, and Approved Document L2A/L2B.
Construction / Installation
Fabrication/Installation in accordance with manufacturer's technical manuals.
CFC and HCFC free phenolic foam panels bonded on both sides to a 26mm micron aluminium foil facing reinforced with a 5mm glass tissue mesh. Minimum density of foam shall be 55kg/m^3
The system shall be manufactured and installed by a specialist contractor. The specialist's operatives shall have successfully completed a training course with the manufacturers of the insulated panels and the . All materials used for the ductwork system shall be approved by the insulated panel manufacturer.
Provide internal stiffeners as necessary

All access doors shall be insulated to the same standard as the ductwork and the vapour barrier must be maintained.
Connection to system components shall be by aluminium flanges.
Supports shall be provided at centre not exceeding 3m and at all changes in direction and branch connections. All ductwork ancillaries shall be independently supported.
External Ductwork
All external ductwork shall be provided with a weatherproof finish comprising either 0.7mm thk "Aluzink sheet or a proprietary laminated foil / film introduced during the fabrication of the ductwork.

2141 HANGERS AND SUPPORTS:
Provide hangers and supports throughout in accordance with DW 144; DW 154 Part 5 or DW 191, Section 7 as appropriate. See also clause 4021 for hangers and supports workmanship.
Comply with BS EN 12236.
If a proprietary suspension system is provided it shall comprise channel sections with return lips and compatible fixing accessories made of material to BS EN 10162, BS EN 10210.
Ensure all steel components such as studding, bolts and steel screws, bolts, nuts and washers are either cadmium plated and passivated or zinc electroplated to BS 7371 after manufacture. Do not use metal fixing components likely to deteriorate and/or cause damage
Where a wire rope suspension system is used an alternative to drop rods or studding comply with the following standards:
BS EN 12385-1.
BS EN 13411-3.
BS EN 13411-4.
BSRIA COP 22/2002

2151 SUPPORT OF AIR TERMINAL UNITS:
Support air terminal units and their plenums independently of the ceiling grids, unless otherwise indicated.
Hangers shall be adjustable.

3000 ACCESSORIES AND COMPONENTS

3010 CONSTRUCTION AND FINISHES:
Ensure that materials of accessories are compatible with ductwork and that finishes of accessories comply with any special requirements for ductwork. Ensure casing bases of components are compatible with ductwork in which they are incorporated.

3021 ACCESS/INSPECTION OPENINGS:
Provide access openings for inspection/servicing in accordance with DW/144, DW 154 Part 6, section 15 and appendix D table 14 or DW 191 Section B as appropriate, and:
Adjacent to all fans
Adjacent to all dampers
As necessary for cleaning purposes
See also clause 3051.

3031 TEST HOLES
Provide test holes in ductwork systems to allow complete testing and balancing of each system in accordance with CIBSE Commissioning Code Series A and BSRIA AG3/89.3:2001. Drill test holes on site in accordance with DW/144.
Provide test holes on each side of all equipment in the system, at least 1.5 duct diameters upstream of all dampers and elsewhere as indicated/specified. Seal all test holes with blind grommets.
Provide at each location the number of test holes shown below:
Circular duct

Duct diam (mm)	No of test holes
Up to 150	1
151 to 450	2
Over 450	4

Rectangular/flat oval ducts

Longest side (mm)	No of test holes

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Up to 200	1
201 to 400	2
401 to 600	3
601 to 800	4
801 to 1000	5
1001 to 1200	6
1201 to 1500	7
Over 1500	One per 250mm

3041 **HOLES FOR CONTROLS/INSTRUMENTS:**
Provide suitably sized and positioned holes in ductwork, in accordance with DW/144 or DW 154 to accommodate all necessary thermostats, humidistats and other control. Holes to be bossed and screwed or drilled as appropriate. Where holes are provided on insulated ductwork, extend to finish flush with insulation.

3042 **INSTALLATION OF INSTRUMENTS AND CONTROLS:**
Instruments and controls should be installed to manufacturers or specialist supplier's requirements. The installation must be checked by the manufacturer or specialist supplier, and rectified as necessary.

3051 **CLEANING ACCESS**
Provide access openings for cleaning in accordance with DW/144, TR/19 or DW/154 appendix D as appropriate. In addition, provide access openings such that no point is greater than 5m from an opening.
Provide access openings at the top and bottom of every riser.
Refer to BSRIA TN 18/92 for minimum dimensions of access doors.
See also clause 4091.
Where Advanced level of PDI with post installation clean is specified, the specialist cleaning contractor, in addition to taking advantage of openings fitted by the ductwork installer, shall supply and install any additional cleaning openings to suit their selected specific methods of cleaning and suit the practical site conditions relative to the fabric of the building and position of other services.
The specialist cleaning contractor shall select and propose for approval the most appropriate cleaning method from table 8 in TR/19 (section 8.11).

3055 **ACCESS/INSPECTION/CLEANING OPENING COVERS**
Provide purpose made covers to all access and inspection and cleaning openings. Fit covers with quick release catches. Provide restraining straps. Provide full-face soft neoprene gasket secured to ductwork with adhesive to ensure an air tight seal. Covers shall be capable of withstanding the respective system test pressures.
Any access openings cut in on site shall have the exposed cut edges covered with a protective band.

3056 **HINGED ACCESS DOORS**
Provide purpose made hinged access doors where indicated in accordance with DW 144. Fit access doors with latch style fastenings. All doors shall be supplied with approved retaining device fixed to door and frame. Access doors shall be capable of withstanding the respective system test. Provide full-face soft neoprene gasket secured to ductwork with adhesive to ensure airtight seal. Provide handles on all access doors.

3058 **PRE-INSULATED DOORS AND COVERS:**
On all insulated ductwork, provide standard access, inspection and cleaning covers and doors with (minimum) 25 mm thickness of insulation. Doors and covers shall be constructed and installed in such a manner that the internal face of the duct and cover/door is maintained when fixed. On insulated services all access covers/doors shall be fitted with raised sloots, which shall be equal to the depth of the insulation.

3061 **CONTROL/BALANCING DAMPERS - GENERAL**
Dampers shall be provided where indicated on the drawings or called for elsewhere in the specification. Additionally the Contractor shall provide sufficient dampers to regulate and balance the system. Dampers on grilles or diffusers shall be used only for fine and secondary control. All dampers shall be sufficiently rigid to prevent fluttering.
Dampers constructed by the ductwork fabricator shall not be acceptable unless specifically agreed with the Designer in advance.

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Dampers shall incorporate a locking device and blade position indication. A sample shall be submitted of the proposed dampers prior to the commencement of the installation.
After final balancing the quadrant shall have a small 'V' shaped notch filed in the quadrant indicating the centre line of the lever when in the operating position.
On insulated ducts, the damper actuator quadrant and linkage shall be located proud of the external face of the duct insulation.

As a minimum control / balancing dampers shall be provided at the following locations:

At each fan
At each main branch
At each sub-branch
At any branch serving 3 or more terminals
At each terminal / grille

Where possible dampers on terminals / grilles shall be installed in duct connections other than with the grille.

3062 **CONTROL/BALANCING DAMPERS**
Unless otherwise specified, provide extruded aerofoil section, plain opposed blade control and balancing dampers in accordance with DW/144 /or DW/154 Part 8 as appropriate. Manufacturers to confirm that dampers have been aerodynamically tested in accordance with BS EN 1751 and where required determination of sound power levels to be by measurement in a reverberation room in accordance with BS EN ISO 5135.
Provide locking device and position indicator on all dampers.
Dampers shall be single blade up to 200mm ducting height, elsewhere they shall be multi-blade, opposed blade type with each blade not exceeding 175mm in width and not longer than 1200mm.
Dampers shall be of the aerofoil blade (double skin) multi-leaf opposed blade type (unless otherwise specified) with the blades rigidly fixed to the horizontal spindles.
Each damper gear shall be suitable for operation over the pressure and temperature range of the medium being controlled.
Where dampers are required to operate to a fully closed position, dampers shall be of the low leakage type.
Remote blade operation
Where indicated, supply and install proprietary remote control unit (supplied by the damper manufacturer). Unit to be complete with all necessary brackets and linkage at the control unit. Control unit to provide indication of position of blades. Provide label at the control unit to indicate function.

3063 **IRIS DAMPERS:**
On final circular runs to and from terminals, provide iris pattern control dampers in accordance with DW/144 or DW/154 as appropriate. Provide each damper with locking device and position indicator.

3064 **MOTORISED CONTROL DAMPERS:**
Provide control dampers complete with motor, motor linkage and motor support. Motorised dampers shall generally be suitable for 24V on-off reversible motor and shall have a manual override facility.
The Contractor shall ensure they provide the controls specialist with full details of the damper selected and the total operating torque with damper in closed position, to enable the controls specialist to select a suitable actuator or actuators. The exact details of the actuator requirements shall be agreed with specialist controls supplier.
Damper motors, thrusters, positioners and remote operating gear (where required) shall be rigidly mounted on purpose-made brackets and carefully aligned.
Actuators shall have visual position indication and have the capability to provide positive feedback of position to the controls system.

3070 **FIRE DAMPER FUSIBLE LINKS:**
Supply spare fusible links for fire dampers and combination fire/smoke dampers. Supply ten in total or 1 for every 10 dampers installed (whichever is the greater). Supply links to fuse at temperature indicated

3071 **FIRE STOPS - PLASTICS DUCTWORK:**

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Supply and install fire dampers or intumescent sleeves in accordance with DW154 Part B section 17, in accordance with clause 4151

3075 FIRE DAMPERS GENERAL: (NES 3070 & 3075 merged)
Provide fire dampers in accordance with DW145, relevant parts of DW144, DW154 Part B paragraph 17 and clause Y30 4151.
Manufacturers to confirm that where required fire dampers have been aerodynamically tested in accordance with BS EN 1751 and where required determination of sound power levels to be by measurement in a reverberation room in accordance with BS EN ISO 5135.
Fire-resistance tests of thermal release mechanism in accordance with BS ISO 10294-4.
Types as scheduled: -
Multi-leaf fire dampers
or Intumescent fire dampers . Install in accordance with DW 144, size and location as shown on the drawings.
Fire resistance tests for intumescent dampers shall be in accordance with BS ISO 10294-5.
or Stainless steel shutter fire dampers with shutter blades out of the air stream.
or Multiple "Hit & Miss" steel plates fire damper
or Intumescent sleeves on plastic ductwork up to 350mm dia

Fire dampers shall be supplied and fixed in accordance with the manufacturer's recommendations and installation methods which conform to the prevailing Building Regulations (ADB) and are acceptable to the District Surveyor/Building Control Officer and Fire Officer generally in accordance with DW 145. The proposed installation method must be supported by a valid test report or assessment provided by an approved third party notified body.

The construction shall allow for all additional framing supports, bracing and fire stopping as may be necessary to adequately attach/install the fire dampers to the structure. The assembly is to be approved by the Building Control Officer/District Surveyor and Fire Officer.

Each fire damper and associated installation method shall have at least the same standard of fire integrity as the wall or floor through which the duct passes.
The classification of fire dampers is to be in accordance with BS EN 13501-3 and shall have a minimum integrity classification 'E' to meet that of the wall or floor.

When fire integrity of 4 hours is required, either two dampers (classified E120) factory assembled in series (if acceptable to the local authority) or a single damper having a classification E240 may be used. To achieve these classifications, fire resistance tests shall be in accordance with BS EN 1366-2, undertaken by a notified body.

Shutter dampers shall be provided with the shutter blades located outside the air stream (unless otherwise indicated). Each damper shall have a stainless steel curtain in all-welded galvanized steel casing with stainless steel side seal gaskets. The damper blade curtain shall be held in the folded position by a dual safe thermal actuator and fusible link.

All damper blades shall be tensioned to ensure instantaneous closure on thermal activation at 72^{0}C (unless specified elsewhere). A self-latching reset mechanism shall be provided for easy re-setting of the damper curtain.
On completion of the installation, the contractor shall be responsible for ensuring the inspection and testing of all fire dampers installed are carried out. Upon completion of the tests, the certificates must be issued for confirming that the dampers have been inspected and that they function correctly in accordance with the manufacturer's data sheets.

Access panels with chains shall be provided adjacent to the access side of all fire dampers.
In no instances shall flexible duct connections be allowed onto fire dampers through walls or floors.
Approved flexible connectors for breakaway joints, or duct expansion in case of fire, may be used in association with fire dampers.
Provide local external visual indication of fire damper blade position, unless indicated otherwise.

3072 SMOKE CONTROL DAMPERS:
Smoke dampers shall comply with DW145 and relevant parts of DW144.

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Types to be as identified elsewhere in the particular specification, schedules or on drawings. For control requirements refer to Y30sch3, Y30sch4 and work section W60.
Manufacturers to confirm that where required smoke control dampers have been aerodynamically tested in accordance with BS EN 1751 and where required determination of sound power levels to be by measurement in a reverberation room in accordance with BS EN ISO 5135.
Smoke dampers shall be supplied and fixed in accordance with the manufacturer's recommendations and installation methods with installation mounting frames which conform to the prevailing Building Regulations (ADB) and are acceptable to the District Surveyor/Building Control Officer and Fire Officer and are generally in accordance with DW 145. The proposed installation method must be supported by a valid test report or assessment provided by an approved third party notified body.

The construction shall allow for all additional framing supports, bracing and fire stopping as may be necessary to adequately attach/install the smoke dampers to the structure. The assembly is to be approved by the Building Control Officer/District Surveyor and Fire Officer.
Smoke control dampers to be in accordance with BS EN 12101-8, tested for fire resistance to BS EN 1366-10 and classified in accordance with BS EN 13501-4.

Smoke control dampers placed on the market and intended to operate as part of a pressure differential system or smoke and heat control system to be in accordance with BS EN 12101-8.

Smoke dampers shall be of the single blade or multi-blade type as indicated elsewhere in this specification. Damper blades shall be mechanically connected to an actuator to hold the blades in either the open or closed position dependent on the control mode chosen.

On completion of the installation, the contractor shall be responsible for ensuring the inspection and testing of all smoke dampers installed are carried out. Upon completion of the tests, the certificates must be issued for conforming that the dampers have been inspected and that they function correctly in accordance with the manufacturer's data sheets.

Access panels with chains shall be provided adjacent to the access side of all smoke dampers (additional access may be required for cleaning purposes and should be supplied if necessary).
In no instances shall flexible duct connections be allowed through walls or floors. Approved flexible connectors for breakaway joints, or duct expansion in case of fire, may be used in association with smoke dampers.

Provide local external visual indication of smoke damper blade position, unless indicated otherwise.

Where scheduled, provide a linee type interlocking opposed blade design mechanism to the dampers to prevent the blades from being re-opened due to air pressure and ensure the damper does not rely on the actuator to hold the blades closed. When fitted with an actuator with failsafe close, the damper blades will close and the damper only opens again if the power is restored to actuator or if the actuator has an override hand operation.

3082 COMBINATION FIRE/SMOKE CONTROL DAMPERS
Installation of Combination fire/smoke dampers shall comply with DW145 and relevant parts of DW144.
Manufacturers to confirm that where required smoke control dampers have been aerodynamically tested in accordance with BS EN 1751 and where required determination of sound power levels to be by measurement in a reverberation room in accordance with BS EN ISO 5135.
Types to be as identified elsewhere in the particular specification, schedules or on drawings. For control requirements refer to Y30sch3, Y30sch4 and work section W60.
Combination smoke and fire dampers shall be supplied and fixed in accordance with the manufacture's recommendations and installation methods which conform to the prevailing Building Regulations (ADB) and are acceptable to the District Surveyor/Building Control Officer generally in accordance with DW145. The proposed installation method must be supported by a valid test report or assessment provided by an approved third party notified body.
The construction shall allow for all additional framing supports, bracing and fire stopping as may be necessary to adequately attach/install the fire dampers to the structure. The assembly is to be approved by the Building Control Officer/District Surveyor and Fire Officer.

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Each combination smoke and fire damper and associated installation method shall have at least the same standard of fire integrity as the wall or floor through which the duct passes.
The classification of combination fire and smoke dampers is to be in accordance with BS EN 13501-4 and shall have an integrity classification 'E' to meet that of the wall or floor supported

When a fire integrity of 4 hours is required, either two dampers (classified E120, ES60 (min) factory assembled in series (if acceptable to the local authority) or a single damper having a classification E240, ES60 (min), may be used.
To achieve these classifications, fire resistance tests shall be in accordance with BS EN 1366-2 and BS EN 1366-10 undertaken by a notified body.
Combination fire and smoke dampers tested ad-hoc to BS 476-20 and BS 476-22 shall be permitted only under conditions where the Building Regulations (ADB) specifically allow. This requirement shall be confirmed before supplying such tested product.

Combination smoke and fire dampers shall be of the single blade or multi blade type as indicated elsewhere in this specification. Damper blades shall be released from their open position by means of either a thermal release device rated at a temperature indicated elsewhere in this specification, or via a mechanical actuator connected to a smoke alarm or control system, or a combination of both dependent on the control mode selected as scheduled.
On completion of the installation, the contractor shall be responsible for ensuring the inspection and testing of all combination smoke and fire dampers installed are carried out. Upon completion of the tests, the certificates must be issued for conforming that the dampers have been inspected and that they function correctly in accordance with the manufacturer's data sheets.
Access panels with chains shall be provided adjacent to the access side of all combination smoke and fire dampers.
In no instances shall flexible duct connections be allowed through walls or floors. Approved flexible connectors for breakaway joints, or duct expansion in case of fire, may be used in association with combination smoke and fire dampers.
Provide local external visual indication of combination smoke and fire damper blade position, unless indicated otherwise.
Where scheduled, provide a linee type interlocking opposed blade design mechanism to the dampers to prevent the blades from being re-opened due to air pressure and ensure the damper does not rely on the actuator to hold the blades closed. When fitted with an actuator with failsafe close, the damper blades will close and the damper only opens again if the power is restored to actuator or if the actuator has an override hand operation.

3852 **PRESSURE CONTROL FLAPS, STAINLESS STEEL FRAMES:**
Supply pressure control flaps as indicated on drawings or as scheduled. Supply flap and adjustable balance weight assembly manufactured from stainless steel. Construct wall mounting casings from stainless steel or nylon coated mild steel unless otherwise indicated.
Set the balance weight assembly on flap to control at pressure required.

3853 **WALL MOUNTED PRESSURE RELIEF DAMPERS:**
Provide wall mounted dampers with subframe. Supply frames made from galvanised sheet steel and blades made from aluminium unless otherwise indicated.

3854 **DOOR MOUNTED PRESSURE RELIEF DAMPERS:**
Provide door mounted dampers with subframe. Supply frames made from extruded aluminium section with aluminium or PVC blades unless otherwise indicated.

3855 **SHUT OFF DAMPERS:**
Supply shut off dampers to give shut off of 100%.
Manufacture from sheet steel coated with polyurethane lacquer, suitable for either pneumatic, electro-pneumatic or electric/electronic control as required by the control system.

3856 **NON RETURN DAMPER:**
Supply non-return dampers where indicated/specified. Manufacture with galvanised sheet steel frame and aluminium blades.

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3101 **FLEXIBLE DUCTWORK: (NES 3100 & 4015 merged)**
Supply flexible ductwork, insulated to same standard as used for the main distribution ductwork in accordance with DW/144. Installation to comply with BSRIA Guide BG43 – Flexible Ductwork.
Material – Aluminium/Polyester laminate encapsulating high tensile steel wire helix.
Insulated ducts to have inner core of aluminium/Polyester laminate encapsulating high tensile steel wire helix, with mineral wool insulation and an outer core of aluminium and polyester laminate. Insulation
Building Control and Fire Officer Approvals shall be obtained for the use of the flexible ductwork to be installed.
Comply with BS EN 13180 and provide a test certificate proving compliance with the mechanical characteristics of this standard.
Flexible ductwork used to make final connection between distribution ductwork and terminal units and from terminal devices to supply grilles, it must be kept as short and straight as possible and shall not be used to take up gross misalignment. Maximum length of flex to be three diameters or 1m, whichever is the smaller.
Where the flexible ductwork is to be insulated, this shall be Class "O" fire rated.
The maximum frictional resistance to airflow per unit length of the flexible duct shall be agreed with the Designer. The radius ratio R/D for bends shall not be less than 2 where R is the centre line radius and D is the diameter of the flexible duct.
The flexible ductwork shall be to a standard of air tightness equal to that of the ductwork, and constructed to meet the fire precautions recommended in BS 9999 which comprise:-
Ductwork and insulation to have a test certificate proving reaction to fire performance requirements of BS 9999. Materials to conform to Euroclass A1 as specified in BS EN 13501 or when tested to BS 476-6 has a fire propagation index of not more than 12 and a sub-index of not more than 6.
Materials shall not produce smoke or toxic fume hazards if involved in a fire.
Support rings to be sized so as not to constrict the cross-sectional area of the ductwork. Duct support ring minimum width – 25mm.
Flexible ducts to overlap rigid duct or terminal device spigot by a minimum of 50mm
Make a seal between flexible duct and rigid connection using mastic sealant or duct tape.
Use a mechanical fixing for connection using a duct band.

3111 **FLEXIBLE JOINT CONNECTIONS**
Supply and install flexible joints as detailed in relevant parts of DW 144 or DW 154 as appropriate. Comply with relevant parts of BS 476.
All flexible joint connections shall comply with current Building Regulations regarding the spread of fire and smoke.
Position
Use flexible joints to make connections to:
Air diffusers, grilles and air registers,
On inlet and outlet connections to all fans or fan and attenuator assemblies,
At building movement joints, and
Elsewhere as indicated/specified.
On fans;
Flexible joints on fan connections shall be between flanged ends. The flexible material flange shall be backed by an angle or flat iron flange and the flexible joints shall be secured held between the metal flanges. Flat iron bands used with fan inlets shall be not less than 5 mm thick.
Flexible joints shall be equal in cross-section to the points of connection, not longer than 250 mm or less than 50 mm.
Properties
Flexible joints shall be "Neoprene" coated glass fibre or other materials excluding asbestos and have fire resistance properties of 30 minutes integrity. Class 1 surface spread of flame to BS 476: Part 7 and not produce smoke or toxic fume hazards if involved in a fire.

3120 **BIRD WIRE GUARDS:**
Fit bird screens of 12mm square mesh wire on all intake and extract louvres to atmosphere. Wire gauge to be not less than 1mm.
Finish, plastic coated wire.

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3130 **INSECT GUARDS:**
Provide insect guards where indicated scheduled.
Screens to be supplied in kit form for installation on site.
Material: Black PVC coated glass fibre mesh
Aperture size: 1.1x1.55mm
Weight: 155 g/m2
Free area: 62%

3132 **SPREADER PLATE:**
Provide duct mounted perforated inlet plate to humidifier sections to equalize air velocity over humidifier section.

3131 **SEALANTS GASKETS AND TAPES:**
For sealing materials and method of use comply with DW 144 Section B or DW 154 section B as appropriate. Gaskets or performed strips must be of an equivalent width to the faces of joint flanges. The use of self-adhesive tapes shall not be permitted. On circular ductwork chemical reaction sealing tapes may be used with the Designer's prior agreement. Sealants, gaskets and tapes shall be constructed using WRC approved sealants, gaskets, joints, adhesives etc, which will not support bacterial growth and which produce minimal fire or smoke hazards if involved in a fire, this to include attachments such as grilles etc.

3132 **SPLITTERS:**
Do not use splitters without obtaining written consent or unless the use of splitters is specifically specified.
Construct splitters in same gauge and material as enclosing ductwork and attach to duct as described in DW 144 Part 3.

3133 **TURNING VANES**
Use square bends with turning vanes in all cases for flat, oval and rectangular ductwork unless otherwise agreed in writing.

3135B **TURNING VANES-LOW AND MEDIUM PRESSURE**
Provide double skin aerofoil pattern turning vanes in low and medium pressure ductwork. Construct vanes from material similar to enclosing ductwork. Fasten turning vanes as described in DW 144 Part 3.

3135B **TURNING VANES-HIGH PRESSURE:**
Provide turning vanes of double skin aerofoil pattern in high-pressure ductwork, constructed from material similar to enclosing ductwork. Fasten turning vanes as described in DW 144 Part 3.

3141 **PRESSURE CONTROL FLAPS (Air pressure control valves)**
Supply pressure control flaps with flap and adjustable balance weight assembly manufactured from stainless steel. Construct wall mounting casings from stainless steel. Blades to pivot on sealed for life ball bearings.
Set the balance weight assembly on flap to control at pressure as indicated.

3151 **PRESSURE RELIEF DAMPERS:**
Wall mounted dampers with subframe.
Material
Supply frames made from Extruded aluminium section.
Supply blades made from Grade 304 stainless steel

3161 **SHUT OFF DAMPER:**
Supply shut off dampers to give shut off of 100%
Frame manufactured from galvanized sheet steel, blades to be double skin stainless steel with synthetic leading and trailing edge seals and double side seals suitable for electric/electronic control.

3171 **NON RETURN DAMPER:**
Supply non return dampers manufactured with galvanized sheet steel frame or aluminium alloy extrusions and aluminium blades supported on plastic moulded bearing surfaces

Ensure non return dampers in smoke handling systems have the required stability and integrity rating to match the system requirements.

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4000 **WORKMANSHIP**

4011 **GENERAL WORKMANSHIP:**

Install ductwork in accordance with DW 144, DW 154 and DW 191 as appropriate. Ensure that there are no sharp edges or corners on cut edges on ductwork, flanges and supports.

Unless indicated otherwise, the outermost surface of exposed ductwork or insulation shall be not less than 100mm away from walls and ceilings to permit access for cleaning.

Ductwork shall be constructed such that all internal surfaces are generally smooth and will not normally retain moisture.

Ductwork shall be run generally parallel with walls and ceilings in order to circumvent building projections (or pass through structures where permitted) as shown on the drawings.

Internal roughness and obstruction to airflow (other than dampers, vanes etc) or sharp edges of corners on the outside of ductwork, flange supports etc shall not be accepted.

Weatherproof collars shall be provided where roofs or external walls are penetrated.

Attention shall be paid to the making and sealing of joints in ductwork, particularly where these occur on the blind side of a duct or are subsequently obscured by other parts of an installation or building fabric etc.

Install pre-insulated ductwork in accordance with manufacturer's instructions.

4015 **PROTECTIVE FINISHES:**
Comply with DW 144 for provision of protective finishes to ductwork. Make good welding damage..
Paint all bare edges and bare metal with two coats of zinc rich paint.
Provide any other special finishes as defined.

4021 **HANGERS AND SUPPORTS WORKMANSHIP:**
Support ductwork in accordance with DW 144, DW 154 Part 5; or DW 191 as appropriate.
Where insulation of ductwork is specified, install supports to ensure that the insulation can be easily applied and (where applicable) that integrity of vapour seal can be maintained. When installing vapour seal insulation blocks at supports, ensure there is complete vapour seal around the block prior to fixing the bracket. Blocks shall be the same thickness as the insulation and be of sufficient length either side of the support so as to enable vapour sealing on to the block. (Vapour sealing must not incorporate the bracket).

The Contractor shall purpose design supports for diagonally or vertically run ducting or shafts and other particular applications.

Where ducts or shafts are outside buildings or protective enclosures, and Local Authority regulations apply –
a) Submit detailed fabrication drawings to the Local Authority.
b) Obtain written evidence of Local Authority approval.
c) Submit drawings and evidence of approval to the Designer.

Where cantilever brackets or other special forms of support are required they shall be structurally strong enough to take the load and to transfer the imposed load to the building structure. Provide details of the loads imposed on the structure to the Structural Engineer.

The ductwork hangers shall be galvanised, adjustable and have, between the hanger and the ductwork, a gasket to prevent metal to metal contact.

Shot fired fixings shall not be permitted.

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Bright zinc plated drop rods, nuts, bolts and washers shall be used on all supports.

All bearers shall be galvanised or zinc rich finish.

Two piece band clips, galvanised or zinc rich finish shall be used on circular ducts. Fig 65 (with drop rod) shall be used whenever applicable.

Flat oval ductwork – only Fig No 71 shall be permitted. Galvanised or zinc rich finish shall be used.

After all installation work is complete, cut back drop rods to ensure that projection through bottom bearer does not exceed twice the thickness of the securing nut.

On all cold services (i.e. below 15 degC), a vapour seal is required (including air inlets and downstream of heat reclaim coils). Ensure continuity of vapour barrier over ductwork support.

4822 **APPEARANCE OF DUCTWORK SUPPORTS:**
Cut off protruding ends of hanger rods and bolts close to nuts. Ensure that supports and drop rods are clear of ducts and not enclosed in thermal insulation, as DW 144 Section 19.6.

4823 **PROPRIETARY SUPPORTS:**
Use proprietary system of ductwork supports as appropriate. Obtain prior agreement from Designer of system to be used.

4825 **COMPONENT SUPPORT ON PRE-INSULATED ALUMINIUM DUCTWORK:**
Support ducts with dimensions less than 1m at intervals of no more than 4m. Support ducts with dimensions over 1m at intervals of no more than 2m. Provide independent support for all accessories.

4841 **EXTERNAL DUCTWORK AND SUPPORTS:**
Comply with BESA DW 144 section 26 protected from the elements by a waterfight membrane installed immediately after the ductwork has been installed unless scheduled otherwise.
Where all welded construction is required (as scheduled), use black mild steel sheet, galvanised after manufacture as BESA DW144 Appendix C.
All welded external ductwork shall be constructed from mild sheet and sections, minimum thickness 1.0mm and shall be galvanised after manufacture. All ductwork shall be flanged and all nuts, bolts and fixings shall be bright zinc plated.

All supports shall also be constructed from mild steel sections and shall be galvanised after manufacture. Submit proposals to Designer and Structural engineer for comment.
Particular care shall be taken in selecting structural fixings that will provide a life cycle appropriate to the buildings intended use. All supports and fixings shall comply with Local Authority requirements. Obtain approval from the Local Authority where required.

4850 **DUCTWORK FLOOR SUPPORT**
Submit proposals to Designers for comment.

4854 **AIRWAY OBSTRUCTIONS**
Fit and secure rigid sheet metal fairings which are shaped to form rounded leading edges on the 'Upstream' ends, and tapered trailing edges on the 'Downstream' ends of obstruction.

4855 **DUCTWORK VIBRATION ISOLATION**
Ensure that ductwork does not come in direct contact with building fabric except in cases of fire dampers, silencers and builders frames. Isolate all supporting members/bearers from ductwork; secure lining of 6mm thick rubber, PVC or felt strip to support by means of adhesive.

4856 **ACCESSORY SUPPORT:**
In accordance with DW 144 Part 8 for supporting ductwork ancillaries. Submit details of supports to Designer for agreement.
Provide additional supports adjacent to dampers, diffusers and other items of equipment as necessary to prevent distortion.

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4861 **DRAINAGE OF DUCTWORK:**
Arrange ductwork to drain any entrained moisture and ensure the lapping of joints prevents moisture leakage.

4871 **CONNECTIONS:**
Plant connections
Make connection between air handling assembly and ductwork system in accordance with DW 144 and manufacturers recommendations.
Connections to building openings
Comply with DW 144 Appendix K or DW 154 Part 8 as appropriate.

4880 **EXPANSION JOINTS - PLASTIC DUCTS:**
Provide expansion joints in accordance with DW 154

4881 **INTERNAL CLEANLINESS:**
Provide the level of care and protection as defined in BESA document TR/19, level as scheduled. Where level is not otherwise specified or scheduled, supply and recirculation systems are to be Advanced PDI level; extract systems are to be Intermediate PDI level.

Seal all open ends as installation proceeds by caps or blank flanges, to prevent ingress of foreign matter.
Cap material
Metal.
or Plastic.

Unless scheduled otherwise for installations to Advanced PDI level (and elsewhere as specified), all ductwork shall be thoroughly cleaned immediately prior to handover in accordance with TR/19 2013, using dry vacuum cleaners or a combination of the methods outlined in table 8 in TR/19 to ensure that no traces of dust, dirt or other foreign matter are present in the systems. To facilitate this requirement, provide cleaning access openings and covers in ductwork at intervals such that no point in the ductwork is more than 5 metres from an opening and elsewhere as required by TR/19. The location of the openings shall be selected by the contractor. Confirmation of the acceptability of the solution shall be obtained from a specialist cleaning contractor.

Comply with TR/19 section 7 and DW/172 in relation to kitchen extract systems.

4882 **WET METHOD OF CLEANING:**
Where specifically scheduled, the method of cleaning in accordance with the BESA Guide TR/19 - Wet cleaning, Table 8 shall be used.

The system should be thoroughly dried prior to commissioning/de-commissioning to prevent moisture assisting in the growth of micro-organisms.
A risk assessment must be carried out before any cleaning chemicals or biocides are considered. The details of any such chemicals or biocides must be recorded and any adverse effects of the applied chemicals assessed and determined, with appropriate safe procedures set out in a formal method statement.
Steam cleaning and high pressure watewash are not recommended for ductwork that is situated above ceilings or in sensitive areas unless carried out in a controlled manner to contain leakage. Procedures to take account of operative safety must be adopted, and should be set out in written form.
Careful consideration should be given to the use of chemicals and/or water for surfaces that are porous e.g. internally-lined ductwork, attenuators, fibre board ductwork, attenuators, fibre board ductwork etc., to prevent permanent damage.
Before applying wet cleaning methods care should be taken that condensed vapours and cleaning fluids can be removed from the ductwork system.

4901 **WEATHERPROOFING**
Fit ductwork with trimming angle and weather cravat, skirt, flashing plate and cowl where ductwork passes through or terminates in roof, to ensure a weatherproof seal to building structure.

4911 **DUCTWORK SLEEVES:**
Enclose ducts passing through building elements, (walls, floors, partitions, etc.) within purpose made sleeves. Cut sleeves of the same material as the duct and pack with mineral fibre or similar

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non-flammable and fire resistant material to form a fire/smoke stop of adequate rating and to prevent air movement and noise transmission between duct and sleeve.
Provide enclosing flanges on either side of wall where ductwork is exposed in rooms. Fix enclosing flanges back to wall to give a neat appearance.
Where finished insulation is carried through duct sleeves pack space between insulation finish and sleeve to form fire stop.

4121 **FIRE RATED DUCTWORK SLEEVES:**
Ensure fire rated ductwork sleeves, when required, are installed to the manufacturer's requirements.

4125 **EXPANSION AND CONTRACTION**
When installing long runs of air ducting, give attention to the direction of expansion or contraction movement due to thermal changes. Take up movement by flexible inserts.

4127 **MOVEMENT AND NOISE**
Prevent undue ducting movement, with consequent noise, by separating metallic contact surfaces with packing material, and interpose auxiliary flexible joints and anchoring supports along with ducting runs.

4131 **INSTALLATION OF CONTROL EQUIPMENT**
Fit sensors, damper motors and other control equipment as required. All control equipment should be installed to manufacturers or specialist supplier's requirements. The installation must be checked by the manufacturer or specialist supplier, and rectified as necessary

4141 **INSTRUMENT CONNECTIONS:**
Provide instrument connections as necessary.

4151 **FIRE PRECAUTIONS:**
Install fire dampers, smoke dampers and fire/smoke dampers as necessary to meet the fire compartmentation of the project. Refer to architects drawings for fire compartmentation.

4160 **DAMPER ACCESS:**
Ensure access is provided to damper mechanisms on fire dampers; smoke dampers; combined smoke and fire dampers; and volume control dampers through access doors, false ceilings etc.
Demonstrate that damper blades close completely.

Demonstrate that fire links can be replaced. Where more than one fire damper is installed in a frame ensure access is provided to all fire dampers.

4171 **POSITIONING:**
Position components in accordance with manufacturer's instructions as shown on the manufacturer's drawings or specialist supplier's drawings or specialist contractor's drawings as appropriate.

4181 **FLEXIBLE DUCTWORK, WIRE LOOP TIES:**
Ensure that flexible ductwork does not become kinked or flattened. Support flexible ductwork using wire loop tie supports to prevent sagging.

10000 Based on NES Y30 TEXT Sept 18

Y40 – Air Handling Units

1000 **GENERAL MECHANICAL PERFORMANCE, COMPONENT RATINGS / SELECTION**
Mechanical performance - BS EN 1886 (refer to schedule for casing strength, air leakage thermal transmittance and thermal bridging classifications and general acoustic performance)
General requirements, ratings and performance for units as a whole, components and sections in accordance with BS EN 13053.
Fit clean filters in all air handling systems (AHU's and any duct mounted units) before the fans SFP values are checked at commissioning. When clean filters are fitted check the specific fan power SFPv for calculation of the building as constructed CO_2 emission rate.
Heat exchangers and recovery equipment to comply with BS EN 305, BS EN 306, BS EN 307, and BS EN 308 as appropriate to the application.
For Healthcare applications comply with HTM 03-01. Should there be a conflict between this design guide and clauses in this specification HTM 03-01 shall take precedence.
Fans driven by electric motors with electric input between 125W and 500kW to comply with EC Regulation 327/2011 with regard to ecodesign requirements.
Comply with EU regulation 1253/2014 for small packaged ventilation units comprising fan(s), heat recovery system, filters and controls (or a combination of these components) up to 1000m³/hr with regard to ecodesign requirements.

1005 **LOCATION:**
Supply air handling units suitable for positioning as indicated.

1007 **DESIGN DUTIES FOR FANS IN AHU's:** (pick one)
Supply air handling units to meet air volumes and external resistances, as indicated.

Air Volume
Ensure scheduled volume is provided when operating against resistance of system corrected for changes between specified and selected component resistances.

System Resistance
Adjust scheduled resistance to compensate for actual resistance of selected components and any changes made by the contractor to the ductwork layout, quantities and types of bends etc from that indicated on the tender drawings

Operating Point
Select operating point on pressure/volume curve to provide stable and efficient operation. Fans shall be selected to give the lowest possible noise rating having regard to their duty and type.
Whenever possible the fan supplier shall select fans over the range of air flows where the efficiency is not less than 85 % of the optimum efficiency in accordance with Annex E in BS EN ISO 12759.

Guaranteed Performance
Provide fan performance figures in accordance with BS EN ISO 5801, BS 848-1 and BS 848-9, ISO 13348.

Quoted fan duties are based on pressure losses external to the AHU and on the equipment air side pressure losses as scheduled in Y40sch.

1010 **AIR LEAKAGE (CASING AND FILTER BY-PASS):**
Ensure air handling unit is sealed.
Unless scheduled otherwise the maximum AHU casing leakage rate shall be a function of the air filters within the air handling unit. Leakage rates at the test pressures defined in BS 1886 shall not exceed rates defined in the relevant tables within BS EN 1886. (Table 4 for 400 Pa negative test pressure and Table 5 for 700 Pa positive test pressure)
Filter bypass leakage, at 400Pa test pressure, shall not exceed the acceptable maximum % of volume flow rate defined in BS EN 1886 for the class of filter scheduled or detailed in the particular specification.
Provide special requirements as indicated or scheduled.

2000 **PRODUCTS/MATERIALS**

2021 **DOUBLE SKIN CASING AIR HANDLING UNITS:**
Outer skin material
Zinc coated steel hot dip galvanized to BS EN 10346 or BS EN 10143, or Plastic coated galvanized sheet steel unless otherwise indicated.
Inner skin material

Y40 – Air Handling Units

As outer skin

Outer and inner skin material

Construct double skin panels from proprietary building panels.

External casing / frame finish

Painted, three coats, with high quality gloss top coat colour to BS 4800 as indicated, or stove enamelled, unless otherwise indicated. If the manufacturer's proposals differ from this standard then details shall be submitted to the CA for comment prior to manufacture.

Internal casing / frame finish

Painted, three coats, with high quality gloss top coat colour to BS 4800 as indicated, or stove enamelled, unless otherwise indicated. If the manufacturer's proposals differ from this standard then details shall be submitted to the CA for comment prior to manufacture.

2838 AIR HANDLING UNIT CONSTRUCTION:

General construction

Construct unit to withstand maximum fan static pressure without plastic deformation.

Ensure panels do not deflect by more than the values given in table 2 of BS EN 1886 when in operation at the maximum fan pressure at selected design fan speed. Refer to schedule Y40 for class.

Casing Class D1 - 4mm/m maximum relative deflection.

Casing Class D2 - 10mm/m maximum relative deflection

Use corrosion resistant fastenings throughout.

Do not use self tapping screws.

Provide panel gaskets to give a durable seal between panels and frames to prevent excessive air leakage.

Construct frame to prevent cold bridging and the risk of surface condensation when there are large temperature differences between inside and outside or when the air handling unit is located externally.

Stacking or vertical units

Configuration to be as scheduled. Strengthen framework to support additional weight.

Casing thermal performance

Ensure the casing thermal performance is tested in accordance with the requirements of BS EN 1886.

Thermal transmittance U of the casing shall be classified in accordance with Table 8 of BS EN 1886. - Refer to schedule Y40 for class required.

Thermal bridging factors Kb shall be classified in accordance with Table 9 of BS EN 1886. Refer to schedule Y40 for class required.

Casing acoustic performance

Ensure that the sound insertion loss of the unit is determined in accordance with BS EN 1886

Casing Insulation

Ensure insulation complies with BS 476 parts 6 & 7. Where extract sections are used for high temperature smoke extract mineral wool shall be used. Ensure insulation is fixed securely to panel and protected to prevent migration of fibre into air flow. Insulation shall provide thermal and acoustic treatment. Insulation to be inorganic, vermin proof and non-hygroscopic. Provide insulation to achieve acoustic performance as indicated and meet the requirements of Y50 (ductwork)

Ensure insulation is vapour sealed throughout and incorporate thermal breaks

Framework

Ensure framework is self-supporting and rigid enough to prevent distortion during transportation and final assembly on site.

For vertical units strengthen framework to support additional weight

Frame construction shall be welded, rolled or extruded with purpose made corner joints or pentapost type frame with purpose made corner joints.

If frame is welded ensure welds are ground flush and painted with an appropriate protective paint.

Insulate framework if it is considered that there is a risk of surface condensation.

Provide formed or RSC base with unit.

Ensure unit satisfies the fire protection criteria given in BS EN 1886.

Ensure unit satisfies the mechanical safety criteria given in BS EN 1886.

Casing finish to be as clause 2021

2841 AIR HANDLING UNIT ACCESS:

Y40 – Air Handling Units

Provide access openings and covers complete with opening devices, and sealed to prevent air leakage. Ensure seals are designed for normal maintenance operations for a minimum of 10 years.

Provide hinged access doors, 400mm minimum width.

Operating device

Lockable tee bar handles, or levers.

Provide access openings to fans, damper sections, filters, coils, inspection chambers, humidifiers, and additionally as indicated (access openings to humidifiers to have vision panel).

Permanent Access Platforms for double deck AHU's

Where top of upper deck is 3m above FFL of general access area, design, supply and install permanent maintenance access platforms for double deck AHU's complete with handrails and toeboard / kick plate on all open sides of the platform, details as scheduled. Where access ladders are incorporated , they shall comply with BS 4211.

Platform and means of access to comply with Work at Height Regulations 2005 and relevant parts of BS EN ISO 14122

Materials – galvanised steel, with open mesh flooring.

2842 LIGHTING

Provide a suitably IP rated bulkhead light (compact fluorescent type) in each of the access and fan sections. Lights to be switched by a switch mounted on the side of the unit.

Provide all wiring as part of AHU package. Wire separately to Fan Motor. Terminate in a terminal box mounted on the unit. Power supply to the lighting shall be provided by the Controls Specialist from separately fused ways in the nearest MCC or distribution board within the plant room.

2850 WALK – IN AIR HANDLING UNITS:

Ensure floor is double skin with internal framework to support weight of two men, tools and equipment.

Provide weatherproof bulkhead luminaries and switches.

Provide non slip floor surface

Ensure access doors can be operated from inside and outside.

Provide walkways in units over 2m high.

2851 EXTERNAL AIR HANDLING UNITS:

Construct air handling units for external use. Ensure casing is sealed with a permanently elastic sealing compound.

Provide weatherproof isolators.

Provide connection for lightning protection.

Provide sealed, pitched roof, extended beyond outer edges of unit case. Arrange unit to shed water from roof in a controlled manner.

3808 ACCESSORIES/COMPONENTS

3811 FAN SECTION:

Generally

Comply with the requirements of Y41 and Y92. Provide fan aerodynamic performance tests in accordance with BS EN ISO 5801, BS 848-1; noise tests in accordance with BS EN ISO 5136 and Parts 1-4 of BS ISO 13347; fan vibration measurements in accordance with BS ISO 14695 and balancing and vibration measurements in accordance with BS ISO 14695.

Fans for use in potentially explosive atmospheres / flameproof zones to be in accordance with BS EN 14986 and relevant parts of BS EN 13463 or BS EN ISO 80079 and relevant parts of BS EN IEC 60079 / BS EN 60079 series and be compliant with the ATEX directive.

Provide frame for motor and fan and comply with fire regulations. Ensure frame is isolated from casing.

Mount motor internally (or externally if so indicated).

For blow through units, ensure air flow in downstream sections of unit have relatively uniform velocity profile.

Supply fan guards to BS EN ISO 12100 and BS EN 13857

Accessories

Provide flexible connection between fan discharge and casing spigot. Ensure flexible connections comply with fire regulations.

Provide manometer connections to measure static pressure at fan inlet eye.
Provide manometer connections to measure static pressure at fan discharge, and additionally as indicated.

Anti-Vibration mounts
Provide anti-vibration mounts with a minimum of 25mm static deflection to isolate fan & motor from the casing

Drive
Direct, or belt driven as scheduled.
Provide belt driven fans with two or more belts. For each belt driven fan provide a change of belts and drives (to be sized after balancing the system). Allow for changing belts and drives and recommissioning fan and rechecking system as necessary.
Fit variable speed drives to all fans rated at more than 1.1kW and as scheduled.
Provide fan guards to fan motors

3820 **FILTER SECTION:**
Provide frames to allow withdrawal of filters.
Panel and bag filters shall be replaced with new, after commissioning and before the AHU SFPv (Specific fan power) is checked for Building Regulations Part L compliance. Filters shall be constructed such that no harmful fibres are carried out into the airstream.
Panel filters shall be constructed from water resistant materials.
Filters and frames in gas fired units shall be capable of withstanding temperatures that could result following a power failure or air flow failure (ie no run of fan).
Surfaces of air filters should be inherently non-flammable or so treated as to make them non-flammable for the duration of their recommended working life.
Classification of filters for general ventilation to be to BS EN 779 or BS EN ISO 16890-1 as scheduled.

3831 **HEATER BATTERIES:**
Provide slide rails to allow each coil section to be removed independently for access.
Fit baffle plates to prevent air bypass of coil.
The maximum air velocity through coils shall not exceed 4m/s
Rated performance shall be rated in accordance with BS EN 1216

3832 **GAS FIRED HEATING SECTION** [redacted]
Duty and details as scheduled.
Provide gas heater section comprising single or multiple indirect gas fired heaters manufactured with a tubular heat exchanger mounted in a steel support frame. The burner assembly to be complete with gas valve, burner relay, ignition and flame sensing rod, fan control relay, high and low limit thermostat. Unit shall be complete with induced draft combustion air fan. The unit shall be complete with a control panel incorporating all safety features and BMS interfaces as scheduled on the Controls diagrams (CON drawings).

Heaters to be installed within a suitable air handling unit section and include a separate section to contain the gas heater controls, induced draft fan and flue system. The section to be completely sealed from the ventilation air section and be complete with combustion air inlet hood and a lockable hinged access door. A blank panel shall be provided above the access door to accommodate the flue pipe connection. With an external weatherproof air handling unit the blank panel shall also contain flue discharge terminal complete with a mesh safety guard.

Unless scheduled otherwise supply stainless steel multi-wall metal system chimney up to 1200mm diameter in accordance with BS EN 1856-1 tested in accordance with the test methodology in BS EN 1859 and BS EN 13216 as appropriate.
Install factory-made chimneys to BS EN 1856-1 in accordance with BS EN 15287-1 and manufacturer's instructions and recommendations.
Minimise the number of joints, do not locate joints in depth of floors. Install with any sockets facing upwards.
Fill joints with approved jointing compound to give gas tight seal.
Install non vertical runs at not more than 45° from the vertical.

Materials
Heat exchanger: Aluminised steel for recirculation units
Stainless steel for full fresh air applications
Controls
Modulating capacity control. The heater shall be interlocked with the supply fan to shut down on air flow failure.

Heater bypass air section complete with manual locking damper to be supplied by air handling manufacturer or as part of the heater unit supplied and fitted by the heater manufacturer.

Gas heaters to be commissioned by the heater manufacturer or specialist agent.

3841 **COOLING COIL SECTION:**
Provide slide rails to allow each coil section to be removed independently for access.
Water shall not be carried over from the cooler into the airstream.

Incorporate drip trays with drains to both coil and headers.
The maximum air velocity through coils shall not exceed 2.0m/s, if eliminator not provided.
The velocity shall not exceed 2.5m/s with an eliminator fitted.
Rated performance shall be rated in accordance with BS EN 1216

3842 **PLATE HEAT EXCHANGER (RECOUPERATOR):**
Refer to clause Y43 2072 for materials and workmanship requirements
Minimum dry heat recovery efficiency – 50% (actual energy transferred / maximum possible energy transfer) unless scheduled otherwise.
Internal leakage < 1%
Limiting pressure drop < 250Pa

3843 **THERMAL WHEEL:**
Refer to clause Y43 2073 for materials and workmanship requirements
Minimum dry heat recovery efficiency – 65% (actual energy transferred / maximum possible energy transfer) unless scheduled otherwise.
Internal leakage < 5%
Limiting pressure drop < 200Pa

3844 **RUN AROUND COILS:**
Refer to clause Y43 2071 for materials and workmanship requirements
Minimum dry heat recovery efficiency- 45% (actual energy transferred / maximum possible energy transfer) unless scheduled otherwise.
Internal leakage < 1%
Limiting air side pressure drop across each coil < 100Pa
Limiting water side pressure drop < 25kPa
Rated performance shall be rated in accordance with BS EN 1216

3845 **DETAIL SPECIFICATION OF COMPONENTS:**
For further details of:
Filters see Y42 and AHU schedule
Coils and heat recovery equipment see Y43
Humidifiers see Y44
Attenuators see Y45
Louvres Y45 (acoustic) and Y48
Vibration isolation Y52.

3851 **DRAINAGE FROM AIR HANDLING UNIT COMPONENTS:**
Provide drainage pipework from cooling coils, humidifiers and components where water may collect. Comply with recommendations in CIBSE Technical Memorandum TM13 in connection with Legionnaires' disease. As a minimum
Provide the following:

Y40 – Air Handling Units

Drain pans shall be fitted under cooling coils and Humidifier, laid with a minimum fall of 1 in 20 in all directions towards a bottom drain connection. Side drain connections shall not be acceptable.
Drain pans shall be removable for cleaning.
Traps shall be in glass unless otherwise indicated.
A space of not less than 600mm shall be provided on either side of cooling coils and humidifiers to facilitate inspection, cleaning and maintenance.

Removable walkways shall be provided over flooded chambers.
All ferrous metal surfaces shall be treated to prevent corrosion.
Eliminator plates, where provided, shall be withdrawable for cleaning.
No materials which support bacterial growth shall be used in any of these assemblies. Such materials include some jointing compounds, rubber, mastic, wood and some plastics.
On all cooling coils provide drain trap of at least twice working air pressure in depth.

Provide an air break between trap outlet and drainage system. Pipe each trap to drain via a tun-dish or pipe each trap separately to discharge over a gully to prevent the potential of cross contamination between AHU's.

3855 **HUMIDIFIER SECTION:**
Provide humidifier section as indicated.
: Ensure casing is specially treated for moisture.
For vertical air handling units ensure that eliminators and drainage are correctly arranged on humidifiers.

3861 **CONTROL DAMPERS:**
Provide control dampers in accordance with DW 144.
Control damper type
Iris dampers, Multi-leaf dampers, or as otherwise indicated.
Section
Double skin section, unless otherwise indicated.
On large dampers arrange as multiple sections with individual actuators, to ensure correct operation.
Blades
Double sealed opposed blade, unless otherwise indicated.
Ancillaries
Position indicator, Locking device, and as indicated.
Motorized control dampers
Provide control dampers complete with extended spindle, and motor, motor linkage and motor support (details to be agreed with the specialist Controls supplier), unless otherwise indicated.
Ensure damper motors are selected to match torque rating of dampers.

3871 **CONTROLS:**
Provide control panels where required and detailed in the schedules or scope of works.

3881 **FACTORY INSTALLED ACCESSORIES:**
Provide the following in addition to scheduled items

protected wireways for power, lighting and control wiring.

external terminal boxes for all electrical components.
mounting plates for control and sensing devices.
internal access platforms to components above 1.8 metres.
vision panels to humidifier sections and as indicated.

4000 **WORKMANSHIP**

4011 **COMPONENT ASSEMBLY:**
Make up air handling units from standard modular components assembled such that air cannot by-pass active components and airflow is even throughout unit.
Assemble air handling units using gasket to prevent air leakage from casing.
Site drilling
Do not carry out any site drilling without prior agreement.

Y40 – Air Handling Units

4020 **ACCESS:**
Ensure air handling units are positioned to allow adequate space for maintenance and access.

4030 **HUMIDIFIER INSTALLATION:**
Comply with manufacturer's installation instructions for steam electrode type of humidifier.

4040 **DUCT CONNECTIONS:**
Ensure air is straightened as it leaves unit discharge. Ensure ductwork connection is long enough to ensure the aerodynamic performance of the fan is not affected.

4050 **SERVICES CONNECTIONS:**
Ensure panels are sealed around electrical cable and pipework service entry points to prevent air leakage. Provide flexible cables between fan motor and local isolator.

4060 **ISOLATION OF UNITS:**
Provide: means of isolating air handling units electrically to allow maintenance and repairs to be carried out.
means of isolating pipework to air handling units to allow maintenance and repairs to be carried out.
means of isolating steam to humidifier when access door is opened.

4071 **DRAINAGE OF FREE WATER:**
Make provision for free water to be caught, collected and drained away.
Provide U-traps on all drains having a minimum depth of twice the maximum negative/positive pressure created by the fan. Allow for turbulence in the trap when selecting it.
Provide traps with a facility to allow the "topping up" of dry traps.

4081 **SUPPORT AIR HANDLING UNIT**
On builders work base, unless otherwise indicated.

4091 **FACTORY TESTS:**
Carry out tests at the factory as scheduled.
Factory tests can be tests undertaken by the manufacturer on a type basis.
Tests shall be in accordance with BS EN 1886 and BS EN 13053
Air flow performance test in accordance with BS 5583.

4101 **TESTING PRIOR TO INCORPORATION IN WORKS:**
Carry out testing to measure the parameters as scheduled
Tests shall be in accordance with BS EN 1886 and BS EN 13053.
Air flow performance test in accordance with BS 5583.

10000 Based on NES version Y40TEXT Dec 18

Y41 – Fans

1000 **GENERAL**
Standards
Provide fans manufactured and tested in accordance with appropriate British Standards.
With regard to safety requirements, comply with BS EN 60335-2-80 where applicable.
Fans for smoke and heat control to be in accordance with BS EN 12101-3
Fans for use in potentially explosive atmospheres / flameproof zones to be in accordance with BS EN 14986 and relevant parts of BS EN 13463 or BS EN ISO 80079 and relevant parts of BS EN IEC 60079 / BS EN 60079 series and be compliant with the ATEX directive.
Inline and chimney outlet exhaust fans to comply with BS EN 10475-2
Kitchen extract fans to comply with BESA DW / 172.

Fans driven by electric motors with electric input between 125W and 500kW should comply with EC Regulation 327/2011 with regard to ecodesign requirements.
Comply with EU regulation 1253/2014 for small packaged ventilation units comprising fan(s), heat recovery system, filters and controls (or a combination of these components) up to 1000m³/hr with regard to ecodesign requirements.

1005 **APPROVED FIRMS:**
Select fans from Quality Assured firms registered under CAME scheme, unless otherwise indicated.

1011 **DESIGN DUTIES:**
Air Volume
Ensure scheduled volume is provided when operating against resistance of system corrected for changes between specified and selected component resistances.
System Resistance
Adjust scheduled resistance to compensate for actual resistance of selected components and any changes made by the contractor to the ductwork layout, quantities and types of bends etc from that indicated on the tender drawings
Operating Point
Select operating point on pressure/volume curve to provide stable and efficient operation. Fans shall be selected to give the lowest possible noise rating having regard to their duty and type.
Whenever possible the fan supplier shall select fans over the range of air flows where the efficiency is not less than 85 % of the optimum efficiency in accordance with Annex E in BS EN ISO 12759.
Guaranteed Performance
Provide fan performance figures in accordance with:
BS EN ISO 5801 for all types except those designed solely for air circulation.
BS 848-9, ISO 13348 for tolerances, methods of conversion and technical data presentation.
BS EN ISO 13350 for testing of jet fans.

Quoted fan duties are based on pressure losses external to the fan unit and on the equipment air side pressure losses as scheduled in Y41sch.
Before ordering the fans, the contractor shall adjust the fan static pressures to suit pressure drops of actual components used in the systems
Adjust fan heads if changes are made to ductwork routing or arrangement in preparation of installation drawings or details.
Quoted fan duties include the following commissioning allowances:-

	Low Pressure Systems	Medium & High Pressure Systems
On Flow Rates	10 %	5%
On Head	20%	15%

Allow for a pulley and belt change on belt driven fans and impeller change or angle adjustment on direct drive fans.

1020 **PROTECTION:**
Protect casings, impellers and shafts against corrosion. Protect bearings against dirt and moisture.

Y41 – Fans

1051 **FAN MOTORS**
Comply with reference section Y92 clauses.

1052 **FAN MOTOR STARTERS**
Incorporated in Controls - reference W80.
Comply with reference section Y72 clauses.
Fit variable speed drives to all fans rated at more than 1.1kW and as scheduled.

2000 **PRODUCTS/MATERIALS**

2010G **OPERATING CONDITIONS:**
Installation arrangement as shown on drawings.
Configuration
Parallel or series operation as shown on drawings.
Sound Power Level
Select fan, motor, drive and speed control system not to exceed sound power levels or sound pressure levels scheduled or specified elsewhere. Provide sound power data in accordance with BS EN ISO 5136 and parts 1-4 of BS ISO 13347
Select plant that does not have a distinguishable, discrete, continuous noise or give rise to distinct impulses.
Air Density
Relate fan performance to air density 1.20kg/m3.
Temperature Range
Minimum to maximum operating temperatures –10°C to 40°C or as scheduled / indicated.

2010B **POTENTIALLY EXPLOSIVE ATMOSPHERES**
Constructional requirements:
The constructional requirements for fans constructed to Group IIG (of explosion groups IIA, IIB and hydrogen) categories 1, 2 and 3, and Group IID categories 2 and 3, intended for use in explosive atmospheres shall be in accordance with BS EN 14986 and relevant parts of BS EN IEC 60079 / BS EN 60079 and BS EN ISO 80079.
Ambient atmosphere pressure:
Absolute pressure ranging from 0.8bar to 1.1bar.
Temperature range:
Minimum to maximum operating temperatures of -20°C to 60°C inlet gas temperature, -10% to +20% of nominal gas flow.

2020A **CONSTRUCTION AND HANDLING:**
Casings
Construct rigid casing free from drumming under operating conditions.
Flange dimensions to BS EN ISO 13351
Supply in sections as required for access or handling.
Safety Standards
BS EN 60335 – 2 – 80 for the safety of electric fans for household and similar Purposes.
BS EN ISO 12499 – for guarding
Rotating assemblies
Balance in accordance with relevant parts of BS ISO 21940.
Shafts and hubs
Machine impeller bosses and shafts to BS 4500 and key in accordance with BS 4235-1. Hold impeller to shaft with set screw or taper lock fitting.
Shaft bearings - Sealed for life.
Drives and guards
Provide guards over shaft, couplings and rope in accordance with BS EN ISO 12100 for general principles of design and HSE requirements.
Material - galvanized or sheet steel.
Lifting
Provide lifting eyebolts or similar facilities on fans or sections heavier than 20kg.

Y41 – Fans

2831 TESTING:
Provide results of aerodynamic performance tests in accordance with BS EN ISO 5801, BS 848-1; noise tests in accordance with parts 1-4 of BS ISO 13347 and /or BS EN ISO 5136 as appropriate and fan balancing and vibration measurements in accordance with BS ISO 14695, BS 848-6.
The minimum energy efficiency requirements for fans driven by electric motors with electric input between 125W and 500kW should comply with EC Regulation 327/2011.

2850A MATERIALS - GALVANISED SHEET STEEL:
Construct casing from galvanised sheet steel in accordance with BS EN 1SO 1461, BS EN 10326, BS EN 10327.or BS EN 10143 unless scheduled otherwise.

2856z MOTOR:
Speed
Single, two or variable speed, as indicated.
Standards
Where variable speed drives are fitted to direct drive fans, ensure the drive meets the safety requirements of BS EN 61800-5-1. Comply with Y72 and Y82 clauses
Options:
When fan is handling saturated or corrosive air, provide motor ventilation to clean air,

2865 DRIVE / COMMISSIONING ALLOWANCES:
Direct, or belt driven as scheduled.
Provide belt driven fans with two or more belts. Belt drives shall comply with BS 3790.
For each belt driven fan provide a change of belts and drives (to be sized after balancing the system). Allow for changing belts and drives and recommissioning fan and rechecking system as necessary.
For each direct drive, adjustable pitch, axial fan, allow for a change of pitch angle (to be determined after balancing the system). Allow for recommissioning each system after the fan blade pitch change.
Refer to schedules for commissioning allowances included in duties.

2870A AXIAL FLOW FANS:
Fan impeller and casing aerodynamic efficiency
Manufacturer's standard to achieve overall efficiency of the fan, motor and drive combination scheduled or detailed elsewhere in the project particular specification.
Operation
Single; two in series; or multi-stage contra- rotating as indicated.
Bearings
Provide bearings suitable for mounting and direction of flow as shown on drawings.
Impellers
Fixed pitch; or adjustable pitch as indicated.
Casing – enclosing impeller and motor.

2880A SINGLE INLET SINGLE WIDTH CENTRIFUGAL FANS:
Fan impeller and casing aerodynamic efficiency
Manufacturer's standard to achieve overall efficiency of the fan, motor and drive combination scheduled or detailed elsewhere in the project particular specification.
Operation - single.
Impeller Design
Supply fan with impeller to suit operating conditions indicated.
Casing – single inlet single width.
Mounting – channel frame.
Drain
Fit drain connection at lowest point of scroll as indicated.

2880C DOUBLE INLET DOUBLE WIDTH CENTRIFUGAL FANS:
Fan impeller and casing aerodynamic efficiency
Manufacturer's standard to achieve overall efficiency of the fan, motor and drive combination scheduled or detailed elsewhere in the project particular specification.
Operation - single.
Impeller Design

Y41 – Fans

Supply fan with impeller to suit operating conditions indicated.
Casing – double inlet double width.
Mounting – channel frame.
Drain
Fit drain connection at lowest point of scroll where as indicated

2890A PROPELLER FANS:
Fan impeller and casing aerodynamic efficiency
Manufacturer's standard to achieve overall efficiency of the fan, motor and drive combination scheduled or detailed elsewhere in the project particular specification.
Drives
When motor spindle is extended for mounting blade hub, connect motor to casing, diaphragm plate or mounting ring with support arms.
Impellers
Supply profile blades designed to give uniform airflow.
Mountings
Support fans on plate with circular opening sized and
Located in accordance with fan manufacturer's requirements.

2900A MIXED FLOW FANS:
Fan impeller and casing aerodynamic efficiency
Manufacturer's standard to achieve overall efficiency of the fan, motor and drive combination scheduled or detailed elsewhere in the project particular specification.
Operation - single.
Provide bearings suitable for mounting and position indicated on drawings.

2206z CONSTRUCTION OF SMOKE EXTRACT FANS AND NATURAL VENTILATORS (D14 SBB.021):
Ensure smoke extract fans and ventilators are constructed so that when in use no flames or hot gases are deflected directly onto an adjacent structure.
Ensure materials used in the construction of the smoke extract fans and ventilators do not add to the fire risk of the building, nor contribute to a fire during use.
Construct smoke extract fans and ventilators from material defined in BS 476-4 as non-combustible.
Ensure smoke extract fans and ventilators with insulation material, plastic louvres, flaps, sheets or slopes have a Class 1 spread of flame rating when tested in accordance with BS 476-7 and are classified as 'does not readily sustain ignition' to BS 476-12.
Powered smoke and heat exhaust ventilators (fans) shall comply with BS EN 12101-3.

3000 ACCESSORIES

3010 INSPECTION DOORS – AXIAL FANS:
Fit air-tight inspection doors giving access to drive motors and other components requiring regular servicing or maintenance.

3020 INSPECTION DOORS – CENTRIFUGAL FANS:
Fit air-tight doors in scroll and cover.

3030 INSPECTION DOORS – PROPELLER FANS:
For diaphragm mounted fans fit an air-tight inspection door positioned to give access to drive, or other sub-components requiring regular servicing or maintenance.

3040 INSPECTION DOORS – MIXED FLOW FANS:
Fit air-tight doors giving access to drive motors and other components requiring regular servicing or maintenance.

3041 ACCESS PANELS – KITCHEN EXTRACT FANS
Access panels fitted to the casing shall be the full width of the impeller and located to facilitate cleaning and maintenance.

Y41 – Fans

3050A GUARDS:
Provide guards in accordance with BS EN ISO 12100.
Fit safety guards on air inlet and air outlet connections where these are freely accessible to personnel in accordance with BS EN ISO 12499, BS 848-5.
Provide bird guards unless fans are protected elsewhere (eg by birdguards at louvres).

3055z CONNECTIONS TO DUCT:
Provide flexible connections unless otherwise indicated.

3070A GUIDE VANES - AXIAL FANS:
Supply fan with integral downstream guide vanes. Or guide vane unit fitted upstream, or as otherwise indicated.

3080 GUIDE VANES - CENTRIFUGAL FANS:
Fit automatically controlled inlet guide vanes to inlet of fan.
Provide an actuating device for each set of inlet guide vanes.

3090 GUIDE VANES - MIXED FLOW FANS:
Fit automatically controlled guide vanes.

3100z SHUTTERS:
Fit shutters to prevent reverse flow through fan.
Back draft shutters or motorized shutters as indicated.

3110 AIR FLOW SENSORS:
Fit air flow sensors on twin fan units to sense fan failure and provide automatic changeover to standby fan.

3120 ACCESS:
Provide access via hinged casing or as otherwise indicated.

3141 SPEED CONTROLLER:
Where provided, ensure speed controllers are matched to fans.

3150 STANDBY MOTOR:
Provide standby motor as indicated.

4000 WORKMANSHIP

4010 LOCATION:
Install fans in positions indicated, in accordance with manufacturer's instructions and recommendations in CIBSE TM 42 Fan Application Guide.

4020 ATTITUDE:
Mount impeller shaft horizontally unless otherwise indicated.

4030 ALIGNMENT:
Ensure fan is installed aligned to allow optimum air flow path.

4040 TESTING:
Ensure fan is isolated from installation during air leakage testing of ductwork.

4051 DRAIN CONNECTION:
Fit trap to drain connection at lowest point of scroll on centrifugal fans unless otherwise indicated.

10000 Based on NES Y41text Dec 19

AECOM

Y44 – Humidifiers and Dehumidifiers

1000 GENERAL

1005 DESIGN DUTIES:
Supply humidifiers and dehumidifiers to meet required duty, with air conditions as indicated. Comply with any specific requirements or limitations. The humidifiers shall comprise all components described in this section of the specification, including duct section / access, drip trays, steam distributors, interconnecting pipework eliminator section, etc.

1010 GENERAL CONSTRUCTION:
Ensure all parts of humidifiers and dehumidifiers in contact with water and steam are manufactured from corrosion resistant material and are suitable for temperature and pressure conditions.
Ensure components in contact are arranged to avoid electro-chemical action between dissimilar metals.
Ensure humidifiers and dehumidifiers discharge uniformly over cross sectional area of air duct casing.

1020 PROTECTION:
Protect all equipment from dirt after manufacture by fitting blank flanges or caps to pipe connections and enclosing complete units in dustproof containers.

1030 STANDARDS
CE marking.
ISO 9002 Certified
Water Supply (Water Fittings Regulations) 1999.
HSE Approved Code of Practice L8 Legionnaires Disease and all parts of HSG 274.
CIBSE TM 13:2000 Minimising the risk of Legionnaires' disease

2000 PRODUCTS/MATERIALS

2010z STEAM GENERATOR TYPE WITH ELECTRIC RESISTANCE ELEMENTS:
Supply humidifier to discharge dry steam into air duct through distribution headers using an externally mounted generator.

Steam Generator
Removable electric resistance type elements arranged for indicated number of control steps. Include separate pilot heater with controlling thermostat, low water level cut-out switch and overload protection for each section of element.
Provide access into generator for cleaning.
Provide connections for cold water inlet, drain and overflow.

Housing
Enclose steam generator, ancillary tanks and pipework, electrical equipment, and wiring within a compartmented housing manufactured from galvanized sheet steel with decorative finish.
Install operating switches and lamps/gauges indicating operating/fault conditions on outside of housing.
Include support points to allow wall mounting.

Steam Distributors
Construct in the form of a slotted sheet metal duct or perforated pipe. Steam pipes shall be installed with a built-in inclination for continuous condensate drainage without the need for a separate condensate return line.

Support
Provide all necessary flanges/cover plates, and brackets for fitting and supporting distributors within air duct casing. For manifolds in excess of 900mm in length provide support at both ends.

Connections
Connect to remote mounted steam generators using flexible steam hose enclosed in braided metal sheath or purpose made sheet metal duct. The hose shall be selected and supplied by the humidifier manufacturer and installed in accordance with the manufacturers instructions.

Casing
Reinforce to form a rigid watertight structure. Incorporate glands or seals where pipes penetrate casing.
Material – stainless steel to BS EN ISO 9445-1
Internal casing finish - Manufacturer's standard.

Drain

AECOM

Y44 – Humidifiers and Dehumidifiers

Drain all condensate formed in distribution headers back into generator or to waste via a condensate separator installed at the steam pipe connection to the distributor when condensate cannot return to the unit by gravity

Feed Tank

Include feed water tank with ball valve complete with backflow prevention device to suit fluid category in accordance with
England and Wales – The Water Supply (Water Fittings) Regulations 1999, the Water Act 2014 and the Construction Products Regulations 2013.
Scotland – The Water Supply (Water Fittings) Byelaws 2014.
Northern Ireland - The Water Supply (Water Fittings) Regulations (Northern Ireland) 2009.
Equalise air pressure between air duct casing and feed water tank.

Controls

Provide all necessary electrical equipment pre-wired within humidifier.
Provide facility for BMS monitoring of unit common alarm fault.

Power supply

Refer to W 60 for details of power supply. A mains isolator shall be provided Adjacent to the unit.

Ensure electrical safety to BS EN 60335-2-88.

2014B STEAM GENERATOR TYPE WITH ELECTRODES:

Supply humidifier to discharge dry steam into air duct through distribution headers using an externally mounted generator.

Steam Generator

Fixed electrodes arranged for indicated number of control steps.
Provide access into generator for cleaning.
Provide connections for cold water inlet, drain and overflow as indicated.

Housing

Enclose steam generator, ancillary tanks and pipework, electrical equipment, and wiring within a compartmented housing manufactured from galvanized sheet steel with decorative finish.
Install operating switches and lamps/gauges indicating operating/fault conditions on outside of housing.
Include support points to allow wall mounting.

Steam Distributors

Construct in the form of a slotted sheet metal duct or perforated pipe.

Support

Provide all necessary flanges/cover plates, and brackets for fitting and supporting distributors within air duct casing. For manifolds in excess of 900mm in length provide support at both ends.

Connections

Connect to remote mounted steam generators using flexible plastic hose enclosed in braided metal sheath or purpose made sheet metal duct.

Casing

Reinforce to form a rigid watertight structure. Incorporate glands or seals where pipes penetrate casing.
Material - stainless steel to BS EN ISO 9445-1

Internal casing finish – Manufacturer's standard.

Drain

Drain all condensate formed in distribution headers back into generator or to waste as shown on drawings.

Feed Tank

Include feed water tank with ball valve complete with backflow prevention device to suit fluid category in accordance with
England and Wales – The Water Supply (Water Fittings) Regulations 1999, the Water Act 2014 and the Construction Products Regulations 2013.
Scotland – The Water Supply (Water Fittings) Byelaws 2014.
Northern Ireland - The Water Supply (Water Fittings) Regulations (Northern Ireland) 2009.
Equalise air pressure between air duct casing and feed water tank.

Controls

Provide all necessary electrical equipment pre-wired within humidifier.

Power supply – Refer to W 60 for details of power supply. A mains isolator shall be provided Adjacent to the unit.

Ensure electrical safety to BS EN 60335-2-88.

Y44 – Humidifiers and Dehumidifiers

2020 PREFABRICATED MAINS STEAM TYPE:

Supply prefabricated humidifier unit for discharging mains steam into air duct casing in a dry condition.
Incorporate steam distributor pipes designed for low sound emission.

Steam Distributors

Construct in the form of a perforated pipe with steam heated jacket.
Provide all necessary flanges and cover plates, brackets for fitting and supporting distributors within air duct casing.
For manifolds in excess of 900mm in length provide support at both ends. Factory insulate jacket to minimise heat loss to the duct ensuring no particle migration to the air stream will result.

Casing

Reinforce to form a rigid watertight structure.

Material – stainless steel to BS EN ISO 9445-1
A minimum of 2m of straight duct shall be provided downstream and 900mm upstream of the steam lance.

Drain

Drain all condensate formed within humidifier lance to collection point for removal via steam trap.

Pipe Connections

Provide steam and condensate connections to the humidifier unit (where supplied as a complete unit); to individual components (where supplied for site assembly).

Controls

Control output by means of control valve supplied with humidifier.
Incorporate means of separating condensate and dry steam before discharging to distributor tubes.

2021 EVAPORATIVE HUMIDIFIERS

The evaporative humidification system shall be supplied and installed by the air handling unit manufacturer in accordance with the manufacturer's instructions, HSE Approved Code of Practice L8, all parts of HSG 274 and CIBSE TM 13:2000 Minimising the risk of Legionnaires' disease
The humidifier manufacturer shall test and commission the system.
The Contractor shall obtain a mains water analysis and the humidifier manufacturer shall include in the packaged humidifier all necessary facilities to enable the system to operate on this water supply without the need for additional water treatment plant.

Supply wetted media pad cassette(s) complete with reservoir/basin with a sloping bottom and a drain point located at the lowest point of the drain pan.

Materials]

Water re-circulation pump with flow regulation valves to cassettes.

Use non-corrosive materials for re-circulation pump.
Provide re-circulation pump motor suitable for operation in an environment saturated with moisture.

Water Connections

Provide backflow prevention arrangement applicable to fluid category as defined in The Water Supply (Water Fittings) Regulations 1999
Provide:
Automatic float operated water filling valve.
Overflow and deconcentration device.
Drain and overflow nozzles.
Use smooth bore mesh reinforced PVC pipework and fittings.
Run the de-concentration drain directly to a point of discharge.
Incorporate a water trap in the de-concentration drain and the emptying drain to prevent the water seal being removed by the negative air pressure within the air handling unit.

Ancillary components

Automatic solenoid valve with constant flow regulator on the incoming water supply.
Automatic drain valve and overflow.
Control the water level within the humidifier pan via a float valve and monitored flow with alarm.
Provide an automatic motorised ball valve operating the drain from the reservoir to ensure the pipework and the reservoir are both fully drained after every humidification operation or every 24 hours, whichever is the sooner.

Incoming and re-circulated water filters.
UV lamps.
Integral droplets separator.
Biocide dosing system.

Rigid welled media.

Material
Incombustible ceramic coated glass fibre material with wetting agents and additives.
Configuration
Corrugated and cross-channel with a horizontal mounted distribution pad.
Casing
Stainless steel frame incorporating a water distribution header with a flow regulator.

Header assembly

Secure the header assembly to the cassette with a safety catch.

Access

Provide a minimum maintenance access of 500mm downstream of the drain pan.

Face velocity

Maximum face velocity across the welled media 3.5 m/s without a droplet separator.
Maximum face velocity across the welled media 4m/s with a droplet separator fitted.

Dosing System

Install a dosing system to enable a time controlled dosing of biocides into the humidifier pan.
Components
Suction lance with level switch and dirt filter.
Pump, delivering a constant flow independently of the pressure head.
Nozzle for mounting on the humidifier pan.
Hoses, piping and pipe fasteners ready to assemble.
Alarms and controls.

Conductivity System

Install a conductivity system to allow conductivity controlled bleed-off.
Components
Conductivity transmitter with display of actual value or set point.
Probe with a cable and temperature compensation.
Alarms and controls.

Control panel

Supply a fully programmable control panel (for each humidifier)
Mount control panel on the side of the air-handling unit.
Include the following alarms and control functions:
Humidifier recirculating pump motor protection, pump failure alarm.
Drain valve malfunction alarm.
Reservoir water flow sensor – high water consumption alarm.
Operating hours counter with maintenance alarm.
Automatic draining of reservoir.
Automatic draining of internal supply pipes to headers.
Overflow protection (via flowmeter).
Dosing system timer and dosage control.
Low biocide level indicator.
Low UV intensity alarm.
Conductivity system display of set point and actual value.
High conductivity alarm.
Provide interface with the building management control system.

3872 DESICCANT DEHUMIDIFIER:

Engage a desiccant dehumidification specialist to design, supply, install, commission and set to work the desiccant dehumidification installation, whether stand-alone of included as part of an air handling unit..
Desiccant media.
Silica gel.
Casing - Corrosion resistant coated aluminium profiles or stainless steel sheet metal
Controls - Provide all necessary electrical equipment pre-wired within dehumidifier including.
Integrated, Microprocessor based controls.

Humidify with alarm and display
Control panel with diagnostic display
Blocked filter alarm
Rotor stopped alarm
Low return airflow alarm

3880 ACCESSORIES

3882 ACCESS SECTIONS:

Provide access sections, not less than 600mm wide, upstream and downstream of each humidifier for inspection, cleaning and maintenance.

3910A ACCESS DOORS:

Provide hinged airtight and watertight access door in casing for maintenance and cleaning purposes.
On steam humidifiers, fix to access door an indelibly marked label to read "Isolate Steam supply before opening" in letters at least 25mm high.

3912 DRIP TRAYS:

Incorporate a drip tray into base of casing to collect condensate with a minimum fall of 1 in 20 in all directions towards a drain socket
Provided in the bottom of the tray. (Side outlet connections will not be permitted). Extend tray, or
Provide additional tray, where eliminator plates are fitted.
Fabricate tray in one piece from stainless steel and finish as follows:-
Provide water proofing compound (two coats).

Insulate external surfaces, at works, with 12 mm minimum thickness slabs and cover with sheet metal.

3928z INSPECTION WINDOWS:

Provide double glazed inspection window in casing.

3930 WALKWAYS:

Provide walkway for maintenance access.

3941 LIGHTING:

If mounted within an air handling unit provide bulkhead type luminaire with appropriate IP rating, wired to a switch mounted outside unit.
For duct mounted humidifiers provide a light box mounted externally to illuminate the interior of the humidifier section, wired to a switch mounted outside the unit.
Power supply to the lighting shall be provided by the electrical contractor from a separately fused way in the nearest lighting distribution board

3950 SPREADER PLATE:

A duct mounted perforated inlet plate shall be provided to equalize air velocity over unit section.

3951z ELIMINATOR SECTION:

Include eliminator section adjacent to the casing outlet to prevent water carry-over. Ensure eliminator section is removable. Support blades rigidly at top and bottom with intermediate support.
Blade material
or Stainless steel.
or Rigid polypropylene suitable for working temperatures of 130degC.

Incorporate an, insulated drip tray into the base of casing to collect condensate with a minimum fall of 1 in 20 in all directions towards a drain socket
Provided in the bottom of the tray.
(Side outlet connections will not be permitted.)
Fabricate in one piece and finish as follows:-
Fabricate tray in one piece from stainless steel and finish as follows:-
Provide water proofing compound (two coats).

Y44 – Humidifiers and Dehumidifiers

Insulate external surfaces, at works, with 12mm minimum thickness slabs and cover with sheet metal.

3870 **DUCT CONNECTIONS:**
To match air handling unit and method of assembly.
or With external flanges drilled for bolting to counter flanges on adjacent plant or ductwork

4000 **WORKMANSHIP**

4005 **INSTALLATION FOR MAINTENANCE/INSPECTION TO HSE ACOP L8:**
Locate and install ultrasonic and spray humidifiers to ensure all required actions / maintenance tasks in Appendix 3.1 in HSG 274 Part 3 can be undertaken in a safe manner.

4010 **POSITION/LOCATION:**
Locate humidifier to ensure air velocity is uniform over inlet duct with at least 1.0m of straight outlet duct free of obstructions.
Ensure there are no adverse effect on air heating coils. Ensure no damage or hazard occurs in event of overflow.

4020 **ASSEMBLY:**
Connect between humidifier components (where not supplied already piped up) in accordance with manufacturer's recommendations.

4030 **CONDENSATE CONNECTIONS:**
Arrange condensate lines to ensure back pressure does not exceed manufacturer's recommendations.

4034 **WATER CONNECTIONS:**
On all water fed units provide automatic control & stop valves on cold water connections. Provide

4040 **THERMAL EXPANSION:**
Arrange pipe connections to take up thermal expansion without imposing stress on humidifiers.

4051 **DRAIN CONNECTIONS / TRAPS:**
From all humidifier base trays provide drain connections incorporating a glass trap with a seal of depth of at least twice the working static head pressure at that point in the system.

Provide each item with an independent drain, laid to a minimum fall of 1 in 60 with a cleaning eye at each change of direction, discharging with a minimum air gap of 100 mm over a gulley or tundish.
Protect any glass trap installations from damage.
Locate so that it can be back lit with a torch by maintenance staff.

4060 **FIXINGS:**
Support humidifiers from building structure on zinc coated steel supports, independently of adjacent ductwork.
Provide separate supports for casings (not forming part of an air handling unit) and components mounted outside casings.

4070 **EVAPORATIVE HUMIDIFIER INSTALLATION:**
Install the humidifier in accordance with the supplier's instructions.
Arrange the pipework to the distribution header and the drain pan in accordance with the manufacturer's recommendations to ensure an even distribution of water across the full width of the cassette. Ensure that the distribution pipework drains back into the drain pan and the drain pan empties upon activation of the automatic drain valve. Avoid water traps in supply pipework.

4082 **LIGHTING FOR MAINTENANCE PURPOSES:**
For units installed in air handling units provide bulkhead type luminaire in the humidifier section with appropriate IP rating, wired to a switch mounted outside the AHU.
For duct mounted humidifiers provide a light box mounted externally to illuminate the interior of the humidifier section, wired to a switch mounted outside of the unit.
Power supply to the lighting shall be provided by the electrical contractor from a separately fused way in the nearest lighting distribution board.

Y44 – Humidifiers and Dehumidifiers

M060 Based on NES Y44 text – June 17

Y45 – Silencers & Acoustic Treatment

1000 GENERAL

1012 DESIGN DUTIES:
Supply equipment to meet dynamic insertion losses or acoustic performance indicated with resistance to air flow as indicated with any specific requirements or limitations as indicated.
Note: Plastic films used to protect infill from moisture or grease ingress may reduce the acoustic performance. Where this method of protection is employed, due allowance shall be made for any loss of performance when selecting equipment to meet the specific insertion loss or acoustic performance.

1020z TESTING:
Manufacturers shall provide certified insertion loss data as defined and derived in tests to BS EN ISO 7235, for each of the eight octave bands.
Generated sound power levels in dB (re 10^{-12}Watts) shall also be provided along with certified insertion loss data for each silencer duty.
Where equipment is manufactured in modules, the performance ratings shall apply to the unit as a whole.

1030z PROTECTION:
Where silencers are to be exposed to external weather conditions, their inner and outer surfaces shall be protected in accordance with the relevant ductwork specification.

Silencers are to be delivered to site with blocked ends to prevent damage.
Provide suitable bracing and restraint, for both transportation and storage, to maintain acoustic and physical integrity.

1040 DIRECTION OF FLOW:
Clearly mark direction of air-flow on silencers.

2000 PRODUCT/MATERIALS:

2010z FIRE PROPERTIES:
Use non-flammable adhesives. Ensure that all insulating materials and coverings are non-combustible material covered with a material that complies with flame spread requirements of BS 476 - 7, Class 1 or Class 0 as required by Building Control/Fire Officer.

2020z CIRCULAR SILENCERS - CASING TO DW/144:
Provide circular silencers compatible with ductwork installation.
Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic, and non-combustible.
Construct casing to DW/144 with external flanges drilled for bolting to counterflanges on adjacent plant or ductwork, or with spigot ends where not connected to ductwork.
Retain infill by perforated galvanized mild steel sheet
Comply with KGE/UP/10 and BS 5644 for attenuators in flue dilution systems. Material of construction to be 304 stainless steel.

2030z CIRCULAR SILENCERS - NON-METAL:
Provide circular silencers compatible with ductwork installation.
Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic, and non-combustible.
Provide with external flanges drilled for bolting to counterflanges on adjacent plant or ductwork, or with spigot ends where not connected to ductwork.

2032z "MELINEX" LININGS TO SPLITTERS AND SILENCERS:

Unless scheduled otherwise provide a "Melinex" lining in front of the infill in the following systems:
Systems serving clinical areas in healthcare applications
Systems serving clean rooms
Systems where cleaning is required including kitchen extract
Systems where the acoustic louvre will be handling moisture or chemically laden air

Y45 – Silencers & Acoustic Treatment

Where a 'Melinex' lining is to be included in front of the infill to prevent product migration or contamination of the infill it shall be greater than 23µm thick.
Full account of the reduction in performance of the silencer brought about by the addition of the lining shall be made when selecting silencers to meet the required performances.

2040z RECTANGULAR SILENCERS - CASING TO DW/144:
Provide rectangular silencers compatible with ductwork installation.
Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic, and non-combustible.
Construct splitters with low loss fairings where required to achieve pressure drop performance.
Construct casing to DW/144 with external flanges drilled for bolting to counterflanges on adjacent plant or ductwork, or with spigot ends where not connected to ductwork.

Retain infill by perforated galvanized mild steel sheet
Comply with KGE/UP/10 and BS 5644 for attenuators in flue dilution systems. Material of construction to be 304 stainless steel.

2041z ACOUSTIC SPLITTERS:
Fix half width splitter to each side wall or as indicated.
Construct splitters to ensure that infill is retained and individual acoustic integrity is maintained.

Construct splitters with low loss fairings on entry and exit where necessary to meet pressure loss requirements.
Provide additional stiffening on horizontally mounted splitters.
Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic, and non-combustible.
Retain infill by perforated galvanized mild steel sheet unless otherwise indicated.

2050z RECTANGULAR SILENCERS - NON-METAL:
Provide rectangular silencers compatible with ductwork installation.
Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic, and non-combustible.

Provide external flanges drilled for bolting to counterflanges on adjacent plant or ductwork, or with spigot ends where not connected to ductwork.
Construct splitters with low loss fairings where required to achieve pressure drop performance.

2051z AIR TRANSFER/CROSS TALK ATTENUATORS:
Provide attenuators for air transfer and cross talk applications where indicated.
Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic, and non-combustible.
Construct splitters with low loss fairings where required to achieve pressure drop performance.
Construct casing to DW/144 or compatible with ductwork installation.

Provide external flanges drilled for bolting to counterflanges on adjacent plant or ductwork, or with spigot ends where not connected to ductwork.

2060z ACOUSTIC LININGS, PERFORMANCE TO BS EN ISO 354:
Line internal surfaces of ducts as described in DW/144.

Provide lining that is inert, fire proof, inorganic, vermin proof, non-hygroscopic and non-combustible.
Material - polyurethane foam, melinex lined.
Lining to achieve the following minimum random incidence absorption coefficients in accordance with BS EN ISO 354, or as indicated.

Frequency Hz	125	250	500	1k	2k	4k
	0.15	0.25	0.5	0.7	0.8	0.9

Protect lining against product migration and erosion.

2080z ACOUSTIC INSULATION:
Where indicated provide acoustic insulation.

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Y45 – Silencers & Acoustic Treatment

Provide flexible system unless indicated otherwise. Supply with associated acoustic insulation as a factory made composite whenever possible.
Standard: Tested and rated in accordance with relevant parts of BS EN ISO 10140
Fire resistance: Class O Building Regulations when tested to BS476 -6 and BS 476-7.
Flexible system

Continuous quilted mineral (rock) fibre mat of density not less than 45kg/m^3 or foam at least 50mm thick with sandwich layer of polymeric material, minimum 1mm thick, with minimum mass of 10 kg/m^2 (unless scheduled otherwise elsewhere in the particular specification). Ensure surface finish complies with BS 476 – 7, Class 1 as a minimum. The polymeric mass layer should be positioned outermost from the sound source and overlapped at all joints. The product must be designed to maintain its original thickness subsequent to installation. The lagging should be cut 25mm oversize and a 25mm strip of the inner resilient element removed to create an overlap.
The mass layer must not come in contact with the duct of pipe
Overlap and seal all joints with adhesive and external reinforcing tape.
Overlap and seal all joints with adhesive and suitable external reinforcing tape.

Particular attention should be paid to support the acoustic lagging at joint locations and where sagging may occur, eg in "soffit" areas.

For circular applications including soil-vent and rainwater pipes, ductwork etc, the lagging should be secured in place, either by using integral self-adhesive overlap or an alternative method approved by the SO. For vertical installations above 3m additional support should be provided in the form of aluminium bands at 200mm.

2120 ACOUSTIC LOUVRES: (Refer to Y46. 2222)

2140z ACOUSTIC ENCLOSURES:
Construct wall panels, frames and floor panels to meet the performance indicated, from materials suitable for location.
Ensure joints provide adequate seal to meet requirements.

Achieve minimum random incidence absorption coefficients in clause 2080z in accordance with BS EN ISO 354, unless otherwise indicated.
Provide inspection windows where indicated.
Supply cable access floor panels where indicated.

3000 WORKMANSHIP

3010 GENERAL:
Install acoustic treatment equipment in positions indicated, in accordance with manufacturer's instructions.

3020 ACOUSTIC ENCLOSURES:
Ensure that erection is carried out by enclosure manufacturer.

3030 ACCESS TO ACOUSTIC ENCLOSURES:
Provide door type openings in enclosures as required for access to items enclosed.
Provide openings for inlet and discharge ductwork and for connections as indicated.
Provide angle flange connections for mating to ductwork and equipment.

3040 SUPPORTS:
Supply steel section supporting frames or brackets where silencers are fixed to the walls of air chambers.

3050 ACOUSTIC LININGS:
Where personnel access is provided, protect acoustic linings to prevent damage.

3060z SOUND PRESSURE LEVEL READINGS:
Measure sound pressure levels at the positions indicated using equipment in accordance with BS EN 61672-1 and BS EN 61672-2.

Y45 – Silencers & Acoustic Treatment

3070z SOUND INSULATION MEASUREMENTS:
Measure sound insulation of building elements in accordance with the relevant parts of BS EN ISO 16283 as appropriate.

9000 NES
Based on version NES Y45 last March 18

Y45 – Silencers & Acoustic Treatment

Y46 – Grilles/ Diffusers/ Louvres

1000 GENERAL

1011 PERFORMANCE:
Air Supply
Unless detailed otherwise elsewhere in this specification or drawings, the maximum mean air velocity in the occupied zone shall comply with category B thermal environment in accordance with BS EN ISO 7730 (PPD<10%) table A5.
eg for offices and other mainly sedentary spaces : Cooling 0.19m/s; Heating 0.16m/s.
Blades – Supply grilles and diffusers with blade profile to ensure correct aerodynamic performance and minimal noise generation.
Louvres - Ensure air velocities through face area of louvres minimises "carry-over" of rain, snow or other precipitation into ducts, shafts or plant rooms and ensure louvres are tested in accordance with BS EN 13030 and are the subject of on-going factory production control auditing. Performance classes to BS EN 13030 are as scheduled in Y46sch1.

1020z SIZE / FIXINGS GENERALLY
All sizes indicated are 'nominal'. Provide site dimensions of all louvres, diffusers and grilles before manufacture. Ensure integration and co-ordination with ceiling details, other drawings and with ceiling grid site setting out as indicated on the architects drawings.

1020 NOISE LEVELS:
Ensure sound power levels or room NR / NC levels indicated are not exceeded. Ensure accessories for grilles and diffusers have low noise generation characteristics, and cause minimum disturbance to airflow.

1041 ELECTRICAL BONDING TERMINAL:
Ensure an electrical bonding terminal suitable for connection of 6 mm² maximum conductor is provided on all metal grilles, diffusers and louvres.

1033 PROTECTIVE WRAPPING:
Apply protective wrapping to exposed architectural finishes prior to despatch to site.

1050 TESTING:
Provide air terminal devices tested in accordance with, BS EN ISO 5135 for determination of sound power levels and BS EN 13030 for performance testing of louvres.

2000 PRODUCTS/MATERIALS

2022 MOUNTING:
Grilles
Flanged screw fixings – Used on the following grille types: fixed blade, adjustable blade, egg crate, non-vision
Concealed fixings – Used on the following grille types: mesh, linear
unless otherwise indicated

Diffusers
Flanged screw fixings – Used on the following diffuser types: punkah louvre
Hidden screw fixing – Used on the following diffuser types: circular, linear, straight line fixed louvre
Rear suspension brackets – Used on the following diffuser types: perforated face, adjustable curved blade, straight line fixed louvre, high induction, laminar flow panel
Internal concealed fixings - Used on the following diffuser types: linear lighting/air module, straight line fixed louvre
Hidden bayonet fixing – Used on the following diffuser types: extract/exhaust valve
unless otherwise indicated

Louvres
Side screw fixings.
or Rear angles or cleats.
or As otherwise indicated.

2010G GRILLES - FIXED BLADE TYPE:
Secure blades within flanged mounting frame or core collar.

Y46 – Grilles/ Diffusers/ Louvres

Provide support mullions to ensure blade stability.
Style, blade rows and air pattern control as indicated on schedule or drawings.
Fix blades at an angle to the horizontal

2670A GRILLES - ADJUSTABLE BLADE TYPE:
Pivot blades within flanged mounting frame and retain blades in set position by tensioners external to the airstream.
Allow each blade in a row of blades to be individually adjustable.

2670A GRILLES - MESH TYPE:
Core material
Cellular, expanded or perforated as indicated on schedule or drawings.
Frame
Flange mounting frame or plate flange as indicated on schedule or drawings.
Fixing
Permanently fixed or designed for easy removal, as indicated.

2670z GRILLES - EGG-CRATE TYPE:
Core material - Aluminium or plastic or as otherwise indicated.
Style — With frame or as otherwise indicated.

2650 GRILLES - LINEAR TYPE:
Supply linear type grilles with one row of parallel blades. Secure blades within mounting frame or opening. Permanently set at angle indicated.

2660A GRILLES - LINEAR FLOOR TYPE:
Supply linear type floor grilles with one row of parallel blades. Permanently set at angle indicated. Incorporate bar reinforcement.
Loading
Pedestrian or computer room to special requirements as indicated.

2670A TRANSFER GRILLES - SIGHTPROOF NON-VISION TYPE:
Supply sightproof non-vision grilles with one set of blades.
Fix within a flanged mounting frame or a core box unless otherwise indicated.

2670B TRANSFER GRILLES - LIGHTPROOF NON-VISION TYPE:
Supply lightproof non-vision grilles with two sets of blades.
Fix within a flanged mounting frame or a core box unless otherwise indicated.

2670C TRANSFER GRILLES - FIRE RESISTANT NON-VISION TYPE
Supply grilles comprising Zintec steel frame with an intumescent core and two steel grilles, colour as indicated or scheduled.
Comply with the requirements of BS 8800.
Fire resistance tests for wall, ceiling or floor mounting types in accordance with BS EN 1364-5 or BS 476-22.
Fire resistance tests for door mounting types in accordance with BS 476-22.

Fix as indicated in accordance with the manufacturer's recommendations.

2670D TRANSFER GRILLES - FIRE RESISTANT NON-VISION TYPE WITH SMOKE CONTROL FACILITY:
Supply grille assembly comprising Zintec steel frame with an intumescent core with damper and actuator assembly to automatically close in the event of an alarm, power failure or damage to wiring. Units to be complete with steel cover grilles, colour as indicated or scheduled.
Comply with the requirements of BS 8800.
Fire resistance tests for door mounting types in accordance with BS 476-20 and BS 476-22.
Smoke leakage tests for smoke shutter type through door sets to be in accordance with BS 476-31.1.
Fix as indicated in accordance with the manufacturer's recommendations.

2680A CONE TYPE CIRCULAR DIFFUSERS:
Supply circular diffusers manufactured to ensure rigid and smooth outer cone or frame, and inner assembly.
Space all cones to ensure even distribution of air flow with minimum resistance and noise, and to allow easy cleaning.
Cone type
Fixed or adjustable deflection cone type as indicated.

2680B PAN TYPE CIRCULAR DIFFUSERS:
Supply circular diffusers manufactured to ensure rigid and smooth outer cone or frame, and inner assembly.
Pan type
Fixed or adjustable pan type as indicated.

2680C CIRCULAR DIFFUSERS - CORE ADJUSTMENT:
Provide core adjustment to obtain required air distribution pattern. Allow inner assembly to move vertically by vertical sliding action or rotation as indicated.

2650A DIFFUSERS - LINEAR TYPE:
Supply single unit or continuous length linear diffusers manufactured with one or more rigid and smooth line slot units with parallel bars and partitions. Fit closing caps at ends of single or multiple continuous length units.
Provide continuous lengths complete with locating pins strips with keys to ensure correct alignment of abutted ends.
Air Controller - Fit each slot with device indicated.

2100 DIFFUSERS - PERFORATED FACE TYPE:
Supply perforated face diffusers with rigid and smooth inlet spigot expanded to butt and seal against easily removable framed perforated front panel. Incorporate back deflectors above front panel, set to give required performance.
Supply type and profile of framed perforated front panel to mount flush with surrounding false ceiling panels.

2110A ADJUSTABLE CURVED BLADE DIFFUSER:
Supply diffusers manufactured from curved cross sectional profile parallel blades pivoted at each end within flanged mounting frame. Ensure that each blade is individually adjustable to give directional control of airstream. Retain blades in set position by tensioners external to airstream.
Control ways as indicated on drawings or schedules.

2120A ADJUSTABLE CURVED BLADE DIFFUSER WITH REMOVABLE INNER CORE:
Supply diffusers manufactured from curved cross sectional profile parallel blades within removable core frame and include integral multi-blade volume control at each blade set. Ensure assembly is removable from flanged mounting frame. Make provision for volume control adjustment by loose key.
Ensure that each blade within core is individually adjustable, and that each core is designed to give directional control of airstream through each 80o angle.
Control ways as indicated on drawings or schedules.

Y46 – Grilles/ Diffusers/ Louvres

2130A **STRAIGHT LINE, FIXED LOUVRE DIFFUSER WITH FIXED CORE:**
Supply diffusers manufactured from louvre type parallel blades permanently set and securely fixed within frame.
Pre-set each blade to give directional control of airstream.
Control ways as indicated on drawings or schedules.

2130B **STRAIGHT LINE, FIXED LOUVRE DIFFUSER WITH REMOVABLE CORE:**
Supply diffusers manufactured from louvre type parallel blades permanently set and securely fixed within frame.
Supply core frames which are easily removable from flanged mounting frame.
Pre-set each blade to give directional control of airstream.
Control ways as indicated on drawings or schedules.

2140A **SPHERICAL PUNKAH LOUVRE DIFFUSERS:**
Supply diffusers manufactured with adjustable core.
Supply core in the form of a rotatable sphere with circular outlet nozzle, the whole retained by a flanged cup allowing manual change of discharge air pattern to give an adjustable high velocity jet, full diffusion, or complete shut-off.
Incorporate tapped ring for duct mounting, complete with felt, foam rubber or plastic sealing ring and fixing bolts or screws. When connecting to ends of flexible ducting, fit rigid flanged extension collar.

2140B **DRUM PUNKAH LOUVRE DIFFUSERS:**
Supply diffusers manufactured with adjustable core.
Supply core in the form of a rotatable cylinder with a rectangular outlet nozzle, the whole retained by a flanged frame allowing manual change of discharge air pattern to give an adjustable high velocity jet or full diffusion, by adjustable integral vertical blades.
Incorporate tapped ring for duct mounting, complete with felt, foam rubber or plastic sealing ring and fixing bolts or screws. When connecting to ends of flexible ducting, fit rigid flanged extension collar.

2150 **DIFFUSERS - LINEAR LIGHTING/AIR MODULAR TYPE:**
Supply diffusers complete with connecting unit for installation behind module flanges, ensuring neat and unobtrusive appearance.
Fit plenum box with integral independent air volume regulating vanes to direct an equal air velocity along complete length of connecting air diffuser slot. Ensure easy access from below to regulating vanes. Retain vanes in set position by tensioners external to air stream.
Fit spigot, suitable for flexible ducting joint connection to plenum box.
Ensure that supports are independent, and do not depend upon module casing or flanges.

2160 **LAMINAR FLOW PANELS:**
Supply laminar flow panels each with a large perforated face plate complete with rear plenum box or spigot entry.

2170A **HIGH INDUCTION DIFFUSERS, SECONDARY AIR INDUCTION:**
Supply high induction diffusers fixed or variable geometry using secondary air induction into diffuser housing.

2170B **HIGH INDUCTION DIFFUSERS, TURBULENCE/ROTARY MOTION:**
Supply high induction diffusers fixed or variable geometry using high levels of turbulence or rotary motion in discharge air pattern to accelerate mixing.

2180 **DIFFUSERS - EXTRACT/EXHAUST VALVE TYPE:**
Supply diffusers incorporating intake ring and adjustable valve disc assembly.
Provide bayonet type fixing for purpose made mounting ring with plastic foam sealing gasket.
Provide setting template.
Adjust valve to required setting and lock valve in required position.

2185 **FABRIC AIR DUCT DISTRIBUTION DEVICES:**
Supply fabric air distribution devices complete with all necessary stiffening devices, facilities for joining sections, support system, suspension rails and fixings.

Manufacturer to provide full performance data for devices selected including air flow rate, pressure loss, throw etc.
The facilities shall be designed to prevent condensation and dust build up.
Shrinkage to be limited to 1% when washed in accordance with the manufacturers recommendations unless scheduled otherwise.
Materials to be classified for reaction to fire in accordance with BS EN 13501-1. Classes acceptable are A1, A2 or B having smoke emission classification of s1 and production of flaming droplets/particles classification of d0.
Test methods - BS EN ISO 1182, BS EN ISO 1716, BS EN ISO 11925-2 and BS EN 13823 as appropriate.

2190A **LOUVRES - EXTERNAL AIR SUPPLY/EXTRACT TYPE:**
Provide louvres which have been tested in accordance with BS EN 13030, and which are the subject of ongoing factory production control auditing.
Performance and classification to BS EN 13030
- Ensure louvres perform to water penetration class a1 a face / core velocity as scheduled.
- Ensure louvres achieve a coefficient of discharge class as scheduled.

Construction
- Construct louvre frame and aerodynamically profiled louvre blades from galvanized mild steel or aluminium.
- Provide integral drainage channels.
- Retain infill on louvre blades by perforated sheet of galvanized mild steel or aluminium.

Screen
- Fit a bird-screen using mesh no coarser than 12mm, across inside face of louvres.
- Fit an insect-screen using mesh no coarser than 3mm, across inside face of louvres only where scheduled.

Quality assurance
- Ensure manufacturers are a firm of Assessed Capability to BS EN ISO 9001 and produce louvre to relevant Quality Assessment schedule.

Installation
- Install louvres strictly in accordance with the manufacturer's instructions.

2200 **LOUVRES/SCREEN WALLING:**
Provide louvres which have been tested in accordance with BS EN 13030, and which are the subject of ongoing factory production control auditing.
Performance and classification to BS EN 13030
- Ensure louvres perform to water penetration class a1 a face / core velocity as scheduled.
- Ensure louvres achieve a coefficient of discharge class as scheduled.

Construct with mullions into which blades are fitted and provide blades with aerodynamic profiles and integral drainage channels. Mount assembly within frame. Ensure louvre system is integrated with weather louvres and incorporates doors with concealed hinges and frames. Where necessary provide mitred corners and slope louvres.
Ensure adequate space for access and maintenance of louvres and associated equipment is provided.
Screen
- Fit a bird-screen using mesh no coarser than 12mm, across inside face of louvres.
- Fit an insect-screen using mesh no coarser than 3mm, across inside face of louvers as indicated

Ensure manufacturers are a firm of Assessed Capability to BS EN ISO 9001 and produce louvre to relevant Quality Assessment schedule.
Install louvres strictly in accordance with the manufacturer's instructions.

2210A **GALVANISED STEEL:**
Galvanize steel in accordance with BS EN 10346, or BS EN 10143 and

2210B **ALUMINIUM:**
Use aluminium sheet/extruded aluminium produced to BS EN 485, BS EN 515, and BS EN 573 or BS EN 755

2220A **GRILLE AND DIFFUSER CONSTRUCTION:**
Ensure grilles and diffusers are robust and mounting frame flanges on square and rectangular terminals have mitred corners. Fit a rubber or plastic foam sealing strip or gasket to rear face of flange.

Y46 – Grilles/ Diffusers/ Louvres

Diffusers
Ensure face of diffuser outer cone or frame is completely smooth.

Finish
Powder coat finish to an RAL colour specified as indicated or specified by the Architect.

2200A LOUVRE CONSTRUCTION:
Ensure louvres are robust. Incorporate in purpose made sub-frame. Provide drip sills.

2252 ACOUSTIC LOUVRES: (REF: Y45 21208)
Performance
Provide acoustic louvres as indicated, to meet performance indicated when producing a static pressure loss within that scheduled for the specified air flow.
Provide certified acoustic performance data measured in accordance with relevant parts of BS EN ISO 10140.

Ensure louvre withstands specified wind loads and prevents ingress of rain.
Construction
Construct louvre frame and aerodynamically profiled louvre blades from
galvanized mild steel.
or aluminium.
or as otherwise indicated.
Provide integral drainage channels.
Provide acoustic infill which is inert, fire proof, inorganic, vermin proof and non-hydroscopic.
Acoustic infill to be wrapped with woven glass scrim cloth or 'Melinex' to prevent migration of particles into the airflow / protect the infill. Full account of the reduction in performance of the acoustic louvre brought about by the addition of the infill protection shall be made when selecting silencers to meet the required performances.
"Melinex" polyester film to be provided in front of the infill in the following applications unless scheduled otherwise:
Systems serving clinical areas in healthcare applications
Systems serving clean rooms
Systems where cleaning is required including kitchen extract
Systems where the acoustic louvre will be handing moisture or chemically laden air

Retain infill on louvre blades by perforated sheet of
galvanized mild steel.
or aluminium.
or as otherwise indicated.
Arrangement
In breakdown form for site assembly.
or In modular panel form.
or For assembly on site to form an enclosure complete with roof and door.
or As otherwise indicated.
Screen
Fit a bird-screen using mesh no coarser than 12mm, across inside face of louvres.
Fit an insect-screen using mesh no coarser than 3mm, across inside face of louvers as indicated.
Quality assurance
Ensure manufacturers are a firm of Assessed Capability to BS EN ISO 9001 and produce louvre to relevant Quality Assessment schedule.

3000 ACCESSORIES

3010A OPPOSED BLADE VOLUME CONTROL DAMPERS :
Balance and tension operating mechanisms to give positive setting for blade positions from fully open to fully closed.
Local blade operation
Supply device for operating the damper blades through face or side of grille/diffuser as indicated.
Remote blade operation

Y46 – Grilles/ Diffusers/ Louvres

Supply and install proprietary remote control unit with all necessary brackets and linkage at the control unit. Provide label at the control unit to indicate function.

3040A BUTTERFLY VOLUME CONTROL DAMPERS:
Operate via a simple hooked wire key connecting with a lug on the underside of each plate; or by a loose key locating into a control mechanism.

3051 "IRIS" TYPE VOLUME CONTROL DAMPERS:
When in fully open setting ensure that unit inside diameter is equal to full internal diameter of air diffuser spigot, or ducting branch connection.
Operation
By loose key, unless otherwise indicated.

3060A FIXED AIR FLOW DEFLECTORS:
Direct airstream evenly from main ducting into branches or spigots serving air grilles and diffusers by using a number of equally spaced curved blades linked together.

3060B ADJUSTABLE AIR FLOW DEFLECTORS:
Direct airstream evenly from main ducting into branches or spigots serving air grilles and diffusers by using a number of equally spaced curved blades linked together.

3070 BLANKING PLATES:
Supply blanking plates to restrict projection of air flow from a particular section of grille or diffuser. Ensure that indicated dimensions or angles in degrees are maintained.

3080 PERFORATED BAFFLE PLATES:
Cover full width or depth of plenum box and extend beyond each side of air inlet to ensure even air distribution. Position centrally relative to plenum box air inlet.

3090 PERFORATED SCREENS:
Fit perforated screens behind grille volume control devices to equalize air flow and pressure. Contain perforated sheet within rigid surrounding frame, incorporating fixing brackets or lugs.

3100 CEILING OR WALL MOUNTED PLENUM BOXES:
Supply single plenum box or series of plenum boxes butted together to form continuous length, as indicated. Ensure sturdy and rigid construction with circular inlet spigots 85mm minimum length.
Incorporate at least four drilled angle brackets, or flat bar lugs, for securing to, or suspension by rods or wires from building or other construction.

3110 FLOOR MOUNTED PLENUM BOXES:
Supply single plenum box or series of plenum boxes butted together to form continuous length, as indicated. Ensure sturdy and rigid construction with circular inlet spigots 85 mm minimum length. Ensure box base material and reinforcement is able to withstand pressures of concrete handling and pouring when casting into floor slab.
Incorporate at least four drilled angle brackets, for fixing to slab soffit, or building ragged ties when casting into a floor slab.

3120A HINGED LOUVRE ACCESS PANELS AND DOORS:
Incorporate purpose made access panels or doors within body of louvres, manufactured from compatible materials.
Use hinged access panels or doors of single or double style and with front or rear locking facilities.

3130z SPARES:
Supply 5 loose keys, suitable for adjusting each size and type of grille, or operating accessories.

4000 WORKMANSHIP

4010 GRILLE/DIFFUSER LOCATION:

Y46 – Grilles/ Diffusers/ Louvres

Fit at terminal air supply, extract and transfer points indicated, in accordance with the HEVAC Air Diffusion Guide.

4020 **LOUVRE LOCATION:**
Fit at system main air intake and discharge points, as indicated.

4030 **ACCESSORIES:**
Supply all grilles, diffusers etc with OBDs unless indicated otherwise. Fit other accessories to each grille and diffuser in accordance with manufacturer's instructions and as indicated.

4040 **CONNECTION TO DUCTWORK:**
When connecting directly to duct spigot, secure grille mounting frame or flange with screws, or bolts and nuts, to returned flange, with filled in corners, at end of duct spigot.

4050z **INSTALLATION IN BUILDERSWORK:**
Ensure outer edge of grille mounting frame or flange extends on all sides beyond the joint between any builders work frame and surrounding building construction.
Ensure grilles are sealed to building fabric - including ceilings, to prevent air leakage from pressurized rooms to voids above.
Fix louvres to building fabric using face flange.
or Building in lugs.
or Rear studs.
or Masonry frame - supply only for fixing by others.
or As otherwise indicated.

4060A **TRANSFER GRILLES:**
Where transfer points are located in partitions or walls, prevent through vision by fitting a fixed blade grille on both faces of partition or wall. Connect cavity wall or partition transfer grille assemblies with ducting sleeve or collar extending between grilles.

4060B **TRANSFER GRILLES WITH FIRE DAMPER OR WITH FIRE DAMPER + SMOKE CONTROL DAMPER**
Where transfer points are located in partitions or walls, prevent through vision by fitting a fixed blade grille on both faces of partition or wall. Connect cavity wall or partition transfer grille assemblies with ducting sleeve or collar extending between grilles.
Incorporate fire damper in fire compartment wall transfer grille assembly.
Comply with the manufacturer's installation instructions and any control / wiring requirements in WBD or scope of works.

4070 **INSTALLATION OF FABRIC AIR DUCT DISTRIBUTION DEVICES:**
Ducts to be delivered to site in sealed polyethylene bags and stored on site in a dry, dust free environment in accordance with the manufacturer's recommendations.
Do not crush or bend devices.
Install devices and join sections in accordance with the manufacturer's recommendations.
Commission system in accordance with the manufacturer's recommendations.

4075 **FIXING:**
Provide details of fixing method for all grilles, diffusers and other terminal devices for approval.

10000 BASED ON NES Y46 Sept 18

AECOM

Y50 – Thermal Insulation

/1000 **GENERAL**

1010 **TEMPERATURE RANGE:**
Refer to insulation manufacturer's recommendations to determine suitability of different insulation materials at different temperature ranges.

1021 **STANDARDS:**
All thermal insulation and methods of application shall comply with the requirements of the current version of British Standards, Codes of Practice Building Regulations including but not limited to:-
Relevant parts of BS 476, BS 2972, BS EN 13188, BS 3958, BS 5422, BS 8000, BS 5608, BS 5970, BS 7572, BS EN 13941 and BS EN ISO 12241 as appropriate to the project particular requirements.
For product clauses comply with BS EN 14303, BS EN 14304 and BS EN 14314
Latest edition of Building Regulations Part L Approved Documents and the following 2nd tier documents:
Non domestic and domestic building services compliance guide.
TM54 HVAC compliance guide.
Description of terms as BS 3533.
Use insulating materials that comply with EC Regulation 842/2006 The F Gas Regulation, on certain fluorinated greenhouse gases.
Use insulating materials that comply with EC Regulation 1005/2009 The Ozone Regulation, on substances that deplete the ozone layer.
All insulation products must have a Declaration of Performance (DoP) certificate and be CE marked in accordance with the Construction Products Regulations (CPR).
Comply with BS EN 15783 and BS EN 15804 in preparing environmental product declarations (EPD's)

1031 **MATERIALS:**
All insulation materials, adhesives and finishes shall be in compliance with BS 476-4 , non-combustion test; or obtain a Class 'O' fire rating to Building Regulations to BS 476-6 and 7 and shall not be flammable or support combustion.
Materials classified according to BS EN 13501-1 shall not show propensity for continuous smouldering combustion when tested in accordance with BS EN 16733
Ensure metals and materials that cause galvanic corrosion are not installed in contact. Do not use galvanised or zinc coated steel jacketing and accessories on austenitic stainless steel or nickel steel/alloy equipment and piping.

All insulation materials shall be:-

- Inherently proof against rotting, mould and fungal growth and attack by vermin.
- Non-hygroscopic and in all respects be suitable for continuous use throughout the range of operating temperatures and within the environment indicated.
- Wholly compatible with the material it is insulating at the design working temperature and environmental conditions.
- Free from chemicals which may contribute to corrosion or degradation of the insulated surface or finish.
- Comply with the Health & Safety at Work Act and COSHH Regulations and be non carcinogenic.
- Asbestos Free. (Where any work is carried out on existing thermal insulation material or finish which contains asbestos in any form, attention is drawn to responsibilities under the provisions of the Control of Asbestos Regulations 2012).
- First class quality new materials delivered to site fully dried out and housed in dry store until ready for use.

For all mineral wool insulation products, test evidence must be available showing that the fibres from which the products are made are not classified as a possible human carcinogen, as detailed by European Directive 97/69/EC and the Approved Supply List of CHIP98

Use insulating materials with a Global Warming Potential (GWP) of less than 5.
Use insulating materials with an Ozone Depletion Potential (ODP) of zero.

Y50 – Thermal Insulation

1835 **EUROPEAN CLASSIFICATION FOR REACTION TO FIRE PERFORMANCE:**
Supply insulating materials classified in accordance with BS EN 13501-1 Fire classification of construction materials. Classes acceptable are A1 / A1L, A2 / A2L or B / BL having smoke emission classification of s1 (materials that give off little or no smoke) and production of flaming droplets/particles classification of d0.
Test methods
BS EN ISO 1182, BS EN ISO 1716, BS EN ISO 11925-2 BS EN 13823 as appropriate.

1845 **CONTROL OF FIBRE MIGRATION:**
Ensure all mineral wool type materials are fully wrapped with foil cover and sealed with tape to stop fibre migration.

1851 **SPREAD OF FLAME:**
When completed, ensure surface-finish complies with BS 476-7 Class 1 spread of flame, unless otherwise indicated.

1852 **PRE-INSULATED PIPELINES AND AIR DUCTLINES:**
In locations where insulation cannot be installed after erection of pipelines or air ductlines pre-insulated sections shall be installed. Insulation to such sections shall be equivalent in thermal and physical properties to that specified for the remainder of the system. Where vapour barriers are provided their integrity shall be maintained over the pre-insulated sections and the junctions to the remainder of the system.

1855 **SMOKE EMISSION CHARACTERISTICS:**
Ensure only products classified by BS EN 13501-1 as s1 (materials that give off little or no smoke) are used.

1860 **PRE-INSULATED EQUIPMENT:**
Where fire and surface spread of flame certificates relate to factory made products, ensure that certificates are still valid where products are incorporated in pre-insulated equipment.

1870 **PROTECTION APPLIED IN SITU:**
Where fire and surface spread of flame certificates relate to factory made products, ensure that the certificate remains valid when the finish is site applied.

1881 **ELECTRICAL BONDING:**
Ensure an electrical bonding connection of 6-mm² conductor is provided where required to maintain electrical continuity.

1891 **INSPECTION AND TESTING:**
Where indicated arrange performance test of thermal conductivity on materials selected, carried out at manufacturer's works or at an approved laboratory and in accordance with appropriate British Standard.
Provide assistance to allow for inspection of all sizes of insulation on all services after installation to determine thickness and compliance with specification. Make good any sections that are cut during inspection for thickness and compliance with specification.

2000 **PRODUCTS/MATERIALS**

2010 **THERMAL CONDUCTIVITY:**
All thermal conductivity figures given in insulation product clauses are typical values at the mean temperature stated, as declared in manufacturers Declaration of Performance (DoP) certificates in accordance with the CPR.

Y50 – Thermal Insulation

2016 **THERMAL PERFORMANCE LIFE EXPECTANCY**
Ensure the insulation will maintain its thermal performance for a minimum of the plant design life and provide manufacturers details which define the life expectancy of the insulation material. The Lambda value of the insulation should also be quoted at both manufactured and aged value in accordance with BS EN 14314 for phenolic foam products.

2021 **RESTRICTIONS ON USE OF MATERIAL:**
Protect insulated stainless steel surfaces from the risk of stress corrosion in accordance with the recommendations in BS 5970.
Do not install insulants with man-made mineral fibres in food preparation areas or aseptic areas.
For all mineral wool insulation products, test evidence must be available showing that the fibres from which the products are made are not classified as a possible human carcinogen, as detailed by European Directive 97/69/EC and the Approved Supply List of CHIP98 and that the fibres should be bio-soluble.

2030 **ROCK or GLASS MINERAL WOOL PIPE INSULATION:**
Standard - BS EN 14303
Nominal density 120 kg/m³
Thickness 20mm to 100mm
Thermal conductivity
Rock Wool – Typical value of 0.033-0.034W/mK at a mean temperature of 10°C
Glass Wool – Typical value of 0.033 W/mK at a mean temperature of 10°C
Finish -Reinforced aluminium foil with at least 25mm overlap.

2040 **MINERAL WOOL RIGID DUCT INSULATION:**
Standard - BS EN 14303.
Type – Rock or glass
Nominal density - 45 - 48 kg/m³
Thickness - 25mm to 100mm.
Thermal conductivity – - Typical value of 0.033 – 0.034W/mK at a mean temperature of 10°C
Finish- Reinforced aluminium foil

2050 **MINERAL WOOL FLEXIBLE DUCT INSTALLATION:**
Standard - BS EN 14303.
Type – Rock or glass
Nominal density 28- 45 kg/m³
Thickness - 25mm to 80mm
Thermal conductivity – Not exceeding 0.033 – 0.034 W/mK at a mean temperature of 10°C
Finish -Reinforced aluminium foil

2060 **ROCK OR GLASS MINERAL WOOL LAMELLA OR CRIMPED MAT DUCT INSULATION:**
Standard - BS EN 14303.
LAMELLA
Nominal density –24 - 45 kg/m3.
Thickness - 25mm to 80mm.
Thermal conductivity
Typical value of 0.04 W/mK at a mean temperature of 10°C
Finish – Reinforced aluminium foil.
The Lamella duct insulation must be factory produced, by the mineral Wool manufacturer, 'on line' in one continuous process and not converted as a separate production process.

CRIMPED MAT
Nominal density – 25 to 45 kg/m3
Compression resistance – Maximum of 13% compression at a static load of 2 kPA,.
Thickness - 25mm to 80mm.
Thermal conductivity

Y50 – Thermal Insulation

Typical value of 0.039 W/mK at a mean temperature of 50°C
Finish – Reinforced aluminium foil.

2111 **CLOSED CELL RIGID PHENOLIC FOAM (PF) PREFORMED SECTIONS - CFC AND HCFC FREE:**
Standard - BS EN 14314 Nominal density - 35 - 40 kg/m³.
Temperature range - -180° to +120°C.
Thickness - 15mm to 50mm.

Thermal conductivity
Typical value of 0.025 W/mK at a mean temperature of 10°Cwhen fully aged in accordance with BS EN 14314.

Finish
Reinforced aluminium foil or manufacturer's standard matt black as scheduled.

All phenolic foam sections shall have been completely treated, at the insulation manufacturer's works, with a suitable dust suppressant, acid neutralising and passivating coating. Also, all exposed edges of phenolic foam insulation shall be sealed to the surface being insulated with a suitable vapour sealing mastic

2121 **CLOSED CELL RIGID LAMINATED PHENOLIC FOAM (PF), DUCT INSULATION SLAB - CFC AND HCFC FREE:**
Standard - BS EN 14314 Nominal density - 40 kg/m³.
Thickness - 20mm - 50mm
Thermal conductivity
Typical value of 0.022 W/mK at a mean temperature of 10°C when fully aged in accordance with BS EN 14314.

2131 **HIGH DENSITY PHENOLIC PIPE AND DUCT SUPPORT FOAM - CFC AND HCFC FREE**
Standard - BS EN 14314
Nominal density – 80 kg/m³ to 120 kg/m³.
Temperature range - 180°C to +120°C.
Thermal conductivity
Typical value of 0.045 W/mK at a mean temperature of 50°C. when fully aged in accordance with BS EN 14314.

2140 **CLOSED CELL NITRILE AND EPDM RUBBER ELASTOMERIC SHEET AND PREFORMED FLEXIBLE SECTIONS CFC/HCFC FREE AND ZERO ODP/GWP:**
Standard BS EN 14304
Nitrile rubber
Nominal density - 45 - 100 kg/m3.
Temperature range – 50°C to +110°C
Thickness
Sections
6mm to 32mm for pipe sizes 6mm to 114mm.
Sheets – 6mm to 50mm.
Thermal conductivity
Typical value of 0.036 W/mK at a mean temperature of 20°C.
EPDM rubber
Nominal density – 45 – 100 kg/m3.
Temperature range – -50 to +150oC
Thickness
Sections – 10mm to 25mm for pipe sizes 10mm to 89mm.
Sheets - 10mm to 32mm.
Thermal conductivity – Typical value of 0.045 W/mK at a mean temperature of 40°C.

2170 **VAPOUR BARRIER PERMEANCE:**
Comply with requirements of BS 5422 and BS 5970.

Y50 – Thermal Insulation

Maximum permitted water vapour permeance in relation to plant temperature at an ambient temperature of +20°C (dry bulb) to be in accordance with BS 5422, Table 1.

2185 **ACOUSTIC INSULATION:**
Where indicated provide acoustic insulation.
Refer to Y45 clause 2090z for technical details and schedule Y45sch for locations / systems.

2190 **ADHESIVES**
Comply with the recommendations of clause 10.1 of BS 5970 for insulation bonding adhesives; lagging adhesives; and facing and film attachment adhesives.

2195 **FIRE PROTECTION CLADDING**
Where indicated, ductwork shall be provided with a proprietary fire protection cladding material as described below.

The fire protection material and all ancillary fixing products shall be shown as a system (by independent test) to meet the requirements of BS EN 1366-1 in the case of supply and extract ventilation systems and classified in accordance with BS EN 13501-3.
In the case of smoke extract / fire ventilation the system shall meet the requirements of BS EN 1366-1 and BS EN 1366-8 or BS EN 1366-9 and classified in accordance with BS EN 13501-4.
For kitchen extract ducting systems it shall be shown by test or assessment by an independent 3rd party to meet the requirements BS 476-24 or BS EN 1366-1 and classified in accordance with BS EN 13501-3.
In each case the criteria as defined in the above test standards of stability, integrity and insulation shall each be achieved fully for the required period of protection as scheduled or described in the particular specification.

Generally all ducts shall be protected on all four sides. Where an adjacent slab or wall is conveniently placed to form one side of the enclosure this may be utilised subject to its fire rating being as that of the required enclosure being adequately connected and sealed to the wall or slab, and subject to agreement by the Engineer.

The following proprietary constructions are acceptable and represent the minimum required. All material thicknesses, adhesives and final installation and the underlying ductwork shall in all ways comply with the requirements of the Manufacturers material and installation instructions, Building Regulations and the Buildings Control officer to suit the scheduled period of fire protection and whether ducts are exposed internal or external fire or both.

Promat "Viscolad" 430 kg/m³ Board Cladding – (where ducts are required to be protected, the ducts shall initially be encased with mineral rock Wool slabs having a minimum density of 80kg/m³ or 80kg/m³)
Rockwool "Fire Duct" 160 kg/m³ Ductwork slab rigid Insulation Fire Protection Board Cladding
Saint - Gobain Isover "Ultimate-Protect" 85 kg/m³ slab and flexible wired mat.

2201 **POLYISOBUTYLENE PROTECTION:**
Polyisobutylene – minimum thickness 0.8mm.

2202 **PVC PROTECTION:**
Rigid PVC - thickness 0.35mm.

2203 **ALUMINIUM SHEETING PROTECTION:**
Apply flat (embossed)or profiled aluminium cladding directly to insulating material, thickness, 0.56mm on pipework, 0.71mm on ductwork

2204 **ALUMINIUM-ZINC COATED STEEL PROTECTION:**
Mild steel sheet continuously hot dipped with 185gm aluminium-zinc coating to BS EN 10326 and BS EN 10327 applied directly to insulating material.

Y50 – Thermal Insulation

0.4mm thick lid sheet. Installation shall be in accordance with the manufacturers recommendations.

2205 **SELF ADHESIVE WEATHER RESISTANT ZERO PERM MULTI-LAYER LAMINATE FOIL/FILM PROTECTION:**
Enclose insulation with laminated foil/film around insulation and finish ensuring 75mm overlap for a complete vapour barrier.
Film to be either factory pre-applied or applied in-situ and be capable of providing vapour barrier. Product to be tested in accordance with BS 476 parts 6 & 7 and BS EN ISO 1716. Finish to be class O. Products to be highly puncture and tear resistant and have supporting test data in accordance with ASTM D-1000 & ASTM D-624. Product to be supported by a 10 year guarantee.
Normal use - 5 ply laminate comprising 3 layers of aluminium and 2 layers of polyester film coated with pressure sensitive adhesive.
Minimum application temperature -20ºC
Heavy duty use (eg pipework / ductwork which could be walked on regularly or low level pipework in plant areas) - 13 ply laminate. Minimum application temperature -20ºC
Seams on bends, elbows, tees etc and underlying foil faced insulation are to be sealed with the foil/film manufacturers recommended tape. Installation to be in accordance with the manufacturer's recommendations.

2211 **REINFORCEMENT:**
Use one of the following methods where reinforcement is required.
Galvanized wire netting - comply with BS EN 10223, not less than 0.9mm diameter wire, 25mm mesh (50mm mesh on ductwork).
or Galvanized wire -not less than 0.8mm diameter wire, spirally wound at 75mm pitch.
or Aluminium bands - not less than 20mm wide x 0.5mm thick with galvanized wire end loops, at 300mm centres.

2221 **VALVES, ANCILLARIES AND FLANGE INSULATION:**
Install insulation on all flanges and valves and other pipeline ancillaries. The only exception is on valves and pipeline ancillaries on hot services smaller than 32mm on internal applications where the heat loss can be demonstrated as "always useful". (Where un-insulated valves or ancillaries could cause a safety hazard, they shall be insulated)
Use a protected metal split casing fabricated from 1.2mm aluminium sheet filled with spring clip fasteners, filled with insulating material with same thermal performance as insulation on adjoining pipe.
or Use moulded insulation boxes filled with insulating material with same thermal performance as insulation on adjoining pipe.
or Use proprietary flexible insulation jackets manufactured from aluminised glass cloth, with a minimum of 50mm mineral Wool infill fastened with Velcro and draw cord fastening.
Valve boxes shall include removable covers over handwheels and stems, comply as appropriate with BS 5970. Additionally, on cold applications, wrap cold piping valve bodies and flanges with 50mm thick flexible material with facing and seal joints to maintain vapour barrier.

2225 **DUCTWORK FLANGE INSTALLATION**
Insulation thickness should be selected such that a minimum thickness is carried over flanges and/or stiffeners for continuation of vapour barrier and/or sufficient insulation to avoid condensation.

2231 **PROTECTION FOR HEAT EXCHANGERS AND OTHER VESSELS WITH CHEST COVERS:**
Insulation to be mineral wool lamella or crimped flexible mat.
Finish with ribbed or embossed aluminium sheeting 0.9mm thick or 0.7mm aluminium-zinc coated steel embossed or ribbed sheeting with lapped, rivetted and sealed joints, laps to shed water. Seal all joints at manholes and stools. Fit cut outs with purpose made over-plates or collars. Domed tops of calorifiers to be finished in segments.
Enclose chests and access covers in removable aluminium covers lined with high density flexible material. Remove manufacturer's name plate and refix on cladding.

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2241 **INSULATION FOR BOILER FLUES, MINERAL WOOL, ALUMINIUM BANDS:**
Where twin wall pre-insulted flues are not specified and a single wall carbon steel flues is installed, flues and chimneys to be insulated in accordance with BS 5970 using mineral Wool industrial wired mat with a minimum density 80 kg/m³
Use preformed sections secured by metal bands direct to flue. Use multi-layers and stagger joints for thicknesses in excess of 65mm.
Material
Bonded mineral Wool with ribbed or embossed aluminium sheeting 0.9mm thick secured with aluminium bands.

2250 **PRE-INSULATED BOILER FLUES:**
Provide pre-insulated boiler flues where indicated / scheduled.

2260 **PRE-INSULATED STORAGE VESSELS:**
Ensure insulation standards on pre-insulated storage vessels meet the general specification requirements of the works.

2270 **CYLINDER JACKETS:**
Provide cylinder jackets as indicated.

2281 **PUMPS AND OTHER IRREGULAR SHAPES:**
All pumps, heat exchangers and other irregular shapes shall be insulated to prevent condensation. All heat exchangers and other pipeline ancillary components shall be insulated to control heat loss. Where access is required to pumps and other irregular shapes submit proposals for materials and methods of applying a demountable finish, for approval.
Comply with requirements of BS 5970.

2285 **THICKNESS OF INSULATION:**
Supply thickness of insulation as indicated. For HWS pipework trace heated for temperature maintenance refer to clauses 2291 and 2301 and schedule Y24.
Where a material with an alternative thermal conductivity (k factor) is offered, utilise a thickness which will provide an equivalent degree of insulation to the combination of thickness and k factor specified. The figures are derived from the tables given in BS 5422 and the calculation methods given in BS EN ISO 12241.

2286 **CALCULATION OF INSULATION THICKNESS - BUILDING REGULATIONS:**
Provide insulation of thickness conforming with the requirements of the Building Regulations (England and Wales) Part L Approved Documents or the Scottish Technical Handbooks, and the calculation methods given in BS EN ISO 12241 using the standardised assumptions within table G1 of BS 5422.

2287 **CALCULATION OF INSULATION THICKNESS - ECA ENHANCED:**
The insulation manufacturer selected for a particular project should calculate the minimum required thicknesses of pipework insulation based on the actual conductivity of the product at the relevant temperature and the criteria on the ECA web site for an eligible installation using the methodology set out in BS EN ISO 12241 and the assumptions set out in Table G1 of BS 5422.

2289 **INSULATION THICKNESS TABLES AND PIPE SIZES:**
Unless stated otherwise the thicknesses given in the tables in this specification are the nearest commercially available material thickness to meet the minimum calculated thickness to BS ISO 12241 and the product declared performance data for CE marking. Thicknesses have been calculated by manufacturers for each product and use thermal conductivity values calculated from the mean insulation temperature based on the fluid and air temperatures listed in the relevant tables. Should alternative products be offered that may have different performance data the Contractor shall ensure the manufacturer undertakes calculations and submits appropriate thickness table.
For HWS pipework trace heated for temperature maintenance refer to clauses 2291 and 2301 and schedule Y24.

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Unless specified otherwise elsewhere, the thicknesses for pipe of greater diameter, flat surfaces or irregular shaped plant items shall not be less than that for the largest pipe size given in the thickness tables.
Most tables give steel pipe sizes as OD, equivalent nominal bore sizes are given below

Approx. OD (mm)	Nominal bore	Approx. OD (mm)	Nominal bore
17	10	140	125
21	15	165	150
27	20	219	200
34	25	273	250
42	32	324	300
48	40	356	350
60	50	406	400
76	65	457	450
89	80	508	500
114	100	610	600

2251 **NON DOMESTIC HOT WATER SUPPLY SERVICES THICKNESS TABLE BUILDING REGULATIONS: ROCK & GLASS MINERAL WOOL:**
Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide, Northern Ireland Technical Booklet F2 and Section 6 of the Scottish Non Domestic Technical Handbook.

Outside diameter of steel pipe (mm)	Thickness of rock mineral wool (mm)		Thickness of glass mineral wool (mm)	
Surface emissivity	0.05	0.9	0.05	0.9
17	25	30	25	30
21	25	30	25	30
27	30	35	30	40
34	30	35	30	40
42	30	35	30	40
48	35	40	40	40
60	40	40	40	40
76	35	45	40	40
89	35	45	40	40
114	40	45	40	50
140	40	45	40	50
168	40	50	40	50
219	40	50	40	50
273 and above	45	50	40	50

Basis: Horizontal pipe at 60°C in still air at 15°C, thermal conductivity values calculated from the mean insulation temperature based on the fluid and air temperatures.
Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter.
Use this table for insulation thickness of plastic pipework of the nearest equivalent outside diameter.
For trace heated HWS pipework for temperature maintenance, the thicknesses shall be adjusted (as advised by the trace heating specialist) to ensure the correct combination of thermal insulation (thermal conductivity / thickness) and heating cable (ie output / straight or double or spiral) to meet the design parameters in schedule Y24.

2305 **NON DOMESTIC HOT WATER SUPPLY SERVICES BUILDING REGULATIONS PHENOLIC FOAM**
Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide, Northern Ireland Technical Booklet F2 and section 6 of the Scottish Non Domestic Technical Handbook.

Outside diameter of	Thickness of phenolic foam (mm)

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steel pipe (mm)		
Surface emissivity	(0.05)	(0.9)
17	15	15
21	15	20
27	15	20
34	20	20
42	20	20
48	20	25
60	20	25
76	25	25
89	25	25
114	25	30
140	25	30
168	25	30
219	30	30
273 and above	30	30

Basis: Horizontal pipe at 60°C in still air at 15°C, aged k value. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Thicknesses of nitrile rubber are minimum calculated thicknesses.
Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter.
Use this table for insulation thickness of plastic pipework of the nearest equivalent outside diameter.
The above thicknesses relate to Class O rated insulated. the thicknesses may vary for other ratings.

For trace heated HWS pipework for temperature maintenance, the thicknesses shall be adjusted (as advised by the trace heating specialist) to ensure the correct combination of thermal insulation (thermal conductivity / thickness) and heating cable (ie output / straight or double or spiral) to meet the design parameters in schedule Y24

2306 **NON-DOMESTIC HOT WATER SERVICE AREAS, BUILDING REGULATIONS - NITRILE RUBBER:**
Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide, Northern Ireland Technical Booklet F2 and section 6 of the Scottish Non Domestic Technical Handbook.

Outside diameter of steel pipe (mm)	Approx. thickness of nitrile rubber (mm)	
Surface emissivity	(0.05)	(0.9)
17	26	31
21	28	33
27	30	35
34	32	37
42	33	38
48	35	41
60	36	42
76	38	44
89	38	44
114	39	45
140	40	47
168	41	48
219	41	48
273 and above	42	49

Basis: Horizontal pipe at 60°C in still air at 15°C. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Thicknesses of nitrile rubber are minimum calculated thicknesses.
Use this table for insulation thickness of copper pipework of the nearest equivalent outside

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diameter.
Use this table for insulation thickness of plastic pipework of the nearest equivalent outside diameter.
The above thicknesses relate to Class O rated insulation. The thicknesses may vary for other ratings.

2307 **NON-DOMESTIC HOT WATER SUPPLY SERVICES, ECA ENHANCED:**
The insulation manufacturer selected for a particular project should calculate the minimum required thicknesses of pipework insulation based on the actual conductivity of the product at the relevant temperature and the criteria on the ECA web site for an eligible installation using the methodology set out in BS EN ISO 12241and the assumptions set out in Table C1 of BS 5422: 2009. The table below defines the maximum permissible heat losses to be used in the calculations.

Non-Domestic Hot Water Supply Maximum Permitted Heat Loss (W/m)	
Temperature	60°C
Outside Pipe Diameter (mm)	
17.2	6.04
21.3	6.45
26.9	7.00
33.7	7.71
42.4	8.46
48.3	9.01
60.3	9.94
76.1	11.25
88.9	12.17
114.3	14.28
139.7	16.09
168.3	18.24
219.1	22.08
273 & above	25.95

2308 **DOMESTIC HOT WATER STORAGE VESSELS IN NEW AND EXISTING BUILDINGS- ROCK MINERAL WOOL:**
Provide insulation thicknesses to limit heat losses from DHW storage vessels to the maximum recommended in Table 27 in the Non-domestic Building Services Compliance Guide (NDBSCG):2013.
Minimum thickness of insulation for vessels of capacity less than those in the table below to be 80mm.
Insulation thickness for vessels with capacity greater than 2m³ to be 120mm.
Install insulation in accordance with the manufacturer's recommendations.
Encase insulation in 1.0mm thick galvanised mild steel sheets.

Nominal Capacity (litres)	Typical vessel Diameter (m)	Typical vessel Height or length(m)	Maximum Heat Loss (kWh/24h)	kW	W/m²	Rock mineral wool slab thickness mm
700	0.675	1.750	4.1	0.171	38.6	80
800	0.750	1.950	4.3	0.179	32.7	90
900	0.800	2.000	4.5	0.188	31.1	100
1000	0.850	1.950	4.7	0.196	30.9	100
1200	0.900	2.100	4.9	0.204	28.3	100
1500	1.050	1.950	5.1	0.213	26.0	110
2000	1.050	2.500	5.2	0.217	21.7	120

Basis of table: Part of Table 27 in NDBSCG:2013, rock mineral wool slabs (plain, without foil facing) conforming to BS EN 14303, 45Kg/m³ and thermal conductivity of 0.042W/mK at 50°C mean temperature.

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2311 **NON DOMESTIC HEATING SYSTEMS BUILDING REGULATIONS [INTERNAL PIPEWORK] ROCK MINERAL WOOL**
Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide Northern Ireland Technical Booklet F2, and section 6 of the Scottish Non Domestic Technical Handbook.

Outside diameter of steel pipe (mm)	Thickness of rock mineral wool insulation (mm)					
Temperature of contents °C	≤95		96-120		121-150	
Surface emissivity	0.05	0.9	0.05	0.9	0.05	0.9
17	25	30	25	30	25	30
21	30	35	30	35	30	35
27	35	40	40	45	40	45
34	35	40	45	55	55	55
42	35	40	55	60	65	70
48	40	45	55	60	70	75
60	40	45	60	65	75	80
76	45	50	60	65	80	90
89	45	50	65	70	80	90
114	50	55	65	75	90	100
140	50	55	70	75	100	100
168	50	55	70	80	100	100
219	50	60	75	80	100	120
273 & above	50	60	75	90	110	120

Basis of calculation of thicknesses: Horizontal pipe at 75 °C (LTHW) or 100 °C (MTHW) or 125 °C (HTHW) in still air at 15 °C. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Use this table for insulation thickness of copper or plastic pipework of the nearest equivalent outside diameter.

2312 **NON DOMESTIC HEATING SYSTEMS [EXTERNAL PIPEWORK] MINERAL WOOL INSULATION LOW EMISSIVITY OUTER SURFACE (LES):**
Minimum insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide

Nominal Steel Pipe Size (bore - mm)	Temperature of contents °C
	75 (Low temperature hot water)
	Thickness of Rock mineral wool insulation (mm)
10	60
15	60
20	60
25	60
32	60
40	70
50	70
65	70
80	70
100	70
125	70
150	70
200	70
250 & above	70
Flat Surfaces	70

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The thicknesses tabled are the nearest commercial equivalent to calculated thicknesses based on: Horizontal pipe with water at 75ºC (LTHW) in still air at -5ºC.Use this table for insulation thickness of copper pipework of the nearest equivalent diameter.
Use this table for insulation thickness of copper pipework of the nearest equivalent diameter.

2315 NON DOMESTIC HEATING SYSTEMS BUILDING REGULATIONS [INTERNAL PIPEWORK] GLASS MINERAL WOOL
Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide Northern Ireland Technical Booklet F2, and section 6 of the Scottish Non Domestic Technical Handbook.

Outside diameter of steel pipe (mm)	Thickness of rock mineral wool insulation (mm)					
Temperature of contents ºC	≤95		96-120		121-150	
Surface emissivity	0.05	0.9	0.05	0.9	0.05	0.9
17	25	30	25	30	25	30
21	30	40	30	40	30	40
27	30	40	40	40	40	40
34	40	40	50	50	50	50
42	40	40	50	50	60	60
48	40	50	50	60	60	80
60	40	50	60	60	80	80
76	50	50	60	60	80	80
89	50	50	60	60	80	80
114	50	50	60	60	80	100
140	50	60	80	80	100	100
168	50	60	80	80	100	100
219	50	60	80	80	100	100
273 & above	50	60	80	80	100	100

Basis of calculation of thicknesses: Horizontal pipe at 75 ºC (LTHW) or 100 ºC (MTHW) or 125 ºC (HTHW) in still air at 15 ºC. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Use this table for insulation thickness of copper or plastic pipework of the nearest equivalent outside diameter.

2325 NON DOMESTIC HEATING SYSTEMS BUILDING REGULATIONS [INTERNAL PIPEWORK]- PHENOLIC FOAM INSULATION:
Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide Northern Ireland Technical Booklet F2, and section 6 of the Scottish Non Domestic Technical Handbook.

Outside diameter of steel pipe (mm)	Thickness of phenolic foam insulation (mm)	
Temperature of contents ºC	≤95	
Surface emissivity	0.05	0.9
17	15	15
21	15	20
27	20	20
34	20	20
42	20	25
48	25	25
60	25	25
76	25	30

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89	25	30
114	30	30
140	30	35
168	30	35
219	30	35
273 &above	35	35

Basis of calculation of thicknesses: Horizontal pipe at 75 ºC (LTHW) or 100 ºC (MTHW) or 125 ºC (HTHW) in still air at 15 ºC. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Use this table for insulation thickness of copper or plastic pipework of the nearest equivalent outside diameter.

2325A NON DOMESTIC HEATING SYSTEMS [EXTERNAL PIPEWORK] PHENOLIC FOAM INSULATION LOW EMISSIVITY OUTER SURFACE (0.05):
Minimum insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide

Nominal Steel Pipe Size (bore - mm)	Temperature of contents ºC Low temperature hot water 75ºC Thickness of phenolic foam insulation (mm)
10	30
15	30
20	35
25	35
32	35
40	40
50	40
65	45
80	45
100	45
125	45
150	50
200	50
250 & above	50
Flat Surfaces	50

The thicknesses tabled are the nearest commercial equivalent to calculated thicknesses based on: Horizontal pipe with water at 75ºC (LTHW) in still air at -5ºC.Use this table for insulation thickness of copper pipework of the nearest equivalent diameter.
Use this table for insulation thickness of copper pipework of the nearest equivalent diameter.
Basis: Aged k- value

2326 NON DOMESTIC HEATING SYSTEMS BUILDING REGULATIONS [INTERNAL PIPEWORK]- NITRILE RUBBER INSULATION:
Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide, Northern Ireland Technical Booklet F2 and section 6 of the Scottish Non Domestic Technical Handbook.

Outside diameter of steel pipe (mm)	Thickness of nitrile rubber insulation (mm)					
Temperature of contents ºC	≤95		96-120#		121-150#	
Surface emissivity	0.05	0.9	0.05	0.9	0.05	0.9
17	27	31	28	29	32	35
21	31	35	32	36	38	42

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27	34	39	40	45	48	52
34	38	42	47	52	59	65
42	38	44	51	57	74	81
48	40	46	52	58	77	84
60	42	48	56	62	82	89
76	44	50	59	66	87	95
89	45	52	61	67	90	98
114	47	54	65	71	96	103
140	48	55	68	74	100	107
168	49	56	70	77	102	110
219	51	58	72	79	106	115
273	51	58	74	81	109	118

Thicknesses of nitrile rubber are minimum calculated thicknesses.
Basis: Horizontal pipe at 75°C (LTHW) or 100°C (MTHW) or 125°C (HTHW) in still air at 15°C. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Use this table for insulation thickness of copper or plastic pipework of the nearest equivalent outside diameter.
for service temperatures above 110°C specialist high temperature Foamed EPDM rubber must be used as recommended by the manufacturer.

2327 **NON-DOMESTIC HEATING INSTALLATIONS, ECA ENHANCED:**
The insulation manufacturer selected for a particular project should calculate the minimum required thicknesses of pipework insulation based on the actual conductivity of the product at the relevant temperature and the criteria on the ECA web site for an eligible installation using the methodology set out in BS EN ISO 12241and the assumptions set out in Table C1 of BS 5422: 2009. The table below defines the maximum permissible heat losses to be used in the calculations.

Non-Domestic Heating Installations Maximum Permitted Heat Loss (W/m)			
	Low	Medium	High
Temperature	< 95°C	96-120°C	121-150°C
Outside Pipe Diameter (mm)			
17.2	7.78	10.57	13.27
21.3	8.42	11.25	14.08
26.9	9.05	12.08	15.02
33.7	9.88	13.04	16.07
42.4	10.83	14.12	17.34
48.3	11.42	14.80	18.09
60.3	12.61	16.22	19.62
76.1	14.12	17.88	21.41
88.9	15.28	19.20	22.87
114.3	17.51	21.68	25.53
139.7	19.72	23.99	27.98
168.3	22.34	26.63	30.69
219.1	26.61	31.15	35.25
273 & above	30.91	35.83	40.05

2331 **DOMESTIC CENTRAL HEATING AND HOT WATER SYSTEMS ROCK & GLASS MINERAL WOOL INSULATION:**
Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Domestic Building Services Compliance Guide Northern Ireland Technical Booklet F1, and section 6 of the Scottish Domestic Technical Handbook.

Outside diameter of copper pipe (mm)	Thickness of rock mineral wool (mm)	Thickness of glass mineral wool (mm)

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Surface emissivity	0.05	0.9	0.05	0.9
15	-	-	20	20
22	20	20	20	20
28	20	25	20	20
35	20	25	20	25
42	20	25	20	25
54	20	25	20	25

Basis of calculation: Horizontal pipe at 60°C (LTHW) in still air at 15°C. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Mineral wool sections are not available for pipe outside diameters less than 17mm.
Use this table for insulation thickness for plastic pipework of the nearest equivalent outside diameter.

2332 **DOMESTIC CENTRAL HEATING AND HOT WATER INSTALLATIONS, ECA ENHANCED:**
The insulation manufacturer selected for a particular project should calculate the minimum required thicknesses of pipework insulation based on the actual conductivity of the product at the relevant temperature and the criteria on the ECA web site for an eligible installation using the methodology set out in BS EN ISO 12241 and the assumptions set out in Table C1 of BS 5422: 2009. The table below defines the maximum permissible heat losses to be used in the calculations.

Domestic Heating & Hot Water Maximum Permitted Heat Loss (W/m)	
Temperature	60°C
Outside Pipe Diameter (mm)	
8	5.82
10	6.20
12	6.52
15	7.03
22	8.02
28	8.87
35	9.63
42	10.38
54	11.83

2336 **DOMESTIC CENTRAL HEATING AND HOT WATER SYSTEMS - PHENOLIC FOAM**
Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Domestic Building Services Compliance Guide, Northern Ireland Technical Booklet P1 and section 6 of the Scottish Domestic Technical Handbook.

Outside diameter of copper pipe (mm)	Thickness of phenolic foam insulation (mm)	
Surface emissivity	0.05	0.9
15	15	15
22	15	15
28	15	15
35	15	15
42	15	15
54	15	15

Basis: Horizontal pipe, water at 60°C in still air at 15°C, aged k value. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.

2337 **DOMESTIC CENTRAL HEATING AND HOT WATER SYSTEMS – NITRILE RUBBER**
Insulation thickness to achieve the maximum permissible heat loss stated in the Building Regulations Part L Domestic Building Services Compliance Guide, Northern Ireland Technical Booklet P1 and section 6 of the Scottish Domestic Technical Handbook.

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Outside diameter of copper pipe (mm)	Thickness of nitrile rubber insulation (mm)	
Surface emissivity	0.05	0.9
8	9	9
10	13	13
12	13	19
15	19	19
22	19	25
28	19	25
35	25	25
42	25	25
54	25	32

Basis: Horizontal pipe, water at 80°C in still air at 15°C, aged k value. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.

2340 **STEAM AND CONDENSATE SYSTEMS FOR HVAC SYSTEMS - ROCK MINERAL WOOL:**

Outside diameter of steel pipe (mm)	Thickness of rock mineral wool insulation (mm)					
Temperature of contents °C	Condensate ≤100°C #		Steam & Condensate Up to 149°C ## (3.5 barg max)		Steam & Condensate 150°C and above ###	
Surface emissivity	0.05	0.9	0.05	0.9	0.05	0.9
17	25	30	25	30	45	50
21	30	35	30	35	55	70
27	40	45	40	45	75	80
34	45	55	55	55	90	100
42	55	60	65	70	120	120
48	55	60	70	75	120	120
60	60	65	75	80	120	130
76	60	65	80	90	130	140
89	65	70	80	90	130	140
114	65	75	90	100	140	140
140	70	75	90	100	140	150
168	70	80	100	100	140	150
219	75	80	100	120	150	150
273	75	90	100	120	150	160
Flat surfaces	75	90	100	120	150	160

Basis of calculation of thicknesses: BS 5422 Table 16 Horizontal pipe at 100°C in still air at 15°C, high emissivity outer surface (0.9). Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Basis of calculation of thicknesses: BS 5422 Table 16 Horizontal pipe at 125°C in still air at 15°C, high emissivity outer surface (0.9). Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Basis of calculation of thicknesses: BS 5422 Table 16 Horizontal pipe at 150°C (but using heat losses for 125°C) in still air at 15°C, high emissivity outer surface (0.9). Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
These thicknesses are greater than those for process pipework with a hot face temperature of 200°C to control heat loss and limit surface temperature. (Tables 21 and 24 in BS 5224).
Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter.

2385 **COOLED WATER SUPPLIES, BUILDING REGULATIONS, HEAT GAIN AND CONDENSATION CONTROL ON COOLED AND COLD WATER SUPPLIES – ROCK MINERAL WOOL:**
Insulation thicknesses are the worst case to control heat gain to maximum permissible figures stated in

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the Building Regulations Part L Non Domestic Building Services Compliance Guide Northern Ireland Technical Booklet F2, and section 6 of the Scottish Non Domestic Technical Handbook and control condensation in accordance with BS 5422.

Outside diameter of steel pipe (mm)	Thickness of mineral wool insulation (mm)					
Temperature of contents °C	>10		4.9 to 10		0 to 4.9	
Surface emissivity	0.05	0.9	0.05	0.9	0.05	0.9
17	20	20	25	25	30	30
21	20	20	25	25	30	30
27	20	20	30	30	35	30
34	20	25	30	30	35	35
42	25	25	30	30	40	35
48	25	25	35	30	40	35
60	25	25	35	35	45	40
76	30	30	40	35	50	45
89	30	30	40	35	50	45
114	30	30	45	35	55	45
140	35	30	45	40	55	45
168	35	30	50	40	60	45
219	35	30	50	40	65	45
273	40	30	55	40	70	45
324	40	40	55	45	70	60
356	40	40	60	50	75	60
406	45	50	60	60	75	70
456	45	60	60	70	80	80
508	45	60	65	80	80	90
610	50	80	70	90	90	110
Flat	50	80	70	90	90	110

Basis for condensation: control ambient temperature of 25°C and a relative humidity of 80%. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter.
Use this table for insulation thickness of plastic pipework of the nearest equivalent outside diameter.

2396 **COOLED WATER SUPPLIES, BUILDING REGULATIONS, HEAT GAIN AND CONDENSATION CONTROL ON COOLED AND COLD WATER SUPPLIES – GLASS MINERAL WOOL:**
Insulation thicknesses are the worst case to control heat gain to maximum permissible figures stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide Northern Ireland Technical Booklet F2, and section 6 of the Scottish Non Domestic Technical Handbook and control condensation in accordance with BS 5422.

Outside diameter of steel pipe (mm)	Thickness of glass mineral wool insulation (mm)					
Temperature of contents °C	>10		4.9 to 10		0 to 4.9	
Surface emissivity	0.05	0.9	0.05	0.9	0.05	0.9
17	20	20	20	25	25	25
21	20	20	25	25	30	30
27	20	20	25	25	30	30
34	20	20	25	30	40	30
42	20	20	30	30	40	40
48	25	25	30	30	40	40
60	25	25	30	30	50	40
76	25	25	40	40	50	40
89	25	25	40	40	50	40
114	30	30	40	40	50	40
140	30	30	40	40	50	40
168	30	30	40	40	60	50
219	40	30	50	40	60	50

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273	40	30	50	40	60	50
324	40	40	50	45	60	60
356	40	40	50	50	60	60
406	40	50	60	60	80	70
456	40	60	60	60	80	80
508	40	60	60	80	80	80
610	40	80	80	80	80	100
Flat	50	80	80	90	80	100

Basis for condensation: control ambient temperature of 25°C and a relative humidity of 80%. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter.
Use this table for insulation thickness of plastic pipework of the nearest equivalent outside diameter.

2411 **COOLED WATER SUPPLIES, BUILDING REGULATIONS, HEAT GAIN AND CONDENSATION CONTROL ON COOLED AND COLD WATER SUPPLIES – PHENOLIC FOAM:**
Insulation thicknesses are the worst case to control heat gain to maximum permissible figures stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide Northern Ireland Technical Booklet F2, and section 6 of the Scottish Non Domestic Technical Handbook and control condensation in accordance with BS 5422.

Outside diameter of steel pipe (mm)	Thickness of phenolic foam insulation (mm)					
Temperature of contents °C	>10		4.9 to 10		0 to 4.9	
Surface emissivity	0.05	0.9	0.05	0.9	0.05	0.9
17	15	15	20	15	25	20
21	15	15	20	15	25	20
27	15	15	20	20	25	20
34	20	15	25	20	30	20
42	20	15	25	20	30	25
48	20	20	25	20	30	25
60	20	20	25	25	35	25
76	20	20	30	25	35	30
89	20	20	30	25	40	30
114	25	20	35	25	40	30
140	25	20	35	25	45	30
168	25	20	35	25	45	30
219	30	20	40	30	50	35
273	30	25	40	30	50	35
324	30	25	40	30	55	35
356	30	25	45	30	55	35
406	30	25	45	30	55	35
456	35	25	45	30	60	35
508	35	25	45	30	60	35
610	35	25	50	30	65	35

Basis for condensation: control ambient temperature of 25°C and a relative humidity of 80%. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures, Aged k value.
Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter.
Use this table for insulation thickness of plastic pipework of the nearest equivalent outside diameter.

2412 **COOLED WATER SUPPLIES, BUILDING REGULATIONS, HEAT GAIN AND CONDENSATION CONTROL ON COOLED AND COLD WATER SUPPLIES – NITRILE RUBBER:**
Insulation thicknesses are the worst case to control heat gain to maximum permissible figures stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide Northern Ireland Technical Booklet F2, and section 6 of the Scottish Non Domestic Technical Handbook and control condensation in accordance with BS 5422.

Outside diameter of steel pipe (mm)	Thickness of nitrile rubber insulation (mm)

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Temperature of contents °C	>10		4.9 to 10		0 to 4.9	
Surface emissivity	0.05	0.9	0.05	0.9	0.05	0.9
17	15	21	20	26	23	30
21	16	22	21	27	24	31
27	17	23	23	29	2	33
34	18	25	24	31	29	36
42	19	26	25	32	30	38
48	20	27	26	33	31	39
60	20	27	27	35	33	40
76	21	28	28	37	37	45
89	21	29	29	37	37	45
114	22	30	29	37	37	45
140	22	30	30	38	37	45
168	22	30	30	39	38	47
219	22	31	30	39	38	47
273	22	31	30	39	38	47
324	25	35	30	40	40	50
356	25	35	35	40	40	50
406	25	40	35	40	45	50
456	25	40	35	40	45	50
508	25	40	35	40	45	50
610	25	40	35	40	45	50

Basis for condensation: control ambient temperature of 25°C and a relative humidity of 80%. Thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter.
Use this table for insulation thickness of plastic pipework of the nearest equivalent outside diameter.
Thicknesses of nitrile rubber are minimum calculated thicknesses

2322 **CHILLED AND MAINS COLD WATER SUPPLIES THICKNESS TABLE [EXTERNAL PIPEWORK] To prevent condensation and control heat gain to maximum permissible figures stated in building regs part l non domestic building services compliance guide – mineral wool low emissivity outer surface (0.05):**
Minimum insulation thickness with an ambient air temperature of 30°C and relative humidity of 80%

Nominal Steel Pipe Size (bore - mm)	Temperature of contents °C			
	>10		5-10	
	Thickness of mineral wool insulation (mm)			
	Rock	Glass	Rock	Glass
10	30	30	60	50
15	30	30	60	50
20	30	30	50	50
25	40	30	50	50
32	40	40	50	50
40	40	40	50	50
50	40	40	50	50
65	40	40	50	50
80	40	40	50	50
100	40	40	50	50
125	40	40	50	50
150	40	40	50	50
200	50	50	50	60
250	50	50	50	60
300	50	50	60	60
350	50	50	60	60
400	50	50	60	70

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Nominal Steel Pipe Size (bore - mm)	Temperature of contents °C			
	>10		5-10	
	Thickness of mineral wool insulation (mm)			
450	50	50	60	70
500	60	60	60	70
Flat Surfaces	60	60	70	70

Use this table for insulation thickness of copper or plastic pipework of the nearest equivalent diameter.
Thicknesses relate to class O rated insulation.

2420 PROTECTION AGAINST FREEZING – ROCK MINERAL WOOL:

Outside diameter of pipe (mm)	Indoor condition where freezing might occur	Outdoor condition where freezing might occur
	Thickness of mineral wool insulation (mm)	
Copper		
15	-	-
22	20	50
28	20	25
35	20	20
42	20	20
54	20	20
76	25	25
108	25	25
Steel		
21	40	-
27	20	45
34	20	25
42	20	20
48	20	20
60	20	20
76	25	25
89	25	25

Basis BS 5422 Table 28: Initial water temperature +2°C, evaluation period 12hrs thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
If mineral wool is used on pipes smaller than 20mmNB the required insulation thickness is too large to be applied in practice. To provide the appropriate degree of frost protection a combination of insulation and trace heating will be required.
Indoor condition is for ambient air temperature of -8°C, permitted ice formation of 50%.
Outdoor condition is for ambient air temperature of -10°C, permitted ice formation of 50%.

2421 PROTECTION AGAINST FREEZING – GLASS MINERAL WOOL:

Outside diameter of pipe (mm)	Indoor condition where freezing might occur	Outdoor condition where freezing might occur
	Thickness of glass mineral wool insulation (mm)	
Copper		
15	-	-
22	25	60
28	20	30
35	20	20

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42	20	20
54	20	20
76	20	20
108	20	20
Steel		
21	50	-
27	25	40
34	20	20
42	20	20
48	20	20
60	20	20
76	20	20
89	20	20

Basis BS 5422 Table 28: Initial water temperature +2°C, evaluation period 12hrs thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
If mineral wool is used on pipes smaller than 20mmNB the required insulation thickness is too large to be applied in practice. To provide the appropriate degree of frost protection a combination of insulation and trace heating will be required.
Indoor condition is for ambient air temperature of -8°C, permitted ice formation of 50%.
Outdoor condition is for ambient air temperature of -10°C, permitted ice formation of 50%.

2430 PROTECTION AGAINST FREEZING - PHENOLIC FOAM:

Outside diameter of pipe (mm)	Indoor condition where freezing might occur	Outdoor condition where freezing might occur
	Thickness of closed cell phenolic foam (mm)	
Steel		
21	30	75
27	15	30
34	15	20
42	15	15
48	15	15
60	15	15
76	15	15
89	15	15
Copper		
15	35	130
22	15	30
28	15	20
35	15	15
42	15	15
54	15	15
76	15	15
108	15	15

Basis BS 5422 Table 28: Initial water temperature +2°C, evaluation period 12hrs, thermal conductivity calculated from the mean insulation temperature based on the fluid and air temperatures.
Indoor condition is for ambient air temperature of -8°C, permitted ice formation of 50%.
Outdoor condition is for ambient air temperature of -10°C, permitted ice formation of 50%.
Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter.

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2440 PROTECTION AGAINST FREEZING - CLOSED CELL NITRILE RUBBER:

Outside diameter of pipe (mm)	Indoor condition where freezing might occur	Outdoor condition where freezing might occur
	Thickness of closed cell nitrile rubber (mm)	
Steel		
21	54	-
27	21 25)	50
34	13(13)	31(35)
42	7(9)	17(19)
48	4(6)	10(13)
60	2(6)	6(6)
76	(6)	3(6)
89	(6)	2(6)
Copper		
15	84	-
22	18	50
28	10	31
35	6	17
42	6	10
54	6	6
76	6	6
108	6	6

Basis BS 5422 Table 20: Initial water temperature +2°C, evaluation period 12hrs, thermal conductivity values calculated from the mean insulation temperature based on the fluid and air temperatures.
If nitrile runner is used on pipes smaller than 20mmNB for the outdoor condition, the required insulation thickness is too large to be applied in practice. To provide the appropriate degree of frost protection a combination of insulation and trace heating will be required.
Figures (xx) are nearest commercially available material thicknesses. Greater thicknesses to be achieved by layering of insulation.

Indoor condition is for ambient air temperature of -8°C, permitted ice formation of 50%.

Outdoor condition is for ambient air temperature of -10°C, permitted ice formation of 50%.
Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter.

2456 INSULATION THICKNESS ON DUCTWORK, BUILDING REGULATIONS:
Insulation thickness to limit heat gains and heat losses stated in the Building Regulations Part L Non Domestic Building Services Compliance Guide, Northern Ireland Technical Booklet F2 and section 6 of the Scottish Non Domestic Technical Handbook.

Material	Thickness of insulation (mm)					
	Warm air ductwork			Chilled air / dual purpose ductwork		
Surface Emissivity	Low (0.05)	Med (0.44)	High (0.9)	Low (0.05)	Med (0.44)	High (0.9)
Rock Mineral wool (Ductwrap)	40	40	40	50	60	70
Glass mineral wool	40	40	40	50	60	60
Phenolic foam	20	25	25	35	40	40
Nitrile rubber	32	37	40	51	60	62

Basis:
Warm air ductwork - horizontal duct at 35°C with 600 mm vertical sidewall in still air at 15 °C.

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Chilled air ductwork - horizontal duct at 13°C with 600 mm vertical sidewall in still air at 25 °C
Thermal conductivity values calculated from the mean insulation temperature based on the fluid and air temperatures.
Thicknesses of mineral wool and phenolic foam are the nearest commercially available thickness to meet minimum requirements.
Thicknesses of nitrile rubber are minimum thicknesses.

2475 CONDENSATION CONTROL ON CHILLED AIR DUCTWORK :
Insulation thickness for condensation control on ductwork carrying chilled air in ambient conditions: indoor still air temperature 25°C, relative humidity 80%, dew point temperature 21.3°C.
All ductwork shall be insulated where were visible (ie exposed ductwork) when the duct surface temperature is below the dew point of the air within the space served.

Surface emissivity	Low (0.05)				Medium (0.44)				High (0.9)			
Material	MW	GW	PF	NF	MW	GW	PF	NF	MW	GW	PF	NF
Min air temp inside duct°C												
15	30	25	20	12	25	25	20	-	25	25	20	6
10	50	40	30	21	25	25	20	-	25	25	20	11
5	70	50	50	31	40	40	25	-	25	25	20	17
0	80	50	60	40	50	50	30	-	30	40	20	22

MW – Mineral Wool, GW – Glass mineral wool, PF – Phenolic foam, NF – FEF nitrile foam

Basis: Table 12 in BS 5422, thermal conductivity values calculated from the mean insulation temperature based on the fluid and air temperatures.
All ductwork shall be insulated where were visible (i.e exposed ductwork) when the duct surface temperature is below the dew point of the air within the space served.
Thicknesses of nitrile rubber are minimum thicknesses.

2450 THICKNESS OF INSULATION TO BS 5422 FOR PROCESS PIPEWORK AND EQUIPMENT:
The process plant manufacturer or specialist pipework installer shall select the appropriate insulation material.
Comply with the requirements of sections 4 and 10 and relevant annexes of BS 5422 and supply minimum thickness of insulation for services in accordance with relevant tables in BS 5422 to control heat loss or limit surface temperature to suit the system operating temperature and insulation material thermal conductivity.
Table 21 - Minimum insulation thickness for process pipework and equipment to control heat loss.

2455 THICKNESS OF INSULATION TO BS 5422 FOR REFRIGERATION PIPEWORK AND EQUIPMENT:
The chiller or refrigeration plant manufacturer or specialist refrigeration pipework installer shall select the appropriate insulation material for the application.
To control heat gain and condensation, comply with the requirements of section 6 of BS 5422 and supply minimum thickness of insulation in accordance with relevant tables below and Annexes F and H in BS 5422 to suit the system operating temperature and insulation material thermal conductivity.
Table 1 – Maximum permitted water vapour permeance in relation to plant temperature at an ambient temperature of +20°C (dry bulb).
Table 4 – Minimum insulation thickness for refrigeration applications to control condensation and control heat gain on a high emissivity outer surface (0.90) with an ambient temperature of +25°C and a relative humidity of 80%.
Table 5 – Minimum insulation thickness for refrigeration applications to control condensation and control heat gain on a low emissivity outer surface (0.05) with an ambient temperature of +25°C and a relative humidity of 80%.

Y50 – Thermal Insulation

3000 WORKMANSHIP

3011 GENERAL:
Install insulation in accordance with BS 5970.
Carry out thermal insulation work using a specialist firm employing skilled craftsmen conversant with class of work, being members of the Thermal Insulation Contractors Association.
Do not apply thermal insulation until installation has been fully tested and all joints proved sound.
Ensure all materials are kept dry.
Ensure all pipework surfaces are dry before the installation of thermal insulation.
Where systems are to be lagged, insulate all of the items on the system (eg plenum box) unless indicated otherwise.
Separation
Insulate each unit separately. Do not enclose adjacent units together.
Clearance
Ensure clearance between insulated pipes.
Application
Apply insulants, facings, coatings and protection strictly in accordance with manufacturer's instructions.
Finish
Neatly finish joints, corners, edges and overlaps and, where possible, arrange overlaps to fall on blind side.
Ensure overlaps are neat and even and parallel to circumferential and longitudinal joints.
All nameplates shall be covered with removable sections of insulation that are easily identifiable, or where practical, name plate is removed and repositioned on the outer face of the insulation.
The insulation shall be applied such that plant and equipment can be cleaned and inspected with allowance made for removal of access covers, bolts, nuts and probes without damage to the insulation.
Care shall be taken to ensure that where required, a complete vapour seal is maintained. In particular, the insulation to and around the points where supports, brackets and hangers occur on vapour sealed services shall ensure provision of a complete barrier to moisture transmission.
All exposed ends of insulation shall be sealed to prevent migration of fibres and then capped with suitable protective capping adequately fixed.
Where an insulated pipe/duct passes through an external building element adequate precautions shall be taken to prevent entry of the rain water into the building.
In instances where phenolic foam sections are applied to copper pipework, the pipework shall be clean and dry prior to the application of the insulation. Care shall be taken to ensure that in all cases where there is a likelihood of the copper pipework coming into contact with cor foam, a bore coating is incorporated into the phenolic foam.
Insulation shall be protected during the progress of the work and maintained dry.

NOTE:
Attention is drawn to the risk attached to the use of PIB, polyurethane, PVC, polystyrene, isocyanurates etc., even where these materials are claimed to be fire resistant and/or self-extinguishing, they have proved in the past to produce toxic smoke causing a hazard to persons working in the area and to fire fighting teams. These types of insulation or finish shall not be used inside of a building or areas under cover. PIB may be used external to the building only where indicated.

3020 INSTALLATION OF FOIL FACED MINERAL WOOL INSULATION ON PIPEWORK:
Ensure joints are close butted together. Secure overlaps with adhesive or matching class 'O' tape, a minimum of 50mm wide, on both longitudinal and circumferential butt joints. Insulate fittings to same standard as adjacent pipework and use mitred segments where necessary, taped as above.
Where a vapour seal or fibre containment is required tape exposed insulation membrane and return to pipe surface.
Where insulation abuts pipe support inserts that have integral vapour barriers seal using 'O' tape to continue vapour barrier or containment.

3030 INSTALLATION OF FOIL FACED PHENOLIC FOAM INSULATION ON PIPEWORK:

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Ensure joints are close butted together. Secure overlaps with adhesive or matching class 'O' tape, a minimum of 50mm wide, on both longitudinal and circumferential butt joints. Insulate fittings to same standard as adjacent pipework and use mitred segments where necessary, taped as above. Ensure the passivating internal bore coating of the insulation is not damaged, particularly at corners and other irregular shapes.
Before phenolic resin foam sectional insulation is applied, ensure that all pipework is clean, dry and free of any debris or corrosive substances such as excess soldering flux, building materials.
Installation shall be by a contractor approved by the manufacturers strictly in accordance with the manufacturer's installation instructions.

3040 INSTALLATION OF INSULATION ON PIPEWORK - WITH CANVAS FINISH:
Ensure joints are close butted together and secure overlaps with adhesive and smooth out. Insulate fittings to same standard as adjacent pipework and use mitred segments where necessary. Secure with adhesive using a minimum of 50mm wide canvas to cut mitred joints. Apply two coats of class 'O' polymer solution.

3050 INSTALLATION OF CLOSED CELL NITRILE RUBBER INSULATION ON PIPEWORK:
Install closed cell nitrile rubber in accordance with manufacturer's recommendations.
Check installation procedure when closed cell nitrile rubber is to be installed on stainless steel pipework.

3060 INSTALLATION OF FOIL FACE SEMI-RIGID SLAB INSULATION ON DUCTWORK:
Secure the insulation with adhesive in accordance with manufacturer's recommendations. Use insulation hangers spaced at maximum 300mm centres on the underside of ducts.
Cut slabs so that the top and bottom pieces overlap the sides. Seal joints and pin penetrations using 100mm wide class 'O' aluminium foil tape. Where cut outs for test holes, etc occur tape over insulation membrane and return to the duct surface.
Where insulation abuts duct support inserts that have integral vapour barriers seal use class 'O' foil tape to continue vapour barrier.

3070 INSTALLATION OF FOIL FACED FLEXIBLE DUCTWORK INSULATION:
Secure the insulation with adhesive in accordance with manufacturer's recommendations. Use insulation hangers spaced at maximum 300mm centres on the underside of rectangular and flat oval ducts.
Seal joints and pin penetrations using 100mm wide class 'O' aluminium foil tape. Where cut outs for test holes, etc occur tape over insulation membrane and return to the duct surface.
Where insulation abuts duct support inserts that have integral vapour barriers use class 'O' foil tape to continue vapour barriers.

3080 INSTALLATION OF FOIL FACED LAMELLA OR CRIMPED MAT ON DUCTWORK:
Secure the insulation with adhesive in accordance with manufacturer's recommendations. Use insulation hangers spaced at maximum 300mm centres on the underside of rectangular and flat oval ducts.
Seal joints and pin penetrations using 100mm wide class 'O' aluminium foil tape. Where cut outs for test holes, etc occur tape over insulation membrane and return to the duct surface.
Where insulation abuts duct support inserts that have integral vapour barriers use class 'O' foil tape to continue vapour barriers.

3090 INSTALLATION OF INSULATION ON TANKS:
Fit insulation so that two opposite pieces overlap the sides. Bond insulation to the tank with adhesive, applied in accordance with the manufacturer's recommendations. Closely butt together all slabs and seal joints with a matching self adhesive tape 100mm wide.

3101 INSTALLATION OF MINERAL WOOL INSULATION ON VESSELS:
Cut Lamella or crimped mat to length to wrap around vessel with an additional 75mm to form an overlap. Remove insulation from facing of overlap together with dust, and seal overlap with adhesive in accordance with manufacturer's instructions. Butt joints closely together and seal with matching self-adhesive tape at least 100mm wide.

Y50 – Thermal Insulation

On heat exchangers and HWS calorifiers in plant rooms, domed tops of calorifiers shall be finished in 0.9mm stucco embossed aluminium sheeting in coned segmental tops.
Manway chests shall be enclosed in removable stucco embossed covers lined with mineral fibre mattresses of 85 - 100 kg/M3 density, flanges and end covers on heat exchangers shall be similarly treated.

3102 **INSTALLATION OF INSULATION ON FLANGED TANKS:**
Insulate with an initial layer of 40mm thick plain mineral fibre slabs (nominal density 45 kg/m³) secured by approved adhesive and stick pins, followed by a further layer of 40mm thick mineral fibre slabs (nominal density 45 kg/m³), secured to first layer by an approved adhesive and previously applied stick pins. This shall then present a uniform thickness at minimum of 40mm. Finish to insulation shall be factory applied reinforced aluminium foil laminate, joints in surface covering to be secured with 100mm wide plain soft aluminium foil self adhesive tape to maintain a vapour barrier. Particular attention shall be paid to the vapour barrier where self adhesive stick pins protrude through the mineral fibre insulation and its factory applied finish. (2nd layer).
Final finishes shall be as scheduled.

3105 **INSULATION OF EXTERNAL DUCTWORK AND FLAT SIDED TANKS**
On flat, oval or rectangular ductwork and flat sided tanks, build up the insulation on the top surface of the duct in order to provide a self draining surface. Minimum slope to be 1 in 10. Ensure average thickness for the side is equivalent to other sides and that at no point is the thickness below that required to avoid condensation.

3120 **INSTALLATION OF POLYISOBUTYLENE (PIB) PROTECTION:**
Wrap pipework and fittings, ductwork or tanks and vessels with PIB sheeting lapped at every joint by at least 50mm. Solvent weld joints in accordance with manufacturer's recommendations and arrange joints to shed water and prevent the ingress of water.

3125 **INSTALLATION OF MULTI-LAYERED LAMINATE FOIL/FILM PROTECTION:**
Install laminated foil/film protection, in accordance with manufacturer's instructions.
Installation may be either factory pre-applied or applied in-situ.
Ensure all surfaces are dry and clean, free from dust, oil and grease/silicone.
Arrange joints to give water shed with the lap facing down.

3131 **INSTALLATION OF INSULATION ON PIPEWORK - WITH SHEET METAL FINISH:**
Secure insulation with metal bands at each end of section and at maximum centres of 450mm. Ensure joints are close butted together. Insulate bends with mitred segments of insulation banded into position. Insulate fittings are to the same standard as the adjacent pipework. All bends on cold services the vapour barrier surface shall be protected with a suitable absorbing strip since it will be necessary to secure any sagged segments with pop rivets, ie. the vapour barrier shall be retained by bedding any rivets into the strip (eg: Class 'O' Armaflex tape). If exposed to weather, seal all joints with suitable mastic. Form sheet metal to fit tightly over the outer circumference of insulation with a longitudinal overlap of at least 40mm. Secure the outer part of overlap with self tapping screws or rivets at centres of not more than 150mm except on pipes with vapour barrier, or metal bands.
Ensure circumferential overlaps are at least 50mm, secured with self tapping screws or rivets. Make provision to accommodate expansion and contraction at intervals. Ensure all joints are lapped to shed liquids and seal all joints exposed to weather or spillage. Cover all bends and fittings with matching sheet metal, tailored to fit and sealed as appropriate. Fit pre-insulated, purpose-designed boxes to valves, flanges, etc.

3141 **INSTALLATION OF SHEET METAL FINISH ON DUCTWORK, TANK AND VESSEL INSULATION:**
Form sheet metal to fit tightly over the insulation with a longitudinal overlap of at least 40mm. Secure the outer part of overlap with self tapping screws or rivets at centres of not more than 150mm.
Ensure circumferential overlaps are at least 50mm, secured with self tapping screws or rivets. Make provision to accommodate expansion and contraction at intervals. Ensure all joints are lapped to shed liquids and seal all joints exposed to weather or spillage.
Ducting - Rectangular

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The whole shall be enclosed in 0.9mm stucco embossed aluminium cladding applied in the form of lock formed strip and/or folded or flat sheeting. Care shall be taken to support as necessary the underside to minimise sagging. Cladding shall be fixed to support cladding which shall be taped to and continues the vapour barrier.
Ducting - Circular
The insulation shall be enclosed in a layer of reinforced aluminium foil, joints secured with 75mm wide soft aluminium foil self adhesive tape to maintain a vapour barrier. The whole shall be enclosed in 0.9mm stucco embossed aluminium sheeting, secured by matching aluminium straps and/or self seal rivets to avoid puncturing the vapour seal.
For low temperature ducting (below 10°C) mastic treatment shall be applied in the overlaps since rivets may puncture the vapour barrier.

3151 **INSTALLATION OF PROTECTION:**
Ensure that where protection is applied to insulation, the joints fall blind side and that all joints are made to shed water and sealed with waterproof tape, adhesive or joint sealant where appropriate.

3170 **INSTALLATION OF PROTECTION - ALUMINIUM SHEETING:**
Secure lapped joints (at least 40mm) by means of pop rivets at a maximum spacing of 150mm. For cold piping use matching aluminium straps at maximum spacing of 225mm. On piping operating below ambient temperature seal all joints against moisture. For external use make joints shed water and use sheets with treated surface.
Where 'lockform' seams are used submit proposals for dealing with surfaces curved in three dimensions.

3185 **APPLICATION OF WEATHER PROOF PAINTS:**
Do not apply weather proof paints in ambient temperatures below 5°C

3190 **INSTALLATION OF RIGID PVC PROTECTION**
Apply rigid PVC sheet and pre-formed fittings directly to insulation with an overlap of at least 40mm on longitudinal and circumferential joints.
Secure longitudinal laps with plastic rivets at 150mm centres.
Ensure rigid PVC is not installed in contact with heat sources.

3210 **FLANGES AND VALVES:**
Cut back to allow removal of bolts and nuts, finish with neat bevel or use end caps.
Where boxes are used fit over insulation on adjacent piping. Ensure operation of valve remains unimpaired with box in place.

3220 **LINERS:**
Where load bearing insulation is required use segmental liners suitable for temperature. Fit insulant up to liner and carry facing across the pipe ring.

3231 **INSTALLATION WHERE INSULATION IS CARRIED THROUGH PIPELINE SUPPORT:**
For cold services ensure insulation is carried through.
For hot services ensure insulation is carried through as scheduled.
For load bearing insulation carry through insulation and finish.
For non-load bearing insulation on hot pipework close butt to section of load bearing finished material suitable for working temperature 100mm long.
For non-load bearing insulation on cold pipework, close butt to high density phenolic foam supports. Ensure the vapour barrier is maintained.

3240 **INSTALLATION WHERE INSULATION IS NOT CARRIED THROUGH PIPEWORK OR DUCTWORK SUPPORT:**
Provide end caps to match applied finish.

3241 **PIPE SLEEVES:**
Carry finished insulation including vapour barrier through pipe sleeve.

Y50 – Thermal Insulation

3242 **PIPE SLEEVES THROUGH FIRE RATED PARTITIONS**
Where the insulation is to be carried through the partition - thermally insulated proprietary fire sleeves shall be used tested in accordance with BS 476 or BS EN 1366 to meet the fire rating of the partition. The sleeves shall be either:
"Rockwool" Fire Pro Insulated fire sleeves comprising a combination of mineral wool and graphite intumescent or
BIS "Pacifyer" one piece stainless steel sleeve with an intumescent lining the full length and 3 bands of acoustic foam adhered to the bore of the sleeve. Where the insulation is required to carry through the wall or partition / vapour seal is required oversized mineral wool shall be fitted to the pipework with an oversized Pacifyre fitted over the mineral wool.

Installation shall be in accordance with the manufacturer's requirements.

3250 **INSTALLATION WHERE INSULATION IS CARRIED THROUGH DUCTWORK SUPPORT:**
Provide insulation between duct and support using high-density phenolic foam or polyisocyanurate strips. Butt insulation to spacer and carry over finish by 40mm and tape joint. Provide a sheet metal protecting sleeve.

3251 **DUCTWORK SUPPORTS:**
On cold services, ensure insulation carried through between duct and support
Provide insulation between duct and support using high-density phenolic foam or polyisocyanurate blocks. Carry over finish by 40mm and tape joint. Provide a sheet metal protecting sleeve.
Where insulation not carried through between duct and support provide end caps or bevelled seal.

3252 **DUCT SLEEVES:**
Carry finished insulation through duct sleeves.

3255 **VAPOUR BARRIERS**
Vapour barrier shall be applied over insulation on services, plant etc, working at or below ambient temperatures and they shall be continuous, maintained dry, completed and sealed as a vapour barrier throughout before reducing the service to its working temperature.

The insulation at all support points shall be pre-formed load bearing inserts manufactured from hardwood, phenolic foam or other specified material, and to the same thickness as the adjacent insulation on each side of the brackets/support.
Each insert shall incorporate a bright aluminium foil covering to provide a vapour barrier to match that of the adjacent insulation.
The length/width of each insert shall protrude not less than 40mm on either side of the bracket/support.
The insulation either side of the brackets/support shall butt up tightly to the insert and the vapour barrier made continuous by taping the joints between the foil faces on the insulation and inserts with a minimum 50mm wide Identen T303 Class '0' foil tape.
For HTHW, steam and condensate pipework where roller and chairs form supports, a galvanised sheet steel protective sleeve shall be provided around the insert between the roller and the guide bracket (Phenolic foam shall not be used on HTHW and steam pipework or systems that exceed its temperature limit.
It is essential to maintain the integrity of vapour seals.

3260 **LIQUID VAPOUR BARRIERS:**
Apply vapour seal solution evenly by brush in accordance with manufacturer's instructions; use solution which dries to a colour distinctive from insulating material.

3270 **INTEGRITY OF VAPOUR BARRIERS:**
Where a vapour barrier is indicated ensure its integrity throughout.
Repair immediately any damage to vapour barriers and where such barriers have been applied off site, repair to manufacturer's instructions.

Y50 – Thermal Insulation

Where aluminium sheeting is used for protection submit proposals for securing sheeting without impairing the integrity of the vapour seal, for approval.

3280 **WATER TANKS**
Arrange insulation and finish to allow removal of access covers and/or tank top.

10000 Based on NES Y50 TEXT June 18

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Y50 – Thermal Insulation

Y51 – Testing & Commissioning of Mechanical Services

1000 GENERAL

Undertake inspection and commissioning of the building services systems in accordance with The Building Regulations Approved Documents L1 & L2 and relevant CIBSE / BSRIA commissioning codes.

Where an existing system has been extended or modified, then, unless noted otherwise in the scope of works, the complete system shall be re-commissioned. For example if a new prime mover has been installed or the original prime mover up rated in an air or water system and the system has been extended to serve additional terminals.

Appoint a commissioning manager / Specialist Commissioning Agent and undertake Commissioning Management in accordance with CIBSE commissioning code M.

The Contractor shall review all designs to ensure that systems are commissionable in accordance with the codes of practice detailed in Y51. If additional facilities are required the Contractor shall advise the designer prior to commencing work on site.

Produce and issue a notice to the local authority at the end of the commissioning that shall declare that a commissioning plan has been produced and followed and the commissioning results confirm that the performance of the engineering systems is in accordance with the original design. Where deviations / excursions from the design have been agreed with the designers / and client these shall be documented in the notice.

During the commissioning stage systems shall not be left running / unattended without Contractor attendance on site eg overnight or during weekends. Should a component failure occur the engineering services shall be configured to safely shut down.

Where required carry out Seasonal Commissioning in accordance with clause Y51 3025 as defined in clause Y51 1002 (in accordance with the requirements of BREEAM) and scheduled in in A31sch1 or A31sch2 and Y51sch3.

For Dry Riser and Wet Rise fire fighting mains; where identified elsewhere within this specification or required by the local fire brigade, comply with the requirements of BS 9990 Clause 7.2 for protection of buildings under construction.

BREEAM projects – requirements:
Refurbishment and Fit Out 2014 and BREEAM New Construction 2014 requirements
- Comply with Issue ID Man 04 Commissioning and Handover
- Comply with Issue ID Man 05 Aftercare
- Comply with Issue ID Ene 02 Energy Monitoring
- Comply with Issue ID Wat 02 Water Monitoring
- Comply with Issue ID Wat 03 Water Leak Detection
- Comply with Issue ID Pol 01 Impact of Refrigerants
- Refer to schedules and scope of works for project specific requirements.

1002 DEFINITIONS

The following definitions, some extracted from BSRIA Guides BG2/2010 and BG49/2013, and BREEAM New Construction 2014 and shall apply to all systems.

Capacity Tests

The proving that the capacity of installed plant and equipment items meets the specified duty.

Commissioning

The advancement of an installation from the stage of static completion to working order to specified requirements. For pipework distribution systems it includes the setting to work of an installation and the regulation of flow rates.

Design Criteria

The measurements and quantities selected as the basis for the design of a system.

Performance Criteria

The specified, numerically quantifiable, characteristics and tolerances to be achieved by the system.

Y51 – Testing & Commissioning of Mechanical Services

Performance Testing

The proving that the installed system can maintain the specified, numerically quantifiable, characteristics and tolerances to be achieved by the system.

Fine Tuning

The adjustment of a system where usage and system proving has shown such a need.

Pre-Commissioning Checks

Specified systematic checking of a completed installation to establish its suitability for commissioning.

Pressure and Leakage Testing

The measurement and recording of pressure retention, and fluid losses or gains in the plant Equipment, distribution ways and terminals.

Regulation

The process of adjusting the rates of fluid flow in a distribution system to achieve specified values.

Setting to Work

The process of setting a static system into operation.

Static Completion

The state of the system, when it is installed in accordance with the drawings and specification, ie being clean and ready for setting to work. In the case of water systems this includes flushing, cleaning, pressure and leakage testing, filling and venting.

System Proving

Measuring, recording, evaluating and reporting on the seasonal performance of the systems against their design values.

Testing

The measurement and recording of specified quantifiable characteristics of an installation or parts thereof. NOTE: This includes off-site testing.

Environmental testing

The measurement and recording of internal environmental conditions including temperature, humidity and noise levels (with artificial loads applied and using instruments independent of the BMS where indicated). The measurement of external noise levels
Refer to scope of work and Y51sch2 for details.

Seasonal Commissioning (as defined in BREEAM for one credit)

For Complex systems with a specialist commissioning manager
The following seasonal commissioning responsibilities will be completed over a minimum 12 month period, once the building becomes occupied:

Complex systems with a specialist commissioning manager

- Testing of all building services under full load conditions, i.e. heating equipment in mid-winter, cooling/ventilation equipment in mid-summer, and under part load conditions (spring/autumn)
- Where applicable, testing should also be carried out during periods of extreme (high or low) occupancy
- Interviews with building occupants (where they are affected by the complex services) to identify problems or concerns regarding the effectiveness of the systems
- Re-commissioning of systems (following any work needed to serve revised loads), and incorporating any revisions in operating procedures into the O&M manuals.

Where specialist building services systems such as fume cupboards, microbiological safety cabinets and a cold storage system are present then the assessor must ensure that these systems are included in the specialist commissioning agent's responsibilities

Simple systems (naturally ventilated) – with an external consultant/facilities manager.

- Review thermal comfort, ventilation, and lighting, at three, six and nine month inter-vals after initial occupation, either by measurement or occupant feedback.
- Take all reasonable steps to re-commission systems following the review to take account of deficiencies identified and incorporate any relevant revisions in operating procedures into the O&M manuals.

2000 STATIC TESTING

2010z PRESSURE TESTING PIPEWORK - GENERAL:
Comply with procedures given in BESA Guide to Good Practice for Site Pressure Testing of Pipework. (TR/6) Ensure safety precautions detailed in HSE Guidance Note GS4 Safety in Pressure Testing are adopted.
Isolate components that cannot withstand the test pressures. Isolate these as near to the component as possible.
Provide a blanked connection to accommodate a check gauge in addition to the accurate gauge fitted to section under test.
Test concealed or buried pipework and ductlines before any permanent covering is applied.

Carry out works test for individual items of equipment as detailed in the work sections of this specification
Advise appropriate personnel, in advance, of the time tests may be witnessed.
Agree test pressure and duration for water mains with local water authority.

2012 PRESSURE AND LEAKAGE TESTING - AIR DUCTLINES:
Carry out air pressure and leakage testing on air ductlines in accordance with DW/143, DW/144 or DW/154 as appropriate and as indicated in section Y30.

2015 PRESSURE AND LEAKAGE TESTING – BUILDER'S WORK SHAFTS, VOIDS, ENCLOSURES AND FLOOR VOIDS / PLENUMS:
Ensure all builder's work shafts, voids and enclosures are pressure and leakage tested, and signify acceptance of standard and integrity of construction, prior to pre-commissioning of engineering installations.
Pressure test floor plenums / voids using a specialist building airtightness tester ATTMA registered to level 2 using ATTMA standard TS L2 and BSRIA BG65/2016 – Floor Plenum Air tightness Guidance and Testing Methodology.
Maximum value of plenum air leakage to be 0.7l/s/m2 of floor area at a test pressure of 50Pa or 5% of the air volume flow rate supplied to the plenum.
Maximum raise access floor leakage to be 1.0l/s/m2 of floor area without carpets at a test pressure of 50Pa

2030 PRESSURE TESTING - WATER CIRCULATING AND SUPPLY SYSTEMS AND STEAM AND CONDENSE LINES:

Carry out Hydraulic Pressure Testing as described in BESA Guide to good Practice for Site Pressure Testing of Pipework (TR/6). Test section by section for one hour, as the work proceeds and prior to application of thermal insulation as follows.

Y51 – Testing & Commissioning of Mechanical Services

Operating gauge pressure less than 3.5 bar, test gauge one and a half times the maximum working pressure.
Operating gauge pressure 3.5 – 7.0 bar, test gauge pressure twice the maximum working pressure.
Operating gauge pressure greater than 7.0 bar, test gauge pressure 14.0 bar or one and a half times the maximum working pressure, whichever is the greater.

Comply with BESA TR/20 part 8 for steam and condensate systems.

2838 **PRESSURE TESTING - UNDERGROUND PIPEWORK:**
Test to a gauge pressure twice the operating pressure or 7 bar, whichever is the greater, for 4 hours.
Test pre-insulated bonded steel pipe systems for district heating in accordance with BS EN 13941
Test pre-insulated non bonded pipe systems in accordance with the system manufacturer's recommendations.
Test pre-insulated bonded flexible pipe systems in accordance with the system manufacturer's recommendations

2842 **PRESSURE AND LEAKAGE TESTING - WATER SERVICES INSTALLATIONS:**
Inspect and test water services installations in accordance with relevant parts of BS EN 806 and BS 8558 and to the requirements of the Local Water Undertaking.
Ensure the provisions laid down in BESA TR/6 Site Pressure Testing of Pipework for testing underground CWS mains are carried out.

2848 **PRESSURE TESTING - FIRE RISERS:**
Undertake static pressure tests followed by flow and pressure tests in accordance with BS 9990. Demonstrate to Fire Brigade when tests are satisfactory.
On completion of the static test check operation of the non-return valves integral within the inlet breeching unit by using the static pressure exerted by the full water capacity of the riser.
For Wet Riser pipework undertake static water pressure test to a pressure not less than the system closed valve pressure exerted by the wet riser pump set when designed to operate at the flow and pressure defined in BS 9990. Ensure pressure is maintained for a minimum period of 15minutes.

2855 **PRESSURE TESTING - REFRIGERANT PIPEWORK:**
Test refrigerant pipework using the strength test procedure as detailed in Clause R8.4 of the CIBSE Commissioning Code R: 2002. Test refrigerant pipework using the leak test procedure as detailed in Clause R8.5 of the CIBSE Commissioning Code R: 2002. Test refrigerant pipework using the deep vacuum test method as detailed in Clause R8.6 of the CIBSE Commissioning Code R: 2002

2862 **PRESSURE AND LEAKAGE TESTING - GAS PIPEWORK OTHER THAN MEDICAL GASES:**
Pressure test and commission gas infrastructure pipework (external to buildings) in accordance with BS EN 12327
Carry out a pneumatic leak test on natural gas pipework followed by a pneumatic pressure test as described in BSEA TR/6 Site pressure testing of pipework.
For Natural gas systems, Purging and soundness testing shall only be carried out by authorised persons in accordance with the Institutions of Gas Engineers Publication IGE/UP/1 "Soundness Testing and Purging of Industrial and Commercial Gas Installations".
Test records shall be kept based on IGE/UP/1 requirements and prepared to provide a record of satisfactory witnessed tests and procedures for soundness testing and purging.

For small low pressure natural gas systems comply with IGE/UP/1A and for domestic natural gas systems comply with IEGA/P1 B

For other systems (such as gaseous fire protection systems), carry out a pneumatic leak test followed by a pneumatic pressure test as described in BESA Guide to Good Practice for Site Pressure Testing of Pipework (TR/6). Upon their completion, pressure/leak test the areas to be protected to ensure that their leakage characteristics are as assumed in the specialist's design.

2865 **PRESSURE TESTING - OIL PIPEWORK:**

Test oil pipework installation in accordance with relevant part of BS 5410 to suit the application and TR/6 Site pressure testing of pipework. BESA. Guide to good practice.

2872 **PRESSURE AND LEAKAGE TESTING - PIPED MEDICAL SERVICES:**
Test to requirements of Hospital Technical Memorandum 02-01 Part A.

2875 **TESTING CONDENSE AND OVERFLOW SYSTEMS:**
Test condensate drainage systems from cooling coils and any overflow pipework / drainage pipework from plant in accordance with BS EN 12056-2 and BESA TR/6 Site pressure testing of pipework.

2882 **PRESSURE AND LEAKAGE TESTING - SOIL, WASTE, VENTILATION, ANTI-SYPHON AND RAINWATER PIPEWORK:**
Test section by section as the work proceeds and subsequently on completion with all sanitary fittings fixed and working.
Submit systems to two separate tests, Air test and Hydraulic Performance test in accordance with BS EN 12056 – 2.
Siphonic rainwater pipework shall be tested in accordance with manufacturer's recommendations.

2898 **PRESSURE TESTING - UNDERSLAB DRAINAGE:**
Test section by section as the work proceeds and subsequently after completion of backfilling and compaction to the satisfaction of the Engineers and the local Authority.
Individually test sections which will be permanently embedded in the structure or concealed in ducts or voids.
Submit sections to two separate tests Water test and Test for Straightness and Obstruction in accordance with BS EN 752 and BS EN 1610.

2908 **VACUUM SYSTEM TESTING:**
Test medical and laboratory vacuum systems in accordance with HTM 02-01 Part A.

2102 **TESTING WIRING INSTALLATIONS:**
Ensure all electrical installations associated with the system, are tested in accordance with BS 7670 IET Wiring Regulations before any plant is run.

2112 **TESTING RECORDS:**
Keep a systematic record of tests. Submit samples of test record sheets for agreement prior to testing. Obtain signatures of nominated witnesses to tests. Distribute records as indicated in specification section A33.

3000 **COMMISSIONING**

3002 **COMMISSIONING PROPOSALS**
Submit proposals for commissioning as indicated in specification work Section A33 or A64 - General Engineering Technical Items. Use commissioning specialists who are members of The Commissioning Specialist Association (CSA).

3012 **CLEANING DUCTWORK SYSTEMS:**
Clean ductwork before plant is first run, using access openings in ductwork. Carry out cleanliness checks and procedures listed in CIBSE Commissioning Code Series A Air Distribution and BSRIA Guide BG49/2013 Commissioning Air Systems. Also refer to specification section Y30, clause 4001 and schedule Y30sch1 regarding ductwork internal cleanliness.

3014 **CLEANING PIPEWORK SYSTEMS:**
Flush and clean all pipework systems before the plant is first run. Carry out flushing procedures listed in CIBSE Commissioning Code W: Water Distribution Systems and BSRIA Guide BG29/2012 Pre-commissioning cleaning of pipework systems and the requirements of specification section Y25.

3020 **COMMISSIONING CODES:**
Carry out commissioning of installations in accordance with the procedures, checks and tolerances given in the BSRIA Application Guides for water systems and air systems to achieve the standards set in the CIBSE Commissioning Codes.

Y51 – Testing & Commissioning of Mechanical Services

3025 SEASONAL COMMISSIONING

Provide appropriately qualified personnel and all necessary equipment and materials to execute the seasonal commissioning works. The same organisation / team that carried out the original construction works shall undertake the seasonal commissioning.
A schedule of suitable working periods and essential services to be maintained during any work will be provided by the building operator.
A programme for the works shall be provided at least 1 month prior to the start date. This should account for any phased handovers, cause as little disruption as possible and ensure essential services are maintained.
The works shall comply with all statutory and client specific Health and Safety requirements.
Any performance deficiencies found during seasonal commissioning shall be corrected.
All seasonal commissioning shall be carried out in accordance with the project commissioning specification, an approved method statement, manufacturers' guidelines and the day-to day operational requirements of the building users.
Record all seasonal commissioning works and after completion of the works update all building documentation including O&M manuals, Building Manual, Building Log book, Building User Guide and the Building Information Model (BIM). Any changes made to the systems during the works shall be clearly identified.
BREEAM New Construction 2014 requirements
Comply with Issue ID Man 04 Commissioning and Handover.
Comply with Issue ID Man 05 Aftercare.
BREEAM Refurbishment and Fit Out 2014 requirements
Comply with Issue ID Man 04 Commissioning and Handover.
Comply with Issue ID Man 05 Aftercare

3031 COMMISSIONING WATER DISTRIBUTION SYSTEMS:

Preliminary checks
Carry out checks and procedures as detailed in CIBSE Commissioning Code W.
Ensure system is statically complete as defined in BSRIA Guide BG2/2010 Commissioning of water systems in buildings
Use pre-commissioning checklist from BSRIA guide BG2/2010
Setting to work and regulation
Set to work and regulate water distribution systems in accordance with CIBSE Commissioning Code W and BSRIA Guide BG2/2010 Undertake an initial scan of the system and document the results. Follow guidance for commissioning of variable flow water systems in CIBSE KS9 (Commissioning variable flow pipework systems)and BSRIA BG2.
Measurement
Use instruments for measurement generally as detailed in BSRIA Guide BG2/2010
For each belt driven pump provide a change of belts and drives (to be sized after balancing the system). Allow for changing belts and drives and recommissioning pump and then rechecking system as necessary to achieve the specified duty.

For each direct driven pump (both single pumps and twin headed pumps) without inverter or other speed control, allow for a change of impeller (to be sized after balancing the system). Allow for changing impeller and recommissioning pump and then rechecking system as necessary to achieve the specified duty.

3041 COMMISSIONING AIR DISTRIBUTION SYSTEMS:

Preliminary checks
Carry out checks and procedures as detailed in CIBSE Commissioning Code A, Section A1.
Ensure system is statically complete as defined in BSRIA Guide BG49/2015 Commissioning of air systems.
Use pre-commissioning checklist in BSRIA guide BG 49/2015
Setting to work and regulation
Set to work and regulate air distribution systems in accordance with CIBSE Commissioning Code A and BSRIA guide BG 49. Undertake an initial scan of the system and document the results.
Measurement of air flow

Use instruments for measurement and methods of measurement detailed in BSRIA Guide BG 49/2015 and CIBSE commissioning code A.

Undertake tests and checks to ventilation and air conditioning systems generally in accordance with BS EN 12599 in order to verify the fitness for purpose of the installed systems before, during and after handover. Method statement to include relevant checklists from BS EN 12599.

For each belt driven fan provide a change of belts and drives (to be sized after balancing the system). Allow for changing belts and drives and recommissioning fan and rechecking system as necessary.
For each direct drive, adjustable pitch, axial fan, allow for a change of pitch angle (to be determined after balancing the system). Allow for recommissioning each system after the fan blade pitch change.

Undertake works and checks generally in accordance with BS EN 12599: *Ventilation for buildings – Test procedures and measurement methods to hand over air conditioning and ventilation systems* – in order to verify the fitness for purpose of the installed systems before, during and after handing over. Method statement to include relevant checklists from BS EN 12599.

3051 COMMISSIONING BOILER PLANT:

Follow the procedures laid down for carrying out Preliminary Checks and Start Operation in accordance with CIBSE Commissioning Code B and manufacturer's instructions.
Apparatus and Instruments
Use Apparatus and Instruments detailed in CIBSE Commissioning Code B, Appendix BA1 Apply tolerances defined in Appendix BA1.

Commission the combustion aspects steam boiler plant in accordance with the principles outlined in CIBSE Commissioning Code B. Follow the procedures in the relevant parts of BS EN 12952 and BS EN 12953 for testing, commissioning and acceptance tests of steam boiler plant.
The boiler manufacturers in accordance with a method statement, which has been approved by the client's insurance inspectors and the CA, must commission steam boiler plant.

3052 COMMISSIONING STEAM SYSTEMS:

Commission steam systems in accordance with:
The boiler manufacturer, specialist steam equipment manufacturers' and water treatment specialist's recommendations
The CSA (Commissioning Specialists Association) Technical Memorandum - TM7

Steam boiler plant
Combustion aspects of steam boiler plant to be commissioned in accordance with the principles outlined in CIBSE Commissioning Code B.
Follow the procedures in the relevant parts of BS EN 12952 and BS EN 12953 for testing, commissioning and acceptance tests of steam boilers and ancillary plant.
The boiler manufacturers must commission steam boiler plant in accordance with a method statement, which has been approved by the client's insurance inspectors and the Contract Administrator.

3055 COMMISSIONING OF GAS PLANT AND SYSTEMS:

Commission gas fired plant on industrial and commercial premises in accordance with IGEM/UP/4.
Commission gas infrastructure (external to buildings) supply systems in accordance with BS EN 12327.
Undertake all completion and commissioning procedures detailed in Section 17 of IGEM/UP/2 edition 3 and provide new gas pipework commissioning checklist based on Appendix 16 in UP/2.
Provide a scheme for inspection, testing and maintenance of the gas installation for inclusion in the O&M manuals to ensure continued integrity.

3060 COMMISSIONING REFRIGERATING SYSTEMS:

Commission refrigerating systems in accordance with CIBSE Commissioning code R.

3061 COMMISSIONING PLANT ITEMS AND OTHER SYSTEMS:

Where no CIBSE or BSRIA manuals are published that cover the commissioning of specific plant items or other systems submit detailed proposals and comply with the manufacturers' recommendations for setting to work.

3061 INSTRUMENTS AND GAUGES:

Ensure instruments are correctly calibrated. Record details of instruments on record sheets.

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Submit evidence of correct calibration of instruments to be used in connection with commissioning and testing.

3101 **AIR SYSTEMS COMMISSIONING RECORDS TO BSRIA GUIDE BG 49/2015:**
Keep a systematic record of commissioning results and distribute as indicated.
For air systems.
A record of the initial scan of the system shall form part of the commissioning results. These results shall be included in the Operation and Maintenance manuals.
Use record sheets as detailed in BSRIA Guide BG 49/2015 Commissioning Air systems.

3102 **WATER SYSTEMS COMMISSIONING RECORDS TO BSRIA GUIDE BG2/2010:**
Keep a systematic record of commissioning results and distribute as indicated.
For water systems
A record of the initial scan of the system shall form part of the commissioning results. These results shall be included in the Operation and Maintenance manuals.
Use record sheets as detailed in BSRIA Guide BG2/2010, Commissioning of water systems.

3112 **COMMISSIONING OF ELECTRICAL INSTALLATIONS:**
Refer to specification section Y81

Ensure all electrical installations associated with the system are tested and commissioned before any plant is run.

Carry out electrical checks listed in CIBSE Commissioning documents:-
Series A Air Distribution Systems - A1.5
Code W: Water Distribution Systems

3120 **BMS COMMISSIONING – PRE-COMMISSIONING (inc NES clause 3140)**
Ensure that the BMS is pre-commissioned to allow the building services plant to operate under "manual" running conditions.
Ensure that the control valves can be manually set in their fully open position to allow the balancing of pipework flows.
Ensure that dampers can be manually opened to allow the commissioning of air systems.

Ensure that as much pre-commissioning work as possible is performed off-site:
Ensure that the following is followed:

Pre-commissioning action	*Pre-commissioning off-site*
Control application software	Yes (final commissioning on-site)
User interface software	Yes (final commissioning on-site)
Control panels	Yes (final commissioning on-site)
Terminal units (fan coil units, etc)	Yes (final commissioning on site)
Wiring	No
Communications network	No
Sensors	No
Actuators	No
Integration gateways	Partial

Ensure that a record of all settings, set-points and offsets are maintained throughout the pre-commissioning period.
Ensure that all final physical adjustments to the field devices are indelibly marked.
Ensure that all packaged plant interfaced with the BMS is fully tested and commissioned by the manufacturer or installer.
Ensure that the BMS is pre-commissioned in accordance with the requirements of CIBSE Code C (Commissioning of automatic control systems).
Ensure that the BMS is pre-commissioned to allow the building services plant to operate under "manual" running conditions.
Ensure that the control valves can be manually set in their fully open position to allow the balancing of pipework flows.
Ensure that dampers can be manually opened to allow the commissioning of air systems.

3130A **BMS COMMISSIONING - PLANT READY FOR CONTROL SYSTEM COMMISSIONING**
Confirm that the following plant commissioning has been performed before commencing the final BMS commissioning:
Water systems
Ensure the system is cleaned and flushed to remove any debris.
All regulating, isolating and control valves in place and operating correctly.
That all flow measuring devices are in place and in the correct location for accurate measurement (including pressure tappings).
The system is vented.
That the proportional balancing is completed to obtain the branch flow rates in the correct ratio to each other (or through the use of and setting of self-balancing valves).
That the pump flow rate has been adjusted to provide the specified flow rate.
Air systems
Debris has been removed from the air distribution system.
That dampers are in the correct location and fully functional.
That fire/smoke dampers open.
Test holes have been drilled and sealed with removable plugs.
That in-situ flow measuring devices have been installed.
Ductwork air leakage testing has been performed (if specified).
Completion of proportional balancing of regulating dampers so that terminals share the air flow in the correct proportions.
Regulation of the fan(s) to provide the specified flow rate.
Packaged equipment
Ensure that plant and controls have been fully commissioned and are functional, ready for integration with other plant/systems.
That control equipment inputs/outputs are in the specified format for connection to the main control system.
Confirm that the plant is commissioned in accordance with:
Air distribution systems, CIBSE Code A
Boiler plant, CIBSE Code B
Refrigeration systems, CIBSE Code R
Water distribution systems, CIBSE Code W
Commissioning of water systems BG2/2010, BSRIA
The commissioning of air systems in buildings, BG49/2015, BSRIA.

3151 **COMMISSIONING BMS / AUTOMATIC CONTROL SYSTEMS**
Carry out commissioning of Automatic Control Systems in accordance with Manual prepared by the controls equipment manufacturer. Carry out the Checking and Setting-Up procedure detailed in the CIBSE Commissioning Code C, Section C1.
Measurement
Carry out measurements in accordance with CIBSE Commissioning Code C, Appendix C2.1.
Ensure that the BMS is commissioned in accordance with the requirements of CIBSE Code C
Wherever possible load, prove and commission all software off-site.
Carry out all tests necessary to ensure the correct operational state of the installation. Load and prove all software. Set all variable parameters and switches to the appropriate values and settings to ensure compliance with the specification.
Prior to activating any BMS control of plant demonstrate all safety interlocks and ensure all fail safe conditions are implemented and operational.
Record values and settings of all variable parameters and switches set as part of the commissioning process. Include these records in Record Documents.
Indelibly mark all physical adjustments to BMS devices.

3152 **BMS WITNESSING REQUIREMENTS: (NES clause A32 151.000 / W60 360.010))**
The Contractor shall implement the following CA's witnessing requirements. Ensure that on-site commissioning staff facilitate the witnessing process.

Confirm that the BMS hardware is installed in accordance with Section W60.
Verify any operator software and associated graphics.
Witness completely the control of any main and/or critical items of plant along with a random sample of other points.
If less than 300 points, witness all points. Between 300 and 1,000 points witness 50% (minimum of 300 to be witnessed). If more than 1,000 points witness 20% (with a minimum of 500 points witnessed).
Reserve the right to witness 100% of the points if the failure rate is greater than 5%.

Witness a sample of specific functions, eg 10% of alarms and 10% of data logging.
Witness one of several identical items of plant in detail with the others witnessed on a random basis.
Verify the system security access.
Verify that all safety-related functions perform to that specified, eg plant shutdown on fire condition.
Verify all plant restarts according to that specified after building power failure and local power failure.
Witness all power meter data-points to ensure that they match the meters.
Ensure that trend logs are used when witnessing points in order to monitor the performance of control actions.
Verify the handover of all operating manuals and system documentation.
Verify the handover of backup copies of software.
Verify the completion of any specified system operator training.

3153 **BMS - POST HANDOVER CHECKS: (Edited from NES clause A32 152.000 / WGB 360.650)**
Ensure that the following post-handover checks are performed:
Global level checks
Internal air temperature.
Relative humidity.
Ventilation levels
Energy consumption (ensure that the pulse-input counters match the meters).
Requirements associated with seasonal commissioning
Soft landings requirements
Check that each of the above meets the specified requirements.

System level checks
Control strategies. Check that any suspect control strategies are appropriate for the intended application. Check that the suspect control strategy has been implemented and commissioned correctly. Check that the control strategy is still appropriate for the intended use.
Network communications. Check that all relevant field controllers communicate properly. Check for correct sharing between controllers of relevant data and correct inter-controller operation.
Control set-points. Check that the set-points in question are correct and appropriate for the actual operating conditions.
Control loop settings. Check that the control loop settings result in accurate and stable control.
Check that all self-learnt characteristics are valid.
Occupant controls. Check that occupant controls work correctly.
Sub-system/component level
Sensors. Check the accuracy and location of any suspect sensors.
Actuators. Check that any suspect actuators operate correctly.
Dampers and valves. Check that there are no dampers and valves that are jammed and that they operate as intended

4808 **PERFORMANCE TESTING**

4810 **SYSTEM PERFORMANCE TESTING / DEMONSTRATIONS:**
Demonstrate the performance and control sequence, including the operation of all safety devices, of installations including single, standby, multi-duty plants and systems, and of plants specified for future use.

4815z **TESTING OF RESIDENTIAL VENTILATION SYSTEMS:**
Demonstrate the performance of residential ventilation systems through performance testing and installation checks in accordance with BS EN 14134. Comply with the best practice requirements of BSRIA BG 46/2015 "Domestic Ventilation Systems"; for measurement of air flow rates use the unconditional method.

4820z **PERFORMANCE TESTS, CAPACITY TESTS AND ENVIRONMENTAL TESTING:**
Carry out performance and capacity tests and environmental testing for all systems and in all areas of the building to prove and demonstrate the performance of the systems and plant item duties.
Specific Fan Power Validation tests
After fitting clean filters, air handling systems to be commissioned under validation load. Measure the specific fan power SFP of each system for calculation of the building "as constructed" CO_2 emission rate.
Site performance testing of heating and cooling coils

Where specified in the scope of works or scheduled undertake in accordance with Commissioning Specialists Association guide TM10 – Site performance testing of heating and cooling coils.

For environmental testing, the minimum requirement is to test each room using the BMS (unless stated otherwise in Y51sch2) for at least 48hours during which period the temperature and Humidity (if controlled) set points must be varied at least twice to prove the correct responses of control systems and plant. Temperature / humidity logs shall be provided as a record of the testing.
Apply artificial loads to simulate sensible and latent gains. Use calibrated data loggers or chart recorders (independent of the BMS) in those areas detailed in the scope of works, or where indicated in schedule Y51sch2 or otherwise provide test arrangements to simulate the full range of operating conditions and duties.
Undertake system proving during the defects period by recording, evaluating and reporting on the seasonal performance of the systems against their design values. Ensure that both summer and winter maximum and minimum conditions are covered by the test results.
Carry out ambient air quality tests in accordance with BS EN 13528-1, BS EN 13528-2 and BS EN 13582-3 as scheduled.
Carry out measurements of sound or noise levels in all internal and external areas of the building or project to demonstrate that the designed values are being achieved or not exceeded as appropriate.

4824 **CONTROLS DEMONSTRATION AND VERIFICATION:**
Demonstration and verification that the controls systems are fully operational, commissioned and deliverables have been made shall include, but not be limited to, the following:-
: Demonstration of operation of software prior to installation
: Audit of cabling and hardware installation
: Demonstration of physical and logical integrity of system, including demonstrating that sensors and actuators correctly connected and addressed.
: Demonstration of control actions, including operation of all safety devices
: Demonstration of sensor calibration
: Demonstration of successful system software commissioning, including reloading software and documented commissioning data from media and subsequent satisfactory operation.
: Verification of specified graphics
: Verification of satisfactory training of client's staff
: Verification of the handover of all specified operating manuals, documentation and drawings
: Verification of handover of back-up copies of software
: Verification of handover of consumable spares

4826z **RECORDERS:**
During performance, capacity and environmental testing provide recorders as necessary to demonstrate the system performance.

Following completion provide and maintain on free loan portable at least three seven day space temperature and relative humidity recorders, together with adequate charts.
Provide other recorders as agreed with the engineer.

4844A **RAINWATER SYSTEMS:**
Demonstrate by flow tests that the systems give satisfactory performance.

4844B **SANITARY SYSTEMS:**
Comply with performance tests given in BS EN 12056 – 2.

4844C **HOT AND COLD WATER / BOOSTED COLD WATER SYSTEMS:**
Demonstrate and record that outlets supply adequate rates of flow.
Demonstrate that the hot water temperature at each outlet to reaches 50°C (55°C in healthcare premises) within one minute of turning on the tap.
In installations where the HWS return is local to the outlet, demonstrate that the hot water temperature at each outlet to reaches 50°C in less than 30seconds

4044D FIRE FIGHTING / SMOKE & HEAT CONTROL SYSTEMS:
Comply with requirements of the local Fire Authority, with the appropriate sections of BS 9999 and BS 9991 and the appropriate systems standards detailed elsewhere in this specification.

Comply with BS 5306-1 for hose reels.

Dry Riser System; undertake flow and pressure test at the highest outlet .of a flow of 25l/s al a running pressure of 4 bar or as agreed with the fire brigade. On each valve outlet below highest outlet undertake full bore flow test to prove no impedance to valve outlet flow

Wet Riser System; Undertake flow and pressure test at each outlet of 25l/s at a running pressure of 8bar. Or as agreed with the fire authority.
Where requested by the engineer carry out proving test of the riser's intermediate isolation valves and pump suction and delivery valves. Where the valves are monitored undertake proving test of the monitoring system by means of closing each valve and witnessing the alarm signal at the central panel location.

Wet riser storage tank infill main where installed undertake flow test utilising inline flow meter.
Carryout proving test on the open and close operation of the storage tank infill float valves and prove operation of the storage tank high water level and low water level tank alarms and witness alarm signal at the alarm panel

On each pump undertake flow and pressure proving test utilising pump back to tank test line

Undertake pump automatic start test by lowering system pressure to below pump start pressure Test to be undertaken to each pump simulating standby pump operation by isolating lead pump and lowering system pressure..
Witness alarm signal of pump starting at alarm panel.

Simulate pump failure to prove pump failed signal on system alarm
On diesel pump set undertake '6 crank test' to simulate diesel pump failed to start signal.

4044E HYDRAULIC SYSTEMS:
Comply with requirements as indicated.

4044F MEDICAL GAS AND AIR SYSTEMS:
Comply with Health Technical Memorandum 02-01 Part A.

4044G LABORATORY AND INDUSTRIAL SYSTEMS:
Comply with requirements as indicated.

4044H GAS SYSTEMS:
Comply with the requirements of the local Authority.

4044I SILENCERS AND ACOUSTIC TREATMENT:
Demonstrate by measured tests that noise criteria indicated have been achieved.

4044J ACOUSTIC ENCLOSURES:
Demonstrate that measured air leakage complies with scheduled values.

4050z PERFORMANCE TEST RECORDS:
Keep a systematic record of tests. Distribute records as indicated in Section A33.

4052 FINE TUNING:
Carry out fine-tuning as required by the engineer.

10000 NES

Based on NES version Y51 – Dec 18

Y52 – Vibration Isolation Mountings

1000 GENERAL

1010 DESIGN INTENT:
Supply equipment indicated to ensure that vibration from equipment is not transmitted to building, other supporting structure, pipework or ductwork. Consider the potential for structure-borne noise transmission as well as vibration.

1012 SELECTION OF MOUNTINGS
Mountings and inertia bases should be selected to suit the equipment and static deflections scheduled. Number of mounts to be selected by the specialist supplier.

1013 INERTIA BASES
Inertia bases and steel frames are intended to provide a more stable base for plant, provide more uniform weight distribution, reduce the centre of gravity and, if massive enough, reduce the amplitude of vibration.

1020 SPRING ANTI VIBRATION MOUNTINGS:
Select spring mounts with an overload capacity of 50%, for metal springs the outside diameter should be at least 75% of operating height. Permanently identify individual mounts with their load capacity.

1030 SPRING HANGERS:
Provide spring hangers that allow the lower hanger rod to move laterally at least 15°.

1040 LOCKING FACILITY:
Where indicated, provide lockable levelling device.

2000 PRODUCTS/MATERIALS

2011 MAT AND PAD MOUNTINGS:
Provide configured mat mountings with a waffle or ribbed section manufactured from synthetic rubber or neoprene.
or Provide pad mountings manufactured from composite synthetic rubber.
or as otherwise indicated.

Where mats are stacked, bond 1mm steel sheet thickness between each pad and to the top and base without filling voids.

2021 TURRET COMPRESSION MOUNTINGS:
Provide turret compression mountings fabricated from synthetic rubber or neoprene and mild steel.
or as otherwise indicated.
Protect the metal from corrosion by painting and fix friction pads to top and bottom.
Provide bolt holes to allow fixing.

2030 SPRING COMPRESSION MOUNTINGS:
Provide spring compression mountings comprising high strength low stress helical spring capped with steel pressure plate, on resilient base pad, mounted on pre-drilled base for bolting down, and enclosed with cap. Protect metal from corrosion.

2041 CAPTIVE SPRING MOUNTINGS:
Provide captive spring mountings comprising high strength low stress helical spring designed to achieve horizontal and vertical snubbing. Mount spring on resilient base pad predrilled for bolting down and protect against corrosion. Supply complete with a lockable levelling device.

2051 TURRET COMPRESSION HANGERS:
Provide turret compression hangers fabricated from synthetic rubber or neoprene and mild steel.
or as otherwise indicated.
Protect the metal from corrosion by painting and fix friction pads to top and bottom.

Provide bolt holes to allow fixing.

Y52 – Vibration Isolation Mountings

Construct hanger box from steel (minimum thickness 1.6mm) complete with hole for suspension rod and enlarged lower hole for drop rod to equipment.

2061 SPRING COMPRESSION HANGERS:
Provide spring compression hangers comprising high strength low stress helical spring capped with steel pressure plate, on resilient base pad, mounted within hanger box. Construct hanger box from steel (minimum thickness 1.6mm) complete with hole for suspension rod and enlarged lower hole for drop rod to equipment.

Provide spring hangers that allow the lower hanger rod to move laterally at least 15°.

2080 HORIZONTALLY RESTRAINED SPRING MOUNTINGS:
Provide horizontally restrained spring mountings comprising high strength low stress helical spring capped with steel pressure plate, on resilient base pad, mounted within hanger box. Construct hanger box from steel (minimum thickness 1.6mm) complete with holes for installing across connection. In addition supply synthetic rubber or neoprene snubber as a horizontal buffer.

2081 INERTIA BASES - CONCRETE FILLED:
Provide purpose built inertia bases constructed using welded steel frame formwork containing concrete reinforced with 12mm minimum diameter bars at 100mm maximum centres, 35mm above the bottom of the base; and mounted on spring compression mountings.

2082 INERTIA BASES - STEEL FRAMED:
Provide purpose built inertia bases constructed using welded steel frame mounted on spring compression mountings.

2085 MULTIPLE PUMP BASES
Where multiple pumps are fixed to a common base, and they are not to always run at the same time, provide vibration isolation to individual pumps, designed to both avoid the transmission of vibration into the adjacent pumps (in order to avoid "Brinelling" their bearings) and into the pipework to which they are connected.

2101 VIBRATION ISOLATION HOSES:
Provide flexible hose couplings for connecting pipework comprising nylon fabric or steel mesh carcass with waterproof cover and internal lining of material to suit fluid conveyed, temperatures and pressures.

2111 PIPEWORK NOISE ISOLATION:
Incorporate within pipework support ring purpose made isolators manufactured from synthetic rubber or neoprene.
Or provide spring hangers as indicated.

2121 PIPE WALL AND RISER SEALS:
Provide pipe sleeves, minimum length 300mm, with lining of minimum 25mm dense mineral fibre packing sealed with soft setting mastic to both sides unless otherwise indicated.

3000 WORKMANSHIP

3010 GENERAL:
Install vibration isolation equipment and carry out levelling of equipment in accordance with manufacturer's instructions.

3021 CAST IN SITU BASES:
Ensure bases are cast so that in conjunction with the plant load the design static deflection is achieved.

3030 FIXING:
Fix down vibration isolation mountings only where indicated.

3040 HORIZONTALLY RESTRAINED SPRING MOUNTINGS:

Y52 – Vibration Isolation Mountings

Ensure snubbers for limiting excessive movement are installed out of contact during normal operation.

1M080 Based on version NES Y52 March 18

Y54 – Identification (Mechanical)

1000 **GENERAL**

1010 **REQUIREMENTS:**
Identify all pipework, ductwork, equipment, appliances and ancillaries comprising the various systems.

1021 **NEW SYSTEMS:**
Comprehensively label and colour code throughout the works.
Any systems which have the same colour coding but serve different purposes (eg laboratory / Domestic hot and cold water services) shall have additional descriptive identification.

1030 **EXISTING SYSTEMS:**
Where identification details are incompatible with those required for new systems, obtain approval to mode of cross referencing.

1041 **COLOURS:**
To colour ranges given in BS 381C and BS 4800.

1045 **PERFORMANCE and DURABILITY:**
Ensure durability of all safety signage / identification is in accordance with BS ISO 17398

2000 **PRODUCTS/MATERIALS**

2011 **PIPEWORK IDENTIFICATION:**
Standards
Colour code and label to BS 1710.
Identification
Apply primary and secondary identification, to each pipe at least:
Once in every room or enclosed area.
At intervals not exceeding fifteen metres.
At every junction.
At every valve.
At every inspection and access position into service shafts, false ceilings, bullheads etc.
Primary Identification
Apply colour bands, 300mm wide.
Secondary Identification
Apply colour bands, 50mm wide, and superimpose a legend identifying circuit, direction of fluid or gas flow, nominal pipe bore and, where appropriate, fluid or gas pressure.
Legends
Apply to colour bands by transfers of an approved type.

2021 **DUCTWORK IDENTIFICATION:**
Standards
Generally colour code and label to BESA Specification DW/144.
Identification
Apply primary and secondary identification, to each duct at least:
Once in every room or enclosed area.
At intervals not exceeding fifteen metres.
At every junction.
At every damper.
At every inspection and access position into service shafts, false ceilings, bullheads etc.
Primary Identification
Apply colour bands, 300mm wide
Secondary Identification
For ducts with longest side or diameter up to and including 225mm. Paint colour bands 50mm wide and superimpose legends.
For ducts with longest side or diameter over 225mm. Paint or apply transfers to identification triangles, or triangular plates. Superimpose or incorporate legends.
Triangular Plates

Attach to buckle bands or steel pieces and fix to ducting, with apex indicating direction of airflow. Submit details of plates and fixings for approval before painting and marking. Use equilateral triangle of side 150mm minimum.

Legends

Apply transfers of an approved type to colour bands or triangles or triangular plates. Identify floor and space served, associated equipment reference and direction of airflow.

2834z PLANT AND EQUIPMENT IDENTIFICATION, LAMINATED PLATES:

Standards

Identify each item of equipment by name and, where appropriate, by agreed reference characters. Provide colour identification as called for in work sections and, in all cases, colour firefighting equipment red.

Plates

Use rectangular metal or laminated plastic, securely fixed to each item of equipment.

Lettering

Laminated plates, multi-coloured with outer layer removed for lettering. General labels to be white with black lettering.

Legends

Engrave plates with an approved text. Incorporate operating duty of equipment where this is not incorporated in other labelling.

2835 GRAPHICAL SYMBOLS FOR USE ON EQUIPMENT IN ACCORDANCE WITH BS EN 80416:

Graphical symbols for use on equipment to be created and applied in accordance with BS EN 80416-1, BS EN 80416-2, BS EN 80416-3.

2840z VALVES COCKS AND OTHER PIPELINE ANCILLARIES IDENTIFICATION:

Standards

Identify each valve, cock, stop valve, air vent, drain cock etc. with disk engraved with numerical reference and service. Except where exposed in occupied areas.

Discs

Securely attach metal or laminated plastic discs, minimum diameter 35mm, to each item. Discs to be white with black lettering.

Legends

Engrave discs with permanent characters, minimum height 6mm.

Incorporate in operating instructions relating to regulating valves and flow measuring Equipment, details of flow rate, pressure differential and setting.

2858z MEDICAL GAS TERMINAL UNITS:

This section not used

2868z LABORATORY OUTLETS:

This section not used

2870 AIR VOLUME REGULATING AND CONTROL DAMPER IDENTIFICATION:

Standards

Identify each regulating and control damper except where exposed in occupied areas.

On ductwork dampers, clearly indicate commissioning set point.

Identification colours

Use primary and secondary identification colours of associated system for painted or self colour disks.

Discs

Securely attach metal or laminated plastic discs, minimum diameter 35mm, to each item.

Legends

Engrave disks with permanent characters, minimum height 6mm.

2880 INSTRUMENT IDENTIFICATION:

Standards

Identify each instrument by name and, where appropriate, by agreed reference characters.

Plates

Use rectangular metal or laminated plastic, securely fixed to each instrument.

Legends

Engrave plates with an approved text.

2881 DANGER AND WARNING NOTICES:

Hazardous Systems

Colour code and label hazardous systems and equipment to requirements of Health and Safety Executive Guidance Notes.

On natural gas systems, provide identification and warning notices and labels (including a notice adjacent to each main and emergency shut off valve) to meet the requirements of the Gas Safety (Installation and use) Regulations 1998 / ACOP L56, and Institution of Gas Engineers and Managers (IGEM) requirements.

2905 SYSTEM IDENTIFICATION INSTALLATION CHARTS:

System Schematics

Supply and fix a referenced schematic diagram (or diagrams) of all systems as installed, including equipment and ancillary schedules. Show scheduled information on diagram.

Identify all items by appropriate reference characters.

Control Schematics

Supply for incorporation in O&M manuals a referenced schematic diagram (or diagrams) of all control systems as installed, including equipment and ancillary schedules. Show scheduled information on diagram. Identify all items by appropriate reference characters.

Location

Fix in each boiler house, calorifier room, plant room or equipment room.

Finish

Plastic encapsulated chart.

98080 Based on NES Y54 text June 17

Y54 – Identification (Mechanical)

Schedules

A11sch1 – Schedule of Drawings

Drawing No	Description	Scale
HSDU-ACM-XX-01-DR-ME-5001	HSDU MEP SERVICES LAYOUT	1:100 @ A1
HSDU-ACM-XX-01-DR-ME-5002	HSDU EXISTING SERVICES STRIP OUT PLAN	1:100 @ A1
HSDU-ACM-XX-02-DR-ME-5001	PLANT ROOM 4D MEP SERVICES LAYOUT	1:50 @ A1
HSDU-ACM-XX-02-DR-ME-5002	PLANT ROOM 4D EXISTING SERVICES STRIP OUT PLAN	1:100 @ A1
HSDU-ACM-XX-XX-DR-M-5711	HSDU AIR HANDLING UNIT VENTILATION SCHEMATIC	NTS @ A1
HSDU-ACM-XX-XX-DR-M-5712	MP AIR HANDLING UNIT VENTILATION SCHEMATIC	NTS @ A1

A13sch – Schedule of Common Design Criteria

EXTERNAL CONDITIONS / OUTDOOR AIR CATEGORY		
External environmental design conditions:	Summer	28 °Cdb
	Summer	20 °Cwb
	Note heat rejection plant shall be able to maintain 100% load / capacity up to an ambient of 35°Cdb	
	Winter Fabric	-5 °Cdb
	Winter Air Handling	-8 °Cdb

INTERNAL ENVIRONMENTAL DESIGN / COMFORT CONDITIONS		
Packing Area	Temp (All Year)	18 – 21 °C
	Humidity (All year)	40 – 60 %RH
	Pressurisation	(+)ve 30 Pa
Wash Room	Temp (All Year)	18 – 21 °C
	Humidity (All year)	30 – 60 %RH
	Pressurisation	(-)ve 5 Pa
Offices (general)	Winter	20°C min
	Summer	Uncontrolled
	Pressurisation	Atmospheric
Cleaner's	Temp (All Year)	18 – 19 °C
	Pressurisation	(-ve) 10 Pa
Gowning Area	Temp (All Year)	18 – 21 °C
	Pressurisation	(-ve) 10 Pa
Steriliser Maintenance	Temp (All Year)	30 °C max
	Pressurisation	(-ve) 10 Pa
Steriliser Loading	Temp (All Year)	18 – 21 °C
	Humidity (All year)	30 – 60 %RH
	Pressurisation	(-ve) 25 Pa
Materials Transfer Room	Temp (All Year)	18 – 21 °C
	Humidity (All year)	30 – 60 %RH
	Pressurisation	(-ve) 20 Pa
Production Bulk Store	Temp (All Year)	18 – 21 °C
	Humidity (All year)	30 – 60 %RH
	Pressurisation	(-ve) 10 Pa
Corridor	Winter	18°C min
	Summer	Uncontrolled
	Pressurisation	Atmospheric
Sterile Goods Storeroom	Temp (All Year)	18 – 21 °C
	Humidity (All year)	30 – 60 %RH
	Pressurisation	(-ve) 10 Pa
Note: Room pressures with relation to Corridor		

A13sch – Schedule of Common Design Criteria

VENTILATION		
Packing Area	20 AC/hr ISO Class 8 Cleanroom	
Wash Room	6 AC/hr	
Offices (general)	Fresh air rate for occupants	10 l/s person
Cleaner's	Nominal 150 l/s ISO Class 8 Cleanroom	
Gowning Area	20 AC/hr	
Steriliser Maintenance	Nominal 770 l/s	
Steriliser Loading	Nominal 460 l/s	
Materials Transfer Room	Nominal 758 l/s	
Production Bulk Store	10 AC/hr	
Corridor	Nominal 130 l/s	
Sterile Goods Storeroom	Nominal 524 l/s	

Design operating conditions of mechanical distribution systems:

Refer to S51scp, T20scp, and T61scp

Equipment Selections
Any component pressure drops etc. quoted in individual Work Section selection schedules are "notional" figures used for the purpose of preliminary plant and motor selections.
Where "maximum" figures are quoted these are not to be exceeded when selecting equipment.

The Engineering Services Contractor shall substitute the actual pressure drops, flow rates etc. through all components, as purchased and as the final installation configuration, and recalculate equipment duties before selecting and ordering equipment and associated prime movers.

CRV's and DRV's
Select and size CRV's and DRV's on the index run to have maximum pressure losses not exceeding the figures quoted in clause Y20/1022. Select and size other CRV's and DRV's to balance the downstream pressure appropriately when in the 50% closed position.

Control Valves
Select and size Control Valves with a rangeability in excess of 40 and authority not less than the following:-

Diverting & throttling applications	- 0.5
Mixing applications	- 0.3
2 way valves	- 0.25 to match system configuration

Select and size Control Valves on the index run to have maximum pressure losses not exceeding the figures quoted in clause Y20/1022. Select and size other control valves to provide the appropriate control across the controlled device.

Control Dampers
Use opposed blade control dampers unless otherwise indicated. Select and size control dampers to provide authority as follows:-

Opposed blade	5% (ie the pressure loss across a fully open CBD is approximately 5% of the loss in the rest of the system)

A13sch – Schedule of Common Design Criteria

Parallel blade	20%

Fans
Quoted fan duties are based on pressure losses external to any air handling unit or distribution components and on the equipment airside pressure losses stated on the schedules.
Pressure loss allowance for air filters are to be based on the 'dirty' condition.
Quoted fan duties include the following commissioning allowances:-

	Low Pressure Systems	Medium & High Pressure Systems
On Flow Rates	10%	5%
On Head	20%	15%

Fans heads are based on the layout drawings and specified types of duct fittings and as appropriate system resistances stated in schedule Y40 or Y41. If changes are made to the routes by the installer, fittings other than those specified are installed or the resistances of the components selected are different from those stated, adjust fan head to compensate and advise the S.O. of the adjustment.

Pumps
Quoted pump duties include the following commissioning allowances:
Flow Rate 10%
Head 15%
Pump heads are based on the layout drawings and specified types of pipe fittings and as appropriate the system resistances stated in Y20. If changes are made to the routes by the installer, fittings other than those specified are installed or the resistances of the components selected are different from those stated adjust pump head to compensate.

External Noise Criteria

Should the proposed plant be identified as having intermittent, tonal or otherwise characteristic features, a further applicable penalty should be subtracted from any of the proposed noise emission limits in line with requirements of BS 4142.

All services plant noise to be 5dBA lower (10dBA if tonal) than the otherwise prevailing background noise L90 levels when measured at a distance of 1m from the nearest noise sensitive window.

Limitation of Harmonics

Equipment shall comply with the limits stated in Engineering Recommendation G 5/4-1.
For a.c motor control, d.c power supplies, variable voltage controllers, and UPS equipment provide details of harmonic distortion and confirm compliance prior to ordering.

A30schM – Schedule of Mechanical Manufacturers

Equipment	Manufacturer
R11 Foul Drainage above Ground	Contractors selection unless stated otherwise on schedules or in scope of work.
S51 Steam (ancillaries)	Gestra UK (part of Invensys flow control) Spirax Sarco Thermsave Engineering Ltd. (accumulators) Thermal Technology Ltd. Trounsay and Gauvin
U10 Ventilation Refer to relevant Y sections for mechanical ventilation plant	Natural (Passive / mixed mode) air inlet / outlet terminals Passivent Aereco Nuaire Ground – Air heat Exchangers Rehau Demand control air-handling system Swegon
W60 Controls/Monitoring	TAC / Satchwell – (Owned by Schneider Electric) Trend Control Systems Ltd. (Only System Houses who are Trend TTC's or SI's will be will be considered acceptable) Honeywell Control Systems Johnsons Control Systems Sauter Automation Ltd. Siemens Building Technologies (Building Automation) Trane UK Ltd. (Building Management Systems) Cylon Controls
Y11 Valves / Strainers	General service and commissioning Pegler Yorkshire (Broen commissioning valves and PICV's) Crane Frese Hattersley Herz valves Marflow Hydronic Systems Flowcon TA Hydronics (Tour & Andersson) Oventrop SAV UK Ltd. Manifold Commissioning Sestems SAV Crane Hattersley Herz valves Marflow Hydronic Systems TA Hydronics (Tour & Andersson) Differential pressure, high limit, flow control, PICV, and other Crane Danfoss Randall Frese Flowcon Hattersley Herz valves Pegler Yorkshire Honeywell Control Products Marflow Hydronic Systems

A30schM – Schedule of Mechanical Manufacturers

Equipment	Manufacturer
	Oventrop Samson Controls Spirax Sarco SAV UK Ltd. TA Hydronics (Tour & Andersson) General Control valves + TRV's Crane Frese Hattersley Herz valves Oventrop Pegler Yorkshire Broen Aquaflow Regulators Ltd. (flow restrictors) Safety / Pressure relief Bailey Birkett (Safety Systems UK Ltd.) Natio Valves (Delta Fluid Products Ltd.) Spirax Sarco Specialist Valves Applied Energy Products Ltd (Resring thermostatic mixing etc) Galeffi (thermostatic mixing) Crane Donkin Gas Valves Ltd. Hattersley Herz valves (Thermostatic mixing, pressure regulating /reducing, return water temperature controller, preassembled manifold commissioning units) Honeywell ACS Control Products (Thermostatic mixing, pressure regulating /reducing, back flow prevention, thermal balancing / disinfection for HWS) Hopkinsons (Steam) Horne Engineering (thermostatic mixing) Kemper (Thermostatic mixing, pressure regulating /reducing, back flow prevention, thermal balancing) Reliance Water Controls (thermostatic mixing) Sadi (Chemical / corrosion resistant) Landon Kingsway – (Gas/oil shut off) Alcon Solenoid Valves – (Gas/oil/water shut off) Watts Industries (thermostatic mixing, pressure regulating,backflow prevention)
Y11 Expansion Bellows and flexible connections	Boa Flexible Solutions Ltd Isolated Systems Ltd. J & P supplies Ltd. N Minikin & Sons Superflex (Interflex)
Y11 filters, dirt separators, deaerators	Carter Environmental (filters) Engineering appliances Ltd (dirt separators / deaerators) Lubron Water Technologies Plenty Filters (filters) Spirotech (UK) Ltd. (dirt separators / deaerators)
Y11 Steam Traps	Armstrong

A30schM – Schedule of Mechanical Manufacturers

Equipment	Manufacturer
	Spirax Sarco Trousay and Gauvin
Y11 Heat Meters	Switch2 Energy Solutions Ltd (Formerly Vitera Energy Services) Danfoss Gosler
Y30 Y31 Air Ductlines/Dampers	Ductwork Hotchkiss Senior Hargreaves Galloway Group Lindab Specialist ducts Fire Protection Ltd (flamebar fire resistant ductwork) Rega Ductex (flexible acoustic ductwork) Fabricair (textile ducts) KE Fibretex UK (textile ducts) Kingspan (Kooldcut pre-insulated ductwork) Dampers Actionair Group Advanced Air BSB Engineering Trox Quelfire (intumescent collars) Lorient Polyproducts Ltd. (intumescent fire dampers)
Y40 Air Handling Units	Aermec Air-handlers (Northern) Ltd AEUK Bartell Carrier Holland Heating Clivet (packaged roof-top units) Colman Moducel Daikin Dalair Ltd. Ece Uk Field Woods Klima Therm Mallard Eurcair (Part of Mansfield Pollard) Nuaire Stanair Technologies (MProdukt) Swegon (formerly PM Lull) Systemair Ltd. Thermal Technology (Sales) Ltd. Trane Trox Vent Axia VES Andover
Y45 Attenuators/Acoustic Treatment	Allsway Acoustics Industrial Acoustics Co. Trox Brothers Ltd. Galloway Acoustics
Y46 Grilles/Diffusers/Louvres	Advanced Air Gilberts Ltd.

A30schM – Schedule of Mechanical Manufacturers

Equipment	Manufacturer
	Halton Products Motorised Air Products Krantz Koolair (UK) Ltd. Schako Trox (UK) Ltd. Waterloo Air Management
Y50 Thermal Insulation Contractors selection of installation specialist	Insulation Manufacturers Armacell UK GRM Distribution Ltd. Isover (Saint-Gobain) Kingspan Tarec Knauf NMC (UK) Ltd. Neville Thompson (Isogenopak cladding) Rockwool Saint-Gobain Isover Venture Tape Europe (Venturetape self adhesive laminated foil film) Fire Protection Cladding systems Promat "Visuclad" board cladding Rockwool "Fire Duct" Fire protection board cladding Saint Gobain Isover "U- Protect" slab and flexible wired mat
Y51 Testing and Commissioning	Contractor to select specialist who must be a member of The Commissioning Specialists Association (CSA)
Y52 Vibration Isolation Mountings	Industrial Acoustic Company Ltd. Christie and Grey Mason (UK) Ltd. Isolated Systems Ltd.
Y53 Control Components	Aercon (Power Utilities Ltd.) room - pressure controls Inversys Climate Control (Drayton) CMR Controls (room pressure controls) Danfoss Randall Ltd. Honeywell Control Systems Siemens Building Technologies West Energy Saving Technologies Ltd. (Innovative ventilation controls direct Acting by current sensing coolers & other electrical appliances, Thermistor sensor to dead leg of bath or shower). Oliver IGD Ltd. (Gas Detection and Gas Analysis Products) Munro (gas detection)

Pump Ref	Service	Pump Type	Duty				Fluid operating Temp (°C)	Motor type Aefficiency class	Max speed rpm	Electrical		Drive type and location	Notes
			Flow (l/s)	System Resistance (kPA)	Max system operating pressure	Closed Valve head (kPA)				Running current at design duty (A)	Max starting current (A)		
P-PRSI ASC-01	CHW System Secondary Pumps (Duty / Assist / Assist / Standby)	I	15	250	16 bar		5	IE4	1,465	4.4	8.1	Integrated with pump	Variable Volume (Minimum 20% of Maximum)

Pump Type

Pump type => G = Centrifugal – close coupled – end suction with Variable speed drive
OR
I = Single-stage – centrifugal – in-line with integral frequency inverter c/w integrated PI controller

Notes:

1. Quoted pump duties are based on the following pressure loss allowances. Before ordering the pumps, the contractor shall adjust the pump pressures to suit pressure drops of actual components used in the systems and any changes to the layout, and quantities of bends etc from that indicated on the tender drawings. Ensure scheduled volume is provided when operating against resistance of system corrected for changes between specified and selected component resistances.
2. Quoted pump duties include the following commissioning allowances:
   Flow rate 10%
   Head 10%
3. Select pumps for optimum efficiency in accordance with clause Y20.1020
4. All twin headed pumps shall be supplied with a matching blanking plate to enable the pump to be operated with a single head fitted during maintenance or replacement of standby motor / impeller.
5. Variable volume systems.
   Pumps shall be selected with a steep curve in the anticipated range of the system.
6. Variable speed drives specified as integrated with the pump - the drive life expectancy shall be no shorter than the motor life expectancy.

Refer to clause Y72.2191 for standard requirements for VSD's

7. 2 & 4 Pole TEFV, 3-phase, cage induction motors rated for 400 volts, 50 Hz, (outputs 0.75kW and above) shall have a rated efficiency at full load equal to or greater than the IE4 limit as defined in BS EN 60034-30-1 unless noted otherwise.

8 Glandless circulators for heating and HWS circulation (single and twin headed) with motors up to 2.5kW maximum "Energy Efficiency Index" (EEI) to be 0.23 or better in accordance with EC directive 641/2009 and the amendment 622/2012. Pumps to utilise electronically controlled permanent magnet type or EC motor.

9 Centrifugal pumps limiting "Minimum Efficiency Index" (MEI) to be 0.7 or better – in accordance with EC regulation 547/2012

Y30sch1 - Schedule of Air Ductlines

System / location	DW144 Pressure Classification (+ve or –ve)	Material	Operation: Variable volume or CV	Leakage Testing Required to DW143 Y/n/Info	% of system to be leakage tested	Closed loop quality class BS EN 15780	Protection, Delivery & Installation Level (Ref BESA TR19)	Post installation clean Y/n/Info	Notes, Fire/s/ fire rating requirements / other test requirements
I/P supply	+ve	Galvanised	Constant	No	–	High	Advanced	Yes	
General supply	-ve	Galvanised	Constant	No	–	Medium	Intermediate	No	
General extract	-ve	Galvanised	Constant	No	–	Medium	Intermediate	No	

Notes

1. Connections between galvanised ducts and plastic ducts to be flanged
2. Access doors to plastic ductwork to be flanged and bolted
3. Clear PVC inspection panels, flanged and bolted are to be installed at all fire damper locations in plastic ductwork systems
4. Grilles and diffusers and associated plenum boxes shall be supported independently of the ceiling grid unless indicated otherwise.
5. Leakage testing to be in accordance with BESA DW 143 and the requirements of BS EN 12237 and BS EN 1507
6. Refer to clauses Y30 3051 & 4081 for locations of cleaning access doors. The facilities incorporated in the ductwork fabrication / installation drawings shall be confirmed as acceptable by a specialist ductwork cleaning contractor prior to installation.
7. Refer to clause Y30 3101 for flexible ductwork.
8. Refer to Y50 for acceptable fire protection cladding systems and Y50schedule for ductwork insulation and finish.
9. External ductwork to be hot dip galvanised to BESA DW144. Refer to clause Y30 4041

Y30sch2 - Schedule of Dampers

Reference	Function	Position	Damper type	Actuation	Notes
	AHU Intake dampers		Opposed blade		
	Balancing	First connection to terminals Differs	Ms		
PRO-HSDU09-01 and PRO-HSDU09-02	*Pressure Relief/Controlling damper*	*Packing area to Biomedical Transfer Room*	*Self acting pressure relief*	*Accurate at pressure differential of 10pa*	2 No dampers each sized at 0.394 m3/s *Fire rated*
PRO-HSDU09-03	*Pressure Relief/Controlling damper*	*Packing area to Sterilliser Maintenance*	*Self acting pressure relief*	*Accurate at pressure differential of 40pa*	1 No dampers each sized at 0.5 m3/s
PRO-HSDU09-04	*Pressure Relief/Controlling damper*	*Packing area to Cleaners*	*Self acting pressure relief*	*Accurate at pressure differential of 40pa*	1 No dampers each sized at 0.678 m3/s
PRO-HSDU09-05	*Pressure Relief/Controlling damper*	*Packing area to Washing Area*	*Self acting pressure relief*	*Accurate at pressure differential of 35pa*	1 No dampers each sized at 0.314 m3/s
PRO-HSDU04-01	*Pressure Relief/Controlling damper*	*Office (QA) to Gowning room*	*Self acting pressure relief*	*Accurate at pressure differential of 20pa*	1 No dampers each sized at 0.475 m3/s
PRO-HSDU09-01	*Pressure Relief/Controlling damper*	*Gowning room to Corridor*	*Self acting pressure relief*	*Accurate at pressure differential of 10pa*	1 No dampers each sized at 0.155 m3/s
PRO-HSDU13-01	*Pressure Relief/Controlling damper*	*Sterile Goods Storeroom to Corridor*	*Self acting pressure relief*	*Accurate at pressure differential of 10pa*	1 No dampers each sized at 0.314 m3/s *Fire rated*

Y30sch3 - Schedule of Fire and Smoke Dampers

System	Damper Type	Rating Required (min)	Accessories Required	Notes / Control mode of operation
General Supply, General Extract, Packing area Supply	Shutter (stacks out of airstream)	As catalog		

Notes:

1. The "standard installation solution" proposed by the Contractor must be supported by a valid test report or assessment provided by an approved 3rd party.
2. Installation to be in accordance with the methods detailed in HVAC DW/145
3. Smoke control dampers to be in accordance with BS EN 12101-8 tested to BS EN 1366-10 and classified in accordance with BS EN 13501-4.
4. For each motorised fire/smoke damper the manufacturer shall provide a local damper control damper unit (DCU). Panels shall be to a minimum IP54 and include a test switch to facilitate local damper testing. Each DCU will also have on-board Led status indication for power, communication active, damper open & damper closed.

Y40sch – Schedule of Air Handling Units

Unit Ref: Packing Room AHU	**Serving: Packing area**	
Location: Internal	**Maximum Size TBC**	
Unit Configuration: **Supply, in order of airflow:** **Inlet – Back end damper – Access – Frost coil – Access – Panel Filter – Plug fan – Access – Turning section – Access – Cooling Coil (CHW) – Access – Heating Coil (LTHW) – Access – Bag Filter – Access – Humidifier – Access – Outlet**		
Unit Mechanical Performance to BS EN 1886 The unit shall be certified or tested at works in accordance with the above		
General Acoustic Performance	The maximum sound pressure level @ 1m from the unit under conditions of unobstructed propagation over base surfaces shall not exceed 60dB(A).	
Casing Strength classification	D1	
Casing Air leakage class	L2	
Thermal transmittance (U) - Class	T2	
Thermal Bridging (Kb) - Class	TB2	
Inlet Damper		
Frost Coil	**Airflow onto coil** **Duty:** **Type** **Air on coil** **Air off coil** **Water temp. On** **Water temp. Off** **Water Flow Rate** **Limiting water pressure drop**	**2700 l/s** **37 kW** **Suitable for marine environment** **-5°C db** **5°C db** **82°C** **71°C** **0.8 kg/s** **15 kPa**
Panel Filter	**Airflow through filter** **Classification to BS EN ISO 16890-1** **ISO coarse**	**2700 l/s** **65 %**
Bag Filter	**Airflow through filter** **Classification to BS EN ISO 16890-1** **ISO ePM10** **ISO ePM2.5** **ISO ePM1**	**2700 l/s** **50%** **50%** **50%**
High Efficiency Filter	**Airflow through filter** **Class to BS EN 1882-1** **Limiting pressure drop at design airflow**	**2700 l/s** **TBC** **TBC** **TBC**
Cooling Coil	**Airflow into coil** **Duty:** **Air on coil** **Air off coil** **Water on** **Water off** **Water Flow Rate** **Limiting water pressure drop**	**2700 l/s** **70 kw** **28°C wb 38°C db** **12°C wb 14°C db** **6°C** **12°C** **2.8 kg/s** **15 kPa**

Y40sch – Schedule of Air Handling Units

Heating Coil	**Airflow onto coil**	**2780 l/s**
	Duty:	**69 kW**
	Air on coil	**5°C db**
	Air off coil	**23°C db**
	Water temp. On	**82°C**
	Water temp. Off	**71°C**
	Water Flow Rate	**1.5 kg/s**
	Limiting water pressure drop	**15 kPa**
Humidifier	**Type**	**Sieam, fully modulating**
	Duty	**74 kg/hr**
HEPA Filter	**Airflow through filter**	**2780 l/s**
	Filter Class (BS EN 779)	**H12**

Fans / Motors / Drives	**Supply**
Fan type	Duty
Max air volume	2.78 m³/s (including margin)
Unit external static pressure at max volume	850 Pa
Limiting Specific fan power (at design airflow through the AHU)	2.2 W/(litre/s)
Maximum fan power levels (dB re 10-12 W) Atmosphere Side	63,125,250,500, 1k, 2k, 4k,8k (Hz) To meet 60 dBA at 1m
Motor / Drive Details	Direct driven
Motor type	EC (multiple EC fans – minimum 4 @ 30% each)
Motor efficiency limit	Variable frequency drive
Limiting Overall fan/motor/drive efficiency as defined in BS EN ISO 12759	
Variable Speed Drive details / BMS Interface details	
NOTES	

Unit Ref: HSDU AHU	**Serving: General HSDU**
Location: Internal	**Maximum Size TBC**
Unit Configuration: **Supply, in order of airflow:** **Inlet – Back end damper – Access - Frost coil – Access – Panel Filter – Access – Plate Heat Exchanger – Plug fan – Access – Cooling Coil (CHW) – Access – Heating Coil (LTHW) - Access – Bag Filter – Access – Humidifier – Outlet** **Extract, in order of airflow:** **Inlet – Access – Panel Filter – Plug fan – Plate Heat Exchanger – Outlet damper**	
Unit Mechanical Performance to BS EN 1886 The unit shall be certified or tested at works in accordance with the above	
General Acoustic Performance	The maximum sound pressure level @ 1m from the unit under conditions of unobstructed propagation over base surfaces shall not exceed 60dB(A).
Casing Strength classification	D1
Casing Air leakage class	L2
Thermal transmittance (U) - Class	T2
Thermal Bridging (Kb) - Class	TB2

Y40sch – Schedule of Air Handling Units

Inlet Damper		
Frost Coil	**Airflow onto coil**	**2140 l/s**
	Duty:	**29 kW**
	Type	**Suitable for marine environment**
	Air on coil	**-5°C db**
	Air off coil	**5°C db**
	Water temp. On	**82°C**
	Water temp. Off	**71°C**
	Water Flow Rate	**0.63 kg/s**
	Limiting water pressure drop	**15 kPa**
Panel Filter	**Airflow through filter**	**2140 l/s**
	Classification to BS EN ISO 16890-1	
	ISO coarse	**65 %**
Bag Filter	**Airflow through filter**	**2140 l/s**
	Classification to BS EN ISO 16890-1	
	ISO ePM10	**50%**
	ISO ePM2.5	**50%**
	ISO ePM1	**50%**
Cooling Coil	**Airflow into coil**	**2140 l/s**
	Duty:	**45 kw**
	Air on coil	**28°C wb 38°C db**
	Air off coil	**16°C wb 6°C db**
	Water on	**6°C**
	Water off	**12°C**
	Water Flow Rate	**1.8 kg/s**
	Limiting water pressure drop	**15 kPa**
Heating Coil	**Airflow onto coil**	**2140 l/s**
	Duty:	**65 kW**
	Air on coil	**5°C db**
	Air off coil	**28°C db**
	Water temp. On	**82°C**
	Water temp. Off	**71°C**
	Water Flow Rate	**1.42 kg/s**
	Limiting water pressure drop	**15 kPa**
Humidifier	**Type**	**Sieam, fully modulating**
	Duty	**61 kg/hr**

Fans / Motors / Drives	**Supply**	**Extract**
Fan type	Duty	Duty
Max air volume	2.14 m³/s (including margin)	4.14 m³/s (including margin)
Unit external static pressure at max volume	300 Pa	300 Pa
Limiting Specific fan power (at design airflow through the AHU)	2.0 W/(litre/s)	
Maximum fan power levels (dB re 10-12 W) Atmosphere Side	63,125,250,500, 1k, 2k, 4k,8k (Hz) To meet 60 dBA at 1m	63,125,250,500, 1k, 2k, 4k,8k (Hz) To meet 60 dBA at 1m
Motor / Drive Details	EC (multiple EC fans – minimum 4 @ 30% each)	EC (multiple EC fans – minimum 4 @ 30% each)
Motor type	Variable frequency drive	Variable frequency drive
Motor efficiency limit	EC (multiple EC fans – minimum 4 @ 30% each)	EC (multiple EC fans – minimum 4 @ 30% each)

Y40sch – Schedule of Air Handling Units

Limiting Overall Environmental Effidency as defined in BS EN ISO 12759		
Variable Speed Drive details / BMS Interface details		
NOTES		

Notes:

1. Quoted fan duties are based on pressure losses external to the air handling unit and on the following equipment air side pressure losses. Before ordering the fans, the contractor shall adjust the fan static pressures to suit pressure drops of actual components used in the systems and any changes to the ductwork layout, types / quantities of bends etc from that indicated on the tender drawings.

Equipment	Pressure loss (Pa)
Intake & discharge louvres	25
Grilles	15
Diffusers	15
Shutter Fire dampers	10
Control dampers	10
Attenuators	30

2. Quoted fan duties include the following commissioning allowances :–

Pressure Classification	% On flow rate	% On Head
Low	10	15

3. 2 & 4 Pole TEFV, 3-phase, cage induction motors rated for 400 volts, 50 Hz, (outputs 0.75kW and above) shall be High Efficiency having a rated efficiency at full load equal to or greater than the IE2 limit as defined in BS EN 60034-30-1 unless noted otherwise
4. Specific Fan Power (SFP) at 25% of design flow rate to be no greater than that achieved at 100% design flow rate
5. All fans with motors larger than 1.1kW shall have variable speed drives.
6. Refer to clause Y72.2191 for standard requirements for VSD's
7. Panel and bag filters shall be replaced with new, after commissioning and before the AHU SFPv (Specific fan power) is checked for Building Regulations Part L compliance.
8. Filtration:
   a. Primary panel filters providing supply & extract protection of recuperator, with max. face velocity 2m/s (HTM 03-01).
   b. All secondary filters shall be rigid frame filters incorporating pleated-paper elements (Trust amended HTM 03-01).
   c. Neither the filter media nor any material used in the construction of the filters should be capable of sustaining combustion. Particles of filter media shall not detach and become carried away by airflow (HTM 03-01).
   d. Filters to be securely housed and sealed in well-fitting, withdrawable frames (HTM 03-01).
   e. Magnehelic pressure differential gauges to indicate filter condition with BMS signal (HTM 03-01).
   f. Access provided for removal / replacement, with illumination and viewing ports upstream (HTM 03-01).
   g. A common spare of each type of filter to be provided (HTM 03-01).
9. Heat Recovery – Plate heat exchanger with low leakage
10. Refer to the following materials and workmanship reference specifications for further details of AHU components: Filters (Y42); Heating & cooling coils and heat recovery (Y43); Humidifiers (Y44); Attenuators and acoustic treatment (Y45); Vibration isolation Y52.
11. For healthcare applications comply with HTM 03-01 part A.
12. Fan data required at commissioning:
    a. Air volume
    b. Motor input power (which for an EC motor must be read from a meter which calculates the real power from the harmonics present)
    c. SFPv for EPC calculations in accordance with BS EN 16798
13. Glass traps and air break on all condensate systems (HTM 03-01)
    a. Plant base required, minimum height to maintain HTM compliant glass traps

Y40sch – Schedule of Air Handling Units

14. Stainless steel drain trays – completely drain, no upstand, >1 in 20, fully accessible or easily removable (HTM 03-01)
15. Units should be suitable for a coastal environment

HTM items to note –

a) Hinged access doors, minimum 500mm wide (HTM 03-01)
b) Access to both sides of batteries for cleaning
c) Inspection windows at convenient height, upper deck inspection windows located low on the access door (HTM 03-01)
d) Internal lighting (IP55 rated) wired with common switch for entire unit (HTM 03-01)
e) Manual and motorised dampers with side & blade seals to isolate unit when off and for AHU internal cleaning
f) Cooling battery copper tube/copper fins electro tinned or vinyl coated aluminium (HTM 03-01).
g) Cooling coil eliminator, removable if separate (HTM 03-01).
h) Stainless steel coil frame & guide rails (HTM 03-01).
i) Stainless steel drain trays – completely drain, no upstand, >1 in 20, fully accessible or easily removable (HTM 03-01)
j) Where coils are greater than 1m high, intermediate drain trays are needed (HTM 03-01).
k) Baffle to be provided in drain tray to prevent air bypassing the coil (HTM 03-01).
l) Glass traps on all condensate systems (HTM 03-01).
m) Access, with illumination and viewing ports, provided to both sides of all coils (HTM 03-01).

Fan Ref	Service / location	Description / type	Max / Min Air Vol (m³/s)	Static Resistance (Pa)	Limiting SFP (W/l/s)	Motor / drive details					Limiting in duct Sound Power Levels (dB re 10-12 W) at design air flow Octave band mid-frequency (Hz)								Notes
						Rating (kW)	Full load (A)	Speed control method	Overall fan /motor /drive efficiency (%)	Motor Type max speed & phase	63	125	250	500	1k	2k	4k	8k	
EF-HSDU-05	Local Exhaust Ventilation	Centrifugal Extract Fan	0.168	300	0.5														External. Controlled via BMS.

Notes:

1. Quoted fan duties are based on pressure losses external to the fan unit and on the following equipment air side pressure losses. Before ordering the fans, the contractor shall adjust the fan static pressures to suit pressure drops of actual components used in the systems and any changes to the ductwork layout, types / quantities of bends etc from that indicated on the tender drawings.

Equipment	Pressure loss (Pa)
Intake & discharge louvres	N/A
Grilles	N/A
Diffusers	N/A
LTHW heating coils less than 15kW	N/A
LTHW heating coils over 15 kW	N/A
CHW cooling coils less than 15kW	N/A
CHW cooling coils over 15 kW	N/A
Panel filters	N/A
Bag filters	N/A
Shutter Fire dampers	N/A
Smoke dampers / combination fire / smoke control dampers	N/A
Control dampers	N/A
Attenuators	30 Pa

2. Quoted fan duties include the following commissioning allowances:-

	Low Pressure Systems
On Flow Rates	10%
On Head	20%

3. If the quoted fan sound power levels are exceeded by actual figures of fans selected, then the relevant attenuator insertion loss shall also be increased to maintain the permissible discharge and radiated noise levels.
4. 2 & 4 Pole TEFV, 3-phase, cage induction motors rated for 400 volts, 50 Hz, (outputs 0.75kW and above) shall be High Efficiency having a rated efficiency at full load equal to or greater than the IE2 limit as defined in BS EN 60034-30-1 unless noted otherwise.
5. Specific Fan Power (SFP) at 25% of design flow rate to be no greater than that achieved at 100% design flow rate
6. Overall fan/motor/drive efficiency as defined in BS EN ISO 12759.
7. All fans with motors larger than 1.1kW shall have variable speed drives
8. Fan data required at commissioning:
   i. Air volume
   ii. Motor input power (which for an EC motor must be read from a meter which calculates the real power from the harmonics present)
   iii. SFPv for EPC calculations in accordance with BS EN 16798-3

Y45sch - Schedule of Silencers & Acoustic Treatment

Ref	Service	Location	Air Flow (m³/s)	Resistance (Pa)	Typical Size (mm) L/W/H	Dynamic Insertion Loss (dB)								Notes
						63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
ATT-IAP-INT-01	IAP AHU Intake	Level 2 Plantroom	2.76	30	TBC	To meet NR35 in rooms								To be suitable for coastal application. Attenuator to be stainless lined
ATT-IAP-SP-01	IAP AHU Supply	Level 2 Plantroom	2.76	30	TBC	To meet NR35 in rooms								To be suitable for coastal application. Attenuator to be stainless lined
ATT-HSDU-INT-01	HSDU AHU Intake	Roof plantroom	2.132	30	TBC	To meet NR35 in rooms								To be suitable for coastal application. Attenuator to be stainless lined
ATT-HSDU-SP-01	HSDU AHU Supply	Roof plantroom	2.132	30	TBC	To meet NR35 in rooms								To be suitable for coastal application. Attenuator to be stainless lined
ATT-HSDU-EXH-01	HSDU AHU Exhaust	Roof plantroom	4.152	30	TBC	To meet NR35 in rooms								To be suitable for coastal application. Attenuator to be stainless lined
ATT-HSDU-EX-01	HSDU AHU Extract	Roof plantroom	4.152	30	TBC	To meet NR35 in rooms								To be suitable for coastal application. Attenuator to be stainless lined

Notes:

1. Contractor to confirm selected equipment inlet and outlet sound power levels and adjust attenuator insertion loss as necessary.
2. Attenuators to be delivered to site with capped ends to prevent ingress of dirt prior to installation.
3. Attenuators to be constructed from the same materials as ductwork system and have the same surface treatment as defined in Y 30.
4. Attenuators in the discharge side of any flue connection in a flue dilution system shall be fabricated from 304 Stainless steel. Where any appliance operates in condensing mode the complete system shall be fabricated from stainless steel.

Y46sch - Schedule of Grilles and Diffusers

Ref	Service	Type	Material/ Finish	Grille / diffuser size		No. of ways or slots	Mounting height above FFL (m)	Room / Supply air temperature differential °C (Cool/Heat)	Duty				Plenum box details / Dimensions	
				Neck size (mm)	Nominal face size (mm)				Volume (l/s)	Pressure drop (Pa)	Throw (m)	Room Noise Rating (NR)	Height (mm)	Spigot to ht ductwork size (mm)
SD-HSDU06-01	Supply	Louvre-face	Alu powder coat	600	600	4	2.7 (TBC)	2/3	232	<15	2.5	40	To suit spigot size	350 dia.
SD-HSDU06-02	Supply	Louvre-face	Alu powder coat	600	600	4	2.7 (TBC)	2/3	232	<15	2.5	40	To suit spigot size	350 dia.
SD-HSDU06-03	Supply	Louvre-face	Alu powder coat	600	600	4	2.7 (TBC)	2/3	232	<15	2.5	40	To suit spigot size	350 dia.
SD-HSDU06-04	Supply	Louvre-face	Alu powder coat	600	600	4	2.7 (TBC)	2/3	232	<15	2.5	40	To suit spigot size	350 dia.
SD-HSDU06-05	Supply	Louvre-face	Alu powder coat	600	600	4	2.7 (TBC)	2/3	232	<15	2.5	40	To suit spigot size	350 dia.
SD-HSDU06-06	Supply	Louvre-face	Alu powder coat	600	600	4	2.7 (TBC)	2/3	232	<15	2.5	40	To suit spigot size	350 dia.
SD-HSDU06-07	Supply	Louvre-face	Alu powder coat	600	600	4	2.7 (TBC)	2/3	232	<15	2.5	40	To suit spigot size	350 dia.
SD-HSDU06-08	Supply	Louvre-face	Alu powder coat	600	600	4	2.7 (TBC)	2/3	232	<15	2.5	40	To suit spigot size	350 dia.
SD-HSDU06-09	Supply	Louvre-face	Alu powder coat	600	600	4	2.7 (TBC)	2/3	232	<15	2.5	40	To suit spigot size	350 dia.
SD-HSDU06-10	Supply	Louvre-face	Alu powder coat	600	600	4	2.7 (TBC)	2/3	232	<15	2.5	40	To suit spigot size	350 dia.
SD-HSDU06-11	Supply	Louvre-face	Alu powder coat	600	600	4	2.7 (TBC)	2/3	232	<15	2.5	40	To suit spigot size	350 dia.
SD-HSDU06-12	Supply	Louvre-face	Alu powder coat	600	600	4	2.7 (TBC)	2/3	232	<15	2.5	40	To suit spigot size	350 dia.
SD-HSDU06-01	Supply	Louvre-face	Alu powder	600	600	4	2.7 (TBC)	2/2	135	<15	1.25	40	To suit spigot size	400 dia.

NBS Specifications - AECOM

Y46sch - Schedule of Grilles and Diffusers

Ref	Service	Type	Material/ Finish		Extra / structural size		No. of fixings per grille	Nominal Weight above FFL (m)	Room / Supply air temperature difference °C (Deadband)	Duty				Pattern box addition / Dimensions	
					Width (mm)	Nominal face size (mm)				Volume (l/s)	Pressure drop (Pa)	Throw (m)	Noise Rating (NR)	Height (mm)	Spigot ID (if different size (mm)
				col											
SD-HSDU15-02	Supply	Linear-bar	Alu powder coat		600		4	2.7 (1BE)	2/2	135	<15	1.25	40	To suit spigot size	400 dia.
SD-HSDU15-03	Supply	Linear-bar	Alu powder coat		600		4	2.7 (1BE)	2/2	135	<15	1.25	40	To suit spigot size	400 dia.
SD-HSDU15-04	Supply	Linear-bar	Alu powder coat		600		4	2.7 (1BE)	2/2	135	<15	1.25	40	To suit spigot size	400 dia.
SD-HSDU07-01	Supply	Linear-bar	Alu powder coat		600		4	2.7 (1BE)	2/2	70	<15	1.3	40	To suit spigot size	150 dia.
SD-HSDU07A-01	Supply	Linear-bar	Alu powder coat		600		4	2.7 (1BE)	2/2	70	<15	0.5	40	To suit spigot size	300 dia.
SD-HSDU07A-02	Supply	Linear-bar	Alu powder coat		600		4	2.7 (1BE)	2/2	70	<15	0.5	40	To suit spigot size	300 dia.
SD-HSDU13-01	Supply	Linear-bar	Alu powder coat		600		4	2.7 (1BE)	2/2	262	<15	1.4	40	To suit spigot size	300 dia.
SD-HSDU13-02	Supply	Linear-bar	Alu powder coat		600		4	2.7 (1BE)	2/2	262	<15	1.4	40	To suit spigot size	300 dia.
SD-HSDU15-01	Supply	Linear-bar	Alu powder coat		600		4	2.7 (1BE)	2/2	180	<15	2	40	To suit spigot size	350 dia.
SD-HSDU15-02	Supply	Linear-bar	Alu powder coat		600		4	2.7 (1BE)	2/2	180	<15	2	40	To suit spigot size	350 dia.
SD-HSDU24-01	Supply	Linear-bar	Alu powder coat		600		4	2.7 (1BE)	2/2	230	<15	1.2	40	To suit spigot size	250 dia.
SD-HSDU24-02	Supply	Linear-bar	Alu powder coat		600		4	2.7 (1BE)	2/2	230	<15	1.2	40	To suit spigot size	250 dia.
SD-HSDU05-01	Supply	Linear-bar	Alu powder coat		600		4	2.7 (1BE)	2/2	40	<15	1.2	35	To suit spigot size	150 dia.

Y46sch - Schedule of Grilles and Diffusers

Ref	Service	Type	Material/ Finish		Extra / structural size		No. of fixings per grille	Nominal Weight above FFL (m)	Room / Supply air temperature difference °C (Deadband)	Duty				Pattern box addition / Dimensions	
					Width (mm)	Nominal face size (mm)				Volume (l/s)	Pressure drop (Pa)	Throw (m)	Noise Rating (NR)	Height (mm)	Spigot ID (if different size (mm)
				col											
EE-HSDU15-01	Extract	Linear-bar / Anvil	Alu powder coat		600		4	2.7 (1BE)	N/A	345	<15	N/A	40	To suit spigot size	450 dia.
EE-HSDU15-02	Extract	Linear-bar / Anvil	Alu powder coat		600		4	2.7 (1BE)	N/A	345	<15	N/A	40	To suit spigot size	450 dia.
EE-HSDU15-03	Extract	Linear-bar / Anvil	Alu powder coat		600		4	2.7 (1BE)	N/A	345	<15	N/A	40	To suit spigot size	450 dia.
EE-HSDU07-01	Extract	Linear-bar / Anvil	Alu powder coat		600		4	2.7 (1BE)	N/A	70	<15	N/A	40	To suit spigot size	150 dia.
EE-HSDU07-02	Extract	Low Level Vent	TBA with Architect		600		NA	Low Level (1BC)	N/A	80	<15	N/A	40	N/A	N/A
EE-HSDU07A-01	Extract	Linear-bar / Anvil	Alu powder coat		600		4	2.7 (1BE)	N/A	280	<15	N/A	40	To suit spigot size	400 dia.
EE-HSDU15-01	Extract	Linear-bar / Anvil	Alu powder coat		600		4	2.7 (1BE)	N/A	360	<15	N/A	40	To suit spigot size	500 dia.
EE-HSDU15A-01	Extract	Linear-bar / Anvil	Alu powder coat		600		4	2.7 (1BE)	N/A	379	<15	N/A	40	To suit spigot size	450 dia.
EE-HSDU15A-02	Extract	Linear-bar / Anvil	Alu powder coat		600		4	2.7 (1BE)	N/A	379	<15	N/A	40	To suit spigot size	450 dia.
EE-HSDU24-01	Extract	Linear-bar / Anvil	Alu powder coat		600		4	2.7 (1BE)	N/A	100	<15	N/A	40	To suit spigot size	400 dia.
EE-HSDU08-01	Extract	Linear-bar / Anvil	Alu powder coat		600		4	2.7 (1BE)	N/A	330	<15	N/A	40	To suit spigot size	500 dia.
EE-HSDU21-01	Extract	Linear-bar / Anvil	Alu powder coat		600		4	2.7 (1BE)	N/A	385	<15	N/A	40	To suit spigot size	400 dia.

Y46sch - Schedule of Grilles and Diffusers

Ref	Service	Type	Material/ Finish	Grille / diffuser size		No. of ways or slots	Mounting height above FFL (m)	Room / Supply air temperature differential °C (Cool/Heat)	Duty				Plenum box details / Dimensions	
				Neck size (mm)	Nominal face size (mm)				Volume (l/s)	Pressure drop (Pa)	Throw (m)	Room Noise Rating (NR)	Height (mm)	Spigot to fit ductwork size (mm)
		Aircell	cost											
EG-HSDU21-02	Extract	Louvre-face / Aircell	Ala powder cost	600	600	4	2.7 (TBC)	N/A	385	<15	N/A	40	To suit spigot size	400 dia.
EG-HSDU15-01	Extract	Louvre-face / Aircell	Ala powder cost	600	600	4	2.7 (TBC)	N/A	156	<15	N/A	40	To suit spigot size	200 dia.
EG-CDR-01	Extract	Louvre-face / Aircell	Ala powder cost	600	600	4	2.7 (TBC)	N/A	130	<15	N/A	40	To suit spigot size	400 dia.
EG-HSDU05-01	Extract	Louvre-face / Aircell	Ala powder cost	600	600	4	2.7 (TBC)	N/A	40	<15	N/A	35	To suit spigot size	200 dia.
DTG-HSDU20-01	Room Transfer	Transfer		150	300				60	1 m/s	-	40	-	-
DTG-HSDU08-01	Room Transfer	Transfer		500	500				475	1 m/s	-	40	-	-

Notes:

1. All supply diffusers to be complete with plenum boxes. Contractor shall ensure that plenum boxes / spigot sizes are selected to meet the air volume and room noise criteria. Maximum spigot velocity: 2.5m/s
2. Throw is based on a terminal velocity of 0.5m/s at 0.75 x the distance to a wall or the mid-point between 2 diffusers
3. Maximum mean air velocity in occupied zone: Cooling 0.19m/s; Heating 0.16m/s. to comply with category B thermal environment in accordance with BS EN ISO 7730
4. Unless noted otherwise, all grilles and diffusers shall be fitted with opposed blade dampers, this shall be fitted either to the grille or fitted to the plenum box spigot.
5. All grilles and diffusers shall be supported independently of the ceiling grid.
6. Finish: powder coat to an RAL colour as agreed with the architect.
7. Refer to architect's proposed ceiling details for fixing arrangement.

Y46sch1 - Schedule of Louvres and Air Intake / Discharge Terminals

Ref	Type	Size (mm)		Air volume (m³/s)	Face Velocity m/s	Classification to BS EN 13030			Maximum pressure Drop (Pa)	Limiting Noise level (Sound power level dB(A))	Notes / Accessories
		Width or Length	Height			Water Penetration class	Coefficient of discharge class	Limiting core velocity (m/s)			
LV-MP-INT-01	Intake Louvre	1300	1300	2.6	2.5	8	1	2 m/s	25	55 at 3m	Provided by architect

Notes:

1. Louvres to be weather resistant with wire mesh screen to prevent ingress leaves and birds (tested in accordance with BS EN 13030)
2. Finish: Powder coating to be agreed with the architect
3. Comply with specification clause:
   Y46.2180A for louvres

End of Specification

This is the final page of the specification.

AECOM

Morriston Hospital Infrastructure Works –Substation 6

Swansea Bay University Health Board

MEP Specification

MHP2-AEC-SS6-XX-RP-ME-000001

November 2021

Building Engineering

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Swansea Bay University Health Board

Morriston Hospital Infrastructure Works – Morriston Substation 6
MEP Specification
MHP2-AEC-SS6-XX-RP-ME-0001
November 2021

Quality information

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Distribution List

# Hard Copies	PDF Required	Association / Company Name

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MEP Contractor:	Whiteheads Building Services Ltd. Newport Branch
Architect:	IBI Cardiff Branch
Structural Engineer:	RVW Consulting Cardiff Branch
Quantity Surveyor:	Gleeds Cardiff Branch
MEP Engineer:	AECOM Cardiff Branch
Project Manager:	Mace Cardiff Branch

NOTES FOR TENDERERS

This document has been compiled using text from the National Engineering Specification (NES) which is copyright to Trimble. The format and content of the specification has, however being considerably re-arranged and amended from that provided by Trimble.

The technical content of this specification has been prepared using the Common Arrangement of Work Sections for Building Works and is in four sections. Where any British or other standard referred to in the specification is either out of date or superseded by another standard, the most recent version shall apply.

SECTION 1 – SCOPE OF WORKS
A summary description of the Works by Work Section.

SECTION 2 – WORK SECTIONS
The specification for each Work Section is generally sub-divided into two parts:

Part 1 System objectives

The system objectives are clauses giving details of the performance and/or design parameters.

Part 3 Clauses specific to the system

These clauses are specific to the Work Section concerned.
Where clauses contain "type" references, these are for cross referencing within the specification and do not necessarily relate to manufacturers types.

NB: (***Part 2*** relates to the format used in the raw NES and selection schedules for the Y clauses. ***Part 2's are not used in AECOM specifications and are replaced by schedules in section 4***)

SECTION 3 – REFERENCE (WORKMANSHIP) SPECIFICATIONS – Y clauses
These clauses specify items that are common to several systems (for example pipework, ductwork and cabling).
The individual clauses are generally arranged in the order of the Common Arrangement "Y" sections from which they originated.
Generally these specifications represent AECOM's standards, contain all contain clauses applicable to each particular category and are not project specific.
Where choices are required, they are made in the Schedules or Scope of Works; otherwise all of the clauses are applicable.

SECTION 4 – SCHEDULES
This section contains schedules of drawings, manufacturers, equipment duties and selections for plant, ancillaries and system components, specific to this project.

ENQUIRIES TO MANUFACTURERS
Enquiries to manufacturers should include all relevant sections as well as any related contractual information. ie the relevant work section and Y clauses pertinent to the plant item in addition to the plant schedule.

NON-NES CLAUSES
Clauses which are structurally different from NES from which they originated, or are AECOM originated clauses, are generally identified by the clause reference being underlined and/or the last digit of the clause number being increased e.g. 300.010 becomes 300.011.

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Scope of Works

General

Project Description

The project involves the construction of a new 2MVA 11kV/0.4kV Substation 6 at Morrison Hospital and associated works to connect existing services to the new substation.
The new SBUHB Morriston Hospital Infrastructure Works is intended to address the following issues:
The existing Substation 3 and Substation 4 11kV/ 0.4kV transformers at Morriston Hospital are currently overloaded and are not compliant with WHTM 06-01.
The chillers within Plant Room 4C have been replaced and there is insufficient LV capacity in Substation 4 to serve them fully.
The project involves the construction of a new 2MVA 11kV/0.4kV Substation 6 at Morrison Hospital to take the chilling load from Chiller 4C, Radiology and A&E from the existing Substations, thereby releasing spare capacity in those substations.
Replace the existing Substation 1 HV (11kV) Radials serving existing Substations 3 & 4, with a new WHTM compliant 11kV Ring Main to Substations 3, 4 & new Substation 6.
Growth is included in spare ways, containment and the sizing of equipment as detailed within this specification.

The full extent of works are described within the overall tender package including drawings and specifications and a summary of the works is as follows:

- Construction of a new substation comprising of the following which provides N+1 functionality on the new HV/LV distribution system:
  - 2No. 2,000kVA transformers providing
  - 2No. ATS boards
  - 2No. 2,000kVA (@0.8 p.f.) prime rated generators as packaged enclosures
  - ICT hub room
  - Construction of a new LV Switchboard building including:
  - 2No. LV switchboards
  - PFC
  - Associated panel boards and distribution boards for local supplies
- Ducted LV submain cabling between the ATS boards in the new substation and the LV switchboards in the LV Switchboard building and other associated cabling including fibre optic, data and ELV systems, fire alarms
- Modifications of the existing LV distribution to migrate existing supplies to the new Substation 6 LV switchboard including:
  - Plant Room 4C chillers
  - X-Ray and A&E chillers
- Amendment of the existing HV distribution network to create new HTM compliant 11kV ring from Substation 1, serving existing Substation 3 and 4 and new Substation 6.
- Amendment of the existing oil storage tanks and provision of new connection to new generators including fuel pump set.

Unless instructed otherwise, the installation shall be designed and delivered in accordance with:
The relevant British Standards and/or Codes of Practice.
Welsh Health Technical Memorandum (WHTMs) & Health Technical Memorandum (HTMs)
Welsh Health Building Notes (WHBNs) & Health Building Notes (HBNs)

Tendering procedure
AECOM's understanding of the existing services is based on record drawings from Swansea Bay University Health Board (SBHB), and non-intrusive site inspection.
It is therefore required that the Tenderer visit site to gain a full understanding of the scope of works prior to submitting their Tender cost.
All site visits shall be arranged with the Capital Planning Department. No claim 'on the grounds of lack of knowledge' in such respect, or otherwise shall be permitted.
No claim 'on the grounds of lack of knowledge' in such respect, or otherwise shall be permitted.

Building Services

Scope of Works

This specification is for the supply, installation, testing and commissioning of the following building services systems.
The MEP Services Contractor shall be responsible for the supply and installation of Engineering Services within their discipline, as defined in the above information, into a complete and suitable form of installation.

In general, this specification is for the following building services systems:

Mechanical Services	Electrical Services	Public Health Services
Ventilation systems if required	Electrical Supply Distribution (11kV and LV)	Fuel System
Cooling system if required	Containment systems	
BEMS control systems	Earthing & Bonding	
	Lighting installation (internal and external)	
	Emergency lighting	
	Fire detection and alarm systems	
	Small Power Installation	
	Security System	
	Lightning Protection System	
	ICT Services	

The MEP Services Contractor shall note that as detailed under the AECOM Mechanical and Electrical Preliminaries Specification, specific engineering systems have been Performance Specified. As such responsibility for the detailed design of these specific engineering systems rests solely with the MEP Services Contractor.

The MEP Services Contractor shall be responsible for developing the design information detailed within the specifications and indicated on the associated drawings into a complete and suitable form of installation.

Spare Capacity & Future Expansion

The Electrical Installation shall be provided with 25% spare capacity in terms of switchgear spare ways and containment space.

Builders Work

The demarcation of responsibilities for builders work in connection with the engineering services as defined in the Main Contract Preliminaries shall be agreed with the Main Contractor during the tender period and clearly identified in the tender submission.
The Tender shall be complete and include all Builders work associated with the Building Services necessary for a functionally complete installation, including openings in structure, holes, penetrations, bases, plinths, support steelwork, pits, trenches, floor ducts, bunds etc.

The Building Services Contractor shall have included in the tender for all builders work and secondary support steelwork and bracketry associated with the services.

The Building Services Contractor shall provide details of all secondary support work for the approval of the Project Manager and Structural Engineer prior to any installation.

The Building Services Contractor shall note that no holes shall be drilled through the pre-cast slabs without prior agreement of the structural engineer.

Scope of Works

Holes cannot be drilled indiscriminately through the slab as they must be through the non-load bearing section and they must not intersect any structural reinforcement within the slab.

Holes required for services shall be co-ordinated with the Main Contractor to minimise the number of holes to be drilled.

Minimising disruption and coordination of works
The Mechanical and Electrical Services Contactors shall liaise with SBUHB's Estates Department prior to any services isolation or modification commencing to ensure that any disruption to areas that are to remain operational is minimised. All works must be undertaken in strict accordance with the Health Board policy, HTM and HBN guidelines.

The Mechanical and Electrical Services Contactors shall allow for making good any finishes disturbed as part of the removing of redundant services. The sub-contractor shall ensure that other areas of the building remain operational throughout these works where possible. Where disruption to other areas is unavoidable, the Mechanical and Electrical Services Contractors shall liaise with SBUHB's Estate Department prior to any services isolation or modification commencing to ensure that any disruption is minimised.

Relocation of existing services
During the Tender stage, the MEP Services Contactors shall review the routing of all proposed cabling and construction works proposed as part of the scheme.
Should any of the proposed works impact on existing services, the contractor shall allow within their tender for all works required for the temporary or permanent relocation of these services that will be required.

Fire Stopping
The MEP Services Contractor shall provide proprietary Fire Stopping where the Building Services Works pass through a fire compartment.

All service penetrations shall also be fire stopped as required to satisfy the relevant Standards, and meet the requirements of the Fire Officer.

Installation Drawings
The MEP Services Contractor shall be required to produce a set of fully co-ordinated installation drawings prior to any works commencing on site.

The MEP Services Contractor shall be required to use the interim time between receipt of design drawings and documentation and commencement of works to prepare the installation drawings.

The installation drawings are to be issued to the project team for review and comment and the MEP Services Contractor must make due allowances for the drawings to be revised and re-issued following comments. It will be acceptable to issue drawings electronically in AutoCAD format.

The MEP Services Contractor shall not be permitted to commence any works until the installation drawings are completed and commented on by the design team.

Phasing/ Sequencing of works

The MEP Services Contractor shall provide an anticipated sequencing / phasing works for the scheme.

Discrepancies

Where discrepancies exist within the design information the MEP Services Contractor shall inform the Engineer and additional guidance will be provided. Should the MEP Services Contractor fail to clarify any discrepancy, it shall be deemed that the MEP Services Contractor has included.

Scope of Works

Electrical containment
Containment and cable management shall be provided as follows and as detailed on the relevant drawings:

- Galvanised Steel Cable Tray and/or Ladder:
  - HV (11kV) mains cables
  - Low voltage sub mains cables
  - Fire detection and alarm system cables
  - Earthing cables
- Galvanised Steel Cable Basket and/or Trunking:
  - ICT system cables
  - General lighting and power cables
  - Energy monitoring cables
  - Lighting control system cables
  - Building Management System Cables
- All connections to final outlets shall be galvanised steel conduit.

Where tray and basket containment is run externally, a galvanised steel plate lid shall be applied for UV protection.
Where the ELV tray runs through the substation and switchrooms, any fibre optic cabling shall be installed in 50x50mm galvanised steel trunking.

Electrical accessories
In public areas the finishes shall be concealed in building fabric with flush mounted outlets.
In plant areas the finishes shall be surface mounted with metalclad outlets.
In external areas all outlets shall be weatherproof.

Preferred manufacturers and installers
The following preferred manufacturers and, where relevant, incumbents / installers, shall be used to form the basis of the tender and in accordance with overarching procurement requirements for the contract.

Preferred manufacturers

Item	Manufacturer 1 (Preferred)	Manufacturer 2	Manufacturer 3
Transformers	Schneider	GE	ABB
LV Busbars	Schneider	ABB	GE
Substation 6 LV switchboards			
• LV switchboard metalwork	Elsteel	GE	ABB
• LV switchboard switchgear	ABB	Schneider	
• Surge suppression / LPS	BEST	Dehn / Omega Furse	Equal or approved
• Meters	Socomec	Compton	Rayleigh
Generators	Power Electrics	Advanced Diesel	Diesel Electric
Containment	Legrand	Marshall Tufflex	
Distribution boards	Schneider Isobar	ABB	GE
Automatic Transfer switches	ABB	Eaton	Schneider Electric
Isolators / switch disconnectors	ABB	Schneider	
Internal lighting	Thorlux		
Emergency lighting	Thorlux Smartscan		
External lighting	Thorlux		
Fire alarms	To be discussed, open protocol system required.	Equal or approved	

Scope of Works

Item	Manufacturer 1 (Preferred)	Manufacturer 2	Manufacturer 3
Power and accessories	MK	Crabtree	MEM
Lightning protection	BEST / Furse	EES	Dehn / Omega Furse
Access controls	Salto NEO wireless		

Incumbents / installers

Item	Installer 1 (Preferred)	Installer 2	Installer 3
Fire alarm installers	To be discussed.		
Data	Phonelink	Positive IT	Krone installer
Security installer / specialist contractor	Secured Alarms Systems	Plexus	
HV Protection systems	SSE		

Responsibilities
(Also refer to Section A clauses of the Specification for more detail)

Overview of Contractors Responsibilities			
Contractors responsibility	**Deliverables**	**Required at stage**	**Status**
Tender Stage			
Fully understand the tender documents. These consist of this specification (this may be in several volumes) and the tender drawings		Tender Stage	
Visit site to make themselves fully aware of the project and site-specific issues		Tender Stage	
Request any technical clarifications.	Tender clarification documents	Tender Stage	
Carry out initial design work to enable cost estimation for tendering purposes and satisfy themselves of accurate tender.		Tender Stage	
Submit tender. The tender should be broken down into each system as listed in this scope of works. Confirm on the tender that any technical clarifications issued have been taken into account and that the tender is fully compliant (or list any clarifications). Note that it will be assumed that the tender is fully compliant with the tender documents unless specifically stated.		Tender Stage	
Pre-start on site Stage			
Visit site to carry out any surveys necessary.	Survey notes	Pre-start on site Stage	
Fully understand the remaining mechanical and electrical systems and any temporary works required to allow the rest of the building to continue to operate during the contract.	RFI's as required	Pre-start on site Stage	
Test, commission and document existing	Commissioning report	Pre-start on site	

Scope of Works

services including pipework, ductwork and electrical containment to assess current provisions within the site boundary.		Stage	
Formulate and issue technical submissions for each item of equipment and each system – agree the list of submissions with the Engineer. Note that all technical submissions should list any deviations from the specification – any items not specifically mentioned will be assumed to be fully compliant with specification. Submissions will be reviewed and given a status: (Status A – no comments, Status B – proceed but taking into account comments or Status C – rejected – re-formulate and re-submit.)	Technical submissions	Pre-start on site Stage	(See Work Sections)
Formulate and issue working drawings for all systems. Note that the use of AECOM drawings on site is NOT acceptable – all drawings used for installation must be working drawings produced by the contractor. To assist in this, AutoCad format AECOM construction issue drawings can be provided but the Contractor must enhance these as required so they are suitable as installation drawings. Working drawings will be reviewed and given a status: (Status A – no comments, Status B – proceed but taking into account comments or Status C – rejected – re-formulate and re-submit.)	Working drawings	Pre-start on site Stage	(See Work Sections)
Produce builderswork drawing and schedule indicating all holes / supports requirements etc	Builderwork drawings Builderswork schedules	Pre-start on site Stage	
Produce a commissioning method statement	Commissioning statement	Pre-start on site Stage	
Produce all Health and Safety and other method statements as required by the Main Contractor, Client and Engineer.	Health and safety method statements	Pre-start on site Stage	
Agree with Client which items of plant or material or fixtures/fittings are to be retained for their stores.	Schedule of retained equipment	Pre-start on site Stage	
Where temporary works are required to allow a system to be removed, document and agree these with the Client prior to carrying these out.	Temporary works Scope document	Strip-out stage	
Isolate and make safe the systems to be removed.		Strip-out stage	
Where Client has no use for the material or plant, remove from site and dispose.		Strip-out stage	
Installation Stage			
Install systems as listed in this scope of works and specification		Installation Stage	
Carryout snagging and rectify snags	Snagging status list	Installation Stage	
Offer systems for Engineer review prior to commissioning start	Completion certificate for each system	Installation Stage	

Scope of Works

Commission all systems and produce report	Commissioning report	Commissionng Stage	
Offer results to Engineer for review and sample witnessing of the results	System acceptance sheet	Commissionng Stage	
Completion Stages			
Update working drawings to full record drawings taking account of any changes during the installation	Record drawings	Handover Stage	
Compile Operating and Maintenance manuals in the format required by the Client	O&M Manuals	Handover Stage	
Offer O&M manuals and Record drawings to Engineer for review and comments (status A, B or C will be given)	Electronic copy of documents for review	Handover Stage	
Attend site to provide familiarisation sessions with the Users for all M&E systems	Video of training sessions	Handover Stage	
Attend handover meetings as required – note that snag free handover is a pre-requisite for the PC certificate to be issued.		Handover Stage	
Attend site as required to rectify defects that are reported.	Defects completion report	1st year	
At the end of the 12 months defects period, attend site to rectify all remaining defects.	Defects completion report	End of 12 months	

R11 - Foul Drainage Above Ground

System Description
The contractor shall be responsible for the supply, installation, testing and commissioning of a new fully operational above ground drainage system to serve Substation 6, Morriston Hospital, Swansea.

Within the new Substation 6 IT Hub room, condensate pipework shall be provided from the new wall mounted DX unit to a drainage stack. It is the contractor's responsibility to identify a suitable connection location. A drip tray with a drainage connection and leak detection system shall be provided to protect sensitive equipment below as highlighted on the layout.

General

The Contractor shall incorporate all equipment, accessories, controls, supports and ancillaries implicitly or explicitly required either by the specification and drawings, or in accordance with accepted current practice, and procedures, which after assembly, testing and commissioning will enable that section of the Works to function correctly and to achieve the specified performance.

All soil, waste and vent pipes shall have falls not less than those as defined in BS EN 12056-2:2000. Vent pipes must be installed in such a manner as not to create a trap.

Access points shall be provided at all branches, changes of direction, on the vertical drops (1200mm) above each floor and connection to the below ground drainage system.

Scope of Works

The works shall include the provision and full installation, in accordance with the local authority and Building Regulations, of the following:

- Supply, storage and installation of all new soil, waste and vent pipework (where applicable) and fittings
- Connection to all sanitary appliances as detailed within the Architect's sanitaryware schedule
- All associated steelwork supports
- All associated fire stopping (if required)
- Testing and commissioning of all above ground soil, waste and vent pipework systems

All works shall be carried out in accordance with BS EN 12056:2000 and Building Regulations Approved Document Part H and specification workmanship clauses R11, schedule sections R11sch and Y10 clauses.

Where plastic pipework passes through fire compartment floors and walls, intumescent fire sleeves to BS 476 'Fire tests on building materials and structures' shall be fitted.

Thermal expansion must be allowed for on PVC and polypropylene soil waste and vent pipework.

S41 - Fuel Oil Storage/ Distribution

System Description

The Fuel Oil Contractor shall be responsible for the final detailed design, supply, installation, testing and commissioning of the complete fuel storage and delivery system. An indicative distribution schematic has been provided to illustrate system requirements.

A dedicated fuel storage and transfer system is required to be provided to the following areas:

New Generator Compound serving substation 6 Fuel Transfer system

Energy Centre Fuel Storage system
Currently there is a dedicated fuel oil storage system containing of two tanks at circa 136 m^3 each serving existing heating plant located within the energy centre. It is proposed that a new generator compound serving substation 6 will be provided from the same tanks. Therefore, a new pipework connection within the bunded bulk fuel tank area is required.

A new packaged pump set will transfer fuel oil from the fuel tanks, via buried pipework within the trench to a day tank located within the generator compound. When the generator is operating in oil mode it will draw off the fuel oil from the day tank using integral fuel pumps.

The fuel system shall incorporate a flow & return piped arrangement between the oil day tank and the generator. The BMS shall instigate re-circulating pump operation periodically to mitigate stagnant oil. The flow from tank to the pumps shall include a meter linked to the BMS.

Solenoid valves shall be installed on the suction pipework and be controlled at the dictates of the low level tank sensors, so air is not drawn in to the system if a tank section is empty. The pumps shall transfer the fuel from the storage tank to the generator through the day tank arrangement, as indicated on the oil fuel schematic.

The fuel oil pump set shall be located in an existing heating plantroom. The arrangement shall consist of the following main components;

- Duplex fuel oil pumps
- Filter
- Meter

The pipework from the pumps shall run below ground in a trench (pipe in pipe with integral leak detection system) and shall enter the generator compound, and rise to high level as indicated on oil site plan drawing.

Within the heating plantroom, a solenoid operated Automatic Isolation Valve (AIV) with labelling shall be provided at the point of entry for the oil fuel pipe. The AIV shall be interfaced with the fire alarm system, the unit shall be monitored by the BMS.

Scope of Works

Electro-thermal links shall be provided above generator which shall shut the oil solenoid valve in the event of activation by direct heat or signal from the fire alarm system. In addition to this, a wall mounted emergency knock off button shall also be provided within the generator enclosure, to shut the oil solenoid valve. The unit shall be monitored by the BMS.

The control of the pump sets shall be via a level sensor within the day tank.

In addition to the specific requirements of the fuel oil system the following elements shall also be allowed for;

- Commissioning of the complete oil transfer system and associated controls
- Input into Operation & Maintenance manuals
- Provision of as-built drawings
- Fuel oil for commissioning and subsequent initial fill

All pipework all pipework shall be steel (pipe in pipe) which shall be fully protected for the proposed installation method (above or below ground) as indicated on the drawings.

All below ground pipework shall be Durapipe PLX Secondary Contained Close-Fit or equal and approved equivalent.
The pipework shall be monitored for interstitial leaks using the pipework manufacturers recommended / affiliated leak detection system.

Connections to the BMS shall include the following as a minimum;
- Generator Operating Status
- Fuel Oil level sensor
- Pump status (per pump)
- Pump fault (per pump)
- Fuel Metera
- Fire shut off valve status
- Leak detection alarm (Pipework)
- Leak detection alarm (Tank bund)

The oil pipe supply installation shall be in accordance with this specifications Workmanship clauses and pipeline schedule Y10sch.

T20 - Primary Heat Distribution and Local Heating Units (Incorporating T30, T31 and T42)

The Mechanical Contractor shall be responsible for the supply, installation, testing, and commissioning of new electric radiators to serve the new LV Switchrooms and the Auto Transfer Switch rooms at Morriston Hospital, Swansea.

Each radiator will be provided with thermostat (adjustable) only to provide frost protection.

T70 - Local Cooling / Heat Pump units

Proposed Works

The Mechanical Contractor shall employ a Specialist A/C System Installer to provide the following:

- 1 No. DX split system for IT Hub Room cooling

The Specialist shall provide the entire system including all necessary traywork, refrigerant pipework, insulation, condensate pipework, power and controls wiring. Refrigerant pipework from remote compressors shall be

selected, sized and installed by the specialist supplier, i.e. total refrigerant system by a single supplier including all parts and fittings. Internal units shall be connected to the external condensers with all pipe sizes to conform to the manufacturer's recommendations. The finish on all external insulation shall be UV resistant.

The condenser shall be mounted externally at ground floor level. Power for the condenser shall be provided as detailed within the Electrical Specification. These cables shall be supported on a single cable tray, which shall be sized to accommodate the refrigerant pipework, power and controls cables.

The indoor unit for the IT Hub Room shall be a wall mounted cased unit and shall be located to avoid sensitive electrical equipment with refrigerant and condensate pipework also routed to avoid sensitive electrical equipment as indicated on the drawing.

The condensing unit shall start sequentially (soft-start) and shall have an auto restart capability after power failure. The condensing unit shall have inverter-controlled compressors. The inverter driven compressors shall be electronically controlled and capable of changing the speed linearly to follow the variations in cooling and or heating load to maximise energy efficiency.

The interconnecting refrigerant pipework and electrical / controls wiring between the indoor units and the condensing units shall be fixed to electrical trays for support / protection. Rigid galvanised steel capping pieces shall be provided over the pipework/tray where the pipework runs at low level and is liable to damage from foot traffic. The connecting refrigerant pipework shall be insulated and vapour sealed and lengths shall not exceed the maximum length between condenser unit and indoor fan coil unit as recommended by the manufacturer.

The Specialist shall be responsible for all refrigerant pipework, electrical power and control links between the condensing units and the internal units. Refrigerant pipework shall be as recommended by the manufacturer for type of refrigerant used.

A trapped condensate drain shall be taken from each indoor unit and shall discharge into the nearest soil stack.

Each indoor unit shall be complete with integral condensate pump. Condensate shall be removed to drain under gravity via a uPVC (galvanised steel where exposed at high level in areas accessible to general building users) pipework system laid to falls. All condensate pipework shall be adequately supported to prevent any sagging and incorporate rodding eyes at changes of direction. The condensate drainage pipework system shall be connected to the nearest foul water drainage point via a trapped connection and tundish. Flexible hoses shall not be used to carry pumped condensate.

The Mechanical Contractor shall allow for all necessary interconnecting control cabling (daisy chain) between power supplies, whether to the indoor units / outdoor units or both.

The refrigerants used shall have a Global Warming Potential (GWP) ≤1000.

Individual wall mounted remote controllers shall be installed within each room to enable user control of room conditions. The exact locations of the controllers shall be agreed with the Architect prior to installation. All control cabling shall be concealed.

The controllers shall be interfaced to the BMS to allow for remote monitoring.

U10 - Ventilation Supply/Extract

System Description
The Mechanical Contractor shall be responsible for the supply, installation, testing and commissioning of a new ventilation system to serve Substation 6 and LV Switchrooms, Morriston Hospital, Swansea.

The works shall include all elements to produce a complete installation, including, but not limited to; vent plant, plenum connections to louvres, attenuators, ductwork and grilles, ductwork and plant support and vibration isolation, thermal insulation and vapour sealing, air flow control, balance and fire restricting devices.

Scope of Works

The contractor shall validate all drawings of existing services prior to commencement of works and highlight to the design team any deviations between the drawings and the actual installation on site.

The ventilation installation includes the following:

- Extract fan – wall mounted extract fan serving the IT Hub Room
- Natural ventilation openings – louvres to provide natural ventilation, note these will be part of the architectural package

Transformer Rooms and LV Switchrooms
The electrical transformer rooms and LV switchrooms shall be ventilated via ventilation louvres located on adjacent walls of the plantrooms highlighted on the mechanical drawing. All aspects of the louvre construction and installation shall be in full compliance with Health Technical Memorandum 03-01. The louvre shall be of minimum class B at 2.5 m/s.

An indicate size of the louvre is listed in the louvre schedule and is indicated on architectural layouts.

IT Hub Room
The IT Hub Room shall be served from a local extract system comprising a wall mounted extract fan. The extract fan shall be linked to the BMS system.

V10 – Emergency and Standby Generators

System Description

2No. new standby generators providing N+1 resilience are to be installed to the new Substation 6 at the location as shown on the electrical drawings and with connection arrangement as shown on the LV schematic drawing.

The generators and their installation shall be fully compliant with WHTM 06-01.

The new Standby Generators shall be 2000kVA Prime Rated units, Category 2, Class A.

The generators shall be designated 6A and 6B and shall be connected to ATSs, detail and cabling requirements are set out in this Specification and design drawings.

The generator control system shall allow the generators to run in 'Short Term' parallel operation with the DNO Distribution Network. It is not intended to export power to the DNO network, and all equipment shall comply with the Engineering Recommendation G99.

It shall be part of this scope of works for the Contractor to be the point of contact with the DNO through to completion from end of RIBA Stage 4a. The Contractor shall also allow for liaison with the DNO for completion of the G99 Application Form, with data particular to the selected and supplied generators.

The new generators shall have a day tank each within the enclosure. The installation shall also receive a new connection to the existing site oil fuel bulk tanks. The scope of this work is set out in the Mechanical specification elements of this specification and drawings.

The day tank shall be bunded with leakage alarm and low and high independent alarms.

All electrical services associated with the new standby generator including earthing, generator/fuel auxiliary supplies etc., are set out in this document and associated drawings, and shall be part of the Electrical Services scope of works.

The new generators shall be capable of operating at the Prime Rating for a period of 12 consecutive hours, inclusive of a 10% overload for a period not exceeding 1 hour.

The new generators shall be supplied in individual enclosures, the full specification of this is included within this tender documentation.

Scope of Works

Within the generator enclosure a high-pressure water mist fire suppression system with communication link to the site's fire alarm system shall be provided. The fire suppression system shall be interfaced to the fire alarm system to signal its activation to the site's fire alarm system.

The high-pressure water mist Fire Suppression system is a performance specified system, with the design to be developed by the Contractor to comply with BS 8489-1 Fixed Fire Protection Systems – Industrial and Commercial Watermist Systems. Before placing of order the proposed system shall be submitted as a Technical Submittal for approval.

The generators shall have a repeater panel display in the two ATS rooms which shall provide all information available on the generator control panel.

Design Parameters

Complete	400/230V, 50Hz, Rpm, (Usually 1500rpm for standby, lower for base load). Pf 0.8
Earthing	TN
Operation	Prime
Control mode	Automatic with generator control panel and control philosophy as detailed in specification
Performance Class	G3
Start up time	Full load within 15s
Noise emission limit	65dB(A) @ 1m in free-field conditions
Generator set Installation	With integral enclosure
Lighting	Enclosed set - maintained illumination level of 150lux at a working plane of 1200 mm affl and a level at the front and rear of the control panel of 300 lux. Luminaires to be LED
Heating	Thermostatically controlled low temperature electric heating to maintain a minimum temperature in the engine room of 10°C.

SYSTEM DESCRIPTION
The installation shall comply fully with the Work Sections Specification clauses, and the Reference (Workmanship) Specification clauses.

The Contractor shall employ a specialist Sub-contractor (from those listed in the schedule of suppliers) to design, supply, test at works, install, and commission the following:-

Engine-alternator set
Engine cooling system
Exhaust system
Fuel system
Starting system
Acoustic attenuation
Mechanical ventilation
Control system
Enclosure
Services to enclosure including:
Lighting
Small power

Scope of Works

Fire Detection, Alarm, and Suppression.
Builders work
Include tests at Manufacturers works and on Site
Include all wiring, cables, supports, accessories and any works not described above necessary to form a complete installation.

The points of interface between this system and other works are as follows:

Fuel from existing Bulk Store Tanks (refer to Section S41 of this Specification)
Connection to new ATSs
Earthing installation of new Generator (Performance Specified)
Electrical Services associated with auxiliary systems
Communications link between the new Generator and the site ICT system
Fire Alarm interface with Hospital main Fire Alarm system.

Engine:

The engine shall be a 4 stroke, direct injection, compression ignition, continuously, watercooled, turbocharged and air to air charge cooled industrial diesel engine arranged for electric start and stop. Complete with cooling fan drive, lubricating oil filters, air cleaners, start motor, battery charging alternator and regulator, multi cylinder, fuel injection pump, fuel control solenoid, fuel lift pump, engine speed adjustment. The engine shall be fitted with a heavy dynamically balanced flywheel suitable for constant speed generator duty. An efficient approved engine speed governor is fitted to maintain engine speed at all conditions of load.

Duplicated solenoid fill valves for the day tank shall be provided.

Alternator:

The alternator shall be of a brushless design, directly coupled to the engine. The excitation system shall provide a rapid response to load change. The alternator shall be suitable for high motor starter capacity. The unit shall maintain the voltage within the limits of +/- 1.0% from no load to full load, including cold to hot variations at any power factor between 0.8 lagging and unity, inclusive of a speed variation 4.5%. The rotor system shall be dynamically balanced to minimise vibration.

Cooling System:

The engine shall be complete with radiator for cooling the machine in UK ambient Temperatures, with engine driven blower type heavy-duty cooling fan. Radiator core and fin design shall take account and compensate for possible ingress of dirt which would normally clog the fins.

Filtration System:

The engine shall be fitted with dry type air filters with replaceable elements. The engine shall be complete with fuel and lubricating oil filters with replaceable elements.

Starting System:

The engine shall be electric start complete with 24-volt starter motor, supported by heavy duty lead acid batteries, battery racks and interconnecting cables.

Circuit Breaker:

A Cubicle mounted sheet steel box containing a 4 pole motorized circuit breaker with thermal and magnetic overloads shall be provided..

Coupling Arrangement:

Scope of Works

The engine and alternator shall be directly coupled by means of an SAE flange so that there is no possibility of misalignment being found after prolonged use. A flexible coupling shall be used in all cases and the coupling shall be completely guarded for safety purposes.

Mounting Arrangement:

The engine and alternator shall be mounted as a whole on a heavy duty fabricated steel base frame, constructed from folded channel sections and anti-vibration mounting pads affixed between the
engine/alternator feet and the base frame itself. Thus ensuring complete vibration isolation of the rotating assemblies.

Additional items to be included:

Jacket Heater
Dual starter Motors
Dual starting Batteries
Dual Battery Chargers
PMG
Electronic Governor
Anti-condensation heater

Controls:

The generator controls specialist shall fully coordinate with all other aspects of the controls system including the switchgear controls specialist to provide a fully functional system to meet the specification.

In event of mains failure - generator automatically start and feed in 15s or less
If one generator fails to start, remaining single generator shall take full load by operating the emergency backlink (manual operation) through Castell key exchange facility

When mains restored for 5 minutes as determined by sensing of the mains voltage present without interruption (with an adjustable period up to 10 minutes) the generator output voltage shall be modulated to be sunchronous with the mains supply. Following that, period the G99 compliant synchronous operation ofthe generator plant circuit breaker shall open and mains circuit breaker shall close to effect a no break return to mains.

After mains restoration the generators shall continue to run for an adjustable period up to 30 minutes on no load before shutting down automatically.

A test key switch shall be provided on each panel with Auto / Semi Auto / Manual

Control of the electrical infrastructure shall be as detailed on the electrical schematic drawings and includes both manual control with associated Castell key interlocks and automatic systems for items such as generator start on loss of mains etc.

PLC units shall be used as required for automated control of systems. Where PLC units are used, these shall be installed as N+1.

Battery charger units shall have status indication on the following:

Provided to the generator control panel

- An external, weatherproof, enclosure mounted beacon to indicate charging fault
- Status indication and alarm of charging fault signals to the BMS system

Incorporate all necessary controls to deliver the Performance Objectives and Design Parameters
specified herein.

Ensure that the control panel is isolated from generating set vibration. Arrange the enclosure with lockable front access doors, protected to IP54, and finished and painted in the manufacturer's standard colour. Provide mechanical extract ventilation with a filtered air inlet.

Provide a prominent notice to warn of the danger of opening the panel door without isolating supplies.

Scope of Works

Shroud power connections against accidental contact when live, and contain all minor wiring in slotted ducting. Terminate small wiring in shrouded terminal strips and numbered for identification.

Locate the generator control panel / output distribution board inside the generator acoustic enclosure, and provide all power and control wiring between the panel and the various components of the system.

Provide a fully automatic mains failure/synchronising generator control panel, protected to IP54 and mount the panel on or near the engine as appropriate.

Provide a flush mounted microprocessor-based generator controller on the generator control panel such as Rockwell Automation or an equal alternative accepted by the Project Administrator. Ensure that the controller is equipped with an easily readable backlit intelligent LCD Human Machine Interface (HMI) graphical display, and clear visual and audible alarm indicators.

Ensure that the HMI provides a backlit auto dimming LCD minimum colour display with resistive / capacitive touch screen technology and configurable audible sounder. Ensure that the HMI display has a low level of display latency (i.e. display responses quickly without appreciable time lag).

Arrange that the generator controller provides the functionality detailed below unless agreed and accepted by the Project Administrator that equivalent functionality is provided by alternative means.

Provide with tender return a schedule of control panel functionality for the Project Administrator's agreement to include a minimum of the following:

Generating Set Parameter Displays
AC Voltage phase to phase to neutral (on 3 phases)
Ac current (on each of 3 phases)
Frequency
Cos (power factor) average
kW – total + per phase
kVAr – total + per phase
kWH – total
% Voltage difference between bus and generator
Hours Run
Coolant Temperature
Lube Oil Pressure
DC Voltage

Bus Parameter Displays
AC Voltage /frequency within limits indicator
AC Voltage (on single phase)

Operator Controls
Off / Auto / Test / Run Control switch
Emergency Stop Pushbutton
Membrane Keypad with Tactile Feedback
AC Voltage Adjust – Manual and Automatic
Engine Speed Adjust – Manual and Automatic

System Controls
3 Attempt start counter
Cool Down and Pre - Glow delay
Remote Start Capability
Check Synch Relay
Reverse Power Relay
Manual Synchronising
Automatic Synchronising
Automatic Load Sharing Control
Automatic Loading and Unloading Ramp Controller

Scope of Works

Load Sequencing Control

Shutdowns and Alarms
High Coolant Temperature Shutdown
Low Oil Pressure Shutdown
Over speed Shutdown
Fail to Start
Emergency Stop Operated
Reverse Power Shutdown
Over Voltage Shutdown
Under Voltage Shutdown or Alarm
Over Frequency Shutdown
Under Frequency Shutdown or Alarm
Fail to Synchronize Alarm
Battery Under Voltage Alarm
Battery Over Voltage Shutdown or Alarm
Alternator Loss of Excitation Alarm
Over current
Low Fuel Level
Low Coolant Level

Generator Monitoring
Generator AC Voltage – 3 phase (L-L & L-N)
Generator AC Current (per phase & average)
Generator Power (kW) (total & per phase)
Generator kVAR (Total & per phase)
Generator kVAR-hr (Total)
Generator % of rated (Total)
Generator kVA (Total & per phase)
Generator kW-hr (Total)
Generator Power Factor (PF) (Average and per phase)
Generator Frequency

Engine Monitoring
Engine RPM
Battery Voltage
Engine Hours
Engine Successful Start Counter
Engine Oil Pressure (in psi, kPa, or bar)
Engine Coolant Temperature
Engine Crank Attempt Counter
Service Maintenance Interval (Engine Operating Hours or Calendar Days)
Real Time Clock

RS485 module

G99 Protection Compliance
Mains metering and protection while operating in parallel
Protection:
a) Under voltage
b) Over voltage
c) Under frequency
d) Over frequency
e) Loss of mains

Neutral Earth Contactor
2800A Triple Pole Neutral - Earth ACB to generator set at our works. Subject to further design development.

Acoustic Container:

Scope of Works

Provide a weatherproof acoustically treated container enclosure full load rated at 65db(A) @ 1m, from the inlet louvre face, and 65db(A) @ 1m from the discharge louvre face, these are free field figures and do not allow for reverberation.

The unit shall be constructed with ISO Container sides, water shed roof, bottom lifting points, providing a one-piece lift. Appropriate kg/m2 glass fibre infill, covered in pre-galv perforated sheet, “Durbar” chequered floor fully welded and bunded.

All internal faces shall be painted with 2 Coats Sikkens BTLV351 EP primer and 2 coats of Sikkens BTLV351 Topcoat in RAL 9010 gloss finish. External paint finish shall be 2 Coats BTLV351 EP Primer and 2 Coats of Sikkens BTLV350 topcoat In a standard RAL colour to be agreed with the Architect.

All paint finishes applied to new build containers are to be covered by a FIVE-YEAR anti defects warranty against corrosion and delamination of paint finishes.

Access ways in container side shall be included for fuel lines and cable entries. These shall be coordinated with the trench and connection arrangements as shown on the Electrical Services Trench drawing and the Mechanical Services oil pipe drawing.

Typical Container dimensions used for space planning are as detailed on the planning drawings.

Attenuators:

Inlet attenuator shall be of a penthouse design and therefore shall be roof mounted, the outlet attenuator shall be fitted to the end of the container, and shall be designed so that if required can be lifted with the container as one lift.

The elements shall be constructed using a casing in 1.2mm thick pre-galvanized steel containing an infill of non-hygroscopic, fire retardant, boned mineral wool. This shall be faced with a fibre retaining non-woven glass cloth and retained internally using a pre-galvanized perforated steel sheet. Suitable cross members shall be fitted to prevent settlement of the infill.

Weather Louvre’s

Weather louvers shall be integral to the attenuators, and provided as part of the inlet / discharge. Louvres shall be Class A for weather protection and any ingress of water through the louvres shall be trapped and safely drain away.

Fire Dampers Inlet & Discharge

Motorised dampers shall be fitted to the inlet attenuator and shall be sized to suit the face area of the attenuator or aperture opening. Gravity dampers will be used on the discharge attenuators and sited between the radiator canvas and attenuator inner face.

Exhaust System

Supply, deliver and install an Exhaust system complete from the Generator to terminate as indicated on the design drawings. The Generator package shall be complete with all Exhaust & Chimney structural supports.

The exhaust system will include the following:-
Silencer per bank designed to give a noise level at exhaust exit of 65db(a) @1m
Connection pipes from the exhaust bellow to exhaust silencer flange
Exhaust will be finished silver and will be shot blast hot metal sprayed
Twin Wall Exhaust Flue System - stainless steel inner and an AISI 304 stainless steel outer
Self-supporting Chimney and Chimney windsheild

Electrical Package (Container)

Scope of Works

The generator enclosure shall include the following:
LED lighting system with 3hr emergency operation
Above door external bulkhead LED luminaires with local PIR with photocell override and 3 hour emergency integral luminaire
2 x 13 amp switched outlet with RCBO protection
8-way Consumer Unit for the Container Electrical Services, and all wired in galvanized conduit in accordance with IET Wiring Regulations and HTM compliance
Water mist Fire Suppression system with communication link to site Fire Alarm system – refer also to Clause W50.
Flashing Siren red beacon roof mounted for general alarm condition, and Siren to have mute function.
Fire alarm system to be interfaced to site wide fire alarm system. System to include detection and externally mounted sounder beacon.

External Cable Lug

Provide an external cable/conductor lug for connection to the lightning protection system by others.

At Tender Submission

Submit the following documentation to the Contract Administrator for comment as part of the tender submission:
Schedule of the generator sets and auxiliary equipment offered
Specifications, and installed weights of all equipment offered
Confirmation that this Specification can be complied with
Outline proposals for generating plant monitoring and maintenance

Post Tender Acceptance

Submit the following to the Contract Administrator for comment within six weeks of tender acceptance:
Dimensioned general arrangement drawings of all equipment, including foundations, permanent lifting gear, openings and louvre details for ventilation and aspiration air, exhaust system, fire suppression system, space for maintenance, cable and pipework trenches, fuel tanks and fuel supply details, lubricating oil tank details, etc.
Schematic diagrams of the electrical connections and controls
Proposals and quotation for one- year and five- year maintenance contacts
Schedule of control panel functionality
The full specification of the generator and all auxiliary plant and equipment to be supplied, including:
Generator sizing calculation
Net electrical output power at BS ISO 3046-1 standard reference conditions and under the ambient environmental site conditions specified herein
The specification of the fuel oil to be used and fuel consumption at maximum continuous output
The specification of the lubricating oil to be used and lubricating oil consumption at maximum continuous output
Exhaust emissions
Brake mean effective pressure
Detailed general arrangement drawings of all plant and equipment
Builder’s work drawings taking account of all site details known at the time
List of recommended spares and special tools

Pre-acceptance Testing

Two weeks before the works acceptance tests are scheduled, submit a method statement for the following tests and demonstrations:
Works functional tests
Site installation inspection
Pre-running functional checks of the complete generator system, including checks and calibration of all load sensing instruments and interlocks by others
Load bank testing, including a demonstration of synchronising paralleling and load sharing
Mains failure tests
Fire suppression system interface with main Hospital Fire Alarm system
Instruction of the owner's personnel in the operation of the complete generating plant

Scope of Works

Pre-Handover

Four weeks before handing over the completed installation submit the following documents to the Project Administrator for comment:
Makers' works test certificates
Site commissioning and load test certificates
Acoustic test reports
Record drawings
Operation and maintenance manuals

Operation & Maintenance Manuals

Supply two copies of the Operation & Maintenance Manual.

Include all necessary operating instructions, warnings and advice with regard to the engine, generator, controls, switchgear and all ancillary equipment.

Provide the following details:
Complete Generator set description and specification
Operating instructions
Component data sheets
Commissioning method statement
Maintenance instructions
Fault finding guidance
Circuit diagrams and general arrangement drawings
Spares ordering information
Personnel and equipment safety warnings

V11 - HV Supply/Distribution/Public Utility Supply

System Description

Two new 2MVA, 11kV/400V transformers with close coupled Ring Main Units (RMUs) shall be provided within Substation 6. The overall system is an N+N arrangement with designation of 6A and 6B. Transformers shall comply with EU Ecodirective 548/2014 Tier 2 requirements.

The existing 11kV cables serving Substations 3 and 4 (fed from the main intake Substation 1) shall be replaced with new 185mm^2 multicore cables. The existing radial feeders shall be reconfigured to provide a WHTM compliant open ring serving Substations 3, 4 and the new Substation 6. All inter-plant 11kV cables within Substations 3 and 4 shall also be replaced.

The new 11kV cables shall be XLPE/SWA/MDPE Cables to BS6622. All cables shall be BASEC approved. The cables shall be installed either buried direct in the ground, or in cable ducts or on cable tray, as indicated on the drawings. Buried cables shall be laid at a depth of 750mm, as per NJUG guidelines and to the manufacturer's recommendations. Cables buried in open ground shall be covered with reinforced interlocking fibreboards or concrete tiles. Red warning tapes shall be placed 300mm above the tile or cable. Concrete surface markers shall be placed at intervals of approximately 6.5m and at any point where cables cross a road, changes direction or enters a building. New 95mm^2 earthing conductors shall be installed with the new 11kV ring cabling as detailed in section W56.

Existing buried cables becoming redundant shall be cut, capped and abandoned in ground. Locations of all cut locations and capping points shall be detailed on as-built drawings.

Scope of Works

The protection relays on the existing HV switch panel in Sub 1 are to be reused. They shall however be fully tested to ensure they are still operational and protection setting shall be reviewed and amended if required for the new ring configuration.

A new earthing system shall be provided to serve Substation 6 – refer to section W56 for details.

A new G99 application shall be submitted to Western Power Distribution (WPD) in connection with the new Substation 6 generators and will involve information and details of the actual Intake connection point - which for this site is the Incoming HV metering position at Substation 1.

All site network characteristics will be declared in the G99 application by others, however the Contractor shall also allow for liaison with the DNO for completion of the G99 Application Form, with data particular to the selected and supplied Generator specified in Clause V10.

The Contractor shall plan the works on the 11kV system in a staged manner to ensure LV supplies are maintained to all areas of the Hospital at all times. Care shall be exercised in the programming of the works with the full agreement of the Estates Dept to ensure the supply to the hospital is affected by a minimal number of disruptions. Any works that require the loss of power to any part of the hospital or for the Hospital to be supplied via its emergency power generators shall be carefully agreed, in writing, with the Hospital. All shut downs will require a formal isolation request at least 7 days in advance of the proposed works. All HV switching and works associated with the shutdown of HV supplies shall take place out of hours. Any short-term outages required for switching shall be agreed with the Health Board. The Contractor shall submit a switching and commissioning schedule detailing the planned outage and switching dates and sequences for agreement with the Health Board.

Ensure any HV works planned are agreed with the HV AP prior to commencement of the works and make provision for witness testing the works both with HV AP and the Health Board's AP engineer.

Supply Parameters

Primary source of power (PES): The PES for the LV supplies derived from Substation 6 shall be the 11kV electrical network fed from the DNO (Western Power Distribution).

Secondary sources of power (SPS): The SPS for the LV supplies derived from Substation 6 shall be the standby diesel generators connected to the LV side of each generator (refer to section V10).

Rated Voltage (Ur): 12 kV 3 phase 50 Hz
System Frequency: 50Hz
Prospective short circuit current at origin: 21kA
Rated insulation level 75 kV
Rated nominal current for busbars (Ir) 630 A
Rated nominal current for circuit breakers (Ir) 630 A
Rated nominal current for for switches (Ir) 630 A
Rated short time withstand current (Ik) 16 kA
Rated peak withstand current (Ip) 40 kA
Rated duration of short circuit current (tk) 1 s
Enclosure degree of protection IP3XD as a minimum
Type of earthing system: Global earthing system (TBC)
LV Earthing: TN-S

Transformer Protection
Provide a self-powered IDMT overcurrent and earth fault relay complying with BS EN 60255: Merlin Gerin Type VIP 400. Ensure that the protection relays operate the circuit breaker as required by the protection co-ordination study.

A two stage temperature monitoring system for each transformer will be provided and connected to the BMS. The stages will be as follows:
Stage 1 – alert to estates department of high temperature
Stage 2 – HV breaker and associated LV breaker will intertrip.

Scope of Works

HV/LV Intertripping

Restricted earth fault (REF) protection shall be provided on the incomers to the LV switchboard to trip the HV switchgear and to disconnect the HV/LV transformer in the event of an earth fault in the transformer LV windings or in the LV cables between the transformer and the Sub 6 LV switchboards. The REF protection current transformers and relays shall be installed in the LV ATS Switchboard. The location of the neural-earth link shall be coordinated with the current transformer locations to ensure operation of the REF relays under earth fault conditions.

HV/LV inter-tripping control shall be provided. This shall provide protection system relays and protection operating and communicating systems, between protection relays, instrumentation and controls systems to effect integrated discrimination and control.

Remote tripping facilities via a break-glass unit in the LV switch room shall be provided to trip the HV circuit breakers in an emergency.

Provide inter-trip from the LV breaker to trip the HV transformer circuit breaker.

Coordinate the DC battery changing and distribution system provided for the LV Switchgear with sufficient spare ways and capacity for all HV tripping and inter-tripping requirements.

Protection Coordination study

The Contractor shall complete a full protection grading and settings coordination study for the complete 11kV installation to confirm settings to be applied to all new and existing HV protection relays.

Interlocking Facilities

The RMU's / transformer / HV Circuit breakers do not require any dedicated interlocking facilities; all switching operations will be controlled via padlocks, under a Permit to Access and Permit to Work system.

Warning Notices/information

Conspicuous and indelible notices reading "DANGER - High Voltage" shall be provided on all lockable doors to rooms containing or giving access to high voltage equipment.

Electrical safety

Rubber mats complying with BS 921 shall be provided at the front and rear of all high voltage equipment.

System diagrams

A system schematic shall be provided and mounted in each switchroom (A3 size min).

Padlocks

The Contractor shall provide padlocks and key cabinet for all HV switchgear.

V20 – LV Distribution

System Description

The overall system is an N+1 arrangement with designation of 6A and 6B.
A new Substation is to be installed across the existing road from the existing hospital as shown on the drawings.
2No. new HV/LV transformers are to be installed to the new Substation. These transformers will supply individual ATSs and the ATSs are also fed by a standby generator each.
The ATSs then feed an LV system via main switchboards in a new Switchboard building across the road within the hospital site.
The ATSs will include connections for temporary generator and load bank connections.
The new LV switchboards will feed existing supplies for the hospital including:
Existing x-ray chillers

Scope of Works

Existing A+E chillers
Existing Plantroom 4D chillers switchboard.

Watertight glands

Fit all incoming and outgoing cables from above/below with watertight glands. Install all minor control cables in glanded and watertight conduit.

Controls

Control of the electrical infrastructure shall be as detailed on the electrical schematic drawings and includes both manual control with associated Castell key interlocks and automatic systems for items such as generator start on loss of mains etc.

PLC units shall be used as required for automated control of systems. Where PLC units are used, these shall be installed as N+1.

Where batteries are provided for switchgear, battery charger units shall have status indication on the following:

Provided to the switchboard control panel
Status indication and alarm of charging fault signals to the BMS system
The controls system shall be such that should both controllers fail, the breakers can be manually switched for both transformer and generator supplies.

Mimic diagrams in Substation 1

The Electrical Services Contractor shall allow for the site's HV/LV Mimic diagram to be updated to conform to the new layout on completion of works. During the progression of the works the current status of the HV/LV connections shall be clearly shown as temporary amendments to the mimc panel in conjunction with the site AP.

Breaker status indication panels

Breaker status LCD panels shall be installed in each of the ATS rooms and the LV switchrooms.

It is anticipated that these will be mounted on the relevant switchgear and therefore power supplies have not been allowed for these elsewhere in the spaces. Should these not be panel mounted, new locations and power supplies shall be established by the MEP Services Contractor.

These panels will have a schematic representation of all breakers associated with Substation 6 demonstrating their status and position and shall have indication of each generator running status.

Lamp indications

Ensure all indicator lamps use LED technology and have uniform luminance with a viewing angle in excess of 120 degrees.
Ensure LED indicator lamps are powered by extra-low voltage drivers with integral current-limiting functionality and reverse-polarity protection. Provide a push-to-test facility. Ensure LED indicator lamps are replaceable without the use of special tools and are of an industry-standard size and fitting.

Panel labels for information and warning

Fix permanent engraved labels to all panels to provide information and warning to suitably qualified persons carrying out operation and maintenance: Include the following:
a label indicating the function of each switch and indicator lamp
label on each openable panel door reading: "WARNING - ISOLATE PANEL BEFORE MAINTENANCE"
a self-adhesive warning label to each door giving access to 400-Volt circuits
a key diagram showing the source and identification of all power supplies entering
a panel, their function and means of isolation

Device locking

Provide all protection devices complete with all necessary lockable fittings and padlocks, and supply complete with a minimum of three keys for each padlock.

Scope of Works

Meters

An effective energy metering strategy shall be put in place to monitor the consumption of energy delivered by the new Substation 6 Equipment and Plant as required for compliance with standards.
The metering equipment shall allow for monitoring of the energy usage via the BMS, the strategy shall comply fully with the requirements of the Building Regulations.
Meters shall be installed as per the LV schematic and shall be connected to the BMS system.
Each distribution board shall be split DB with lighting and small power metered separately.
Ensure all meters are sourced from established manufacturers are expected to have continuing availability of manufacturer's spares and service support.
Provide multi-function electronic meters and associated current transformers for the incoming supplies and outgoing feeders as shown on the drawings. Use multi-function meters capable of measuring the following parameters:

- voltage
- current
- power factor
- frequency
- active power
- reactive power
- apparent power
- active energy
- reactive energy
- maximum demand
- total harmonic distortion (THD)
- individual harmonic analysis

Ensure meters are fully bi-directional, can meter energy in four quadrants and have self-illuminating electronic display. Provide meters with Modbus communication ports.

Switchgear controls

The switchgear manufacturer shall fully coordinate with all other aspects of the controls system including the generator controls specialist to provide a fully functional system to meet the specification.

ATS

The ATS switchboards 6A and 6B shall be located in their dedicated ATS rooms within the new Substation 6 building. The ATS switchboards shall be Form 4 Type 6, floor standing construction with both rear and front access.
ATSs shall be Elsteel board with ABB switchgear or equal and approved.
The boards shall have the following:
IP rating – IP42
Material – Powder coated steel
Protection – BS EN 60529
IEC 61641 Class I (arc fault protection when all doors are closed and panel not being open)
150mm plinth
ASTA type tested as a composite assembly

The ATS shall include the Neutral Earth link for the distribution system.
Each ATS will incorporate the following:
ACB for top entry LV busbar from the Transformer
ACB for bottom entry LV busbar from the generator
ACB for bottom exit LV cables to the LV switchboards across the road
Busbar link
Connection point and ACB for connection of either:
load bank connection and testing
temporary mobile generator

- MCCB to supply Substation Panel Board

The ATS shall have a Castell key arrangement in order to provide the following functionality:

- Normal operation – transformer fed
- Loss of mains – automatic changeover to be generator fed

- Load bank testing – Isolation of the transformer fed side of the board via busbar coupler in order to allow testing of the generator by connection to load bank whilst the transformer remains live and continues to feed the hospital load
- Mobile generator operation – Mobile generator serving the hospital load under automatic control when connected in G99 synchronised control with the mains supply

Allowance for connection of a mobile temporary generator shall be made on the Substation 6 ATS Boards as indicated on the LV Schematic drawing.

A cat flap solution shall be provided to the ATS room for cable connection from the temporary generator location to the ATS boards. Further details of this arrangement are shown on the Substation electrical drawings.

A small angled weather hat/canopy can be installed over the top of the cable way (cat flap) with the door mounted to open sideways with door having ability to swing open and be demounted.

Underground cast in cable ducts have been allowed between the ATS rooms and the LV switchrooms across the road.

LV submains shall feed the LV switchboards from the ATSs.

HV/LV intertrip

Restricted earth fault protection shall be provided on the incomers to the LV switchboard to trip the HV switchgear and to disconnect the HV/LV transformer in the event of an earth fault in the transformer LV windings or in the LV cables between the transformer and the Sub 6 LV switchboards.
HV/LV inter-tripping control shall be provided. This shall provide protection system relays and protection operating and communicating systems, between protection relays, instrumentation and controls systems to effect integrated discrimination and control.
Remote tripping facilities via a break-glass unit in the LV switch room shall be provided to trip the HV circuit breakers in an emergency.

Substation LV Panel boards 6A and 6B

MCCB Electrical Panel boards 6A and 6B shall be installed in the two ATS rooms. The supplies shall be derived from the ATSs.
The panel boards shall be Form 3b Type 2 and provided with IP3X protection and suitably rated 400V electronic surge protection.
In connection with the new Standby Generators, the Electrical Services Contractor shall provide auxiliary supplies and cabling of the size and installation route as indicated on Design drawings to serve the following generator enclosure installed distribution board provided as part of the packaged generator system.

LV Switchboards 6A and 6B

The new LV Switchrooms 6A and 6B shall be installed to a new purpose-built building that is to be situated at the old oil tank location as shown on the drawings.
The main LV 6A and 6B Switchboards shall be Form 4 Type 6, floor standing construction with both rear and front access.
LV Switchboards shall be Elsteel board with ABB switchgear or equal and approved.
The boards shall have the following:
IP rating – IP42
Material – Powder coated steel
Protection – BS EN 60529
IEC 61641 Class I (arc fault protection when all doors are closed and panel not being open)
150mm plinth
ASTA type tested as a composite assembly

The main LV switchboards shall be rated at 3200A TPN with top entry top exit construction.
Each switchboard shall contain a 3200A TPN incoming ACB and a busbar with the same rating linking between the two switchboards with Castell key interlock arrangement to ensure no dual supply situations can occur.
In the event of one supply failure, the other switchboard shall be abel to be operated to take over both switchboard loads by closing the busbar link.

Scope of Works

The main LV switchboards shall incorporate a number of outgoing ACB's and MCCB's for new and existing loads and spare ways.
The new LV switchboards shall supply a number of loads as detailed below:

- New DB serving the general lighting and power for the LV Switchroom building
- Existing X-Ray chillers local to Substation 3. Back fed using existing cable in front of location for new proposed LV Switchroom 6. Existing cable termination in Substation 3 Main Switchboard to be isolated and withdrawn from Switchboard and existing breaker locked off and relablled. Cable to be re terminated to existing X-Ray chillers control panel and supplied from new LV Switchboard 6A.
- New supply to replace existing supply to Engineering Compound 1 panel board which supplies a number of loads including the A&E chillers.
- Existing Plant Room 4D chiller panel board.

Circuit Breakers

All ACBs shall be as the following or equal and approved:
ABB Sace Emax 2, with fault level to match or exceed the board to which they are installed and utilising LSIG electronic trip units capable of connection and full integration to the site BMS system that can fully interrogate any monitoring information available with the software – details of monitoring information to be agreed with the Health Board during Stage 5.

All MCCBs shall be as the following or equal and approved:
ABB Tmax family, with fault level to match or exceed the board to which they are installed and utilising LSIG electronic trip units capable of connection and full integration to the site BMS system that can fully interrogate any monitoring information available with the software – details of monitoring information to be agreed with the Health Board during Stage 5.

The ACB shall come complete with a locking off facility to allow the ACB to be locked off in its racked in position. The locking off facility should allow a padlock to be used to securely prevent the on/off push buttons from being used. The locking off facility shall allow the isolation procedures within HTM 06-02 to be followed.

The removal of the ACB's from the Switchboard shall be via an ACB Lifting Truck which shall be supplied by the Contractor as part of this Scheme. The Lifting Truck shall be supplied with all lifting brackets as necessary for the safe removal of the ACB's.

Tripping Batteries & Controls Wiring

Provide separate fully status indicating (including charger or battery failure) hot swappable tripping battery units and associated wiring in each LV switchroom 6A and 6B to facilitate operation and controls of circuit breakers
Provide protection system relays and protection operating and communicating systems, between protection relays, instrumentation and controls systems to effect integrated discrimination and control – including restrictive earth unit protection to the transformers, and HV Intertrip to incoming ACB breakers as indicated on the proposed LV Schematic drawing.

The tripping batteries shall be fitted with a panel mounted indicator dial and push to test button for testing of battery charging and discharge operation.

Training

Training is to be provided to Estates Personnel on the use of the ACB's including interrogating the interface screen. Training shall include but not limited to- Isolation methods, racking in/out of the ACB, reset procedures following fault conditions, and interrogation of the panel interface. It is envisaged that 6 training sessions will be required over 3 days (morning and afternoon sessions) in order to accommodate all Shift Tradesmen and Estates Officers.

Power Factor Correction

500kVAR Power Factor Correction shall be installed adjacent to the new Switchboard in a separate free standing cubicle controlled by an integral PFC sequencing relay to provide correction to 0.95 lagging.
PFC to be in 50kVAR steps and disconnect automatically when the generator is supplying the system.

Capacitors shall be detuned.

The PFC installation shall be fully compliant with WHTM 06-01.

The PFC shall disconnect automatically upon loss of mains supply and oemergency generator operation.

Harmonic Filtering

A space for future Harmonic Filtering Unit has also been allowed in the switchrooms and a spare way for future connection shall be provided as per the LV schematic.

The Electrical Services Contractor shall allow to return to site to undertake a harmonic survey following completion and provide appropriate equipment to meet the requirements of G5/4,

Plant Room 4D chiller supplies

Two existing supplies feed the existing Plant Room 4D Panel Board from the existing Switchroom 4. These supplies shall be isolated, disconnected, pot-ended and spare length left coiled at both the source and load ends.
New LV busbars shall be installed from the new Switchboards and feed the incoming ways of the existing Plant Room 4D Panel Board.

Oil fuel pump supplies

The new oil fuel piped connection from the existing oil tanks to the new generators is detailed in the mechanical sections of the tender documentation.
New electrical supplies as detailed on the electrical services drawings are required as follows:
TPN supply from local existing essential distribution board for pump control panel.
SPN supply from local existing essential distribution board for leak detection system.

Trench sump pump supplies

The new trench will be provided with N+1 sump pumps as per the civil engineer's design.
2No. supplies from the substation distribution boards shall be provided as detailed on the distribution board schedules to supply the pump control panels for the pumping system.

LV busbar

Elements of the LV distribution system shall be undertaken in busbar to facilitate efficient energy distribution of significant loads.

Routings and extent of this system are shown on the LV distribution drawings and LV schematic and shall include the use of IP68 resin filled busbar throughout.

Busbar shall be as follows or equal and approved:

IP68 – Schneider Canalis KR Busbar IP68

The Electrical Services Contractor shall employ the services of a certified installer such that the LV busbar system shall be installed, commissioned, tested and certified by a manufacturer approved installer to full compliance with the manufacturer's requirements including all required proprietary parts and supports.

Distribution Boards

New Distribution Boards (DBs) shall be provided as shown on the layout and schematic drawings and DB schedules.

The DBs shall be split lighting and power DBs and in accordance with the requirements of BS EN 61439-3, will be of MCB type and IP3X protected.

The boards shall be as Schneider Acti9 Isobar or equal and approved.

The final circuits shall emanate from the distribution boards to the various rooms and spaces. The Distribution Boards will be provided complete with energy consumption metering connected to the BMS system.

Scope of Works

All distribution boards shall have 25% physical spare capacity to allow for future expansion/reconfiguration and shall be lockable with a key.

V21 – General Lighting

System Description

General

Luminaires shall be as the luminaire schedule provided on the lighting drawing, or equal and approvied. Should an alternative fitting be proposed, the Electrical Contractor shall ensure that calculations have been undertaken to verify compliance with the standards as detailed in the relevant section of this specification.
Calculation outputs shall be provided for review as part of the technical submission process.
The lighting design shall be as the latest version of LG2.

Room	Lux level	Standard / Guide
LV Switchrooms	200lux @ FFL;	
ATS Rooms	200lux @ vertical task work plane	CIBSE Lighting Guide 2
Transformer Rooms		
ATS Rooms		
Server Room	400lux @ FFL	CIBSE Lighting Guide 2
Lobby	150lux @ FFL	CIBSE Lighting Guide 2

Area	Lux Level	Standard/Guide
External LV Switchrooms	10lux @ FFL around perimeters for safe pedestrian access	CIBSE Lighting Guide 2 BSEN 12464-2-2014
External Substation 6 Compound	10lux @ FFL around perimeters for safe pedestrian access	CIBSE Lighting Guide 2 BSEN 12464-2-2014

Internal lighting

New lighting shall be installed to the new rooms constructed as part of this project and as detailed on the lighting drawing.
Areas to be covered include the new Substation 6 and new LV Switchrooms.
Switching, luminaire specification and supplies shall be as indicated on the drawings and DB schedules.
All Plantrooms shall have local manual switching. Other areas and where appropriate, automatic sensors shall be dual function type, comprising of photocell and occupancy/absence detection to conserve energy, by automatically switching off luminaires in areas that are not being used.

Specific Wiring / Connections Requirements

All luminaires shall either be connected by means of a ‘Plug-in’ type ceiling rose or the manufacturers recommended form of connection. All luminaires shall be provided with means of local isolation.

Flex lengths from ceiling roses or other forms of connection shall not exceed 3-metres in length. All flexible cables contained within ceiling voids shall be tied to supports located above the ceilings themselves, to prevent cables resting on the ceiling tiles / grid. The cables shall be tied to avoid damage on the removal of any ceiling tiles or access hatches.

Scope of Works

Cabling shall be of the type as detailed on the luminaire schedule and utilising galvanised steel small power and lighting trunking with connections to fittings and accessories in galvanised steel conduit.

External lighting

New external lighting shall be installed as shown on the external drawings and includes:
- Perimeter building mounted lighting around each of the new buildings.
- Fence mounted lighting covering the external areas around the new Substation 6.

Switching, luminaire specification and supplies shall be as indicated on the drawings and DB schedules.

External lighting shall be controlled by photocell with time clock arrangement with manual override switch.

V22 – General Power

System Description

The general power installation shall be provided as detailed on the drawings and DB schedules.

The general power installation includes the following:
Small power to newly constructed rooms associated with the project
Supplies to MEP systems including mechanical plant and electrical systems
Cabling shall be of the type as detailed on the luminaire schedule and utilising galvanised steel small power and lighting trunking with connections to final outlets and accessories in galvanised steel conduit.

V40 – Emergency Lighting

System Description

New Emergency Lighting shall be installed as per the electrical drawings and luminaire schedule.

The Electrical Contractor shall be responsible for the supply, installation, implementation, testing and commissioning of a new emergency lighting installation, as indicated on the electrical drawings and in this specification, to meet with the agreed requirements of the Client.

The system shall utilise fittings which are either standalone or integrated LED luminaires with integral 3-hour battery packs.

Self Test and System Monitoring

All emergency lighting shall be equipped with a self-test facility to test functionality and battery life. The results of the self-test system shall be clearly displayed on each luminaire via the use of integral bi-coloured LED indicator.

The system shall be as Thorlux Smartscan system or equal and approved and shall be fully integrated into the site wide system with new control equipment provided as required subject to the specialist’s design.

The Electrical Contractor shall be responsible for the provision of all power supplies and additional cabling easements required to complete the installation.

Scope of Works

General

Prior to handover the Electrical Contractor shall be required to provide all requisite Completion and Test Certificates to the Client otherwise Practical Completion cannot be recommended.

The Electrical Contractor shall be responsible for the provision of an emergency lighting logbook within the maintenance manuals for future testing purposes.

The Electrical Contractor shall allow for a full discharge test at the end of the defect's liability period. Any batteries failing the test shall be replaced free of charge.

The Electrical Contractor shall be deemed to have included for the provision of client training. The training shall take place immediately following Practical Completion on a mutually agreed date.

W30 – Data Transmission

The Electrical Services Contractor shall employ the services of an ICT Specialist Contractor to modify, extend, supply, install, test and commission the existing data system as identified on the drawings and detailed within the Tender documentation.

The data installation shall be in accordance with the SBUHB ICT Specification as provided in the relevant appendix to this specification.
A new ICT cabinet shall be installed in a dedicated room in Substation 6 fed from fibre optic connections to the site wide network as shown on the Site Wide Electrical drawing.

Cat 6a F/FTP Cca cabling from the ICT cabinets shall feed data outlets as shown on the Small Power and Data drawings.

For routing within the Substation and LV Switchrooms, the fibre optic cables shall be installed in galvanised steel trunking.

Responsibility Matrix

The following table sets out responsibilities associated with the ICT Services solution:

Ref	Item	By Kier	By SBUHB
1.1	Site Backbone Subsystem	✓	
1.2	Building Backbone Subsystem	✓	
1.3	Horizontal Cabling Subsystem	✓	
1.4	Solution testing and provision of manufacturer warranty	✓	
1.5	Wireless coverage design		✓
1.6	Wireless Access points supply		✓
1.7	Wireless Access points installation	✓	
1.8	Wireless solution testing, commissioning and coverage survey		✓
1.9	All active LAN equipment supply, installation, testing and commissioning, see Note 1 below		✓
1.10	ICT accommodation	✓	
1.11	Cabling and equipment cabinets	✓	
1.12	UPS Solution		✓
	Telephone VOIP handsets, radio pagers, "walkie talkies", Computer terminals, screens/monitors, laptops, PDAs, projectors, screens, audio visual etc. Telephone systems		✓
1.14	Patch leads for SBUHB provided devices		✓

Scope of Works

1.14	Patch leads for building services systems, i.e. CCTV, Access Control, Nurse Call, BMS, etc.	✓	

Fibre Backbone Cabling Subsystem

The fibre Backbone Cabling shall be a blown fibre solution to the specification as detailed in the HB specification.

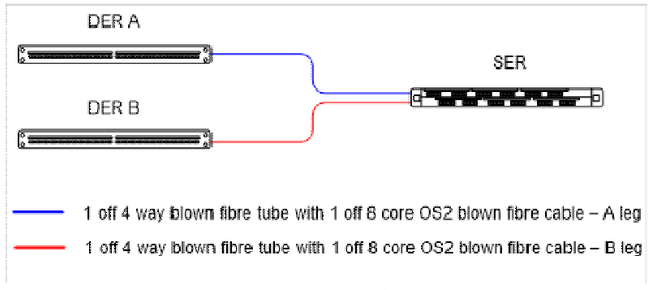
Two new fibre optic connections in blown fibre shall feed the building and have diverse routes from DER A in the PABX Room and DER B in the Tempest Hub Room.

To be read alongside and support the requirements of the SBUHB ICT Specification, the following requirements shall be provided. The SER shall have:

A blown fibre connection with 8 cores from each DER to feed the building.
2No. resilient 8 core OS2 fibre DER trunks – fibre trunks shall not share the same DER
2No. resilient 4-way external blown fibre tube units shall be installed from the main blown fibre ducting to the building entry gas seal unit. It is acceptable to use a large tube unit into the building entry and split it into separate 4 way tube units
2No. resilient gas seal units at the building entry for the A leg and B leg
A 4-way LSOH blown fibre tube unit from each gas seal unit shall be provided to each SER – 1No. for the A leg and 1No. for the B leg
Each DER trunk shall not share the same building entry
Each DER trunk shall not share the same external ducting route
Each DER trunk shall not share the same internal containment route
2No. resilient plastic fibre patch panels with 8 off LC connectors shall be provided – 1No. at the A leg DER and 1No. at the B leg DER
1No. resilient split fibre patch panel with 16No. LC connectors – at each SER, the A leg shall be in the top draw and the B leg in the bottom draw

In the drawing below:

SER is the new cabinet in Substation 6.
DER A is the PABX room
DER B is the Tempest hub room



Fibre Blue and Fibre red needs to be as far apart as possible.

CW1308 10 pair cable

A backup telephone system is required associated with the works and therefore the following is required:

A new 10 pair CW1308 cable from the new comms cabinet in the new substation to the existing PABX room.
Emergency phone outlets as per the small power drawings.

New ICT Cabinet

A new 42U ICT floor standing ICT cabinet shall be provided in the Substation 6 Hub room with the following:

Mounted on a blockwork plinth
Top position for fibre campus backbone (installed as part of the contract)
Next position for 1U fibre horizontal cable manager (installed as part of the contract)

Scope of Works

24 port cat 6a patch panel (installed as part of the contract)
1U 48 port network switch provided by the Health Board
24 port cat 6a patch panel (installed as part of the contract)
2U suitably sized UPS provided by the Health Board
A Minimum of a four-way PDU unit
The Cabinet shall be earthed and be provided with a set of keys for locking.

LV Switchroom 6A and 6B

The new Switchrooms 6A and 6B data outlets shall be fed from the new Substation 6 ICT cabinet.

External cabling

Where cables run to external services or remotely from the ICT cabinet in Substation 6, including externally and in trenches, all cabling shall be external grade. These include, but are not limited to, routes to the locations as per the following:
Generators
External compound mounted equipment
LV Switchrooms 6A and 6B

W40 – Access Control

New access control devices shall be installed as shown on the drawings.

The system shall have 25% spare capacity for future expansion on controller equipment to allow expansion by addition of devices, quantity being 25% more of that installed under this contract.

The Electrical Services Contractor shall employ the services of an accredited Access Control specialist to design, install and commission the system to be of the same manufacturer and system as that currently installed to the site and detailed elsewhere within this specification.
The Access Control system shall be Salto or equal and approved and be fully integrated into the existing building wide system.

The new devices shall be fully integrated into the site wide access control system.

The Electrical Services Contractor shall allow for liaison with the users to confirm system commissioning requirements and design and commission the system to suit these requirements.
Where the security system utilises the data network, the Health Board's Cyber Security Impact Assessment document shall be completed for each security device type.

Screech alarm

The security specialist shall design, install and commission a screech alarm system for the doors as shown on the security drawings.
The system shall be mains powered and a local sounder shall alarm when a door is opened via necessary door contact arrangement as required.
A local key switch to disable the system shall be provided to each door.

W42 – Closed Circuit Television

New CCTV cameras shall be installed as shown on the drawings.

The system shall have 25% spare capacity for future expansion on controller and recording equipment to allow expansion by addition of devices, quantity being 25% more of that installed under this contract.

The Electrical Services Contractor shall employ the services of an accredited Access Control specialist to design, install and commission the system to be of the same manufacturer and system as that currently installed to the site and detailed elsewhere within this specification.
The CCTV cameras shall be HIKVision or equal and approved, and an IP based and to the same specification as that of the latest cameras installed to the existing hospital.

Scope of Works

The new CCTV cameras shall be fully integrated into the site wide CCTV system with local recording equipment and controls in the new ICT cabinet room associated with Substation 6 provided and remote monitoring with full access over the site wide system utilising the ICT network.

The Electrical Services Contractor shall allow for liaison with the users to confirm system commissioning requirements and design and commission the system to suit these requirements.
The Electrical Services Contractor shall allow for commissioning of the system to be remotely viewed on existing monitoring equipment in the Security office and Estates office.
Where the security system utilises the data network, the Health Board's Cyber Security Impact Assessment document shall be completed for each security device type.

The CCTV Specialist shall allow for all necessary licence procurement for ownerships by the Health Board as part of their tender

W50 - Fire Detection and Alarm

System Description

A preliminary layout is shown on the electrical drawings.

The Electrical Services Contractor shall employ the services of an accredited Fire Alarm specialist to design, install and commission the system to be of the same manufacturer and system as that currently installed to the site and detailed elsewhere within this specification.
An open protocol addressable fire alarm system shall be provided throughout the new buildings in accordance with BS 5839 Part 1 or as required for Building Control approval.

The Fire Alarm System shall be and Advanced Systems fire alarm panel or equal and approved and fully integrated into the existing site wide system including fully addressable integration of all devices.

The system shall be Category L1 system for protecting life.

The system shall consist of a main powered fire alarm panel at the location as shown on the drawing. The panel shall be complete with integral battery backup and linked to the site wide system. The fire alarm system shall be of the Analogue Addressable type.

The Cause and Effect shall be designed by the Specialist Contractor and to comply with the Fire Strategy.

The Electrical Services Contractor shall allow for attendance at meetings and discussions to allow the matrix to be updated prior to commissioning of the system by the specialist and subsequent update of all record information.

As part of the fuel oil installation, an Automatic Isolation Valve shall be installed and this shall be connected to the site's fire alarm system. The Electrical Services Contractor shall install a new interface on the local existing fire alarm system and commission this to operate in line with the cause and effect requirements.

W51 – LV Earthing and Bonding

System Description

Bond and connect to earth all exposed conductive parts of the electrical installation and all extraneous conductive parts so that in the event of a fault of negligible impedance, disconnection will take place in a manner and in such time as to ensure no danger arises.

The Electrical Services Contractor shall employ the services of an accredited Earthing specialist to design, install and commission the system to be of the same manufacturer and system as that currently installed to the site and detailed elsewhere within this specification.
The Specialist Contractor shall undertake a full CDEGS analysis (Current Distribution, Electromagnetic Interference, Grounding and Soil Structure Analysis), to determine the requirements of the Earthing requirement and all other survey and design works required to provide a fully compliant system.

Scope of Works

Earthing and bonding of all aspects of the works shall be provided in accordance with the BS 7430, the IET Wiring Regulations (BS 7671) and local electricity supply authority regulations.
The Earthing and Bonding systems shall be provided in line with the recommendations of WHTM 06-01.
A new HV/ LV earthing nest shall be provided for the new Substation 6, designed and installed in accordance with all relevant standards.
Any new earthing system installed for the project shall be designed to be constrained within the red line boundary of the project and coordinated with the Health Board, contractor and architect's physical constraints.
A main earth terminal/s shall be provided within the new Substation 6 Electrical equipment rooms. All new metallic equipment and metal parts of other installations, including exposed structural steelwork, lightning protection, ceiling, grids, incoming gas and water services will be bonded to earth in accordance with BS.7671. Equipotential Bonding shall be provided as required of the project and standards.
A functional earth terminal shall be provided for the ICT Cabinet/s identified as required within the new Substation 6.

W52 – Lightning and Surge Protection Systems

System Description

The Electrical Services Contractor shall employ the services of an accredited Lightning and Surge Protection Systems specialist to design, install and commission the system as detailed within the project specification.

A new lightning protection system and appropriate level of surge protection shall be provided (subject to Specialist Risk assessment), for compliance with BS EN62305 to all areas associated with the project including the new generator enclosures.

The system shall generally comprise of an air termination network earthed via earthing conductors and earth rods. Each rod shall be provided with an inspection pit and test clamp. Down conductors shall be provided to link the air termination system with the ground earth rod system.

The Contractor shall perform a comprehensive risk assessment to BS EN 62305-2 to identify and quantify all risks in order to determine the appropriate level of lightning protection required to meet this specification.

New surge protection shall be provided as detailed on the LV Schematic.

W56 – HV Earthing and Bonding

System Description

The Contractor shall appoint a specialist sub-contractor to complete a survey of the existing earthing system at the Hospital site to confirm suitability for re-use.

The specialist sub-contractor shall produce a design for the new earthing system for Substation 6, which shall be inter-connected to the existing site global earthing system. The earthing study shall include the following activities:

- On-site measurement and result interpretation to determine soil resistivity and produce a multi-layer soil model (two layers as a minimum).
- Continuity tests carried out on site to the existing earthing system and provide a complete set of test results and advise of any remedial work required to meet current standards and also inform the design team during the initial design stages.
- Determination of 11kV ground return current
- Determination of target earth resistance for the new substation earth nests
- Earthing system design (using CDEGS or similar) for the new earth nest to achieve target earth resistance

Scope of Works

- Analysis of the proposed earthing system (using CDEGS or similar) to confirm Rise of Earth Potential, step and touch potentials, stress voltage and transfer voltage under earth fault conditions are within acceptable limits.

The earthing design shall be submitted for approval prior to installation.

The HV and LV earthing systems shall be interconnected (combined) and shall also be connected to the lightning protection system (if provided). The Substation 6 earthing system shall be interconnected to the overall site earthing system via the new 11kV cable sheaths and new copper earthing conductors. New 95mm^2 PVC covered copper earthing conductors shall be installed with the new 11kV cables between Substations 1, 3, 4 & 6, interconnecting the earthing systems between all substations,

The new earthing system for Substation 6 shall be tested using the fall of potential method to confirm the target earth resistance from the earthing design is achieved, before connecting the substation earth to the site earthing system. The resistance of all individual rods shall be tested and recorded on as-built drawings.

System Parameters
Maximum fault level at source: 21kA
Site earthing system: Global earthing system

Design Criteria
The earthing system shall be designed and installed in accordance with:
BS EN 50522
BS 7671
BS 7430
ENA S34
Electricity Safety Quality and Continuity Regulations

W60 - Central Control /Building Management System

The Mechanical Contractor shall employ a Controls Specialist to design, supply, install, test and commission new Building Management System (BMS) functions for new plant.

The works shall include all equipment, software, programming, panels, control valves, linkages, actuators, detectors, sensors, switches, isolators, starters, associated control/power cables and cable containment systems necessary to produce a complete operational installation.

This shall include a mechanical control panel with BMS outstation located within the heating plantroom.

The control panel shall be linked to the existing BMS system via dedicated comms cabling. A data point shall be provided adjacent to each MCC to facilitate connection of the BMS to the internet.

The Controls Specialist shall obtain power for the control panels from an adjacent position as detailed within the electrical package. The Controls Specialist should especially note the works include all cabling from the plant control panel, including all power cabling, to plant/equipment and all interconnecting sensing/control cabling. The cabling and cable containment arrangements shall be in accordance with the latest edition of the IEE regulations, the issued Electrical Specification particular to this project and suitable for the environment at the particular locations.

The BMS must be open protocol and be able to communicate and be compatible with Morriston Hospital existing BMS system.

The works shall include the creation and setting up of all necessary programming software screens, schedules, set points and alarms.

Items located externally shall be of suitable design or protected to IP65.

All relevant British and European Standards shall be adhered to.

Scope of Works

The control panel shall be capable of accepting 50% additional requirement without changes to the main plant items as future proofing for the second Fluoroscopy Suite.

The control panel shall control and power the following equipment:

Fuel oil pumps

Controls Specialist - Works Items
The BMS/Controls works shall include as minimum :
Building Management System (BMS)
Remote Touch Pad/Display Panel
Controllers
Intelligent Unitary Controllers
Controller Software
Mechanical Power Distribution Boards
Controls Equipment
Controls Enclosures
Variable Speed Drives
Uninterruptable Power Supply
BMS IP Network (Dedicated)
Power and Controls Wiring
System Graphics Provision
Commissioning
Demonstration
Documentation
Copies of Application Software
Training
Warranty and Maintenance

Control Enclosures (CE's)

Single Section Form 2 Type 2 IP54 rated CE panels, complete with outstations and isolators shall be provided as part of the controls package. Where CE's are mounted in exposed areas these shall be provided with a weatherproof enclosure or IP 65 rated. The Electrical Contractor shall make, test and prove the feed into the incoming terminal of the CE isolator prior to the CE "going live".

The Single Section Control Enclosures are to be provided and will be supplied with the following:

- Display Panel.
- Panel 'live' and plant alarm lamp.
- Panel control circuit 'live' lamp.
- Panel lamp test push button.
- Plant "hand off auto" switch.
- Each panel will be provided with a UPS battery back-up unit.
- Internal 13A RCD socket for the commissioning engineers.
- BMS Controllers connected to the site wide CNS system via IP connections.

Power to the CE's will be from a Mechanical Distribution Board (MDB) provided by and installed by the Electrical Contractor. Sub metering shall be installed on the electrical supply to each MDB to comply with the requirements of Part L2 of the Building Regulations.

Rotary key control switch operation; provide BMS/Off/Hand rotary switches for each item of plant. Provide indication lamps: Run, Trip, and Enabled for each item of plant.

Where inverters are not integral with the motor, they shall be located adjacent the equipment served or adjacent the MDB. An inverter per pump or fan shall be used where there is duty/standby arrangement. The BMS shall interface with inverter drives as detailed in the scope of works.

Fire alarm interface units shall be located adjacent to the CE's. This shall provide the fire alarm signal to the CE's. The Controls Specialist shall hardwire from the interface unit to the CE. This shall be a suitably-rated fire resisting cable with LSF sheath installed on cable tray.

Scope of Works

Plant shall not operate in Fire Mode during a fire alarm test.

Automatic Controls System

The existing Building management System (BMS) will be adapted to control and monitor the Substation 6 generator/s fuel delivery, HSDU changes, and to accept energy monitoring of the new Substation 6 Electrical supplies. All control functions will be performed by digital direct control (DDC) technology with the exception of any new safety and fire / fireman's' override interlocks which will be hardwired.

BMS System

A new Building Management System (BMS) shall be provided for the project and be fully integrated into the site wide system. All control functions will be performed by direct digital control (DDC) technology with the exception of safety and fire / fireman's' override interlocks which will be hardwired.

The BMS will include the following:

- Monitoring of mechanical equipment
- Monitoring of electrical equipment
- Connection and monitoring of all electrical meters associated with the project
- Alarm connections for the electrical systems

The BMS will comprise a network of intelligent controllers to control and monitor all of the mechanical plant within the building. The building will be installed as a standalone system using the manufacturer's standard system for communication, in-addition to a web based server for communication through the Health Board's data network.

The intelligent controllers will carry out the monitoring and control functions. The BMS will execute, via software, all necessary optimisation, time, temperature, interlocking and energy control requirements of the mechanical systems. It will also monitor the operational status of other equipment such as electrical LV distribution, standby generators, fuel pumps, etc.

As described in section 'V11 – HV Supply/Distribution/Public Utility Supply', there will be a two stage temperature monitoring system for the transformers linked to the breaker controls and BMS system with requirement for the system to alarm via the BMS to the Estates office.
** End of Scope Sections **

‘A’ Clauses

A13 – Description of Works and common design criteria

130.001 PREPARATORY AND OTHER BUILDING WORK:

Building Fabric Works comprising:

Air permeability and pressure testing of the building and any required re-testing in accordance with ATTMA technical standards “Measuring Air Permeability in the Envelopes of Buildings” - L1 (Dwellings) or L2 (Non-Dwellings) shall be undertaken by the Main Contractor.

Builders Work / Fire Stopping

The demarcation of responsibilities for builders work (including fire stopping) in connection with the engineering services as defined in the Main Contract Preliminaries shall be agreed with the Main Contractor during the tender period and clearly identified in the tender submission.
Refer to A13sch3 for project particular requirements.

Provision of certification stating:

The following shall be provided by the Main Contractor:
The building air permeability conforms to the requirements of the Building Regulations Part L2, Conservation of Fuel and Power or other equivalent requirements for Scotland, Wales and NI.
The thermal performance of the building envelope conforms to the requirements of the relevant section of the Building Regulations Approved Documents Part L1 & L2, Conservation of Fuel and Power or other equivalent requirements for Scotland, Wales and NI.

141.000 THE SUBCONTRACT WORK
This sub-contract covers the supply, installation, connection, testing, commissioning and setting to work of the building services installations detailed within the work sections / schedules of this specification and tender drawings including any builder’s work that will not be undertaken by the Main Contractor.

Incorporate all equipment, accessories, controls, supports and ancillaries implicitly or explicitly required either by the specification and drawings, or in accordance with accepted current practice, and procedures, which after assembly, testing and commissioning will enable that section of the Works to function correctly and to achieve the specified performance.

Neither the specification nor drawings shall take precedence. Any apparent discrepancy between the specification and drawings, including the interface requirements between the BMS and packaged plant as detailed on the controls diagrams and individual plant schedules shall be drawn to the attention of the Contract Administrator before or with the tender submission. Otherwise the Contractor shall be deemed to have made the maximum allowance within their tender.

150.000 WORK BY OTHERS AND CO-ORDINATION OF TRADES
Allow for co-ordinating the subcontract works with the works of other trades and installations which may be on site during the period of the subcontract.

200.000 GENERAL REQUIREMENTS

210.001 COMMON DESIGN CRITERIA
The criteria listed in the A13 Schedule of Common Design Criteria apply to all Work Sections included in the Contract unless specified otherwise.
Other design criteria applicable to particular equipment/systems are stated within the appropriate work section.

210.002 FIRE STOPPING
Refer to A13sch3 (Builders Work and fire stopping requirements) for project particular requirements.
Comply with BS 9999, relevant approved technical guidance to Building Regulations. Comply with BESA Technical Bulletin TB/032 for protection of pipework penetrating fire separating elements.
All components forming the seal system to be from the same manufacturer.
Provide a proprietary penetration seal system whenever possible, tested and assessed to BS EN 1366-3 and BS EN 1366-4 and classified to BS EN 13501-2. All products used, to have third party product certification by a scheme accredited by UKAS.
Only use UKAS accredited, third party installer certified specialist contractors. The specialists should be ASFP members and their certification must cover the passive fire protection element they are installing.

A13 – Description of Works and common design criteria

Install all fire stopping systems in accordance with the manufacturer's written instructions and the test/assessment/certification evidence provided by the installer / manufacturer of the penetration seal.
Support centres for services passing through penetration seals serving fire barriers to be the same as those covered by the test/assessment/certification evidence provided by the installer / manufacturer of the penetration seal.
Install and inspect fire stopping systems in accordance with Building Regulations (Approved Document B), ASFP Code of Practice TGD17 and the general best practice guidance given in the ASFP On-site guide to installing fire-stopping.
The contractor shall ensure all services requiring firestopping are installed and set out in line with testing requirements setting out of all sections of BS EN 1366 and all approved documents.
The Contractor shall also check that the proposed fire-stopping material is compatible with the services passing though and will not cause or result in an adverse impact or degradation of the service.

220.100 EXTERNAL NOISE CRITERIA
Building services plant noise level to comply with local planning / environmental authority requirements and statutory noise nuisance legislation.
Should the proposed plant be identified as having intermittent, tonal or otherwise characteristic features, a further applicable penalty should be subtracted from any of the proposed noise emission limits in line with requirements of BS 4142.
Unless detailed or scheduled elsewhere all services plant noise to be 5dBA lower (10dBA if tonal) than the otherwise prevailing background noise L_{90} levels when measured at a distance of 1m from the nearest noise sensitive window.
Unless detailed or scheduled elsewhere, on healthcare projects comply with the requirements of HTM 08-01 to limit external noise levels from services / plant rooms to achieve the following criteria.
Noise levels required by the local authority at the site boundary
The internal noise criteria.
Noise levels in external areas normally occupied by staff or the public of 50dB L_{A90} or no greater than the existing daytime background noise level.

230.100 INTERNAL NOISE CRITERIA:
Limiting noise levels for all types of areas as schedule of Common Design Criteria.
Unless detailed or scheduled elsewhere, on healthcare projects comply with the noise rating requirements of table 2 in HTM 08-01 for the total noise from mechanical and electrical services (including rainwater pipes) operating under normal conditions.
Agree the acceptable increase in internal and external noise levels for emergency plant with the users (normally + 10dB may be acceptable). Ensure sound insulation of rooms is not downgraded by the layout / installation of services.

240.001 ELECTRICAL SUPPLY
The definition of voltage levels used in this document are as follows:

High Voltage –	Voltages exceeding low voltage, as defined in The Electricity Supply Regulations 1988.
Low Voltage –	Voltages exceeding extra low voltage but not exceeding 1000V ac or 1500V dc between conductors, or 600V ac or 900V dc between conductors and earth, as defined in BS 7671.
Extra Low Voltage –	Voltages not exceeding 50V ac or 120V ripple free dc whether between conductors or to earth, as defined in BS 7671.

Where systems are specified as being maintained "under fire conditions" ensure wiring selected is suitable for the temperatures to be encountered.

Any electrical equipment supplied shall comply with the requirements of the Local Electricity Supplier and the limits for harmonics shall not exceed the limits stated in Engineering Recommendation G 5/4.

A13 – Description of Works and common design criteria

250.000 PLANT OPERATING CONDITIONS
Ensure all plant items are suitable for operation in the environment in which they are to be located.
Ensure all plant, motors, starters and ancillary equipment etc. are suitable for operation at full capacity under the specified conditions

260.000 ROOM TERMINAL LOCATIONS:
The positions of all connection points, accessories, apparatus, equipment and other room terminals shown on the tender drawings are approximate and for guidance in the preparation of the tender.
Agree, with CA, which terminals are subject to final positioning on site.
Allow for the movement of all such terminals up to a radius of 2.0m from the positions shown on the drawings.
Mounting heights indicated in tender documents are for tender purposes only. Confirm mounting heights with the CA before commencing work on site.

271.001 ELECTROMAGNETIC COMPATIBILITY AND ELECTROMAGNETIC FIELDS
Ensure all equipment and installations meet the requirements of relevant legislation:
The Electromagnetic Compatibility Regulations 2016.
The Radio and Telecommunications Terminal Equipment Regulations 2000 as amended.
The Medical Devices Regulations 2002 as amended.
The Supply of Machinery (Safety) Regulations 2008 as amended.
Ensure all equipment and installations are suitable for the electromagnetic environment in which they will operate:
Electromagnetic environment zoning:
Conduct a study to validate the electromagnetic environment at each location.
Domestic, commercial and light industrial environment:
Emissions BS EN 61000-6-3
Immunity BS EN 61000-6-1
Industrial environment:
Emissions BS EN 61000-6-4
Immunity BS EN 61000-6-2
Power station or substation environment:
Emissions BS EN 61000-6-4
Immunity BS EN 61000-6-5
High-altitude Electromagnetic Pulse (HEMP) immunity:
Indoor equipment BS IEC 61000-6-6
Distributed infrastructure DD IEC/TS 61000-5-8
Ensure all systems and buildings are assessed for protection to, and that such protection meets the requirements of, BS EN 62305 and BS 7671 (IET Wiring Regulations) for surge protection and lightning protection.
Ensure electrical power installations comply with the electromagnetic compatibility requirements of BS 7671 (IET Wiring Regulations).
Ensure that earthing arrangements and earthing systems comply with BS EN 50310 and BS IEC 61000-5-2.
Ensure that telecommunications installations comply with BS 6701.
Ensure that data and control systems cabling infrastructure complies with BS EN 50174-series.
Ensure that records of installation practices used to achieve compliance with relevant legislation and standards, are maintained throughout design, installation and commissioning, and are provided in operation and maintenance information.
Validate electromagnetic compatibility of the completed works:
Provide evidence of good EMC installation practices.
Provide evidence of product conformity to relevant legislation and standards for electromagnetic compatibility, and suitability of the equipment for the zone(s) in which it is to be installed and used.
Undertake measurements of electromagnetic emissions on completion, to demonstrate that emission levels are within the limits set by the relevant emissions standard for the electromagnetic environment within each zone.
Comply with the Control of Electromagnetic Fields at Work Regulations 2016 during the construction and commissioning of the works.
Ensure the completed works comply as necessary with the Control of Electromagnetic Fields at Work Regulations 2016.
Ensure that areas intended for general occupation and use, do not exceed the indirect-effect action levels and exposure limit values mandated in the Control of Electromagnetic Fields at Work Regulations 2016.
Ensure that the following are clearly identified in the Operation and Maintenance Manual and where appropriate the Health and Safety File:
All areas where the indirect-effect action levels and exposure limit values may be exceeded, and any relevant precautions, safe methods of work and personal protective equipment, that apply to those areas.
All operations and maintenance activities that may exceed the exposure limit values and/or indirect-effect action levels, along with recommended safe methods of work and personal protective equipment required.

All areas where electromagnetic fields exist that may affect employees at particular risk, including users of active and passive implanted medical devices, body worn medical devices or as a result of pregnancy.

290.000 SOFTWARE

Obtain on behalf of the end user all appropriate licences, permissions, copyright waivers, rights of use and the like from the owners of the software rights. Ensure that the end user is properly registered with the software supplier for support and appropriate updating. Ensure that application software is written in compliance with BS ISO/IEC 26513 and BS ISO/IEC 26514.
Ensure that, as far as practicable, all software is commercially available off-the-shelf.
Ensure that any programmable configuration, customisation and bespoke software, is developed, tested and commissioned using relevant processes and procedures complying with BS ISO/IEC/IEEE 12207 or BS ISO/IEC/IEEE 15288, supported by a quality management system meeting the requirements of BS EN ISO 9001

300.001 EXPLOSIVE ATMOSPHERES:

Ensure that all aspects of the Works comply with relevant legislation including:
- The Control of Major Accident Hazards Regulations 2015 (COMAH).
- Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002 as amended.
- The equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 2016.

Employ relevant standards and guidance appropriate to the project particular scope of works in the design, selection, construction and erection of the Works:
- BS EN IEC 60079/BS EN 60079 - series
- BS EN 13463-2 - Non-electrical equipment for use in potentially explosive atmospheres. Protection by flow restricting enclosure
- BS EN 13463-3 - Non-electrical equipment for use in potentially explosive atmospheres. Protection by flameproof enclosure
- BS EN ISO 80079 / BS EN ISO/IEC 80079 - series
- Association of Petroleum and Explosive Administration (APEA) / Energy Institute publication, Design construction, modification, maintenance and decommissioning of filling stations (Blue Book)
- HSE L138 Dangerous substances and explosive atmospheres. Dangerous Substances and Explosive Atmospheres Regulations 2002. ACOP and guidance (second edition, 2013)

Hazard and operability (HAZOP) study
- Where required and described in the project particular scope of works or schedules undertake a HAZOP - Comply with BS EN 61882 Hazard and operability studies (HAZOP studies). Application guide.

Ensure all equipment and installations are suitable for the explosive atmosphere zone in which they will operate.
- Hazardous area zoning:
- Conduct and document a risk assessment and study to ascertain and validate the hazardous area zoning in accordance with:
  - BS EN 60079-10-1 for explosive gas atmospheres
  - BS EN 60079-10-2 for explosive dust atmospheres
  - Association of Petroleum and Explosives Administration (APEA) / Energy Institute publication, Design construction, modification, maintenance and decommissioning of filling stations (Blue Book)
  - HSE L138 Dangerous substances and explosive atmospheres. Dangerous Substances and Explosive Atmospheres Regulations 2002. ACOP and guidance (second edition, 2013)
- Electrical installations and systems
- Ensure electrical installations and systems are designed, selected and erected in accordance with BS EN 60079-14 and BS 7671 (IET Wiring Regulations).
- Ensure electrical installations and systems are designed to be maintained in accordance with BS EN 60079-17 and BS EN 60079-19.
- Ensure intrinsically safe electrical systems and equipment comply with BS EN 60079-25.

Ensure equipment and other products conform to relevant parts of BS EN IEC 60079/BS EN 60079, BS EN ISO 80079 / BS EN ISO/IEC 80079 series and BS EN 13463 for the zone(s) in which they are to be installed and used.
Ensure electrostatic hazards are controlled in accordance with PD CLC/TR 60079-32-1.
Provide evidence of conformity to the relevant legislation for the completed Works:
- Provide evidence of product conformity to relevant legislation and standards for explosive atmospheres, and suitability of the equipment for the zones(s) in which it is to be installed and used.

A13 – Description of Works and common design criteria

310.000 CYBER SECURITY AND DATA PROTECTION:

Ensure that all systems and software provided to this specification facilitate the end user's compliance with the Data Protection Act 2018.
Standards:
- Relevant parts of BS EN 61508 functional safety for electrical/electronic/programmable electronic safety-related systems
- BS IEC 62443-3-3 and BS EN IEC 62443-4-1 security requirements industrial automation and control systems
- BS 7799-3, BS ISO/IEC 15408-1, BS ISO/IEC 15408-2 and BS ISO/IEC 15408-3 for evaluating and assuring IT security risks.
- BS ISO/IEC TR 13335-5 for management of network security.
- PAS 555:2013.
- IET Code of Practice for Cyber Security in the Built Environment

Ensure systems are designed, so far as practicable, to be sufficiently robust to cyber-attack.
Ensure systems are designed, so far as practicable, that they fail safely when compromised.
Ensure systems include for information security monitoring, measurement and analysis in accordance with BS ISO/IEC 27004
Ensure that all software, configuration and system integration activities are implemented, tested and commissioned using relevant information technology security management processes and procedures complying with BS EN ISO/IEC 27000, BS EN ISO/IEC 27001 and BS EN ISO/IEC 27002.
- Ensure systems are protected against cyber security threats prior to handover.
- Ensure all necessary provisions are in place to prevent unauthorised access to systems, equipment and software prior to taking over.
- Ensure all operatives involved in testing of security-related environments and systems are screened in accordance with BS 7858.

Ensure that software and firmware updates can be applied to ensure continued security of the delivered systems.
- Provide software and firmware roadmaps for all products.
- Unless detailed elsewhere in this specification, ensure software and firmware is supported for at least 10 years following handover.
- Provide a software and firmware support and maintenance strategy for all delivered systems.

Ensure all systems and software are audited for compliance in accordance with BS ISO/IEC 27007 and PD ISO/IEC TS 27008, by a company certified to BS ISO/IEC 27006.

10000 Based on NES VERSION A13 Dec 19

A20 – The Contract / Sub-Contract

140.001 PRODUCT GUARANTEES AND WARRANTIES

Comply with the following and the main contract preliminaries.

Product guaranties and warranties provided by manufacturers, shall be valid or be extended up to the end of the Defects Liability Period.

Any product guaranteed or warranted by a manufacturer for a period of time which extends beyond the end of the defects Liability Period shall remain under guarantee or warranty up to the end of the extended period.

Copies of all guarantees or warranties include in each Operation and Maintenance Manual and hand over one additional set on or before Practical Completion.

10000 Based on NES VERSION A20 June 17

A31 – Provision, Content and Use of Documents

100.000 DEFINITIONS AND INTERPRETATIONS

120.000 DEFINITIONS
The definitions of technical terms associated with the engineering services installations are those included in CIBSE, IOP and BSRIA Technical Publications
Loss Prevention Council – Rules for Automatic Sprinkler Installations
BS 7671 – Requirements for Electrical Installations (IET Wiring Regulations).
British Standards, including Codes of Practice.
Associated Statutory Acts.

Where used in the documentation the following definitions shall apply

Duct -An enclosed space specifically intended for the distribution of services, with direct access for personnel.
Trench -A covered horizontal service space in the floor or ground with access from above.
Cavity -A space enclosed within the elements of a building within which services are installed, e.g. the space between ceiling and floor above. See Building Regulations.
Service Areas -Includes areas within a building with limited finishes such as loading bays, car parks etc.
Concealed Services - Includes installations within ducts, trenches cavities.
Exposed Services- Includes installations within plant rooms, outdoors or unprotected within "service" or occupied areas.
System - System means all equipment, accessories, controls, supports and ancillary items, including supply, installation, connection, testing, commissioning and setting to work necessary for that section of the Works to function.
Services - Services means the inclusion of one or more system.

Drawing definitions are generally in accordance with the latest edition of BSRIA BG6, see clauses 150.001 to 183.000.

130.000 REFERENCES TO BSI DOCUMENTS
References to BSI documents are to the versions and amendments listed in the British Standards Catalogue and in subsequent issues of BSI News up to and including the date of Tender.

140.000 MANUFACTURERS' REFERENCES
Manufacturers' references are those current at the time of preparation of the Tender documents.
References mean the particular product as specified in the manufacturer's technical literature current at that time.

150.001 TENDER DRAWINGS
Tender drawings means drawings listed in the Schedules.
The tender drawings show the general arrangement of the Engineering Services to be provided and the inter-relationship of the Works with work to be installed by others.

The drawings are accordingly part diagrammatic, with runs of piping, ducts and cableways being shown to small scale and not necessarily indicating exact installation positions.

The drawings do not necessarily show dimensions required to construct the works, nor do they accurately locate every item of equipment or plant ancillary which does not affect the visual impact of the completed works.

The drawings do not detail the building fabric or structure whether new or existing, nor are they necessarily based upon survey information.

160.000 DRAWINGS DEFINITIONS GENERALLY
The following clauses define concept sketch drawings, concept schematics, developed design drawings, developed schematics, technical design drawings, builder's work information, co-ordination/co-ordinated working drawings, installation drawings, builder's work details, manufacturer's drawings and record drawings. The definitions are from the latest edition of BSRIA BG 6 with the exception of Controls Logic Diagrams and Switchgear and Starter and Control Instrumentation Panel Drawings.

160.001 BIM USE ON THE PROJECT:
When applicable the use of BIM (Building Information Modelling), during the project will be as described in the general scope of works / particular specification and / or Main Contract Preliminaries.

A31 – Provision, Content and Use of Documents

Contribute to the BIM Execution Plan/ Master Information Delivery Plan and confirm the supply chain's capabilities in response to the EIR.
Contractor to demonstrate collaborative 3D Level 2 BIM maturity through defined and compliant information and data on the project
Comply with relevant parts of BS 8541 for Library objects for architecture, engineering and construction classification
2D symbols will be used as per BS 8541-2.
Information delivery as BS ISO 29481-1.
Comply with the following codes and standards as appropriate:

- Relevant parts of BS EN ISO 19650 and PD 19650-0 for collaborative production of information organization and digitization of information about buildings and Specification for Information Management for the Capital/Delivery/Phase of Construction Projects using Building Information.
- PAS 1192-3 Specification for information management for the operational phase of assets using building information modelling
- BS 1192-4 Collaborative production of information. Fulfilling employer's information exchange requirements using COBie. Code of practice
- PAS 1192-5 Specification for security-minded building information modelling, digital built environments and smart asset management
- CIC BIM Protocol
- Government Soft Landings (GSL)

161.000 CONCEPT SKETCH DRAWINGS
Line diagrams and layouts indicating basic proposals, connections to incoming services and utilities, locations of areas of central plant, location and extent of main vertical and horizontal distribution routes in such detail as to illustrate the incorporation of the engineering services within the project as a whole and with respect to any zoning.

161.005 CONCEPT SCHEMATICS
Line diagrams indicating main items of plant and their interrelationships, including incoming services and utilities in such detail as to illustrate the incorporation of the engineering services within the project as a whole.

162.000 DEVELOPED DESIGN DRAWING
A drawing showing the extent of the services installations. The main features of developed design drawings should be as follows:

- Plan layouts to a scale of at least 1:100 with key areas at 1:50.
- Show the extent and types of services terminals visible within the occupied space. Alternatively these can be quantified and scheduled either as a tag on the drawing or as a separate schedule of room data sheet.
- Show approximate locations of horizontal and vertical service runs.
- Show main plant and distribution system sizes, particularly those affecting spatial allocation, while acknowledging that these may need some adjustment and refinement in the operation of the technical design drawings and equipment schedules.
- Pipework and electrical containment represented by single line layouts. Ductwork represented by either double line or single line layouts as required to demonstrate that the routes indicated are feasible (this should be supplemented with key sections / elevations). Symbols and lines conventions in accordance with either a recognised standard (ISO of BS), or a supplied legend.
- Show how space within risers and service zones is allocated to M, E and PH services.
- Where appropriate these drawings should indicate typical room / area details to show key principles of the systems within or serving them.

162.005 DEVELOPED DESIGN SCHEMATICS:
Line diagrams describing the interconnection of components in a system showing the engineering principles. The main features of a developed schematic drawing are as follows:

- The drawings should include all the functional components that make the system work, such as main plant distribution, inline equipment supporting engineering performance, terminal plant providing HVAC performance. Quantities of performance-specified components should only be indicative with accurate quantities on schedules or similar.
- Symbols and line conventions in accordance with a recognised ISO or BS standard or supplied legend.
- Label the drawings with appropriate pipe, duct, busbar and cable sizes, pressures and flow rates. These details may be subject to adjustment during the technical design and construction stages.

Indicate components which have a sensing, control or measurement function.

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The major components indicated on the schematic drawings should be identified for cross-referencing purposes.
Where appropriate these drawings should indicate typical room / area details to show key principles of the systems within or serving them.

163.000 TECHNICAL DESIGN DRAWING:
A drawing showing the intended locations of plant items and service routes in such detail as to indicate the design.
The main features of technical (detail) design drawings should be as follows:

- Plan layouts to a scale of at least 1:100.
- Plant areas to a scale of at least 1:50 and accompanied by cross-sections and elevations as appropriate.

The drawing will not indicate the precise position of services, but it should nevertheless be feasible to install the services within the general routes indicated. It should be possible to produce co-ordinated working drawings or installation drawings without major rerouting of the services. The design must also consider procurement and installation methodologies.

163.002 TECHNICAL DESIGN SCHEMATICS:
Line diagrams describing the interconnection of components in a system showing the engineering principles. The main features of a Technical Design schematic drawing are as follows:

- The drawings should include all the functional components that are to be installed. This includes main plant distribution, inline equipment, terminal plant and components, control components.
- Symbols and inline conventions in accordance with a recognised ISO or BS standard or a supplied legend.
- The drawings should be labelled with appropriate pipe, duct, busbar, cable sizes and fault levels, pressure and flow rates. These details may be subject to adjustment during the construction stage.
- The major components indicated on the schematic drawings should be identified for cross-referencing purposes.
- Where necessary, control methodologies such as load shedding and capacity.

163.005 BUILDER'S WORK INFORMATION:
A drawing to show the provisions required to accommodate the services which significantly affect the design of the building structure, fabric and external works.
Drawings (or schedules) of work to be carried out by building trade and required to be costed at the design state e.g. plant bases.
Drawings to show requirements for building works necessary to facilitate the installation, maintenance and where appropriate the future replacement of the engineering services (other than where it is appropriate to mark out on site).
Drawings shall include for any temporary works to allow installation of the services to the programme

164.000 CO-ORDINATED WORKING DRAWINGS:
Drawings showing the inter-relationship of 2 or more engineering services and their relation to the structure and building fabric. The main features of a co-ordinated drawing are as follows:

- Plan layouts to a scale of at least 1:50, accompanied by cross-sections to a scale of at least 1:20 for all congested areas.
- The drawing should make allowances for installation, commissioning, maintenance and replacement working space and methodologies.
- The drawing should be spatially co-ordinated and there should be no physical clashes between the system components when installed. Critical dimensions, datum levels and invert levels should be provided.
- The spaces between pipe and duct runs shown on the drawing should make allowance for the service at its widest point. Allow for insulation, standard fitting dimensions and joint widths on the drawing.
- Indicate positions of main fixing points and supports where they have significance to the structural design or spatial constraints.

165.001 INSTALLATION DRAWING:
A drawing based on the Technical Design drawing or co-ordinated working drawing with the primary purpose of defining that information needed by the tradesmen on-site to install the works.
Ensure such drawings relate where relevant to builders' work, architectural, structural and other drawings and site surveys.
The main features of installation drawings should be as per co-ordinated working drawings plus:

- Allowances for inclusion of all supports and fixings necessary to install the works.
- Allowances for installation details provided from manufacturers' drawings.

Allowances for plant and equipment. This includes any alternatives to the designer's original specified options that have been chosen.
Space for associated support systems, installation, methodologies and access for maintenance and replacement.
Where co-ordinated working drawings have not been produced, the installation drawing should include co-ordination.

166.000 INSTALLATION WIRING DIAGRAM:
Drawing showing the interconnection of electric components, panels etc in accordance with the design intent indicated in the schematic drawings and incorporating the details provided on manufacturer's certified drawings.
Indicate the following: maximum electrical loading for each supply cable; cable termination facilities; and cable identification and all terminal numbers.

166.005 BUILDER'S WORK DETAILS:
Drawings to show requirements for building works necessary to facilitate the installation of the engineering services.
Unless agreed otherwise, the following can be marked out on-site.
Holes less than the threshold agreed by the team.
Electrical socket and switch boxes
Openings that are best cut into blockwork or partitions

168.000 MANUFACTURER'S DRAWING
Drawing prepared by a manufacturer, fabricator or supplier for a particular project and which is unique to that project. Examples include drawings for ductwork, pre-fabricated pipework, sprinkler systems, control and switchgear panels and associated internal wiring, pre-fabricated plant, customised plant and equipment.

169.000 MANUFACTURER'S CERTIFIED DRAWING
Drawing provided by a manufacturer or supplier to indicate details of the product, components or plant items and which the manufacturer or supplier guarantees the supplied equipment will comply with.

170.001 RECORD DRAWING
Drawing showing the building and services installations as installed at the date of practical completion. The record drawings shall be as defined in A37 and below.
Drawing showing the building and services installations as installed at the date of practical completion. The main features of the record drawings should be as follows:
Use a scale not less than that of the installation drawings.
Include locations of all the mechanical, electrical and public health systems and components installed including ducts, pipes, cables, busbars, plant items, pumps, fans, valves, dampers, control devices, strainers, terminals, electrical switchgear and components, security and fire sensors and control components.
Labelled with appropriate pipe, duct and cable sizes, pressures and flow rates.
Have marked on the drawings the positions of access points for operating and maintenance purposes.
The drawings should not be dimensioned unless the inclusion of a dimension is considered necessary for location.

180.000a CONTROLS LOGIC DIAGRAMS / DRAWINGS
Tender drawings and/or schematic details of all main plant items and associated control components showing the conceptual arrangement of the plant with each item identified together with a description of the controls operation and details of the associated interlocking. Where terminal units are included on the controls diagrams they show the "typical" control requirements for each unit. The Controls Specialist shall establish actual quantities of terminal units and associated control components from the detail design drawings and/or equipment schedules.

181.001 SWITCHGEAR, STARTER AND CONTROL INSTRUMENTATION PANEL DRAWINGS
Drawings showing the construction and internal wiring diagrams of the starters, panels and/or other devices.

181.002 WIRING/CONNECTION DIAGRAMS
Drawings, diagrams or schedules detailing interconnections between control panels, motors, control components, etc.

182.000 AS-INSTALLED DRAWINGS
Drawings/records retained on site to record the progress of and any site modifications to the Works including any changes to software.

183.000 PLANTROOM SCHEDULES AND SCHEMATICS
Drawings or schedules as defined in A37.

190.000 EXAMINATION OF DRAWINGS/INFORMATION
The CA will examine the propositions submitted for compliance, in principle, with the design intent.
Such an examination shall not relieve the originator of such documents of their responsibilities and obligations under the contract.

200.000 DOCUMENTS PROVIDED ON BEHALF OF THE EMPLOYER

200.005 CONTRACT DOCUMENTS
Contract documents means those documents, including drawings and specifications, on which the contract for the Works is based.

201.000 INTERPRETATION OF DOCUMENTS
Drawings provided to a scale of 1:50 or smaller and/or expressed in symbolic terms or which are in diagrammatic format, give indicative locations only and details of components are not to be inferred.
Arrangements shown on Tender Drawings are intended to indicate layout to be generally adhered to, but actual routes of services are to be such as to ensure the neatest possible arrangement.
Notify the Contract Administrator of any conflict of information arising from the use of the specification or drawings.

300.000 DOCUMENTS TO BE PROVIDED AND DESIGN ACTIVITIES BY SUBCONTRACTOR

310.001 DESIGN AND PRODUCTION INFORMATION
Complete the design and detailing of the work additional to that incorporated in the Tender documents and provide complete production information (including, as appropriate, fabrication/ installation drawings, design calculations, specifications, etc.) based on the drawings, this specification and other information provided, liaising with the CA, Principal Designer, Contractor and others as necessary to help ensure co-ordination of the work with related building elements and services.

Request additional information as necessary from the CA and/or Contractor and provide information as necessary in time to meet the programme.

Submit sufficient copies of the design/production information as specified.
Submittals will be examined for compliance in principle with the design intent. Such examination shall not relieve any responsibilities and obligations under the contract or mean that the CA is responsible for the correctness of the submittal or its suitability for purpose.
The CA will record their comments and return to the Subcontractor who shall make any necessary amendments without delay

If submitted design/production information differs from the requirements of the Subcontract documents each such difference must be brought to the attention of the CA, supported by all relevant information.
Prior to submission check and approve all drawings, schedules and any other information provided by manufacturers, nominated suppliers or specialist sub-subcontractors to ensure that all the requirements of the contract documentation have been incorporated. Accompany all documents submitted with a certificate indicating that they have been checked by the Subcontractor.

Submittals will be returned indicating A, B or C action
Status A – No Comment, Status B – Minor Comment, Status C – Rejected.
Documents, which are Status “C”, must be re-submitted. Unless and until it is confirmed that resubmission is not required, resubmit for further checking and comment, and incorporate any necessary amendments all as before.

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320.001

330.000 PREPARATION OF DOCUMENTS
Prepare drawings to commonly recognised scales generally on A1 sheets and details and schedules on A4 sheets.

Prepare electrical drawings in accordance with BS EN 61082-1.

340.001 SYMBOLS
Use symbols and line conventions generally as Tender Drawings. Agree additional notation before preparing drawings.

350.000 DOCUMENT NUMBERING/REGISTRATION SYSTEM
Agree with the CA the document numbering/registration system to be used before preparing any documents.

370.001 TECHNICAL LITERATURE
The Contractor is required to keep copies of any relevant manufacturers' installation or technical literature readily accessible for reference by all supervisory personnel.

380.001 MAINTENANCE INSTRUCTIONS AND GUARANTEES
Retain copies delivered with components and equipment or obtain from manufacturer as necessary and hand over to CA on or before Practical Completion.

10000 Based on NES A31TEXT Dec 19

A32 – Management of Work

120.000 CO-OPERATE
Co-operate with the Contractor, other subcontractors, suppliers, local authorities and statutory undertakings in the execution of their work.

130.000 PROGRAMME/PROGRESS
Provide a programme for the Contract Works.
Due allowance is to be made in the programme(s) for the Works for, but not limited to, the following:
- Ordering and installation periods.
- The completion of drawing, etc. including the 20 days working days for comment
- Work resulting from instructions issued in respect to the expenditure of provisional sums.
- Concurrent work by other trades.
- Any temporary works necessary for the completion of the engineering services installations.
- Pre-commissioning, commissioning and performance testing of the engineering services installations.
- Preparation and provision of Record Drawings and Operating and Maintenance Manuals.

Provide programme information as resource loaded tracking Gantt chart or PERT diagram unless specified otherwise elsewhere in the specification or main contract preliminaries.
Provide a separate and detailed commissioning programme for agreement with the CA. Make due allowance for the following:
- Commissioning, demonstration and instruction procedures.
- Provision of written notice before each (or series of) test, inspection, commissioning or demonstration procedures are to be carried out
- Demonstration to the CA that test instruments and equipment are accurate.

131.000 COMMISSIONING PROJECT MANAGEMENT:
Undertake Commissioning Management in accordance with CIBSE commissioning code M.

Compile a detailed commissioning programme and confirm/agree with the main contractor.
Complete and submit to the project supervisor the appropriate health and safety method statements and risk assessments.
Establish a means (such as checklists) of monitoring the progress of the commissioning.
Ensure that all parties involved in the commissioning process have documentation procedures for dealing with variations to contract. Ensure that a control mechanism is set up which includes documentary backup of what has been changed, how and why.
Establish a consistent numbering system to identify work items.
Ensure the consistent use of mnemonics to identify all BMS components and devices.
Ensure regular database and configuration backups are made throughout all stages of the commissioning process.
Ensure attendance of all appropriate and responsible parties for interface pre-commissioning tests (interface between BMS and other plant items/systems).

136.000 INSTRUCTIONS
Apply for instructions, drawings, etc. in writing, in good time.

140.000 ASSESSMENT AND MONITORING
Record progress of the Works weekly on a copy of the programme kept on site.
Update programme without delay if any circumstances arise which affect the progress of the Works.
Mark up "As Installed" details weekly and before any work is hidden from view.
Where required, environmental assessment of project to meet the criteria for the target rating under the relevant BREEAM Scheme.
Where required, assessment of the project in terms of wellbeing-related features to meet the criteria for the target level of achievement /level of certification under the WELL Building Standard.

150.000 INSPECTION AND MEASUREMENT OF WORK
Provide all necessary assistance to enable CA to examine or measure the Works.

160.000 COVERING-UP
Ensure no section of the Works are covered, concealed insulated until completion of a witnessed satisfactory test.
Give not less than 10 working days' notice when Works which are to be covered or concealed are ready for examination and/or measurement.

A32 – Management of Work

170.000 STATUTORY AUTHORITIES
Orders for the incoming services will be placed by the Main Contractor unless detailed otherwise in the scope of works .

Liase with the Statutory Authorities and provide any test notices required to ensure final connections are made in accordance with the requirements of the testing and commissioning programme

180.000 TEST NOTICES
Provide all formalities in connection with Test Notices, Agreement and Application for Supply Forms etc.
Ensure all documents requiring the Employer's signature are forwarded to the CA in time to meet the building programme in order for the necessary test and supply arrangements to be made.
No additional payments will be made for expenses incurred due to reconnections, re-visits etc., by Supply Authorities or any other officials.

A33 – Quality Standards / Control

130.000 SUBCONTRACTOR'S PERSON-IN-CHARGE
Appoint a foreman-in-charge and/or site agent to ensure constant management and supervision of the Subcontract Works.
Give maximum possible notice before changing the foreman-in-charge or site agent.

140.000 DIMENSIONS
Where installations are dependent upon site dimensions ensure that these are available before proceeding with the Works.
Do not take dimensions by scaling from the drawings.
Where dimensions are indicated on drawings or schedules check these on site, as appropriate, to ensure building construction and manufacturing tolerances can be accommodated.
Do not order or manufacture equipment using dimensions indicated on the Tender drawings, specification or schedules.

145.000 ASSESSMENT AND MONITORING:
Record progress of the Works weekly on a copy of the programme kept on site. Update or redraft programme without delay if any circumstances arise which affect the progress of the Works.
Mark up "As Installed" details weekly and before any work is hidden from view.
Where required, environmental assessment of project to meet the criteria for the target rating under relevant BREEAM Scheme.
Where required, assessment of the project in terms of wellbeing related features to meet the criteria for the target level of achievement / level of certification under the WELL Building Standard.

150.000 SETTING OUT FOR THE SUBCONTRACT WORK
Where this is done by the others check its accuracy and obtain their approval before proceeding with the work.

160.000 SITE MODIFICATIONS
Do not make site modifications to assemblies without authorisation.
Where site modifications to assemblies are authorised make in accordance with manufacturer's certified drawings and instructions. Ensure that modifications made comply with any type test certificate obtained for arrangement of components.

170.001 STANDARDS AND REGULATIONS
Provide all materials and works in accordance with the appropriate British Standard or Code of Practice current at the time of tender and where no BS or CP is applicable the Agrement Certificate for the particular item.
Provide products in accordance with the Construction Products Regulations (CPR). Products covered by harmonised European product standards (hENs) must have a Declaration of Performance (DoP) certificate for the product and be CE marked. Manufacturers of products not fully covered by a hEN or which do not fall within the scope of a hEN shall provide Declaration of Performance documentation in accordance with one of the methods in the CPR.
Comply with all statutory instruments and regulations, and local bylaws relating to the area of the site current at the date of tender.
Comply with the requirements of the Local Authority Building Inspector.
Comply with all relevant requirements included in the Main Contract Preliminaries

Comply with all Statutory Obligations arising from current legislation and regulations, together with other requirements, including, but not limited to, the following as applicable to particular projects

- Statutory Obligations and codes of practice
- For Building Regulations refer to clause A33:172.000
- Health and Safety at Work etc. Act 1974
- HSE L8 Legionnaires' Disease. The Control of Legionella Bacteria in Water Systems ACOP and all parts of HSG274 (for technical guidance). Where required produce risk assessments in accordance with BS 8580-1.
- HSE L5 Control of Substances Hazardous to Health. ACOP and guidance (sixth edition, 2013).
- The Electricity at Work Regulations 1989 as amended and HSE HSR25 Guidance on Regulations (third edition, 2015).
- Management of Health & Safety at Work Regulations 1999
- HSE L8 Legionnaires' Disease. The Control of Legionella Bacteria in Water Systems ACOP and all parts of HSG274 (for technical guidance).
- HSE L5 Control of Substances Hazardous to Health. ACOP and guidance (sixth edition, 2013).

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- Gas Safety (Installation and Use) Regulations 1998
- HSE L56 Safety in the Installation and Use of Gas Systems and Appliances: Gas Safety (Installation and Use) Regulations 1998. Approved Code of Practice and guidance (fifth edition, 2018).
- The Gas Appliances (Enforcement) and Miscellaneous Amendments Regulations 2018.
- The Gas (Meters) Regulations 1983 as amended.
- The Measuring Instruments Regulations 2016 as amended.
- The Petroleum (Consolidation) Regulations 2014.
- The Control of Pollution (Oil Storage) Regulations 2001 as amended.
- The Pipelines Safety Regulations 1996 and amendments
- HSE L82 Guide to the Pipelines Safety Regulations 1996.
- Pressure Systems Safety Regulations 2000 as amended
- HSE L122 Safety of Pressure Systems. Pressure Systems Safety Regulations 2000. ACOP and guidance (second edition, 2014).
- Pressure Equipment (Amendment) Regulations 2015 and The Pressure Equipment (Safety) Regulations 2016.
- The Confined Spaces Regulations 1997
- HSE L101 Safe work in confined spaces. Confined Spaces Regulations. ACOP and guidance (third edition, 2014).
- Work at Height Regulations 2005
- The Energy Performance of Buildings Regulations (England and Wales) Regulations 2012 and amendments.
- The Ecodesign for Energy-Related Products Regulations 2010 as amended.
- The Renewable Heat Incentive Scheme Regulations 2018 and the Domestic Scheme Regulations 2014, both as amended.
- England and Wales - The Water Supply (Water Fittings) Regulations 1999 as amended, the Water Act 2014 and The Construction Products Regulations 2013.
- Scotland - The Water Supply (Water Fittings) Byelaws 2014.
- Northern Ireland - The Water Supply (Water Fittings) Regulations 2009.
- Building (Inner London) Regulations 1987, as amended.
- The Electricity Act 1989 as amended.
- The Electricity at Work Regulations 1989
- The Electricity Safety, Quality and Continuity Regulations 2002 and current amendments.
- Factories Act 1961 and current amendments.
- Clean Air Act 1993 and current amendments.
- The Environmental Protection Act 1990 and current amendments.
- Air Quality Standards Regulations 2010 appropriate to project location.
- The Fluorinated Greenhouse Gases Regulations 2015 as amended.
- The Workplace (Health, Safety and Welfare) Regulations 1992
- HSE L24 Workplace health, safety and welfare. ACOP and guidance (second edition, 2013).
- The Construction (Design and Management) Regulations 2015.
- The Health and Safety (Display Screen Equipment) Regulations 1992 as amended
- HSE L26 Work with display screen equipment. Health and Safety (Display Screen Equipment) Regulations 1992 as amended (Miscellaneous Amendments) Regulations 2002. Guidance on Regulations (second edition, 2003).
- The Clean Air (Arrestment Plant) (Exemption) Regulations 1969 (Wales only).
- The Control of Substances Hazardous to Health (COSHH) Regulations 2002, as amended
- HSE L5 Control of Substances Hazardous to Health. ACOP and guidance (sixth edition, 2013).
- HSE L8 Legionnaires' Disease. The Control of Legionella Bacteria in Water Systems ACOP and all parts of HSG274 (for technical guidance).
- Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002 as amended.
- HSE L138 Dangerous substances and explosive atmospheres. Dangerous Substances and Explosive Atmospheres Regulations 2002. ACOP and guidance (second edition, 2013).
- The Control of Major Accident Hazards Regulations 2015 (COMAH).
- The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016.
- CLP - Classification, Labelling and Packaging of Substances and Mixtures, Regulation (EC) 1272/2008, and amendments.
- Control of Asbestos Regulations 2012 as amended
- HSE L143 Managing and working with asbestos. Control of Asbestos Regulations 2012. ACOP and

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guidance (second edition, 2013).
- The Provision and Use of Work Equipment Regulations 1998 (PUWER) as amended.
- HSE L22 Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. ACOP and guidance (fourth edition, 2014 as amended).
- Personal Protective Equipment at Work Regulations 1992
- HSE L25 Personal protective equipment at work. Personal Protective Equipment at Work Regulations 1992. Guidance on Regulations (third edition, 2015).
- The Lifting Operations and Lifting Equipment Regulations 1998 (LOLER) as amended
- HSE L113 Safe use of lifting equipment. Lifting Operations and Lifting Equipment Regulations 1998. ACOP and guidance (second edition, 2014 as amended).
- The Equality Act 2010 and current amendments.
- BS 8300-1 and BS 8300-2
- The Electrical Equipment (Safety) Regulations 2016
- The Control of Electromagnetic Fields at Work Regulations 2016.
- The Electromagnetic Compatibility Regulations 2016.
- The Radio and Telecommunications Terminal Equipment Regulations 2000 as amended.
- The Medical Devices Regulations 2002 as amended.
- The Supply of Machinery (Safety) Regulations 2008 as amended.
- Public Utility Company and/or Statutory Authority regulations, specifications, and requirements.
- Other Requirements
- British Standards and Codes of Practice.
- BS 7671 - Requirements for Electrical Installations (IET Wiring Regulations).
- BS EN 50110 series - Operation of Electrical Installations.
- Relevant parts of BS EN ISO 14122 for general requirements for safe access.
- Comply with the recommendation in BS 8560 for incorporating safe work at height into the design of buildings during the design process.
- When the provision of ducts in buildings for services forms part of the scope of works, comply with BS 8313 for the design, construction and installation of ducts and installation of services in the ducts.
- Insurance Company Requirements.
- IEC Standards.
- This specification is based on UK and European Standards, to achieve an approach for safety and compatibility for electrical, data network and information technology installations, and equipment, aligning with the European Committee for Electrotechnical Standardisation (CENELEC) approach.
- Identify any instances where the proposed solution does not conform to the above.

Public Utility Company and/or Statutory Authority regulations, specifications, and requirements.
With regard to Gas Act 1986 and the Electricity Act 1989 (consolidated under the Utilities Act 2000) and supporting regulations. Under this legislation where a meter is used to measure the amount of energy supplied for billing purposes, the meters must be of a type verified and approved by OFGEM. In addition, for electricity supplies to domestic customers by licensed suppliers, a certified meter must be used.

All *"equipment"* (mechanical and electrical) that could represent a potential ignition source intended for use in potentially explosive atmospheres must comply with the ATEX Directive 94/9/EC, which is enacted by "The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations, 2016" and "The Dangerous Substances and Explosive Atmospheres Regulations 2002"
The term ***"equipment"*** (with reference to the ATEX directive) is defined 'any item which contains or constitutes a potential ignition source and which requires special measures to be incorporated in its design and/or its installation in order to prevent the ignition source from initiating an explosion in the surrounding atmosphere.' Also included in the term "equipment" are safety or control devices installed outside the hazardous area but having an explosion protection function. "Protective Systems" are defined as items that prevent an explosion that has been initiated from spreading or causing damage. They include flame arresters, quenching systems, pressure relief panels and fast-acting shut-off valves.

Comply with the requirements of the Local Authority Building Inspector. Comply with the requirements of the latest version of Approved Documents L2A/B / L1A/B of The Building Regulations and Part 6 of the Technical Standards in Scotland and all 2nd and 3rd tier documents referred to in these documents.

Notify all authorities in accordance with their regulations and obtain any required approvals for the installation.

Where no specific design, performance or installation standards are quoted the following shall apply:

CIBSE and BSRIA Guides.
CIBSE Codes of Practice / commissioning codes.
CIPHE Plumbing Engineering Services Design Guide.
CIBSE (SLL) Code for Lighting and SLL Lighting Guides.
CIBSE Technical Reports.
CIBSE Technical Memoranda.

Ensure all equipment and systems are designed and installed in accordance with the relevant standards and that operational compatibility exists between the systems and any other system installed at the same location.
Supply plant and equipment to achieve the specified design conditions and to provide stable control.

In the absence of specific design, performance or installation standards being stated seek the instructions of the CA prior to commencement of the Works and with adequate time so as not to cause delay.

When new editions, versions and amendments are published during the construction, seek the instructions of the CA with respect to any modifications or changes necessary.

When applicable, comply with requirements for all targeted BREEAM credits and supply relevant information to the BREEAM Assessor. Targeted credits will be as agreed with the client and BREEAM assessor/advisor.

170.002 SUITABILITY OF MATERIAL AND PRODUCTS:
Use materials and products which:

are new unless specified otherwise.
are suitable for the services and conditions of use normally expected to apply after the installation is complete.
are able to withstand the testing and commissioning conditions specified.
do not initiate mould growth, support vermin, contain animal hair, contain crocidolite or support bacterial life.
do not involve the use of CFC's at any stage of manufacture, installation or subsequent operation except where specified.
are free from objectionable odours of the maximum or normal working conditions of operation.
do not suffer deterioration at the maximum or specified conditions of operation.
are capable of being applied to a base surface without causing damage or deterioration of the base.
are not a fire hazard, and do not evolve dense or toxic fumes when subjected to excessive heat, such as a fire.
when of similar type, are made by the same manufacturer.
whenever possible ensure products are manufactured and/or stocked under one of the following:

BSI Kitemark Scheme
BSI Safety Mark Scheme
from Firms of Assessed Capability to BS ISO 9001
from Stockists of Assessed Capability to BS ISO 9001

170.003 DELETERIOUS MATERIALS
No material generally known to be deleterious are to be used in, or incorporated into, any temporary or permanent Works forming part of the Project.

In particular none of the following items are to be used
: Asbestos or asbestos based products
: Urea formaldehyde or materials which may release formaldehyde in quantities which may be hazardous with reference to the limits set by the HSE
: Material containing fibres less than three microns diameter or 200 microns long
: Lead or any material or product containing lead which may be ingested, inhaled or absorbed
: Polychlorinated biphenyl
: Fibres not sealed or otherwise stabilised to ensure that migration is prevented
: Vermiculite containing fibrous dust
: Polytetrafluoroethylene (IPTFE) except for pipework jointing

Any other products or materials which are generally known within the Building Industry to be deleterious or hazardous to health or safety or to the durability of the property in the circumstances in which they are used including:

: High alumina cement and/or concrete
: Woodwool slabs used as permanent shuttering
: Calcium chloride in admixtures for use in reinforced concrete
: Sea-dredged aggregates for use in reinforced concrete which do not comply with current British Standards
: Aggregates for use in concrete which do not comply with current British Standards
: Alkali reactive aggregates
: Calcium silicate bricks or materials

The Contractor shall check with the manufacturers and/or suppliers of products and materials that any specified product contains such material. If any specified product contains such material, the Contractor shall request and alternative specification of product or manufacturer.

170.004 SAMPLES
Submit samples as detailed elsewhere to the Contract Administrator. Retain on site until the completion of the contract.

The samples shall not be used in the final installation.

172.000 BUILDING REGULATIONS:
The engineering services design, installation, testing and commissioning shall comply with the latest version of Buildings Regulations / Approved Documents or Technical Handbooks and any supplementary guidance, including all amendments, based on the project location. For the UK devolved nations all relevant equivalent documents shall apply.
Where specific reference is made to Building Regulations and / or particular Approved Documents in some specification work sections the text is based on Building Regulations or Approved Document applicable to England. Where the project is in one of the UK devolved nations, then the equivalent documents used by that nation shall apply.

180.000 TYPE TESTS
Provide certificates of verification of type tests. Ensure that drawings and other documents forming part of certificate are available prior to any order being placed.

190.000 TEST CERTIFICATES
Where testing specific to the project is required, ensure test certificates include:
Project title.
Details and date of test.
Instruments used, serial numbers, calibration dates.
Signature of those witnessing test.
Contractor's name.
Specific location of the item in the Works.

200.000 INSPECTION AND TESTS – ON OR OFF-SITE
Submit schedules showing those parts of the Works for which inspections and tests are required in the specifications, to substantiate conformity with the Specification and for which records are required to be maintained.
Should any alternative item be proposed which does not carry appropriate certification, ensure independent testing is carried out at no expense to the Employer to confirm compliance.
Where required, provide formal method statements supported by risk assessments detailing the procedures for carrying-out on site tests.
Agree in advance with all parties procedures for inspections and tests including periods of notice.
Where a test indicates non-compliance with the Specification submit immediately details of the non-compliance and proposals for corrective action.
Arrange access for personnel who require to be in attendance, to manufacturer's or other off site premises when any inspections and tests carried out.

A33 – Quality Standards / Control

Attendance or otherwise of the supervisory personnel during specified inspections or tests will not reduce the obligations or restrictions of the Contract.
Carry out all tests required by legislation under the direction of a "competent person".

210.000 INSPECTIONS AND TEST RECORDS
Prepare a set of drawings and/or report sheets to record accurately the test and inspection information including the following.

Plant identification, section and installation under test.
Manufacturer's reference number.

Date, time, duration of test, weather conditions.
Test results with itemised readings including records of all other checks and tests.
Maintain records of all specified inspections and tests performed including third party and works test certificates.
Include in records, as appropriate, details of the element, item, batch or lot, the nature, number and date of the inspections and tests, the number and type of deficiencies found, any corrective action taken and other relevant particulars.
Maintain all records on site for inspection. On completion of the Works, include copies in the operating and maintenance manuals.
Comply with the requirements of latest version of Approved Documents L1 / L2 of The Building Regulations.
Submit copies of records within one week of request.

220.001 TESTING AND COMMISSIONING OF SERVICES
Use commissioning specialists who are members of The Commissioning Specialist Association (CSA).
Agree a programme for pre-commissioning checks, setting to work, commissioning and performance testing, and allow for all costs incurred.
Comply with the requirements of the latest version of Approved Documents L1 / L2 of The Building Regulations.
Where an existing system has been extended or modified, then, unless noted otherwise in the scope of works, the complete system shall be re-commissioned
During commissioning systems shall not be left running without Contractor attendance on site eg overnight or during weekends. Should a component failure occur the engineering services shall be configured to safely shut down.
Where required, provide formal method statements supported by risk assessments detailing all commissioning procedures.
Give not less than twenty working days' notice and state any requirements for the attendance and co-operation of others.
Provide all necessary facilities to enable tests to be witnessed and inspections carried out either on site or at manufacturer's works.
The CA will only witness test proceedings, confirm recorded results and determine if the specified requirements have been satisfied. If following test or inspection of any plant or part thereof is shown to be defective or not conforming to the specification the CA will reject such defective parts by written notice, within reasonable time, indicating area of dispute.
Appoint a "Commissioning Manager" to oversee the whole of the testing, commissioning, performance testing and instruction of client's staff.
Provide all specialised personnel (including manufacturer's representatives) and co-ordinate their activities.
Where Dry Riser and Wet Rise firefighting mains are installed comply with the requirements of BS 9990 Clause 7.2 for buildings under construction.
Test all equipment, material and systems as detailed in Work Sections, Reference Sections and Schedules. If an inspection or test fails, repeat the procedure, until satisfactory results are obtained.
Complete all tests before any paint, cladding or similar materials are applied or before services are concealed.
Ensure all requirements such as cleanliness, protection from harmful external and internal elements etc. are provided prior to commencement of commissioning.
Following satisfactory completion of testing and when the installations are in a safe and satisfactory condition, set to work, regulate and adjust, as necessary, to meet the specified design requirements.
Provide all necessary instruments and recorders to monitor systems during commissioning and performance testing.
Provide test equipment subject to a quality assurance procedure complying with BS ISO 10012-2.
Do not start performance testing, including system demonstration, system proving or environmental and capacity testing, until commissioning of the system is completed to the satisfaction of the CA.

A33 – Quality Standards / Control

Maintain on site full records of all commissioning and performance testing, cross referenced to system components and on completion of the Works include a copy in each Operating and Maintenance Manual.
Provide all certification documents for approval by the CA before any system is offered for final acceptance.
Gas, fuel oil, electricity and water for testing and commissioning will be provided by the main contractor.
Upon successful completion of performance tests the works shall be thoroughly cleaned and returned to as new condition.
On completion / handover provide a notice to the Local authority confirming that the building services have been commissioned in accordance with requirements of the latest version of Building Regulations Approved Documents ADL1 & ADL2.

230.000 COMMISSIONING PROCEDURES
Observe the following requirements when commissioning the Engineering Services.
Progressive static testing will be witnessed by the CA when work is presented for testing. This will include

Insulation resistance tests.
Earth fault loop impedance tests.
Earth continuity tests.
Pipeline pressure tests.
Air Ductline Pressure Test

Carry out pre-commissioning examination and testing to ensure that each system or item of equipment is complete, in a safe condition and all notices are displayed. "Completion" for operational purposes implies the bulk of snagging has been offered to the CA and that remedial work has been completed. All fans, pumps etc. tested for operation, polarity, phase sequence and impedance etc.
Prepare commissioning programme, taking into account site progress and availability of related services, and agree access required for controls etc.

240.000 OPERATIONAL DEMONSTRATION
Provide a written statement to the CA confirming that each installation has been correctly tested and commissioned and that the performance requirements can be achieved.
Demonstrate to the CA that all system components are operating correctly, and the completely integrated installation will function in accordance with the specified performance requirements.
Carry out performance testing of air-conditioning systems in both summer and winter conditions. If the building not provided with cooling carry out performance testing of the heating systems in winter conditions and demonstrate that the building does not “overheat” as defined in the basis of design or current Building Regulations.
If a BMS is installed this shall comprise setting the BMS to provide a 7 day log of the following parameters:
Air intake and discharge temperature and humidity at all plant.
Ambient air temperature
Space temperatures in all areas.
Heating and chilled water flow and return temperature
Terminal unit heating and chilled water demand
The log shall be triggered when the ambient air temperature reached design condition.
If a BMS is not installed the Contractor shall submit alternative proposals to achieve this requirement. Provide a log-book and record all hours run.

250.000 OUTSTANDING ACCEPTANCE TESTS
Any items which have failed their acceptance tests or where such tests are delayed by the client are to be listed and dates agreed, during the defects liability period when reasonable loads are available.

260.000 SYSTEMS USED BEFORE PRACTICAL COMPLETION
Systems may not, without the prior written approval of the CA be used before Practical Completion.
Systems to be used before practical completion for the benefit of the Contractor and/or Subcontractor must have all consumable elements (including lamps and tubes) replaced by new not more than seven days prior to Practical Completion.
No system shall be put into use prior to handover to the employer, except for testing and commissioning, unless in accordance with the following procedure:
Following the receipt of written instructions, the Subcontractor shall operate designated parts of the Subcontract Works, provided that such operation is practicable and does not prejudice the Subcontractor's responsibilities and obligations under the Subcontract.

A33 – Quality Standards / Control

Additionally and with adjustment to the Subcontract sum, the Subcontractor, shall if instructed, provide:
Comprehensive insurance including indirect loss for any plant being operated, maintenance of the installation, re-instatement of the installation to "as new" condition prior to handover to the Employer.
Allow the defects liability period to commence on handover.

300.000 OPERATION OF SYSTEMS BEFORE THE PRODUCTION OF RECORD DRAWINGS AND/OR OPERATING AND MAINTENANCE MANUALS

Provide attendance, at no expense to the Employer, to put into service, operate 24 hours a day and maintain the systems to the Employer's requirements, including the provision of suitable competent labour, in the event that the Record Drawings and/or Maintenance Manuals are not available when the Works would, in the opinion of the CA, otherwise qualify for Practical Completion.
In the event of the Subcontractor failing to provide this service satisfactorily the Employer shall be entitled to make their own arrangements and recover the full cost through the Contract.

310.000 INSPECTION BY EMPLOYER'S INSURANCE COMPANY

Where indicated in the Work Sections items are to be inspected by a "competent person" acting for the Employer's Insurance Company appointed under the provisions of the Factories Act 1961 or other relevant legislation. The installations concerned shall satisfy the Insurance Company's requirements in all respects.
Agree a programme for inspection and certification of specified equipment.
Inform the CA when equipment is to be ready for examination.
The Employer will place an order with the Insurance Company. Details and nature of the order will be provided to all interested parties.
Provide all detailed drawings etc. of the equipment to enable the Insurance Company to approve design before manufacture.
Arrange for the attendance of the Insurance Company's Engineer/Surveyor at each stage of manufacture and installation and provide all necessary access and facilities for inspecting and testing as may be required.
No plant which is subject to "inspection" will be accepted on behalf of the employer until a satisfactory certificate has been received by the Employer from the Insurance Company.
All Insurance Company charges for examination and approval of drawing, inspection of works during construction and inspection and certification of the completed work will be paid by the Contractor.

A34 – Security / Safety / Protection

115.000 CDM REGULATIONS

Comply with the requirements of the CDM Regulations 2015 by:
- adhering to the rules of the Pre-Construction information and Construction Phase Plan.
- reporting accidents, injuries or dangerous occurrences to the main contractor.
- providing the main contractor with appropriate input to the health and safety plan, including risk assessments, and to the health and safety file.
- providing the main contractor with information on the subcontract works which might affect the health or safety of any person.

120.000 DELIVERY

Provide adequate and safe protection for all materials and products during transport to site.
Deliver all ductwork, tubes, conduit, trunking and associated equipment with open ends effectively plugged, capped or sealed.

130.000 HANDLING

Offload and transport about the works all materials and products in a manner as recommended by manufacturers/suppliers.

140.000 STORAGE

Store all materials and products as recommended by manufacturers.
Provide sufficient, safe and secure storage for all materials and products.
Provide racks to prevent distortion for storage of conduits, pipes and similar materials.
Store all fittings, accessories and sundry items in clean bins or bagged and stowed in racks and maintained under suitable weatherproof cover.

151.000 PROTECTION OF SUBCONTRACT WORKS

Provide adequate and safe protection for all materials and products during and after installation.
Ensure all items are protected against ingress of water and dust, formation of condensation, extremes and rapid changes of temperature, building works and operations of others.
Protect during erection all easily damaged materials with, as a minimum, hardboard covers, and until the area is proven to be weathertight, heavy duty polythene sheet. Such items include but are not limited to:
- control panels,
- switchboards,
- distribution boards,
- heater batteries,
- finned pipework,
- gauge glasses,

Protect all finished items from damage and paint splashes. Install items such as grilles, diffusers, light fittings, switches, accessories etc. as near to completion as practicable.
Install filter media only when the plant items concerned are being commissioned and tested.
Cap all open ends of pipes, ducts, conduit and trunking etc. except when being worked upon.
Leave plant and equipment in a ready to paint condition where specified as part of the Works or to be carried out by others.
Paint parts liable to corrosion immediately after removal of any temporary protection.
Replace material, plant or equipment where deterioration or damage has occurred prior to handover.

160.000 IDENTIFICATION

Where appropriate, ensure that materials, plant and equipment bear the brand name, serial/batch number and any other data required to identify their nature in relation to the Works.

170.000 MOVING PARTS

Immediately prior to Practical Completion adjust, ease and lubricate moving parts as necessary to ensure easy and efficient operation.
Ensure that, whenever necessary, temporary supplies are provided during construction to enable motive plant items delivered and/or installed to be run at regular intervals to avoid damage or deterioration.
Ensure that rotating plant is hand-turned periodically if temporary supplies are not available.

A50 – Works/Products By / On Behalf of The Employer

110.001 PRODUCTS PROVIDED BY THE EMPLOYER:
Details of such products are given in the relevant work sections.
Advise Contract Administrator not less than 2 months before the date such products are required on site. Advise of revised dates to suit any changes to the contract programme.
Take delivery, mark receipts and take into appropriate storage. Advise the CA of details and number of items received.
Once products provided by or on behalf of the Employer are in the possession of the Subcontractor all conditions of the Contract and technical specifications are applicable to such items, including all requirements for protection, storage, distribution, fixing, insurances, replacement if damaged/stolen/lost etc. painting, identification, setting to work and commissioning.

120.001 WORKS
Details of Works by or on behalf of the Employer are given in the relevant work sections.
Advise the Contract Administrator of any requirements related to the contract programme.

10000 NES VERSION
Based on NES A50 TEXT Dec 19

Work Sections

P30 – Trenches/Pipeways/Pits for Buried Engineering Services

100.010 PERFORMANCE OBJECTIVES

To provide excavation, backfill, beds and surrounds for buried pipelines, cables and ducts other than ordinary drainage pipelines.
To lay ducts for telecommunications and data cables.
To provide stop valve surface boxes, access chambers, draw pits and inspection chambers and the like.
To permanently reinstate roads and paths affected by excavations.
All work on underground services shall be in accordance with the guidance in HSG47 – Avoiding danger from underground services

Positioning and planning of utilities shall be in accordance with the latest revision of the following NJUG Guides and specific Part 3 clauses in this specification:

Volume 1: NJUG Guidelines on Positioning and Colour Coding of Underground Utilities
Volume 2: NJUG Guidelines On The Positioning Of Underground Utilities Apparatus for New Development Sites
Volume 3: NJUG Guidelines on the Management of Third Party Cable Ducting
Volume 4: NJUG Guidelines for The Planning, Installation and Maintenance of Utility Apparatus in Proximity to Trees
Volume 5: NJUG on-site environmental good practice guidelines

PART 3 SPECIFICATION CLAUSES SPECIFIC TO P30

300.000 GENERAL

300.010 SUPPLY AUTHORITY REQUIREMENTS:
Ensure all system components are approved by the appropriate Supply Authority and installed in accordance with their requirements. Arrange for them to inspect and approve installations as they proceed.

300.021 ROUTES OF SERVICES BELOW GROUND:
Based on the approximate locations indicated on the drawings, agree precise locations with the CA. Set out trenches clearly and accurately. Locate with temporary marker posts. Excavate trenches taking due care of existing services in the vicinity, carefully setting aside any materials required for backfilling or reinstatement. Ensure that the minimum cover for services is achieved at all times taking into account the location and levels of existing services.

Trench
Allow common trench for all underground services where appropriate.

300.030 SUPPLY OF PIPE DUCTS:
Supply PVC pipe and cable ducts as indicated on the drawings.

300.061 SERVICE CABLE AND PIPE DUCTS: [NES 300.060]
Lay ducts in the formation shown, on newly prepared bedding. Joint ducts in accordance with the manufacturer's instructions.
Ensure that ducts slope no more than 1:60 vertically and 1:30 horizontally.
Ensure that pre-formed duct bends used at ends of duct routes meet the requirements of the cable manufacturer for bending radii.
Prove alignment of completed duct run by drawing through a mandrel 7mm diameter less than nominal duct bore for minimum length 250mm. Clean completed duct run by drawing through a circular wire brush 12mm diameter more than nominal duct bore.
Install a draw wire of corrosion resistant material and minimum breaking strength 550N in each empty duct.
Plug and seal all ducts with proprietary duct plugs, on completion.

310.000 PRODUCTS/MATERIALS

310.020 BEDDING & BACKFILL:
Application - External Services

P30 – Trenches/Pipeways/Pits for Buried Engineering Services

Lay external services on 100 mm imported soft sand. Cover and provide 100mm minimum cover of imported soft sand prior to back filling.

Bed and surround ducts generally with 100 mm single sized 10 mm aggregate to BS EN 12620. Lay and compact uniformly in 100 mm layers.
Bed and surround ducts in 150 mm Concrete to BS 8500-1 / BS EN 206.
20mm aggregate sulphate resisting where necessary, where under roads.
Backfill generally with selected fill, free from vegetable matter, rubbish, frozen soil and excluding lumps and stones retained on a 40mm sieve. Thoroughly compact by hand in layers not exceeding 100 mm.
Backfill under roads with granular sub-base material type 1 to Manual of Contract Documents for Highways Works Vol 1 Clause 803.
Cover newly laid cables with 100mm of bedding material.
Lay cables on newly prepared bedding. Ensure multiple layers of cable are separated vertically by a 50mm layer of hard rammed bedding material. Cover newly laid cables with 100mm of bedding material.
Following back filling permanently re-instate all retained road and footpath surfaces, landscaping, channels, kerbs and edgings etc. and to their previous condition. ie to all areas that are outside of the site boundary.

310.030 ACCESS/INSPECTION CHAMBERS/DRAW PITS:
Provide as indicated on the drawings.
Construct as indicated on the drawings.

320.000 WORKMANSHIP

320.001 STRUCTURES:
Ensure pipes in and out of structures are as short as possible. Surround by concrete at least 150mm thick. Set pipes sufficiently steep to prevent the possibility of differential settlement causing a backfall.

320.002 BACKFILLING OVER CONCRETE:
Do not start backfilling within 24 hours of placing concrete. Do not use heavy compactors and prevent imposition of traffic loads within 72 hours of placing concrete.

320.003 TEMPORARY BRIDGES:
Provide temporary bridges over trenches as necessary to prevent construction traffic damaging pipes after backfilling.

320.011 SERVICE TRENCHES: (NES 300.050)
Provide service trenches to allow the services to be installed, including any separation, in accordance with:

BS 7671 IET Wiring Regulations
BS EN 50174-3 - Information technology. Cabling installation. Installation planning and practices outside buildings.
The appropriate regulations associated with water supply to the building(s).
The Gas (Installation and Use) Regulations 1998 and IGEM Transmission and Distribution (TD) Series Standards.
OFTEC Technical Book 3, BS 5410-1 for installations serving domestic buildings up to 70kW output capacity.

Width to be as small as practicable with sides vertical.
Remove mud, rock projections, boulders and hard spots from trench bottom and trim level.
Carry out walk over survey of trench route, trial hole any area considered to be potentially difficult. Submit report of survey and trial holes and re-plan service routes after survey and trial holes if required.
Establish locations of any other underground service adjacent to service route.
Carry out any indicated work to adjacent services if necessary.
Inform Architect / CA in advance to give them reasonable opportunity to inspect trench for each section of the work.
Excavate trench carefully setting aside any materials required for backfilling or reinstatement and remove excess excavated material from site.
Clear trench bottom of loose stones and place bedding to full width of trench.
Grade trench bottom to a maximum slope of 1:12.
Layout and identify services as NJUG guidelines for positioning and colour coding of underground utilities apparatus.
Carry out all work in adopted streets to comply with the New Roads and Streets Works Act 1991 and associated codes of practice.

P30 – Trenches/Pipeways/Pits for Buried Engineering Services

320.020 LAYING PIPES/PIPEDUCTS/UTILITY SERVICES:
Use slings that do not damage either pipe or coating. Thoroughly inspect pipes prior to slinging.
Do not lower pipes until the trench bottom has been approved to receive the pipes. Ensure pipes are in correct alignment and orientation, concentric with the pipes already laid.
Make joints in accordance with manufacturer's instructions using the proprietary materials indicated.
Use a purpose made adapter for joints between pipes of different materials. If none is available, abut the pipes, tape and seal the gap, surround by 1/2 sections or less for 1m either side of the joint and surround in C20 concrete 150mm thick for 2m either side of the joint.
Install PVC-U pipes and fittings in accordance with BS EN 1401

Lay straight to line, true to gradient or level on an even, continuous bed of the specified bedding material, laid over full width of trench. Provide draw ropes where required.
Protect from damage and ingress of debris, temporarily seal all exposed ends during construction.
Inform Architect / CA and service utilities or subcontractors to give them reasonable opportunity to inspect installation prior to backfilling.
Lay and compact further bedding material to a level not less than 100 mm above crown of pipe.

320.021 BEDDING, PROTECTION AND BACKFILL PIPEWORK:
Make cavities in the bedding to facilitate sling removal. Elsewhere smooth the trench bottom. Prepare one full pipe length in advance of pipelaying.
Locate interfaces between backfilled materials to the weaker material side of theoretical.
Concrete is the strongest and selected fill the weakest. Lay all fill less than 300mm above the top of the pipe barrel in 150mm layers and hand compact. Above this level layers may be 225mm. Over 1m above top of pipe mechanical compaction may be used

320.025 CABLE TRENCHES:
A 100mm depth tolerance shall be included when digging trenches, therefore all services shall be at the depth indicated below plus 100mm. This will allow for the possibility of the ground level being reduced by 100mm.
Haunch cables or ducts in bedding material to a minimum depth of 75mm above highest cable or duct. Install PVC marker tapes to all trenches as detailed below.
Minimum cover in cable trenches
HV cables 800mm (900mm depth).
LV cables 500mm (600mm depth).
Communications cables 500mm.
All cables 900mm minimum cover under roadways.
Mark each change of direction of cables with pre-cast concrete 300x300x150 thick impressed with LV or HV CABLE, laid level with finished ground level.

Installation to be in accordance with latest revision of NJUG Guides:
Utilities Guidelines on Positioning and Colour Coding of Apparatus (Vol 1)
Guidelines for the Planning, Installation and Maintenance of Utility Services in Proximity to Trees. (Vol 4)

320.025a PIPEWORK TRENCHES ETC:
Minimum cover in pipework trenches

Water 750mm minimum (900 -1200mm maximum where practical)
Gas 600mm (footway), 750mm (verge), 900mm (carriageway).
Fuel oil 900mm

To latest revision of NJUG Guides:
Utilities Guidelines on Positioning and Colour Coding of Apparatus
Guidelines for the Planning, Installation and Maintenance of Utility Services in Proximity to Trees
Install PVC marker tapes to all trenches as detailed below.
All services to be 900mm under roadways.

320.030 BACKFILLING GENERALLY:
Laid and well compacted in layers not exceeding 300 mm thick. Do not use heavy compactors before there is 600 mm depth of backfill.

P30 – Trenches/Pipeways/Pits for Buried Engineering Services

320.040 BACKFILLING UNDER ROADS:
Laid and compacted in 150 mm layers.

320.051 TEMPORARY BRIDGES:
Provide temporary bridges over trenches as necessary to prevent construction traffic damaging services after backfilling.

320.061 IDENTIFICATION TAPES:
During backfilling lay continuous colour coded, heavy gauge polythene identification tapes, below surface along the route of each service. Warning tapes to be to BS EN 12613

WIDTH	up to 600mm	600-1000mm	1000-1400mm	1400-1800mm
DEPTH up to 500mm	1 tape at 200mm below ground level in the centre of the trench	2 tapes at 200mm below ground level horizontally spaced 400mm apart	3 tapes at 200mm below ground level each tape horizontally spaced 400mm apart	4 tapes at 200mm below ground level each tape horizontally spaced 400mm apart
DEPTH 500-800mm	1 tape at 200mm and 1 tape at 500mm below ground level in the centre of the trench	2 tapes at 200mm and 2 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart	3 tapes at 200mm and 3 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart	4 tapes at 200mm and 4 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart

320.070 ACCESS/INSPECTION CHAMBERS CONSTRUCTION:
As indicated on the drawings.
Step irons : Bed in joints to all chambers over 900 mm deep at 300 mm vertical centres staggered 300 mm horizontally, with the lowest step iron 300 mm above the base and the top step iron 450 mm below the top of the cover.
Precast slabs : Bed solid in 1:3 cement: sand mortar.

320.080 ACCESS COVER & FRAME INSTALLATION:
Bed frame solidly in 1:3 cement: sand mortar over its whole area, centrally over opening, level with surrounding finishes and square with joints in surrounding finishes or with building. Where frame is in soil or grassed areas, haunch back edge of bedding so that it is not visible.

320.090 TEMPORARY DRAWPIT CONSTRUCTION:
Fill pit with clean dry sand on completion of services installation.

R11 – Foul Drainage Above Ground

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide a piped gravity system to collect foul water from normal toilets, sinks and kitchen appliances and connect to the first underground drain connection.

100.020 DESIGN PARAMETERS
In accordance with BS EN 12056-2, BS EN 752, CIBSE Guide G: Public Health Engineering, current Building Regulations and requirements of the Local Authority.

100.022 BREEAM REQUIREMENTS:
On applicable projects and detailed elsewhere, comply with BREEAM requirements below to suit the type of construction and scheme.
BREEAM New Construction 2014 requirement
- Comply with Issue ID Pol 03 Surface Water Run-off
- Comply with Issue ID Wst 05 Adaptation to Climate Change

BREEAM New Construction 2018 requirement
- Comply with Issue ID Pol 03 Flood and Surface Water Management
- Comply with Issue ID Wst 05 Adaptation to Climate Change

BREEAM Refurbishment and Fit-out 2014 requirement
- Comply with Issue ID Pol 03 Surface Water Run-off
- Comply with Issue ID Wst 05 Adaptation to Climate Change

100.030 GENERAL REQUIREMENTS
Refer also to Scope of Works.
The system has generally been designed on the one pipe system, using foul waste and vent stacks which take the foul water discharge from the toilet areas, shower areas and cleaners sink etc.

Kitchen areas with appliances discharging grease contaminated waste water connect to a separate waste and vent system which in turn connect to a grease converter (grease trap or separator) before discharging to the below ground drainage.

Anti-siphonage and ventilating pipes (and or anti-siphon traps) protect the traps on the appliances from loss of water/seal.

All soil waste and ventilating pipes shall have minimum falls as defined in BS EN 12056-2, or as shown on the drawings. Anti-siphonage pipework and ventilating pipes must be installed in such a manner as not to create a trap.

Access shall be provided at all changes of direction and above the connection point to the below ground drainage as shown on the drawings.

Main soil/waste ventilation pipes shall rise to roof level and terminate with a vent cowl for discharge to atmosphere.

Where plastic pipework passes through fire compartment floors and walls intumescent fire sleeves tested to BS 476 or BS EN 1366-3 shall be fitted.

Drainage pipes that are encased in a facade or cladding system shall be constructed from non-combustible material. Unless detailed otherwise elsewhere pipework to be stainless steel to relevant parts of BS EN 1124. Pipework to be designed to accommodate thermal expansion.

Thermal expansion shall be included on PVC and polypropylene soil waste and vent pipework.
Where pipes penetrate a floor separating habitable rooms in different flats within residential buildings they shall be enclosed for their full height and full horizontal run in each flat and surrounded with sound absorbent material above and below the floor. The installation shall comply with the requirements of Approved Document E of the Building regulations. “Resistance to the passage of sound”.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO R11

R11 – Foul Drainage Above Ground

300.000 PRODUCTS/MATERIALS

300.005 DRAINAGE SPECIALIST:
On design and build projects engage a drainage specialist to develop the design, install, commission and set to work a gravity drainage system inside the building in accordance with BS EN 12056 as appropriate.

300.011 SOIL WASTE AND VENT PIPEWORK
Refer to Schedule of pipelines Y10 for project particular requirements
Materials standards
- Cast iron- BS EN 877
- Welded stainless steel with spigot and socket – Relevant parts of BS EN 1124
- PVC-U – BS EN 1329-1 / BS 4514

300.014 THERMAL EXPANSION ON ALL PVC/POLYPROPYLENE PIPEWORK
Provide expansion joints, thermal movement limiters, anchor points and support/brackets to allow for the correct thermal movement as recommended in the manufacturers installation guide. Alternative forms of thermal expansion arrangements will not be allowed without the prior approval of the CA.

300.015 METAL BANDED FLEXIBLE COUPLINGS ADAPTORS AND BUSHES:
Type as scheduled or described in the particular specification.
Flexible coupling without shear band.
Flexible coupling with shear band.
Flexible adaptor for use with pipes of different outside diameter.
Application
- Repair of damaged pipes
- Connecting pipes of different materials
- Connecting pipes of different diameter
- Jointing short / cut lengths of pipe
- Jointing post-inserted performed junctions

Standard - BS EN 16397-1 and BS EN 16397-2
Materials
- Sleeve - rubber to BS EN 681-1
- Clamping bands 304 stainless steel or 316 stainless steel.

300.016 FIRE SLEEVES

Fire sleeves shall be installed on all PVC/Polypropylene pipework 50mm diameter and above, passing through fire break walls, floors and ceilings and subject to approval by the Local Building Control Authority. To be tested to BS EN 1366-3.

300.017 HORIZONTAL BRANCH CONNECTIONS

All 75mm and 100mm branch connections shall connect to the main horizontal runs via a 135 degree branch and a 135 degree bend.

Where possible all smaller branch connections shall connect to the 75mm and 100mm horizontal runs at an angle of 45 degree above the centre line via a 135 degree bend.

300.018 VENT PIPE TERMINALS

All soil waste and vent stacks and waste and vent stacks shall, unless otherwise stated, shall rise through the roof finish with a weathering slate weathering collar and terminate 450 mm above the roof finish (flat or pitched) with a vent cowl.

R11 – Foul Drainage Above Ground

300.020 FLOOR GULLIES

Standard

Trapped with water seal of at least 50mm - BS EN 1253-1

Without trap - BS EN 1253-2

Gully with light liquid closure to avoid uncontrolled discharge of light liquids such as petrol, diesel and fuel oil into drainage systems in case of emergency to BS EN 1253-5

Material.

Access covers to BS EN 1253-4

Class of gully / cover – as scheduled

300.035 GREASE TRAPS AND GRAVITY GREASE SEPARATORS:

Type, materials, accessories, controls – as scheduled

Standards

Grease separator, design and performance, testing and marking to be in accordance with BS EN 1825-1.

Selection of nominal size to meet performance requirements scheduled and installation of grease separators to be in accordance with BS EN 1825-2.

300.040 FALLS ON SOIL/WASTE PIPEWORK AND VENT PIPEWORK

Unless otherwise stated

All 75mm and 100mm dia. soil and waste pipework shall be installed to a fall of 1:60 all smaller dia. waste pipework shall be installed to a fall of 1:50.

All vent and anti-siphon vent pipework shall be installed to a fall of between 1:80 and 1:100.

300.045 WASTE PIPEWORK DIAMETERS (UNLESS OTHERWISE STATED)

Washhand basin	32mm
Sinks (general)	40mm
Cleaners Sinks	40mm
Shower Tray	40mm
Urinal Bowls	32mm/40mm (as sanitary fitting schedule)
W C Pans	100mm
Bidets	32mm

Specialist equipment waste pipework as per manufacturers' requirements.

300.050 SOIL AND WASTE STACKS TAKING THE DISCHARGE FROM PLANTROOM FLOOR GULLIES

Unless otherwise stated soil waste and vent stacks which take the discharge from plantroom floor gullies shall be installed in cast iron and not PVC.

R11 – Foul Drainage Above Ground

300.130 PLASTICS WC PAN CONNECTOR

Combined solvent weld/pan seal socket connector for horizontal outlet WC pans to BS EN 33 or BS EN 997
For horizontal outlet and shrouded pans
BS 5627 for pans to BS EN33 'S' (turned 'P' traps, or 'P' traps new installations, or 'P' traps replacements) or BS EN 997 for WC pans and WC suites with integral trap.

300.140 GRATINGS:

Application
Vent pipe termination guards
Material
Galvanised steel wire, plastic coated, PVC or copper.

300.150 SINGLE STACK PLUMBING:

Ensure that there is a change of gradient at stack connections. Use swept branches on small diameter pipes. Use swept inlet or 45 degree branch connections for pipe 75 mm dia. or over.

310.000 WORKMANSHIP

310.005 FOOT OF PIPE STACKS:

Fix cast iron rest bends supported on brick-work or concrete bases where indicated on drawings.

310.010 PERFORMANCE CRITERIA:

Install pipework fittings and accessories to ensure that:-
appliances drain quickly, quietly and completely at all times without nuisance or risk to health.
discharge is conveyed without crossflow, backfall, leakage or blockage.
air from drainage system does not enter building.
pressure fluctuations in pipework do not vary by more than plus or minus 38mm water gauge and traps retain a water seal of not less than 25mm.
system can be adequately tested, cleaned and maintained.

310.020 PIPE ROUTES:

Ensure pipe routes are shortest practicable, with as few bends as possible and no bends in wet portion of soil stacks, unless indicated otherwise on drawings.

310.030 COATED PIPES:

Make good damaged coatings and cut ends, or recoat, as recommended by manufacturer.

310.041 INSTALLATION GENERALLY:

Install pipes, fittings and accessories in accordance with BS 8000-0, BS 8000-13, BS EN 12056-2 and manufacturer's recommendations.
Install thermoplastic piping systems in accordance with PD CEN/TR 13801.
Obtain all components for each type of pipework from the same manufacturer, unless otherwise indicated.
Inspect components carefully before fixing and reject any which are defective.
Ensure cut ends of pipes to be clean and square with burrs removed.
Allow for thermal and building movement when jointing and fixing in accordance with tile manufacturers recommendations.

Form junctions using fittings intended for the purpose, ensuring that jointing material does not project into bore of pipes, fittings and appliances.
Avoid contact between dissimilar metals and other materials which would result in electrolytic corrosion.
Provide access covers and cleaning eyes as necessary in convenient locations, to permit adequate testing and cleaning of pipework.
Prevent entry of foreign matter into any part of system by sealing openings during construction. Fit all access covers and cleaning eyes as work proceeds.

310.050 CONNECTIONS BETWEEN PIPES OF DIFFERENT MATERIALS:
PLASTIC

R11 – Foul Drainage Above Ground

PLASTICS

Connect to pipework of other materials using approved connectors and methods in accordance with plastics pipework manufacturer's recommendations, to form a watertight joint.

CAST IRON

Where possible, connect cast iron pipework to clay pipework using super sleeve adapters.

COPPER

Connect copper pipework to clay/cast iron using copper to cast iron/clay adaptors whenever possible.

GALVANIZED STEEL

Connect galvanized steel pipework to cast iron sockets with bitumenized yarn and molten lead, lead wool or an approved cold caulking compound.

Connect galvanized steel pipework to clay/concrete sockets. A purpose made galvanised steel to clay/cast iron transition piece (to be provided by the rainwater pipe manufacturer) to suit the clay/cast iron adaptor.

310.070 WASTES:
Bed in waterproof jointing compound and fix with resilient washer between appliance and backnut.

310.080 WASTE CONNECTORS:
Join to traps as manufacturer's recommendations.

310.091 WC PANS:
Connect to soil pipe spigots with plastic connectors in accordance with connector manufacturer's recommendations.

310.100 TRAP TEST REQUIREMENTS:
Ensure there is a retention of 25mm water seal in every trap, and that no air is blown through the trap seal when performance is tested.

310.110 ACCESS POINTS:
Provide rodding and access points at all changes of direction to enable whole system to be maintained.
Provide square door type access points as indicated on drawings at foot of all soil waste and ventilation pipes and at low level above each floor level. Where practicable, locate access points and horizontal anti-siphon pipes above fitment flood level.
In general make WC connections to drain points and soil pipes via flexible connectors.

10000 Based on NES R11TEXT – Dec 19

S41 – Fuel Oil Storage / Distribution

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide a piped supply system and the storage for the distribution of fuel oil to various user points.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO S41

300.000 PRODUCTS/MATERIALS
See Scope of Works and Schedules for tank sizes, types, ancillaries and other project particular details.

300.001 PRESSURE EQUIPMENT DIRECTIVE/PRESSURE EQUIPMENT REGULATIONS:
All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 2014/68/EU, implemented in the UK through the Pressure Equipment (Amendment) Regulations 2015 and The Pressure Equipment (Safety) Regulations 2016, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.

Only relevant equipment and assemblies certified as compliant will be permitted under this specification, and any substitution put forward must also be compliant with the Directive.

300.005 STANDARDS AND REGULATIONS:
Comply appropriate Regulations and guidance:
- The Control of Pollution (Oil Storage) Regulations (England)
- The Water Environment (Miscellaneous) (Scotland) Regulations
- The Water Resources (Control of Pollution) (Oil Storage) (Wales) Regulations
- Control of Pollution (Oil Storage) Regulations (Northern Ireland)
- Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002 and latest edition of associated HSE code of practice L138.
- Relevant parts of Building Regulations / Approved Documents / Scottish Technical handbook
- Environmental management guidance on oil storage regulations for businesses published by GOV.UK, which replaces The Environment Agency Pollution Prevention Guidelines (PPGs) that were withdrawn in Dec 2015.
- Relevant Guidance for Pollution Prevention series of documents (GPPs that replace PPGs).

Comply with the following Pollution Prevention Guidelines for projects in locations where they are still referenced by the relevant Environmental Agency.
- Above Ground Oil storage Tanks PPG2
- The safe operation of refuelling facilities: PPG 7
- Installation, decommissioning and removal of underground storage tanks: PPG27

Comply with:
- Guidance in Health and Safety Executive HSG176 on design and construction of installations for the storage and use of flammable liquids.
- Code of practice for oil firing: BS 5410-1 or BS 5410-2 or BS 5410-3 to suit particular application.

On applicable projects, all equipment to be covered by OFCERT licence for the application.

300.010 STORAGE TANKS AND VESSELS - STEEL:
Manufacture bunded oil storage tanks in accordance OTEC standard OFS T200 Steel oil storage tanks and tank bunds for use with distillate fuels, bio-fuels, lubrication oils and waste oils. Tanks to be fabricated in accordance with BS 799-5.

300.015 STORAGE TANKS AND VESSELS - THERMOPLASTIC:
Manufacture thermoplastic integrally bunded oil storage tanks in accordance with OFTEC standard OFS T100 Polyethylene oil storage tanks for distillate fuels. Tanks to be complete complete with overfill prevention devices to BS EN 13616. Tanks to be tested and approved in accordance with BS EN 13341.

300.021 ABOVE GROUND STEEL OIL STORAGE TANKS:
Standards
BS 799-5 & OTEC standard OFS T200 or BS EN 12285-2 as scheduled
Access
Provide, sized in accordance with the tank construction standard.
Manholes.
Inspection openings.

Painting and cleaning
Paint and clean tanks in accordance with the tank construction standard and manufacturer's recommendations.
Accessories - provide the following unless scheduled otherwise
Automatic tank contents gauge in accordance with BS EN 13352. Level measurement - class as scheduled
Overfill prevention device to BS EN 13616-1. To be complete with closure device to automatically stop the delivery, preventing the liquid level in the tank exceeding a final closure level.
Bund details - refer to schedules

300.031 BELOW GROUND STEEL OIL STORAGE TANKS:
Standards
BS EN 12285-1, type double skinned as scheduled
Protection against external corrosion - in accordance with BS EN 12285-1 and BS 5410-2 and manufacturer's recommendations.
Accessories
Leak detection system to relevant parts of BS EN 13160
Automatic tank contents gauge in accordance with BS EN 13352 Level measurement - class as scheduled
Overfill prevention device to BS EN 13616-1. To be complete with closure device to automatically stop the delivery, preventing the liquid level in the tank exceeding a final closure level.

300.041 SERVICE TANK:
Standard -BS 799-5.
Access -Provide, sized in accordance with BS 799-5: inspection openings.
Painting and cleaning -Paint and clean tanks, in accordance with BS 799-5.

300.045 OIL STORAGE TANKS, THERMOPLASTIC:
Standards - BS EN 13341 or OFTEC OFS T100 -bunded plastic for domestic use as scheduled.
Tank type – blow moulded polyethylene or rotational moulded polyethylene or Polyamide 6 by anionic polymerization
Marking - Tank to be marked in accordance with BS EN 13341, Section 8.1.
Overfill prevention device to BS EN 13616-1. To be complete with closure device to automatically stop the delivery, preventing the liquid level in the tank exceeding a final closure level.

300.050 HEATERS FOR OIL STORAGE TANKS AND OIL LINES HEATING / TRACE HEATING:
For use with residual fuel oil tanks
Standard
BS 799-5.
Coils shall be : constructed of seamless steel tube to BS EN 10216-1
: designed to allow free expansion and to be supported along their entire length by cradles or similar supports spaced as specified for horizontal steel pipelines.
: continuous, without parallel circuits, with inlet and outlet connections grouped together below the main outflow heater, where installed. Where joints are unavoidable these are to be welded.
Electric trace heating to be in accordance with BS EN 62395-1, BS EN 62395-2, BS EN 60079-30-1 and BS EN 60079-30-2 as appropriate to the atmosphere / area classification.
Comply with the requirements of BS 5410-2
Thermal insulation to be in accordance with BS 5970.

300.061 OIL LEVEL INDICATORS AND AUTOMATIC TANK CONTENTS GAUGES:
Application
For use on all oil storage tanks
Automatic tank contents gauge in accordance with BS EN 13352.Level measurement class as scheduled.
Standard – BS 799-5.
Type
Dip stick.
Hydrostatic type - sealed.
Dial size – 150mm.
Mounting
At low level in end plate above sludge level - horizontal cylinders.
At low level in side plate above sludge level - vertical cylinders and rectangular tanks.
Ancillaries
Mild steel mounting flanges.

Audible and visual high and low level alarm located adjacent fillpoint

300.071 FIRE VALVE SYSTEMS AND THEIR INSTALLATION:
Size - Line size
Standards
Comply with the requirements of BS 5410-2 or BS 5410-1 for installations in domestic buildings up to 70kW output capacity.
Shut off valves to be constructed and tested to BS EN ISO 23553-1
Thermostatic (non electrically operated) remote acting fire safety valves to comply with OFTEC OFS E101
Hold open the automatically operated quick closing valve. Fire valve to close instantaneously when excess temperature detected.
Accessories
Electro-thermal release system
Electro-thermal links are to be located over each boiler, with key reset stop locks adjacent to each exit from the boiler area.
The system is to be provided with 3 hours battery back-up.

300.085 LEAK DETECTION SYSTEM:
Standard
Relevant parts of BS EN 13160
Supply and install a leak detection system in the fuel oil storage/distribution system. Link the system to an integral alarm system. Include facilities in the system for remote monitoring / alarm by a BMS.
Install an automatic shut-off system to ensure no further fuel oil is delivered.

300.101 SINGLE FILTERS:
Size range
25mm - 150mm inclusive
Material
Body
Cast-iron to BS EN 1561 unless otherwise specified.
Filter basket
316 Stainless steel, mesh to suit grade of oil as recommended in BS 799 Part 4
Connections
Flanged to BS EN 1092-2 or BS EN 1092-1 to match system pressure and temperature rating.

300.102 SELF CLEANING SINGLE FILTERS:
Size range
25mm - 80m inclusive
Material
Body
Cast-iron to BS EN 1561 unless otherwise specified.
Filter basket
316 Stainless steel, mesh to suit grade of oil as recommended in BS 799 Part 4.
Connections
Flanged BS EN 1092-2 or BS EN 1092-1 to match system pressure and temperature rating.
Accessories
Remote warning of element clogging and/or automatic cleaning

300.111 DUAL FILTERS:
Size range
25mm - 200mm
Material
Body
Cast-iron to BS EN 1561 unless otherwise specified.
Filter basket
316 Stainless steel, mesh to suit grade of fuel as recommended in BS 799 Part 4
Connections
Flanged BS EN 1092-2 or BS EN 1092-1 to match system pressure and temperature rating
Provide filter with automatically operated changeover valve.

300.141 OIL METERS:

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Provide volumetric rotary-piston meters.
Material
- Meter
  - Anodised aluminium alloy or cast iron, to suit application
- Working chamber
  - Brass
- Ancillaries
  - Percentage flow indicator
  - Remote total indicator
  - Combined rate of flow and total indicator

300.150 CATHODIC PROTECTION OF BURIED METALLIC TANKS:
Cathodic protection to buried metallic tanks and related piping to be provided in accordance with BS EN 13636.

310.000 WORKMANSHIP

310.005 GENERAL SAFETY REQUIREMENTS AND TESTS:
As appropriate to the particular project, comply where practically possible with the requirements of the relevant parts of BS EN 12514 and BS 5410-2 or BS 5410-3 for the safety and corresponding tests for plant, equipment and pipework within an oil supply installation to burners.

310.010 INSTALLATION OF OIL STORAGE TANKS:
Install oil storage tanks in accordance with the following:
- BS 799-5,
- BS 5410-2 for non-domestic installation
- BS 5410-1 for installations in domestic buildings up to 70kW output capacity
- BS 5410-3 for furnaces, kilns, ovens, oil-fuelled generators and other industrial purposes
- OFTEC relevant codes of practice and installation recommendations / relevant technical information Sheets
- Manufacturer's recommendations

310.020 INSTALLATION OF OIL DISTRIBUTION SYSTEMS:
Install oil distribution systems in accordance with equipment manufacturer's recommendations, the standards and relevant Legislation listed in clause 300.005 and the following as applicable to the particular project:
- BESA TR/20 "Installation and Testing of Pipework" Systems – Part 10 - Oil
- Relevant OFTEC relevant codes of practice and installation recommendations / relevant technical information Sheets.
- Ensure pipes are covered by OFCERT license for the application.
- BS 5410-2 - Code of practice for oil firing installations over 45 kW output capacity for space heating, hot water and steam supply services

10000 Based on NES S41 Text Dec19

T20 – Primary Heat Distribution

Incorporating T30 (MTWH) and T31 (LTHW) and T42 (Local heating units)

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide a piped hot water heating distribution system from the plantroom to the heat emitting equipment.
To provide all heat emitting items related specifically to the heating system and comply with BS 6880 Parts 1and 2 - Code of practice for Low temperature Hot Water Heating where applicable.

On applicable projects provide a heat network designed, installed and commissioned following the requirements of CIBSE / CHPA CP1 and to provide heat interface units connected to the heat network or other heat distribution system from a central energy centre or CHP plant. Comply with the guidance in BESA DHC01 for the minimum requirement for space, structural, access and services allowances for a building likely to be connected to a district energy network.
On applicable projects in London follow the guidance in the London Heat Network Manual.

To provide local gas fired radiant or convective heaters.

For pre-insulated underground heating distribution pipework refer to Y10 clauses including 2881, 2882 and 9060 and schedule T20sch3 or Y10sch2.

100.020 DESIGN PARAMETERS
See Schedule of Common Design Criteria.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO T20 (T30, T31, T42)

300.000 GENERAL
Refer to Y10 and Y11 for pipework and pipeline ancillaries installation and workmanship detail requirements.
Refer to Y25 for cleaning and chemical treatment requirements.
Install suitably sized safety valves in all secondary distribution pipework from heat exchangers.

300.001 PRESSURE EQUIPMENT DIRECTIVE/PRESSURE EQUIPMENT REGULATIONS:
All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 2014/68/EU, implemented in the UK through the Pressure Equipment (Amendment) Regulations 2015 and The Pressure Equipment (Safety) Regulations 2016, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.

Only relevant equipment and assemblies certified as compliant will be permitted under this specification, and any substitution put forward must also be compliant with the Directive.

300.011 SITE DIMENSIONS:
Check dimensions on site prior to ordering.

300.012 ECODESIGN REQUIREMENTS FOR LOCAL SPACE HEATERS: (T42)
Equipment to be in accordance with The Energy Related Products Regulations 2010 as amended.
Space heaters up to 120kW to comply with EU Regulation 2015/1188 for seasonal space heating energy efficiency (SHEE), NO_x emissions and product information / instruction manual.

300.020 WATER TREATMENT AND QUALITY:
Refer to scope of works / schedules for water treatment methods / facilities and conditions / properties to be achieved in the circulation water.
Circulation water quality in district heating systems to be in accordance with recommendations in PD CEN/TR 16911. (Recommendations for circulation water in industrial and district heating systems and their operation)

300.021 TESTING:
Test relevant plant equipment at manufacturer's works to appropriate British Standard to suit pressure and temperature conditions of system.

300.025 SAFETY OF WATER BASED HEATING SYSTEMS:
For water based heating systems in buildings with a maximum operating temperature of up to 105°C, provide and install facilities to ensure safety arrangements comply with Section 4.6 in BS EN 12828.
Comply with Annexe E in BS EN 12828 for safety valves in heating systems in addition to the relevant product standards referred to in Y11.

300.030 UNDERFLOOR HEATING INSTALLER SELECTION:
Use a specialist companies to carry out the design, supply, installation, testing and commissioning of the underfloor heating system in accordance with BS EN 1264. The specialist shall advise the size of cupboard, preferred location and access requirements for the manifolds, and associated valves / controls to the Contractor.
Use one of the specialist companies listed in schedule A30M Schedule of Mechanical Manufacturers to carry out the design, supply, installation, testing and commissioning of the under-floor heating system.

310.000 PRODUCTS/MATERIALS

310.021 RADIATORS, CONVECTORS AND TRENCH HEATING GENERALLY: (T31)
Ensure radiators and convectors are manufactured to BS EN 442-1 and tested/rated in accordance with BS EN 442-2.
Ensure fan assisted radiators, convectors and trench heaters are manufactured to BS EN 16430-1 and tested/rated for thermal output in accordance with BS EN 16430-2.
When fan assisted radiators, convectors and trench heaters manufactured to BS EN 16430-1 are to provide cooling they shall be tested / rated for thermal output in accordance with BS EN 16430-3.

Duty and type as scheduled.
Connections
For Steel - Wrought iron bosses welded on at manufacturer's works.
For Cast Iron and Aluminium – Integral screwed
Air cock
Provide return end air cock recessed within unit length.
Finish
Degrease and protect against rusting before application of a high quality stove primer and then powder coat with epoxy polyester, unless otherwise indicated.
Testing
Pressure test not less than 7 bar (gauge) or one and a half times maximum working pressure whichever is greater.
Accessories
Wall/floor brackets or feet as required.

310.030 PRE-INSULATED UNDERGROUND PIPELINES:
Refer to Y10 clauses, including
2881 Pre- insulated underground bonded pipe systems - steel
2882 Pre-insulated flexible insulated underground pipelines – metal and plastic service pipes
9060 Installation of thermally insulated underground pipelines
For project particular requirements refer to schedule T20sch3 or Y10sch2 / scope of works.

310.062 LOW SURFACE TEMPERATURE RADIATORS / CASING: (T31)
Duty as scheduled, to comply with NHS guidelines.
Manufacture emitter in accordance with BS EN 442-1
Thermal output and pressure drop testing/rating to be in accordance with BS EN 442-2
Material – Mild steel (min thickness 1.5mm) powder coated with antibacterial protection
Casing
To have fully radiused corners, and be a one-piece construction which does not require assembly. Cut-outs for pipework, skirting and vinyl flooring etc to be provided during manufacture to eliminate site cutting.
Front panel to be hinged for cleaning.
Grilles to be pencil proof and designed to prevent fingers being trapped. For secure environments the unit shall be tested as being anti-ligature,
LST types in secure environments to have heavy duty cases and be tested as being “anti-ligature” design including providing mesh behind grilles.
Ensure all hot surfaces are concealed and exposed surfaces remain at a temperature of no more than 43°C.
Accessories – unless scheduled otherwise provide:

Air vent and drain cock.
Front panel to be hinged for deep cleaning.
Welded feet and top stay.
Wall brackets.
Plinth for floor mounting to accommodate pipework

310.064 FAN ASSISTED RADIATORS / CONVECTORS: (T31)
Duty and type as scheduled.
Standards
Sound power levels to be measured in accordance with BS EN ISO 3744
Ensure heat emitters are manufactured to BS EN 16430-1 and tested/rated for thermal output in accordance with BS EN 16430-2 and BS EN 442-2
Details – unless scheduled otherwise
Fans / motors
Multiple axial type, fixed to the finned convector using manufacturer's mounting kit complete with modulating speed control or single centrifugal crossflow fan with EC motor and modulating speed control as scheduled.
Controls
Integral temperature sensor and controls to automatically start and modulate fans for morning boost.
Boost switch integrated into radiator to override normal temperature control.
Connections
Brass.
Finish
Degrease and protect against rusting before providing corrosion protection by phosphating followed by powder coating with epoxy polyester unless scheduled otherwise .
Testing
Pressure test at not less than 7 bar (gauge) or one and a half times maximum working pressure, whichever is greater.
Thermal output and pressure drop testing/rating to be in accordance with BS EN 442-2
Accessories / options
Air vent and drain cock.
Wall brackets.

310.066 VENTILATION RADIATORS / CONVECTORS: (T31)
Duty and type as scheduled.
Standards
Sound power levels to be measured in accordance with BS EN ISO 3744
Ensure heat emitters are manufactured to BS EN 16430-1 and tested/rated for thermal output in accordance with BS EN 16430-2 and BS EN 442-2
Details – unless scheduled otherwise
Controls
Integral temperature sensor and controls to automatically start and modulate fans for morning boost.
Boost switch integrated into radiator to override normal temperature control.
CO_2 sensor to control outside ventilation and room exhaust ventilation.
Connections
Brass.
Finish
Degrease and protect against rusting before providing corrosion protection by phosphating followed by powder coating with epoxy polyester.
Colour as scheduled
Testing
Pressure test at not less than 7 bar (gauge) or one and a half times maximum working pressure, whichever is greater.
Pressure drop testing to be in accordance with BS EN 442-2
Accessories / ancillaries
Air vent and drain cock.
Wall brackets.
Outside air inlet louvre – details as scheduled

310.070 NATURAL CONVECTOR HEATERS: (T31)
Duty as scheduled.
Type - Wall mounted low water content convector unless scheduled otherwise
Standards
Ensure natural convector heaters are rated in manufactured accordance with BS EN 442-1.
Thermal output and pressure drop testing/rating to be in accordance with BS EN 442-2
Arrangement as scheduled
Casing
Construct casing from rigid heavy gauge sheet steel, strengthened to prevent drumming, with no sharp edges for safety. Support heating element from casing and ensure casing prevents air by-passing.
Fit foam plastic strips to flanges at rear of casing.
Provide back panels.
Access
Ensure front covers are easily removed for cleaning and access to control and isolating valves.
Finish
Degrease and protect against rusting and provide corrosion protection by phosphating followed by powder coating with epoxy polyester unless otherwise indicated.
Heating elements
Materials
Finned tubes
Copper.
Fins
Aluminium.
Headers
Copper
Connections
Screwed female to relevant part of BS EN 10226 terminating within casing.
Air cock
Fit an air cock on flow connection with the air cock terminating through side of the casing, or behind front grille.
Grilles
Linear grilles to manufacturers' standard, unless otherwise indicated Ensure grilles are pencil proof.
Control Damper
Provide a control damper regulated by a knob on outside of casing with damper position clearly marked.
Testing
Pressure test at not less than 7 bar (gauge) or one and a half times maximum working pressure whichever is greater.
Thermal output and pressure drop testing / rating to be in accordance with BS EN 442-2.
Accessories
Feet to conceal rising pipes when unit fed from below.

310.080 FAN CONVECTOR HEATERS: (T31)
Duty as scheduled.
Standards
Ensure fan assisted convectors equipped with fans to increase the convective thermal output are manufactured in accordance with BS EN 16430-1 and tested/rated for thermal output in accordance with BS EN 16430-2
Ensure fan convector heaters (fan coil units) are rated in accordance with all relevant parts of BS 4856 depending on type specified.
Arrangement
As scheduled
Casing.
Construct casing from rigid heavy gauge sheet steel, strengthened to prevent drumming, with no sharp edges for safety. Support heating element from casing and ensure casing prevents air by-passing. Fit foam plastic strips to flanges at rear of casing. Provide back panels.

Internal lining
Line internal casing surfaces with fire retardant acoustic absorption material, free from surface erosion.

Access

Provide an easily removable panel to give access to fan, motor and filter.
Finish
Degrease and protect against rusting and provide corrosion protection by phosphating followed by powder coating with epoxy polyester unless otherwise indicated.
Heating elements
Materials
Finned tubes
Copper.
Fins
Aluminium.
Headers
Copper
Connections
Screwed female to relevant part of BS EN 10226, terminating within casing.
Air cock
Fit an air cock on flow connection with the air cock terminating through side of casing, or behind front grille.
Fan
Crossflow centrifugal with EC motor or double inlet, double width centrifugal type, dynamically and statically balanced, suitable for high efficiency and quiet running as scheduled.
Motor
Electronically commutated (EC) with infinitely variable speed control unless scheduled otherwise.
Vibration isolation
Isolate motor/fan assembly from casing by anti-vibration mountings.
Filter
Removable, washable type.
Grilles
Linear grilles to manufacturer's standard, unless otherwise indicated. Ensure grilles are pencil proof.
Controls
Pre-wired sensor / controls arranged as described in the controls drawings and scheduled in W60
Testing
Pressure test at not less than 7 bar (gauge) or one and a half times maximum working pressure whichever is greater.
Accessories
Mounting brackets

310.082 TRENCH HEATING: (T31)
Duty and type as scheduled.
Standards
Ensure trench heaters (convectors) are manufactured to BS EN 16430-1 and tested/rated for thermal output in accordance with BS EN 16430-2.
Sound power levels to be measured in accordance with BS EN ISO 3744
Electrical supply to BS EN 60038
Details – unless scheduled otherwise
Fan / motor type
Crossflow with electrically commutated (EU) motor with infinitely variable speed control unless scheduled otherwise.
Casing
Construct casing from rigid heavy gauge galvanised sheet steel, strengthened to prevent drumming, with no sharp edges for safety. Support heat exchanger from casing and ensure casing prevents air by-passing.
Casing minimum thickness - 1.2mm
Finish -Manufacturer's standard unless scheduled otherwise.
Grilles
Anodised aluminium roll-up linear grille to manufacturer's standard.
Stainless steel roll-up linear grille to manufacturer's standard.
Linear grilles to manufacturer's standard.
Ensure grilles are pencil proof.
Filter - fresh module for facade ventilation unit
Removable, washable type.
Connections

Brass compression fittings for connecting to valves terminating in casing.

Controls - fan assisted types

Provide manufacturer's standard wall-mounted digital controller with integral room temperature sensor suitable for interfacing with a BMS for alarm outputs.

Control requirements unless scheduled otherwise.

Provide facility for digital input for remote on/off control.

Unit to operate in natural convection mode with automatic operation of fan to increase output.

Electronically commutated (EC) motor with infinitely variable fan speed control to automatically adjust the fan speed depending on the room temperature.

Integrated timer program for programming day and week switching functions.

Provide manufacturer's standard wall-mounted electromechanical room thermostat and fan speed controller.

Controls - natural convection types

Provide and install in the convector casing a lock shield valve and thermostatic radiator valve with remote sensing bulb and adjuster.

Testing

Pressure test at not less than 7 bar (gauge) or one and a half times maximum working pressure, whichever is greater.

Accessories – unless scheduled otherwise provide the following:

Air vent and drain cock.

Two port LTHW control valve and actuator for on/off control.

Lockshield valve for return shut off / regulation.

Floor mounting brackets with height adjustment.

310.085 UNIT HEATERS: (T31)

Duty as schedule

Standard - Rate unit heaters in accordance with BS 4856.

Electrical details to BS 7697, single or 3 phase as scheduled

Arrangement - as schedule

Casing

Manufacturer’s standard. Construct casing from rigid heavy gauge sheet steel.

Provide access to fan and motor

Extend casing to cover motor and fan.

Position suspension cleats so that the heater will be suspended level before pipework is connected.

Fit spigot for ductwork connection as required.

Finish

Degrease and protect against rusting before application of a high quality stove primer and Stove enamel paint

Colour

Manufacturer’s standard.

Heating elements

Finned tubes

Copper.

Fins

Aluminium.

Headers

Steel.

Connections

Screwed female to relevant part of BS EN 10226 or Flanged to BS EN 1092 parts 1, 2, 3 or 4 - PN to suit fluid and working pressure.

Fan

Propeller type dynamically and statically balanced.

Motor

Totally enclosed, with sealed for life bearings requiring no

Vibration isolation

Isolate motor/fan assembly from casing by anti- vibration mountings.

Louvres

Provide adjustable discharge louvers as indicated.

Testing

Test to BS 4856, not less than 20 bar (gauge) or twice the maximum working pressure whichever is greater.

310.090 CONTINUOUS NATURAL CONVECTORS: (T31)

Standard - Ensure natural convectors are manufactured in accordance with BS EN 442-1,

thermal output and pressure drop testing/rating to be in accordance with BS EN 442-2

Duty as scheduled.

Type

Sill line convector.

Skirting convector.

Handrail convector.

as scheduled

Materials

Finned tubes

Copper.

Fins

Aluminium.

Casing

Provide back plates complete with brackets to support finned tube.

Manufacture back plates from aluminium, or mild steel.

Provide front plates manufactured from aluminium, or mild steel.

Finish

Degrease and protect against rusting before application of a high quality stove primer, unless otherwise indicated.

Outlet

As scheduled

Grille

Aluminium grille, unless otherwise indicated

Testing

Pressure test at not less than 7 bar (gauge) or one and a half times maximum working pressure whichever is greater.

Accessories

Support brackets

310.100 RADIANT PANELS (Heating or heating / cooling): (T31)

Duty as scheduled.

Standards

BS EN 14037-1 - technical specification and requirements.

BS EN 14037-2 - test methods for thermal output.

BS EN 14037-3 - rating method and evaluation of radiant thermal output.

If panels used in a changeover system to provide summer cooling, test panels constructed in accordance with BS EN 14037-1 for cooling capacity in accordance with BS EN 14037-4 and BS EN 14037-2.

Panels for security applications to be anti-ligature design and National Offender Management Service approved.

Material

Coil and Header, coil minimum diameter 20mm and header minimum diameter 32mm. Copper.

Front panel, minimum thickness 2mm. Aluminium, or Mild Steel.

All cover plates shall be manufactured of the same materials as the Radiant Panels and of the identical profile in order that when fitted they provide a smooth continuous face with the minimum gap to accommodate expansion between the panels and the cover plate, these being fixed with spring clips, magnets or set screws as necessary.

Finish

Degrease and protect against rusting before application of a high quality stove primer, unless otherwise indicated.

Insulation

Insulate back of panel with 40mm minimum thickness material with reinforced aluminium foil finish, and all edges taped to prevent fibre migration. Insulation shall be held in place by purpose made clips/fixings.

Air venting

Provide air cock for venting in unit header.

Access

Provide access panel to match front plate.

Support

Provide adjustable hangers for ceiling units and brackets for wall hung units.

310.111 RADIANT STRIP HEATING: (T31)

T20 – Primary Heat Distribution

The radiant Strip Panels shall be aluminium construction having a 16 minimum gauge smooth aluminium face plate to the back of which shall be attached mechanically a special extrusion of such profile as to give at least 50% surface contact to the heating water copper tube. This extension shall be designed specifically for the purpose with the fixing arrangements such that it will allow differential thermal movement between the face plate movement between the face plate and extrusion without facial distortion.
A copper tube grid shall be held into the extrusion such that the tube is held in very close contact but at the same time allowing thermal movement.

The rear of the Strip Panel shall be provided with a 400mm thick fibre glass blanket which shall have all edges taped to prevent fibre migration.
The panels shall be provided with a factory finish.
Junctions between panels shall be by means of purpose made strips in order to allow expansion naturally.
Standards
BS EN 14037-1 - technical specification and requirements
BS EN 14037-2 – test methods for thermal output
BS EN 14037-3 – Rating method and evaluation of thermal output
BS EN 14037-4 – Test method for cooling capacity if used in a changeover system to provide summer cooling

310.120 TOWEL RAILS: (T31)
Duty as schedule
Arrangement
Floor mounted, Wall mounted or including radiator panel as scheduled
Connections
Integral screwed.
Air cock
Provide flush return end air cock.
Finish
Chromium plated.
Testing
Pressure test at not less than 7 bar (gauge) or one and a half times maximum working pressure whichever is greater.
Thermal output and pressure drop testing to be in accordance with BS EN 442-2.
Accessories
Wall /floor brackets.

310.130 EMBEDDED PIPE COILS :(T31)
Duty as scheduled
Supply pipe for installation in screed.
Material
Copper - BS EN 1057, R250 with brazed joints or
Steel – BSEN 10244, heavy, with welded joints or
Plastic to manufacturer's specification.
as indicated.

310.140 HEATED CEILING PANELS :(T31)
Duty as equipment schedule
Provide heated ceiling panels installed by specialist to manufacturer's instructions.

310.150 UNDERFLOOR HEATING :(T31)
Duty and details as equipment schedule
Standards
Design, proving of thermal output, testing and installation in accordance with relevant parts of BS EN 1264
Comply with relevant parts of BS EN ISO 11855.
Pipe and fittings system
WRAS listed.
All underfloor pipework to incorporate an oxygen diffusion barrier.
Material
Crosslinked polyethylene (PE-X) BS 7291-3 or all parts of BS EN ISO 15875, Ends plain, and finish – natural
or Polybutylene (PB) BS 7291 Part 2 or all parts of BS EN ISO 15876 Ends - plain, and finish – grey
or Proprietary plastic multilayer composite system to BS EN ISO 21003

Two layers of PE-Xc to all parts of BS EN ISO 15875 with EVOH oxygen barrier to DIN 4726.
or Metal / plastic multilayer composite system to BS EN ISO 21003.
Welded aluminium forming oxygen barrier between inner and outer layers of PE-X to BS EN ISO 15875-2 or PE-RT to BS EN ISO 22391-2, oxygen barrier to DIN 4726.

310.151 HEAT INTERFACE UNIT (HIU) (Y22 2045).
General
Design, install, test and commission the units and systems into which they are installed following the guidance / recommendations in BSRIA BG62/2015 and CIBSE / CHPA CP1 for heat networks. The extent of design work is outlined in the scope of works / system description.
The HIU shall be CE marked.
Duty and detailed requirements - as scheduled
Electrical details
BSEN 60038, single phase or as scheduled
Arrangement
As scheduled
Standards
Equipment associated with hot and cold water services to comply with Water supply Regulations and have relevant WRAS approvals.
Materials / jointing
Internal interconnecting pipework in the HIU to be copper or 316 stainless steel connections shall be brazed or welded wherever possible, compression or other mechanical fittings will only be acceptable where it can be demonstrated that brazing or welding is not possible. Wherever practical, internal pipework and heat exchangers to be insulated to minimize heat losses.
Casing
Construct casing from rigid heavy gauge sheet steel. Provide label on unit to enable user to isolate the primary supplies in an emergency. Provide access to all components from the front of the unit, side access panel will not be acceptable. Ventilation openings to be provided to prevent overheating of pump motor or control components.
Finish
Degrease and protect against corrosion before application of high quality stove primer and stove enamel paint or powder coating, colour to be manufacturer's standard unless scheduled otherwise.
Connections
Screwed female to BS EN 10226 to suit fluid maximum working pressure.
Heat Exchangers
Plates to be 316 stainless steel and fouling factor of 10% to be used in sizing. Units to be pre-insulated at the manufacturers works.
Pump / Control
Glandless circulator to be Class A with variable speed control. Motors shall have a maximum Energy Efficiency Index (EEI) of 0.2, in accordance with EC directive 641/2009 and the amendment 622/2012. Pump motor to be permanent magnet type, with integral stepless control of pump speed to a minimum flow in response to closing of Thermostatic radiator or other 2 port control valves in the system. Pumps to comply with BS EN 60335-2-51 and relevant parts of BS EN 16297 for calculation of Energy Efficiency Index (EEI).
Circulators having a rated input of up to 200W to be tested in accordance with BS EN 16644 for structure and fluid borne noise.
Testing and Commissioning
HIU to be tested in accordance with BSRIA BTS 2/2015 to provide the following:
Product identification
Space heating circuit capacity
Domestic hot water production
Fluid side pressure drop on both circuits
Plate deflection in Heat exchangers
Heat loss
Hydraulic pressure testing at manufacturers works 1.5 times the maximum working pressure on primary and secondary side as scheduled.
Undertake commissioning and proving of capacity accordance with the relevant CIBSE / BSRIA codes and recommendations of the HIU manufacturer.
Where scheduled provide test data for testing to BESA UK HIU Test Regime Technical Specification to establish how the HIU will interact with a "Heat Network".
Temperature Control
Control of Domestic Hot Water flow temperature to have accuracy no greater than +/- 3ºC.
The controls shall ensure that the heat exchanger surfaces do not reach temperatures that could cause rapid scaling of the heat exchange surfaces.
Heat meter

T20 – Primary Heat Distribution

To be part of units and record and display cumulative energy used (kWhrs), flow and return primary temperatures, instantaneous flow rate / kW. Heat meters to comply with relevant parts of BS EN 1434.
Flow sensor accuracy class as BS EN 1434-1 and Annex MI-004 of the EU Measuring Instruments Directive (MID 2014/32/EU) – class 2.

Cold water meter

To relevant parts of BS EN ISO 4064
To BS EN 14154-4 (if AFD's associated with Smart Metering required)

Accessories

Wall or floor brackets and items as scheduled.
Fixed full bore bypass in the primary heat network connections with binder points for measurement of differential pressure across the HIU.

310.160 PRESSURIZATION PLANT:

Standard

Manufacture pressure vessels for sealed hot water systems in accordance with BS EN 13831, and BS 7074 Part 1 (Domestic heating and hot water supply) or Part 2. (Low and medium temperature hot water heating systems) as applicable.

Manufacture pressure vessels for unvented hot water systems in accordance with BS 6144, and BS 7074 Part 1 (Domestic heating and hot water supply) or Part 2. (Low and medium temperature hot water heating systems) as applicable.

Duty as scheduled.

Accessories

100mm OD minimum system pressure gauge (calibrated in bar & psig)
High pressure switch.
Low pressure switch.
Safety valve
Water meter - integrating total system make-up quantity
Automatic pump changeover, with lead pump selector switch
Power 'on' indicating lamp
High pressure indicating lamp
Low pressure indicating lamp
Power isolating switch
Hand/off/auto switch
Hours run counter
Pump start frequency counter
Control equipment to comply with Health & Safety Executive Guidance Note PMS - Hot water boilers, category 'B'

Alarms

High system pressure
Low system pressure
Excessive pump start
Facility for remote monitoring of a common alarm condition

310.170 GAS / OIL FIRED HEATING PLANT – LOCAL HEATING UNITS (T42):

Refer to schedules / scope of work for project specific type / details and duties.

Direct and indirect fired self-contained heating units standards

BS EN 17082 - domestic and non-domestic gas-fired forced convection air heaters up to 300kW net heat input
BS 5990 - direct gas fired heaters rated from 330 kW up to 2 MW.
BS 5991 - indirect gas fired heaters rated up to 2 MW.
BS EN 1266 - gas-fired with nominal heat input up to 20kW based on net calorific value.
BS EN 13842 - oil fired forced convection air heaters.

Flue gas heat recovery

Type - Plate heat exchanger performance tested in accordance with BS EN 308

Gas fired space heaters standards

BS EN 14829 - independent gas-fired flueless space heaters for nominal heat input not exceeding 6kW.
BS EN 1266 - gas fired convection heaters up to 20kW.

T20 – Primary Heat Distribution

BS EN 449 - LPG domestic flueless space heaters for nominal heat input not exceeding 4.2kW.
BS 5871-1 - gas fires, convector heaters and heating stoves.
BS 5871-2 - inset live fuel effect gas fires of heat input not exceeding 15kW, and fire/back boilers.
BS 5871-3 - decorative fuel effect gas appliances of heat input not exceeding 20kW.
BS 5871-4 - independent gas-fired flueless fires, convector heaters and heating stoves of nominal input not exceeding 6kW.

Gas radiant heater standards

Radiant tube heater incorporating a single burner to BS EN 416 where the supply of combustion air and/or the evacuation of products of combustion is by mechanical means located upstream of the draught diverter if fitted.
Radiant tube heater system incorporating multiple tube heater segments to BS EN 416 where the supply of combustion air and/or the evacuation of products of combustion is by mechanical means.
Radiant strip heaters incorporating a single burner to BS EN 17175, where supply of combustion air and/or evacuation of products of combustion is by mechanical means.
Multi-burner continuous radiant tube heater systems to BS EN 17175, where supply of combustion air and/or evacuation of products of combustion is by mechanical means.
Overhead luminous radiant heaters to BS EN 419
Type A appliance without a fan
Type A appliance with a fan upstream of the combustion chamber / heat exchanger
BS EN 14543 - LPG flueless radiant parasol patio heaters.

Flues to BS EN 1856-1 (tested to BS EN 1859) installed in accordance with BS EN 15287-1 and the unit manufacturers recommendations

320.000 WORKMANSHIP (T31 / T42)

320.010 INSTALLATION (T31 320.010 & T42 300.050, 310.010, 310.020, and 310.030):

Install in accordance with manufacturer's recommendations to give a neat appearance, with supports out of view where possible.
Ensure equipment is firmly fixed and level.
Install domestic systems with heat requirements up to a total of 50kW to BS EN 14336.

Installation / ventilation requirements for local gas / oil fired heaters

Install space heaters in accordance with manufacturer's recommendations.
Install gas radiant heaters in accordance with BS 6896
Install and commission gas fired air heaters of rated heat input not exceeding 2MW in accordance with BS 6230 and manufacturer's instructions.
Install and commission gas-fired air heaters of rated heat input not exceeding 70kW in accordance with BS 5864 and manufacturer's instructions.
Install and commission oil fired air heaters of rated output not exceeding 45kW in accordance with BS 5410-1 and manufacturer's instructions.
Install and commission air heaters for liquid fuel firing installations for non-domestic buildings and buildings containing multiple separate dwellings in accordance with BS 5410-2 and manufacturer's instructions.

Install unit flue and flue connection from unit in accordance with manufacturer's instructions and recommendations.
The heater manufacturers shall install and commission the flues.
Install flue in accordance with BS EN 15287-1.
Minimise the number of joints, do not locate joints in depth of floors. Install with any sockets facing upwards. Fill joints with approved jointing compound to give gas tight seal.

Install oil storage tank in accordance with BS 5410-2 and BS 799-5

Comply with BS 6896, BS EN 13410, BS 6230 or relevant part of BS 5410 depending on heater type, application and fuel, for ventilation / supply of combustion air.

320.020 BUILDERSWORK:

Mark out positions for battens fixed by others, when fixing equipment to stud walling.

T20 – Primary Heat Distribution

320.030 SECOND FIX:
Allow for removal and second fix of all radiators.

320.040 ISOLATION:
Fit an isolating valve on flow and a regulating valve on return unless otherwise indicated.

320.051 EMBEDDED PIPE COILS & UNDERFLOOR HEATING INSTALLATION:
For plastic pipe coils embedded in screed, comply with manufacturer's instructions for installation. Lay insulation and pipework on floor slab and test prior to screeding. Protect against damage to pipework before screeding is carried out. Install panels at depth and in position shown on drawings.
Install in accordance with manufacturer's instructions and BS EN 1264-4 or BS EN ISO 11855-5, the piping system manufacturer's recommendations and comply with BSRIA BG 4/2011 for the general installation process, commissioning, balancing and start-up.

320.070 PRESSURISATION UNIT INSTALLATION:
Install pressurization unit and ancillary equipment in accordance with manufacturer's recommendations including safety valves if not part of the packaged equipment. .
Install expansion vessels and ancillary equipment for low and medium temperature hot water heating systems in accordance with BS 7074 Part 2.
Install expansion vessels and ancillary equipment for domestic heating in accordance with BS 7074 Part 1.
Install double check valves on quick fill connections.

10000 Based on NES:
T20 Dec 19
T30 Dec 04
T31 Dec 19
T42 Dec 19

T70 – Local Cooling Units / Heat Pumps

Incorporating U60

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide individual and locally controlled cooling (or cooling and heating) to the areas listed in the scope of works, using units located within the spaces requiring a cooled atmosphere.

100.020 DESIGN PARAMETERS / STANDARDS
See Schedule of Common Design Criteria.
Refrigerants to have an Ozone depletion Potential (ODP) of Zero.
All components of the refrigeration system to be designed and installed to the requirements of BS EN ISO 12100, BS EN 378 Parts 1-4 - Refrigeration systems and heat pumps – Safety and Environmental requirements, BS EN 12693 (Safety and environmental requirements of refrigerating systems and heat pumps) and BS EN ISO 4126-1.
Comply with BS EN 14825 for testing and rating at part load conditions and calculation of seasonal performance.
The F-Gas Regulations 2015 as amended and relevant DEFRA guidance documents
The Pressure Systems Regulations, The Pressure Equipment Regulations 1999.
The latest edition of the relevant Institute of Refrigeration (IOR) Safety Code of Practice for refrigerant used in the installation.
The IOR Code of Practice for the Minimisation of Refrigerant Emissions from Refrigerating Systems
Systems to be designed to achieve a refrigerant leakage emission of no greater than 1% per year.
The Non Domestic Building Services Compliance Guide referred to in ADL1 and ADL2A/B of the latest edition of Part L of the Building Regulations:

PART 3 SPECIFICATION CLAUSES SPECIFIC TO T70

300.000 PRODUCTS/MATERIALS
See Scope of Works and Schedules
Electrical supply to BS EN 60038

300.001 PRESSURE EQUIPMENT DIRECTIVE/PRESSURE EQUIPMENT REGULATIONS:
All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 2014/68/EU, implemented in the UK through the Pressure Equipment (Amendment) Regulations 2015 and The Pressure Equipment (Safety) Regulations 2016, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.

Only relevant equipment and assemblies certified as compliant will be permitted under this specification, and any substitution put forward must also be compliant with the Directive.

300.015 REFRIGERANTS:
CFC and HCFC refrigerants are prohibited and must not be used.

On applicable projects and detailed elsewhere, comply with BREEAM requirements below to suit the type of construction and scheme.
BREEAM New Construction 2018 Requirement
Comply with Issue ID Pol 01 Impact of Refrigerants.
BREEAM Refurbishment and fit-out 2014 requirement
Comply with Issue ID Pol 01 Impact of Refrigerants.

300.017 ECODESIGN / EER REQUIREMENTS FOR AIR CONDITIONERS:
Equipment to be in accordance with The Energy Related Products Regulations 2010 as amended
Fans incorporated into plant with electric input between 125W and 500kW to comply with EU Regulation 327/2011.
Units with a rated capacity of up to 12kW to comply with EU Regulation 206/2012.
Other plant to comply with EU Regulation 2016/2281 for seasonal space cooling energy efficiency and product information / instruction manuals.
The full load (cooling) Energy Efficiency Ratio (EER) of plant shall be as detailed elsewhere in this specification but shall not be less than the minimum values given in the latest edition of the appropriate Non-Domestic Building Services Compliance Guide.

T70 – Local Cooling Units / Heat Pumps

300.021 COOLING / HEAT PUMP UNIT:

Standards

Relevant parts of BS EN 378, all relevant parts of BS EN 14511 and BS EN ISO 4126-1.
BS EN 12693 for safety and environmental requirements of positive displacement refrigerant compressors.
Comply with BS EN 14825 for testing and rating at part load conditions and calculation of seasonal performance.
BS EN 60335-2-40 for safety of air-conditioners and heat pumps.
Acoustic - determine sound power levels in accordance with BS EN 12102-1

On applicable projects as described in scope of works comply with international standards.
BS ISO 5151 for non-ducted air-cooled air conditioners and air-to-air heat pumps.
BS ISO 15042 for multi-split systems, modular multi-split systems and modular heat recovery multi-split systems.
Relevant parts of BS ISO 16358 for testing and calculation of seasonal performance factors

Casing

Manufacture casing from galvanized sheet steel in steel frame. Seal joints to prevent air leakage. Line casing with thermal and acoustic insulation.
Manufacturer's standard finish.

Access

Provide access to components requiring regular maintenance via access panels with special locks or hinged access doors.

Cooling unit components

Fans

Provide fan, motor and drive assembly mounted on a base frame. Isolate base frame to prevent transmission of vibration to unit.
Supply double inlet, double width forward curved centrifugal fans.
Drive fans from motor by multiple vee belts and pulleys keyed to shaft. Provide means of tensioning belt drive via sliding base.

Cooling section

Provide cooling coil manufactured from copper tube with aluminium fins.
Provide condensate drain pan with drain connection.

Filters

Provide return air filter - BS EN ISO 16890 coarse 50% unless scheduled otherwise.

Accessories

Condensate pump wired to disable the unit in the event of a pump failure

300.030 REMOTE AIR COOLED CONDENSING UNIT:

Provide a condensing unit incorporating hermetic compressor, condenser coil and fan or provide a condensing unit incorporating condenser coil and fan as scheduled.

Where the compressor is incorporated as part of the unit provide compressor complete with crankcase heater, suction and delivery valves, service connections and high and low pressure safety switches.
Standards:
Relevant parts of BS EN 378 & BS EN 14511 and BS EN ISO 4126-1
BS EN 12693 for safety and environmental requirements of positive displacement refrigerant compressors.
Performance testing / rating conditions in accordance with BS EN 13771-2 and BS EN 13215.
Acoustic - determine sound power levels in accordance with BS EN 12102-1
Casing - Provide a weatherproof casing.
Finish - Manufacturer's standard unless otherwise indicated.

300.040 INTEGRAL COMPRESSOR UNIT:

Where specified, supply a fully hermetic compressor and fan mounted within the casing of the air conditioning unit. Provide compressor complete with suction and delivery valves, service connections and high and low pressure switches. Mount compressor on anti-vibration mountings to prevent the transmission of vibration. Fit a crankcase heater to prevent migration of refrigerant.
Ensure unit complies with BS EN 378, BS EN 12693, BS EN 14511and BS EN ISO 4126-1.
Comply with BS EN 14825 for testing and rating at part load conditions and calculation of seasonal performance.

300.046 CONTROL SYSTEM:

T70 – Local Cooling Units / Heat Pumps

Refer to schedules and W60 for details
Locate room thermostats in position representative of ambient conditions on a north facing wall out of direct sunlight.
Configure controls to ensure that cooling and heating cannot operate simultaneously. Ensure heating is off before cooling operates.
Provide a 24 hour/7 day timer.

300.053 WINDOW/WALL MOUNTED AIR CONDITIONING UNIT (wasU60:300.020):

Provide packaged air conditioning unit complete with integral condenser.
Standards BS EN 378, BS EN 12693, BS EN810, BS EN14511, BS EN 60355-2-40 and BS EN ISO 4126-1
Acoustic - determine sound power levels in accordance with BS EN 12102-1
Comply with BS EN 14825 for testing and rating at part load conditions and calculation of seasonal performance.
Access
Provide access to filter, fan and motor.

300.061 REFRIGERANT PIPEWORK

Material

Refrigerant quality copper to BS EN 12735-1, fully annealed and internally degreased and cleaned.
Tubes for equipment to BS EN 12735-2.

Jointing

Do not used screwed joints in pipelines, except for connection to equipment.
Brazing - comply with British Refrigeration Association (BRA): Specification & Procedures for Manual Torch Brazing and Brazer Assessment

Insulation

On internal pipelines, insulate suction pipe from evaporator to compressor.
On external pipelines, insulate both suction and discharge pipes and protect from solar radiation where pipework is not otherwise shielded.

300.062 REFRIGERANT PIPEWORK INSTALLATION [U60:320.020]:

Comply with relevant Institute of Refrigeration (IOR) Safety Code of Practice for refrigerant used in the installation.

Arrange all exposed pipe runs to present neat appearance, parallel with other pipe or service runs and building structure, subject to gradients for draining or venting.

Ensure all vertical pipes are plumb or follow building line.
Support all pipework pipework and controls cabling throughout their length using cable tray, firmly fixed to the building fabric.
Space pipe runs in relation to one another, other services runs and building structure, allow for specified thickness of thermal insulation and ensure adequate space for access to pipe joints, etc.
Take precautions to prevent the discharge of refrigerant gases to atmosphere.
All refrigerant pipework insulation at low level or in locations where mechanical damage could occur or which could be damaged by UV radiation shall be suitably protected.

Where regulations permit supply the split system fully charged with refrigerant and with an oil charge sufficient for the effective and efficient operation of the compressor.

Ensure the completed installation is installed in line with manufacturer recommendations. Carry out strength and leak pressure tests on completion of installation. Evacuate the system and ensure that the system holds a vacuum for a period of 12 hours prior to charging with refrigerant. Submit a method statement to the Engineer for review and comment prior to pressure testing, evacuating or charging.

300.064 DRAINAGE PIPEWORK [U60 300.120]

Provide condensate drainage pipework from all units that could have wet coils to drain.
Refer to schedules and / or scope of work for details, extent of pumping and type of system.
Copper tube to BS EN 1057, fittings solder, Install tees rather than bends to allow cleaning.
Or unplasticised PVC to relevant parts of BS EN ISO 1452.
Provide tundish and air break at units.
Provide trap - depth minimum 1.5 times negative pressure on inlet and 0.5 times negative pressure at discharge
Provide an air break between trap outlet and drainage system. Pipe each trap to drain via a tundish or pipe each trap separately to discharge over a gully to prevent the potential of cross contamination between AHU's.

310.000 WORKMANSHIP

T70 – Local Cooling Units / Heat Pumps

310.010 INSTALLATION:
Install equipment in accordance with manufacturer's recommendations.
Comply with relevant Institute of Refrigeration (IOR) Safety Code of Practice for refrigerant used in the installation.

10000 Based on NES T70 text Dec 19 and NES T14 / U60 TEXT June 18

U10 – Ventilation Supply/Extract

Incorporating U11 (toilet ventilation), U12 (kitchen ventilation), U13 (car park ventilation) T40 (Warm air heating from central ventilation plant)

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES AND REGULATIONS / STANDARDS
To provide an air movement system to ventilate the spaces listed and to remove vitiated air where indicated.

To temper and filter the air where indicated or provide space heating from central ventilation plant (refer to Y40 for air handing units details)
Refer to clause W60 320.101 for control panel design, construction and installation, W60 320.091 for cabinets for BMS equipment design and construction and W60 320.102 for fireman's override fan control panel.

Comply with Building Regulations Approved Document F1 (England and Wales) or Building Standards Domestic or Non Domestic Technical Handbooks, Section 3.14 (Scotland) or Building Regulations Technical Booklet K (Northern Ireland).

Comply, as detailed in the scope of works and schedules (including Y40sch and A13sch), with the requirements of BS EN 16798-3 and additional guidance in PD CEN/TR 16798-4 to achieve the specified category of supply air (SUP) with defined category of outdoor air (ODA).

Comply with BS EN 15423: Ventilation for buildings. Fire precautions for air distribution systems in buildings.

Naturally ventilated / mixed mode buildings. (NES U10 300.005 – 300.015)
Comply with the following unless detailed otherwise in the project specific scope of works.
Any design work detailed in the project specific scope of works for natural / mixed mode ventilation to comply with Code of Practice BS 5925.
Calculations for determination of air flow rates including infiltration to be in accordance with BS EN 16798-7 and energy losses due to ventilation to be in accordance with BS EN 16798-5-1 and BS EN 16798-5-2.
Use Computational Fluid Dynamics (CFD) to predict airflows and temperatures in 3-dimensions in the building and within the natural ventilation devices.
Predict by dynamic simulation whether summertime overheating is likely to occur.
Unless detailed otherwise in the scope of works, the building shall conform to IEQ Category II (Medium level of expectation for indoor environmental quality) in BS EN 16798-1

Employ a specialist or the ventilation terminal unit manufacturer to develop the concept design and the tender stage thermal model and undertake dynamic thermal modelling calculations using manufacturer's data for the selected ventilation terminals in order to ascertain the optimum size, location and number of terminals required.

Kitchen ventilation (U12)
Comply with the design, construction, testing and commissioning requirements of BESA DW/172 appropriate to the scope of works / system description or relevant parts of BS EN 16282 appropriate to the scope of works / system description and schedules.

Car park ventilation systems (U13)
Comply with the requirements of BS 9999, BS 7346-4 or BS 7346-5, BS 7346-7 and BS 7364-8 and Building Regulations Approved Document B (Fire Safety) for car park ventilation in order to limit concentrations of carbon monoxide (CO) and other vehicle emissions in the day-to-day use of car parks and to remove smoke and heat in the event of a fire.
Ensure wiring is suitable for high temperatures to provide a maintained supply.
Comply with BS 7671 (IET Wiring Regulations) and provide power supplies in accordance with BS EN 12101-10.
The cables selected for power and control wiring for the installation shall be fire-resistant meeting the requirements of BS 8519.

Schools

Where applicable, comply with the requirements of the latest version of Building Bulletin 101 Ventilation of School Buildings for school ventilation and baseline designs and strategies for schools, including for the Priority School Building Programme (PSBP) where appropriate

Offices

Where applicable, comply with the top of the range recommended in the British Council for Offices Guide to Best Practice in the Specification of Offices.

Healthcare buildings

Where applicable, comply with the requirements of HTM 03-01 Specialised ventilation for healthcare premises (England, Wales and Northern Ireland) SHTM 03-01 Ventilation for Healthcare premises Part A: Design and Validation (Scotland) for Clinical areas with controlled environmental conditions.

General

Undertake checks and tests in order to verify the fitness for purpose of the installed systems prior to handover in accordance with BS EN 12599.

Refer to Y30sch1 for each ventilation systems cleanliness quality class to BS EN 15780 and PDI level to BESA TR/19

For residential ventilation comply with BS EN 13142 for performance characteristics. Performance test ventilation components/products in accordance with relevant parts of BS EN 13141.

100.020 DESIGN PARAMETERS / REQUIREMENTS

General

See Schedule of Common Design Criteria / clause 100.010.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO U10

300.011 TOILET EXTRACT UNIT (U11 300.010)

Electrical safety to BS EN 60335-2-80.
Motor - Electrical supply to BS EN 60038, type as scheduled
Access - provide access via removable panel.
Controls - On/off with auto changeover.
Accessories
- Backdraught dampers.
- Anti-vibration mounts.

Testing

Where fans approved under CAME scheme are used provide certified data for type.

Where fans are not approved under CAME scheme provide results of aerodynamic performance tests in accordance with BS EN ISO 5801; noise tests in accordance with BS EN ISO 5136, BS ISO 13347 parts 1-4; and fan vibration tests in accordance with BS ISO 14695.

300.015 ECODESIGN REQUIREMENTS FOR AIR HEATING PLANT: (T40)

Equipment to be in accordance with The Energy Related Products Regulations 2010 as amended.
Plant to comply with EU Regulation 2016/2281, including Seasonal Space Heating Energy Efficiency (SHEE) and product information / instruction manuals information on disassembly, recycling and/or disposal.

300.020 NATURAL VENTILATION TERMINAL UNIT MANUFACTURER:

Use ventilation terminal units from a single manufacturer.
The selected ventilation terminal unit manufacturer shall undertake the following
- Provide structural loadings and installation details.
- Produce installation and record drawings for all ventilation terminals, co-ordinated with the architect and structural engineers' details.
- The supply, installation, testing and initial commissioning of all ventilation terminals and all associated controls that make up the ventilation systems in the building.
- Seasonal commissioning to prove the installed system and facilities meet the design criteria and users' requirements.

300.040 INTEGRATION, CONTROL AND MONITORING: (U13 car park ventilation)

Provide an integrated system as detailed in the scope of works / schedules.
Equipment to be controlled / monitored should interface with BMS and fire alarm system as described in the scope of works via:
- Local outstations and/or local control panels

Supervisory control and data acquisition system via:
- Local outstations / control panels

Fire detection and alarm system:
- Ensure interfaces to fire detection and alarm system comply with the requirements of the relevant parts of BS 5839 and BS 7273
- Ensure relevant equipment complies with BS EN 50130-4.

300.050 SOFTWARE: (U13 car park ventilation)

Obtain on behalf of the end users all appropriate licences, permissions, copyright waivers, rights of use and the like from the owners of the software rights. Ensure that the end user is properly registered with the software supplier for support and appropriate updating. Provide documentation for application software in accordance with BS ISO/IEC 26513 and BS ISO/IEC 26514.
Ensure that, as far as practicable, all software is commercially available off-the-shelf.
Ensure that any programmable configuration, customisation, and bespoke software, is developed, tested and commissioned using relevant processes and procedures complying with BS ISO/IEC/IEEE 12207 or BS ISO/IEC/IEEE 15288 supported by a quality management system meeting the requirements of BS EN ISO 9001.

310.000 PRODUCTS/MATERIALS

Provide system components as indicated on drawings and schedules

Natural ventilation (NES U10: 310.010 – 310.040)

Where natural ventilation terminal units include automatic controls, a manual override should be fitted to allow short-term adjustment during unexpected weather conditions.
All natural ventilation terminals to include insect screen and weather protection.
Louvres to comply with Y46 and be tested in accordance with BS EN 13030.
Air transfer devices and trickle ventilators to comply with BS EN 13141-1 for performance testing of externally and internally mounted air transfer devices and BS 6375-1 for performance for weather tightness.
Test local wall ventilators and trickle ventilators to demonstrate they comply with BS EN 1026 and BS EN 1027 for air permeability and water tightness.
- Air permeability 0.25m3/hr at 50Pa in closed position unless detailed otherwise in scope of work
- Water tightness - no leakage at 1000Pa in closed position unless detailed otherwise in scope of work

Sound reduction – weighted element normalised difference to be rated in accordance with BS EN ISO 717-1. Refer to scope of works for project specific requirements.

310.005 MAIN CAR PARK EXTRACT FANS (U13 310.005):

The facilities shall be designed in accordance with code of practice BS 7346-7.
Details of fans are given in work section Y41 and schedules.
Details of controls and BMS requirements and interfaces with main car park extract fans and impulse fans (where installed) are given in the scope of works or work section W60.
Testing
- Test aerodynamic performance to BS EN ISO 5801
- Temperature/time classification to BS EN 12101-3
  - 300°C for not less than 60 minutes unless scheduled otherwise

Power supplies
- Comply with BS 7671 and BS EN 12101-10

Where fans are not approved under CAME scheme provide results of aerodynamic performance tests in accordance with BS ISO 14695, BS 848-6

310.006 CAR PARK MAKE UP AIR HANDLING SYSTEM (U13.310.006):

Refer to scope of works / schedules and work section Y40 for details of air handling units.
Control and BMS requirements and interfaces with main car park extract fans and impulse fans (where installed) are given in the scope of works or work section W60.

310.012 CAR PARK VENTILATION SYSTEM AND IMPULSE JET CAR PARK VENTILATION

U10 – Ventilation Supply/Extract

UNITS (U13 300.001, 300.010, 300.015 & 310. 010)
Refer to schedules for duties / details.
Use a specialist to manufacture, supply and install and commission the car parking ventilation equipment and associated control system to operate the jet fans and associated main car park extract fans.
Where scheduled use a specialist to undertake the detailed design of the system and carry out a detailed CFD study of the car park ventilation system and prepare and submit the CFD analysis to the approving authority, in accordance with the Smoke Control Association / HEVAC Guide - CFD Modelling Guide for Car Park Ventilation Systems. The system shall be designed in accordance with the functional and calculation methods described in BS 7346-7 and BS 7346-8.
Standards
Comply with BS 9999, BS 12101-3, BS 7346-7 and BS 7346-8
Comply with BS 7671 and provide power supplies in accordance with BS EN 12101-10.
The cables selected for power and control wiring for the installation shall be fire-resistant meeting the requirements of BS 8519.
Operation
Sequential impulse fan and main extract fan operation on demand from bespoke control system.
Materials
Polyester powder coated or Manufacturer's standard.
Electrical safety to BS EN 60335-2-80.
Motor
Electrical supply to BS EN 60038
Accessories
Directional outlet diffuser.
Safety inlet guard
Controls - Provide speed controller to match fan.
Testing
Jet fans performance test data in accordance with BS EN ISO 13350.
Temperature/Time classification to BS EN 12101-3: 300°C for not less than 60 minutes unless scheduled otherwise.
Provide results of fan vibration tests in accordance with BS ISO 14695, BS 848-6.

310.015 DUCTWORK SYSTEM FOR CAR PARK VENTILATION (U13 310.015):
All smoke control duct sections should comply with BS EN 12101-7, tested to the requirements of the relevant parts of BS EN 1366 and classified in accordance with BS EN 13501-4.
Smoke control dampers should comply with BS EN 12101-8, tested to BS EN 1366-10 and classified in accordance with BS EN 13501-4.
Provide test classification report using BS EN 13501-4 nomenclature from a UKAS accredited certification body.
The design and selection of the system shall comply with the recommendations of BS 7436-7: Annex A.
Refer to schedule Y30 schedules for project specific details

310.016 KITCHEN VENTILATION CEILINGS (U12 310.030):
Type – refer to scope of works / drawings
Standards
BESA DW/172 and BS EN 16282-3 for design, construction and safety requirements
Details – refer to scope of works / drawings

310.017 TREATMENT OF AEROSOLS/POLLUTION IN KITCHEN EXHAUST SYSTEMS (U12 310.032):
Type – refer to scope of works / drawings
Standards
BS EN 16282-8 for design, construction and safety requirements
Details – refer to scope of works / drawings

310.031 DUCTWORK FOR KITCHEN VENTILATION SYSTEMS (U12 310.030)
For normal applications supply and install ductwork associated with kitchen canopies in accordance with DW144 as detailed in DW 172 and clause Y30.2065
Kitchen extract ductwork to be fire resisting as schedule Y30sch5 and clauses Y30.2110C and 2110D or Y30.2110F or as described in the scope of works.
Where existing systems require inspection and cleaning prior to modification, employ a specialist to undertake the following works approved in accordance with Loss Prevention Standard LPS 2084:
Inspect and clean ductwork that may be contaminated with combustible deposits.

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Make recommendations for access improvements to any areas where there is currently limited access making cleaning / maintenance impractical.
When total grease tightness is required Supply and install grease tight ductwork in accordance withDW172
Access doors for cleaning (with grease tight gaskets) shall be installed at every bend and connection and at every 3m on straight lengths of ductwork on all kitchen extract systems.
Material
1.2mm stainless steel.
or 1.6mm zintec.
Supply and install ductwork to extract steam from dishwasher and potwashing machines in accordance with DW172.
Refer to Y30 schedules and/or U10 scope of work for project specific requirements.

310.032 GROUND –AIR HEAT EXCHANGE SYSTEM - PIPEWORK / DUCTS (NES 230.085)
Refer to schedule U10sch3 for project specific requirements.
Material
Polypropylene to BS EN 1852 and DIN 16962 or HDPE to DIN 16961 or DIN 8074 and 8075 with ring stiffness to BS EN ISO 9969
Or Concrete to DIN 4032 and DIN 4035

All materials installed in the ground to be non-toxic and non-corroding in accordance with VDI 4640 Parts 1 and 4.
The materials shall have a smooth – surface interior, not attract dust, be non-hygroscopic and air tight. Corrugated pipes are not acceptable.
The complete system including all joints to be radon proof.
Installation
Install at a minimum fall of 1:50 towards the building / condensate removal facility

310.041 KITCHEN VENTILATION GAS SAFETY INTERLOCK FACILITIES (U12)
Provide an interlock between all kitchen gas appliances supply and extract ventilation to kitchens, such that the ventilation system operation must be proved before the gas appliance can be used in accordance with BS 6173. If an automatic electric isolation valve system is installed in the gas supply to the kitchen then the ventilation system shall also be interlocked with this system.
Comply with IGEM/UP/19 for the design, and application of interlock devices used within commercial and industrial applications including catering.
Scope to include control panel, pressure switch or sensing device, gas isolation control valve and all interconnecting power and control wiring.
Install interlock system in accordance with the manufacturer's recommendations.
Provide the following interlocks unless detailed otherwise in the scope of works or schedules:

- Primary interlock between ventilation system and appliances using differential pressure switch to shut gas isolation valve and lock out appliance on low pressure failure.
- Primary interlock between ventilation system and appliances by monitoring power used by fans to shut automatic gas isolation valve and lock out appliance on low absorbed power.
- Secondary interlock to shut gas isolation valve and lock out appliance on sensing high CO2.
- Secondary interlock to shut gas isolation valve and lock out appliances on fan failure or trip.
- Interlock with fire detection system
- Interlock with gas detection system
- BMS interface

Where appliances do not have flame failure devices provide a pipework integrity system (formerly referred to as weep by-pass system) in accordance with Appendix 12 in IGEM/UP/2 Edition 3.

320.000 WORKMANSHIP

320.010A INSTALLATION AND COMMISSIONING (NATURAL / MIXED MODE BUILDINGS/ RESIDENTIAL):
For mechanical ventilation systems refer to the appropriate specification sections including Y51 for testing and commissioning of mechanical services.
Provide a method statement for the installation and commissioning of the ventilation facilities and controls.
The following notes are associated with natural and mixed mode ventilation systems.
The installer shall undertake a pre-installation survey prior to delivery of ventilation terminals to check all site dimensions and access facilities. A report shall be produced with results of survey and any remedial work required to the terminals shall be carried out before delivery to site.

The ventilation terminal unit manufacturer shall install and commission the ventilation terminal units and all associated controls or employ a certified, trained and vetted installer to undertake the work on behalf of the manufacturer.
Weathering details for all terminals to be agreed with the architect prior to installation.
Installation of all equipment to be installed in accordance with the manufacturer's instructions.
Commissioning should be undertaken by a control specialist to set the natural ventilation system up to recognise seasonal conditions. These should be set to meet the requirements of the building and its location.
Demonstrate the performance of residential ventilation systems through performance testing and installation checks in accordance with BS EN 14134.
Comply with the best practice requirements of BSRIA BG 46/2015 Domestic Ventilation Systems - A guide to measuring air flow rates. For measurement of air flow rates use the unconditional method.

320.011 EQUIPMENT INSTALLATION
Install equipment in accordance with manufacturer's recommendations.
Install and commission LEV systems in accordance with the latest edition of Health and Safety Executive HSG258.

320.012 PROTECTION (U13 car park ventilation)
Protect all car park duct droppers with 6mm bands 50mm wide. These shall be positioned at 300mm, 600mm and 1200mm affl, and shall be GAM. There shall be a 25mm air gap between the outside of the duct and the protective band.

320.020 KITCHEN CANOPY AND INSTALLATION (U12)
Design, manufacture, supply and install kitchen canopies in accordance with DW 172
Electricity safety of either complete electric hoods or hoods supplied as separate parts which when assembled form a complete working hood, incorporating fan to comply with BS EN 60335-2-99.

320.020A SYSTEM PROOVING / POST COMMISSIONING (NATURAL / MIXED MODE BUILDINGS:
Revisit site 3 months after handover and check all terminal units and associated controls for operation in accordance with the design intent.
Undertake seasonal commissioning as defined elsewhere in this specification.
Visit site 12 months after handover to obtain user feedback from periods of high/low occupancy and during all seasons and adjust controls/fine tune the systems as necessary to improve performance if required. Report findings to the designer and building owner/operator and amend the O&M manuals, Building Log Book and Building User Manual.
Where required comply with the 3 year aftercare requirements of Soft Landings.

320.022 INSTALLATION OF CAR PARK SMOKE CONTROL SYSTEM (U13 320.010):
Install, commission and test the car park smoke control equipment in accordance with manufacturer's instructions, the requirements of the approving authority and BS 7346 Parts 7&8.
In addition to the general requirements for operation and maintenance documentation elsewhere in this specification comply with the requirements of BS 7346 Parts 7&8.

Commissioning should be undertaken by a control specialist to set the natural ventilation system up to recognise seasonal conditions. These should be set to meet the requirements of the building and its location.

320.023 QUALITY CONTROL (U13 320.020):
Record all commissioning measurements and tests and site modifications to hardware or software, and revise operating and maintenance instructions accordingly.
Manage configuration of software settings, data and design, in accordance with an appropriate Configuration Management Plan (CMP), complying as necessary with BS EN ISO 9001, BS ISO 10007, BS ISO/IEC/IEEE12207 and BS ISO/IEC/IEEE 15288.
Provide configuration details along with the operation and maintenance manual on hand-over.
Manage information security of systems, software and data during design, implementation and commissioning in line with BS EN ISO/IEC 27001.

10000 Based on NES U10 TEXT Dec 19
U11 TEXT June 17
U12 TEXT Dec 18
U13 TEXT Dec 19

U10 – Ventilation Supply/Extract

V10 – Emergency and Standby Generators

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide an installation containing a prime mover for the production of electrical energy, including emergency and/or standby generation plant.

Ensure electromagnetic compatibility is taken into account for electrical supply, distribution and power systems in accordance with:
WHTM 06-01 Electrical services supply and distribution for healthcare projects.
BS 7671 (IET Wiring Regulations).

100.021 DESIGN PARAMETERS FOR HEALTHCARE PREMISES
An assessment of the essential power requirements shall be made from an understanding of the clinical risk areas that require power interruptions in the primary supply to be limited to 0 to 0.5 seconds, 0.5 to 15 seconds, and 15 seconds to 3 hours, and to establish the basis of the extent of secondary and tertiary systems required for the project to ensure that system resilience is maximised and risk is minimised.
Design and supply emergency and standby generators to fulfil the requirements of Secondary Power Source in accordance with HTM 06-01.
Emergency power configuration
Ensure the design considers managing the maximum demand profile by operating sources of emergency power in parallel.
Ensure that the grid-connected systems intended to operate in the event that the grid is disconnected (island mode) comply with BS 7671 (IET Wiring Regulations).
Ensure the system has its own means of earthing in accordance with BS 7671 (IET Wiring Regulations) and BS 7430.
Ensure electromagnetic compatibility is taken into account for electrical supply, distribution and power systems in accordance with:
HTM 06-01 Electrical services supply and distribution
BS 7671 (IET Wiring Regulations) Section 444
Refer to scope of works for further details.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO V10.

300.000 GENERAL
Provide alternating current generating set driven by a reciprocating internal combustion engine in accordance with the relevant parts of BS ISO 8528, Building Regulations, relevant parts of HTM-06 on healthcare projects and detailed requirements as scheduled.
Low power generating sets to BS ISO 8528-8.
Emergency power supply to safety devices to BS 7698-12, ISO 8528-12
Inlet air cleaning equipment performance testing to BS ISO 5011

300.011 SITE OPERATING CONDITIONS:
Supply equipment for site operating conditions.

Standard Reference Conditions	BS ISO 8528-1
Site conditions	Unless otherwise stated:-
Height above sea level	Less than 1000m
Max Ambient temperature 40 °C	
Relative humidity	60%
Additional site characteristics as scheduled	

Healthcare premises – comply with the following unless detailed otherwise in the scope of works or schedules
Noise - Within healthcare premises with possibility of adjacent sleeping patients, noise level limited to 65DBA at 5m from set enclosure.
Vibration - Within healthcare premises with possibility of adjacent sleeping patients - limit maximum speed to 1500rpm.

300.012 VOLTAGE AND FREQUENCY CONTROL:
Maintain generated voltage and frequency within limits appropriate to Performance Class

300.013 START UP TIME:

V10 – Emergency and Standby Generators

Ensure generating set runs up to normal speed and is capable of accepting full load in 10 seconds or as otherwise scheduled.

300.014 INTERFERENCE:
Ensure radiated interference is suppressed in accordance with BS EN 55014.

300.020 GUARDS:
Guard all exposed hot or moving parts in accordance with BS EN ISO 12100 and Health and Safety at Work Act, 1974.
Hot surfaces presenting a contact or combustion hazard shall be guarded or insulated with 50mm thick mineral wool mattress to density 90kg/sm and suitable for a temperature of 950 °C. The mineral wool shall be encased in hammer clad overall.
Suitable warning notices shall be displayed on guards.

300.021 ACOUSTIC ATTENUATION
The installation including air intakes, air discharges and exhaust shall limit noise emission from the generator room/enclosure to the lesser of 60 dBA at one metre or as otherwise scheduled.

300.022 VIBRATION

Vibration from set both during start up and whilst operating shall not exceed Base Curve 1 as defined in BS 6472-1.

310.000 PRODUCTS/MATERIALS

310.011 GENERATOR SET:
Provide generating set to relevant parts of BS ISO 8528.
Comprising a diesel engine, direct driven alternator/exciter, cooling system, exhaust system, engine/alternator control panel, a daily service fuel oil tank and engine starting system.
Generator set to be installed and Set configuration to be scheduled.
Anti-vibration mounts shall be provided between the base frame and the enclosure floor to eliminate structure borne noise and vibration.
Refer to schedule for details.

310.021 ENCLOSURE:
Supply weatherproof, acoustic enclosure constructed from mild steel incorporating air inlet attenuators.
Where scheduled provide the following facilities within the enclosure.
Heating
To maintain a temperature of 10°C with an outside temperature of minus 4.5 °C.
Lighting
Illumination level at floor level - 150 lux
Illumination level front/rear panel - 300 lux
Emergency lighting – 1 lux (average)
Manually switched emergency lighting
Flameproof detectors in accordance with BS EN 54-10
Break glass alarm unit
Finish as schedule

310.031 DIESEL ENGINE:
Standard
Performance in accordance with the relevant parts of BS ISO 8528 and BS ISO 3046.
Engine type
Four stroke.
Air cooled / Water cooled as scheduled.
Turbo-charged or normally aspirated to suit duty.
Fuel oil
BS 2869 Class A2 (Gas oil).
Speed governing

Provide engine speed governing system in accordance with BS ISO 3046.
Provide controls to manually adjust speed of engine + or - 5% from nominal speed under all load conditions.
Provide engine over speed protection device in accordance with BS ISO 3046 incorporated in speed control system.
Torsional vibrations - Comply with BS ISO 3046.

310.041 WATER COOLING SYSTEM:
Ensure cooling system cools engine when running on continuous full load and on 10% overload for one hour.
Radiator
Air blast type, complete with integral header,
Provide separate sections for water and lubricating oil where appropriate.
Provide flange for ductwork on radiator discharge where ducted discharge required.
Radiator mounting
Set mounted with engine driven fan upstream of radiator, or
Remote with motor driven fan upstream of radiator where appropriate
Pumps
Provide engine driven pump to circulate jacket water through radiator.
Circulate lubricating oil through radiator where appropriate.
Valves
Provide a thermostatically controlled diverting valve in engine cooling water discharge pipework with by-pass to circulating pump suction.

Drain points
Provide drain points at low points in engine cooling water system.
Accessories
Fill engine cooling water system with mixture of water and antifreeze in accordance with manufacturer's recommendations.
Install thermostatically controlled 230 V single phase, immersion heater in engine cooling water system. Supply power to heater from non- maintained mains supply, controlled by isolating switch on engine/ alternator control panel.
Ensure heater is automatically switched off when engine is running.
Install lubricating oil heater.

310.051 AIR COOLING SYSTEM:
Circulate cooling air for engine by engine driven fan or fans. Where ducted discharge is required terminate assembly with a flange for connection to ductwork.
Ensure cooling system cools engine when running on continuous full load and on 10% overload for one hour.

310.061 FUEL SYSTEM:
Ensure fuel system complies with guidance available on the GOV.UK web site in England and the Control of Pollution (Oil Storage) (England) Regulations as amended. For other parts of the UK comply with relevant Guidance for Pollution Prevention series of documents (GPPs).
Ensure fuel system complies with Water Environment (Oil Storage) (Scotland) Regulations and relevant Guidance for Pollution Prevention series of documents (GPPs).
Comply with relevant Oil Storage Regulations and Guidance for Pollution Prevention series of documents (GPPs).
Comply with code of practice for oil firing: BS 5410-3

Provide a set mounted fuel tank (unless scheduled otherwise), fitted with hand-operated fuel transfer pump and flexible suction hose.
Tank capacity
Fuel for running set on full load for 6 hours unless otherwise scheduled.
Tank fittings
Dial type contents gauge.
Overflow connection.
Filling connection.
Drain plug.
Additional fittings as scheduled.
Fuel filter

Provide fuel polishing system to BS ISO 4406.
Provide fuel filter, to relevant parts of BS 4552, with disposable filter elements, fitted in fuel inlet pipe.
Ensure engine fuel system is isolated and cannot contaminate engine lubricating oil.
Fuel Spillage
Where bulk storage not provided and drums used for refill provide 2 drum modular spill deck with loading ramp. (As New Pig).
Rubber hoses and tubing for fuel circuits for internal combustion engines to BS ISO 19013-1.

310.070 ENGINE LUBRICATION:
Provide automatic engine lubrication using an integral gear driven pump. Provide coarse strainer on suction side and full flow filter on delivery side.
Ensure engine lubricating oil dipstick is accessible and marked to indicate maximum and minimum levels.
Provide engine sump with accessible drain point or drain pipe, fitted with plug.
Provide electric motor driven lubricating priming pump with automatic intermittent time control to keep engine bearings lubricated.
Ensure lubricating oil system enables the engine to run continuously for period indicated at any load without replenishment. Ensure system can be replenished while engine is running.

310.081 ENGINE STARTING SYSTEM:
Provide 24 volt dc supply to start engine from any crankshaft position, by axial type starter motor engaging with flywheel. Ensure starter motor disengages automatically when engine starts or when de-energized.
Where redundant starter motors are specified, N starter motors shall adequately start the engine.
Ensure starter motor is accessible and fit non-conducting protective shrouds to terminals.
Ensure system has sufficient capacity to initiate three starting cycles.

310.091 STARTER BATTERIES/CHARGERS:
Duty
Ensure the battery has capacity:-
to crank the engine, when cold, 6 times in succession at 0˚C with 10 secs between starts.
Battery type
Low maintenance, sealed, Lead Acid.
Connections
Provide inter-cell and output connections shielded with impact-resistant plastic to prevent inadvertent contact.

Battery housing
Supply acid-resistant open-type battery stands or ventilated steel battery cubicle as scheduled.

Charger
Provide current-limited constant-current/ constant-voltage charger in accordance with battery manufacturer's recommendations. Provide for boost and trickle charging as required. Include over current and over voltage protection. Provide earth fault detection and alarm where battery and charging system are not connected to earthed system.
Provide battery on-load disconnection and fuses.
Provide rigid steel free-standing floor-mounted enclosure. Comply with BS EN 60529, degree of protection IP31.
Battery charger monitoring instrumentation
Incoming supply ON/OFF switch.
Charge input and output cartridge fuses.
Voltmeter to indicate battery/charging voltage.
Ammeter to indicate charge /discharge.
Battery charge output failure detector with volt free contacts to actuate a remote alarm.
*Indicator or LED lamps to indicate battery charger incoming supply ON and battery charger output failure.

310.101 EXHAUST SYSTEM:
Provide exhaust system in accordance with manufacturer's recommendations and to meet noise limitation requirements. Include exhaust silencer, expansion bellows and all fittings, gaskets, joints and fixings.
Material

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Manufacturers standard unless otherwise stated.

Ensure engine vibrations are not transmitted to exhaust system.
Provide drain points at system low points to remove condensate.
Provide thermal insulation to manifold and all exposed exhaust pipe runs.
Pressure test exhaust system for leakage prior to connection to engine.

310.111 ALTERNATING CURRENT GENERATOR:
Standards
Relevant parts of BS ISO 8528, BS EN 50347 and BS EN 60034-22
Type
Brushless alternator with 2/3rd pitch windings and directly coupled ac exciter. Incorporate over-excitation protection on solid state rectifiers.
Or permanent magnet type as scheduled.
Mounting
Flange or foot mounted to suit set configuration.
Connections
Star connect with ABC phase rotation with neutral brought to alternator terminal box. Provide a diagram showing terminal markings and phase rotation on terminal box.
Protection
Provide screen protected, drip proof enclosure complying with IP22 of BS EN 60034-5.
Bearings
To suit application.
Accessories
Incorporate damper windings in rotor to provide facility for parallel operation where applicable.

Radio interference suppression – comply with relevant parts of BS EN 55014

310.120 AUTOMATIC VOLTAGE REGULATOR:
Provide solid state type automatic voltage regulator with manual adjustment to set alternator output within 5% of rated voltage.
Mounting
- On alternator, or
- On control cubicle.

Provide enclosure for regulator components isolated from generator using anti-vibration mountings.

310.131 CONTROL GEAR AND SWITCHGEAR / ENGINE/ALTERNATOR INSTRUMENT PANEL:
Provide control gear and switchgear for reciprocating internal combustion engine driven alternating current generating sets with the relevant parts of BS ISO 8528.
Provide control gear and switchgear to connect generator in parallel with mains supply in accordance with BS 7671 (IET Wiring Regulations), BS HD 60364-8-2 (prosumer's electrical installations) and BS EN 50549-1 (where relevant for generating plant for connection in parallel with distribution networks).
Comply with relevant ENA recommendations for grid-connected systems
G98 Recommendations for the connection of type tested small-scale embedded generators (up to 16 A per phase) in parallel with public low voltage distribution networks on or after 27 April 2019, for sites where the total grid-connected generation is up to 16 A per phase and connects at voltages not exceeding 230 V single-phase or 400 V three-phase.
G99 Requirements for the connection of generation equipment in parallel with public distribution networks on or after 27 April 2019, for sites where the total grid-connected generation exceeds 16 A per phase, or at connection voltages exceeding 230 V single-phase or 400 V three-phase.
G100 Technical requirements for customer export limiting schemes.
G5/4-1 for harmonic content.

Provide facilities specified below as a minimum and any additional facilities scheduled.

Panel mounting
- On generator set, or
- Floor standing.

Enclosure

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- Folded steel construction in accordance with relevant parts of BS EN 61439, with degree of protection, IP 31.

Provide 230V thermostatically controlled anti-condensation heater powered from non-maintained supply.
Engine control section
Key operated duty selector switch 3/4 position.
Manual engine start and stop push buttons.
Engine automatic start and stop control system with adjustable time delay start and shut down timers where appropriate.
Engine speed adjustment trimmer rheostat.
Engine hours run recorder.

Engine fault protection
Provide engine fault protection, automatic shutdown and lock out of service devices to protect engine against effects of;
- Over speed.
- Lubricating oil pressure low.
- Cooling water temperature high.
- Additional protection as scheduled.

Engine instruments
- Engine speed (RPM).
- Lubrication oil pressure gauge.
- Cooling water primary return temperature gauge.
- Service hours
- Alternator control section
- Voltmeter to indicate generator line to line voltage and line to neutral voltage.
- Ammeter with selector switch to indicate outgoing circuit line and neutral current.
- Frequency indicator 45-55 Hz to indicate generator frequency.
- Alternator indicator lights

320.000 WORKMANSHIP

320.010 DIESEL GENERATOR SET:
Install diesel generator set in accordance with manufacturer's recommendations. Ensure set is positioned to allow on-site maintenance and repairs, including barring facility where indicated. Provide access for removal of pistons and connecting rods.

320.020 FUNCTIONAL TEST REPORT:
Provide completely documented ISO standard functional test report in accordance with BS ISO 8528-6.

320.031 ACCEPTANCE TEST – GENERATOR SET
Carry out Factory and Site Acceptance Tests witnessed by Supervising Officer and provide report in accordance with BS ISO 8528-6 and the specified requirements. Refer to schedule for further detail.

Carry out following tests on site with all generator system components and interfaces complete;
Simulation of cold mains failure starts and mains reinstatement operations
Operational tests of control system and all interfaces.
Carry out additional tests as scheduled.

Load tests are to be performed using resistive / inductive load banks to simulate rated duties and rated power factors.

320.032 SPECIAL TOOLS
Provide a set of special tools in lockable enclosure in accordance with manufacturers' recommendations, to be kept on site in a lockable enclosure located adjacent to the generator. Identify such tools in Tender submission.

V11 – HV Supply/Distribution/Public Utility Supply

PART 1 SYSTEM OBJECTIVES

100.011 PERFORMANCE OBJECTIVES
To provide:
The distribution of high voltage (11kV) electricity from the main intake substation (Substation 1) to the on-site transformer sub-stations.

Comply with the whole hospital engineering design policies and be compliant with all Department of Health (NHS Estates) documentation including, but not limited to, HTM's and HBN's pertinent to the nature of the project. In particular compliance with DH HTM 06 - 01 Electrical services supply and distribution, DH HTM 06 - 02 Electrical safety guidance for low voltage systems, and HTM 06 - 03 Electrical safety guidance for high voltage systems in healthcare, and achievement of best practice of resilience of supply is required.

100.021 DESIGN PARAMETERS / STANDARDS:
Standards
BS EN 61936-1
PD IEC/TS 61936-2
Relevant Electricity Networks Association (ENA) engineering recommendations and standards

Design and supply the HV supplies in accordance with HTM 06-01 Electrical services supply and distribution and HTM 06-03 Electrical safety guidance for high voltage systems in healthcare.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO V11

300.000 GENERAL

300.002 GENERAL REQUIREMENTS:
Ensure that High Voltage electrical systems are designed, installed and commissioned so that they may be managed, operated and maintained in accordance with the Electricity at Work Regulations and relevant guidance including the Health & Safety Executive Guide HSG85 “Electricity at work: Safe working practices”.

Amend the existing adjustable mimic diagrams of the High Voltage system, including the first Low Voltage switch.

Provide all required locks and keys, and Warning, Caution and all other required notices to enable correct operational use of the system. Ensure notices comply with BS EN ISO 7010.

300.010 HV SWITCHGEAR STANDARDS:
Comply with BS 159, BS EN 62271, relevant parts of BS EN IEC 62271 and Energy Networks Association (ENA) TS 41-36 where applicable.

300.021 TRANSFORMER STANDARDS AND ECODESIGN REQUIREMENTS:
Supply transformers with a no load voltage ratio of 11000/433 volts, 3-phase to BS EN 50541 (parts 1&2)”, relevant parts of BS EN 50464, BS EN 60076 and BS EN 61558 where applicable.
Ecodesign requirements for power/distribution transformers with a minimum power rating of 1 kVA used in 50 Hz electricity transmission and distribution networks or for industrial applications.
Comply with EU Regulation No 548/2014 implementing the Ecodesign Directive 2009/125/EC for small, medium and large power transformers.
Maximum load and no-load losses for liquid-filled and cast iron resin transformers, In accordance with EU Regulation 548/2014 Tier 2 (2021) as scheduled or detailed in scope of works.

300.025 SF6 EQUIPMENT:
Ensure all new SF6 equipment complies with the Fluorinated Greenhouse Gases Regulations 2015 as amended, for supply, installation, maintenance, decommissioning and disposal activities.
Ensure all new SF_6 equipment allows for recycling of SF_6 during maintenance or decommissioning.
Provide manufacturer's information on SF6 leak reduction methods.

300.030 TYPE TEST:
Provide certificates of verification of type test of complete units or components of each assembly as applicable. Ensure that drawings and other documents forming part of certificate are available prior to order being placed.
Certificates issued by ASTA Intertek - are preferred.

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300.040 SITE BUILT ASSEMBLIES:
Ensure that components of site assemblies are part of a proprietary system and type tested as appropriate. Install assemblies in accordance with manufacturer's drawings and instructions.

300.050 SITE MODIFICATION:
Do not make site alterations unless authorised. Where site modifications to assemblies are authorised make in accordance with manufacturer's certified drawings and instructions. Ensure that modifications made comply with type test certificate obtained for arrangement of components.

300.060 ELECTRICAL CHARACTERISTICS:
Ensure that electrical characteristics of component parts of assemblies are as indicated and apply when components are mounted in enclosures. Allow appropriate de-rating factors for effect of enclosures, other components and inter-connections.

300.071 SERVICE CONDITIONS:
As indicated in A13 or A64 of the Specification.

300.081 CO-ORDINATION STUDY
Carry out a complete protection grading and setting calculation of the complete electrical distribution system, including all connected equipment. Engage an independent Chartered Engineer specialising in electrical installation design to:
Undertake and verify the calculation.
Provide fault (short circuit) calculations for the distribution system as indicated on the drawings and a protective device co-ordination study to ensure that all protective devices are co-ordinated, to achieve full discrimination (unless specified otherwise). Base the study on the actual devices and cable lengths installed.
Prepare the fault calculations in accordance with BS EN 60909 and protective device study with an approved proprietary software package, by prior approval written calculations may be used for simple networks, include complete fault calculations for each proposed source and combinations thereof including motor, generator and UPS contributions.
Present the fault calculations including the following:
General description of calculations methods, assumptions and base per unit quantities selected.
Evaluation of grading margins used.
Single line diagrams, source and electrical equipment characteristics (impedance data including X/R ratios, zero sequence impedances, inrush current characteristics, rated currents, design loads).
Calculation of peak and three phase symmetrical / asymmetrical prospective fault currents (short circuit and earth fault) at each switchboard, motor control centre and distribution board.
Typical calculations, tabulations of calculation quantities and results, verification of electrical equipment fault ratings.
Conclusions and recommendations

Carry out the protective device co-ordination study including the following:
Consideration of:
Short-circuits
Overloads
Residual currents
Possible fault currents in systems with semiconductors in accordance with Figure A53.1 of BS 7671 (IET Wiring Regulations)
Time-current co-ordination curves graphically indicating the proposed co-ordination for the system on log-log graph transparencies. Include on each sheet, a complete title and single-line diagram identifying the specific portion of the system covered.
A detailed description of each protective device (overcurrent and/or residual current) identifying its type, function, manufacturer and time current characteristics and tabulation of recommended settings.
Carry out adjustments of the protection settings to confirm that the requirements of the report, ensure that;
Selectivity is achieved throughout the network and select protective devices and settings accordingly.
electrical equipment is protected.
maximum disconnection times are achieved.

Time-current co-ordination curves graphically indicating the proposed co-ordination for the system on log-log graphs for short circuit and earth fault conditions. Include on each sheet, a complete title and single line diagram identifying the specific portion of the system covered.
A detailed description of each protective device identifying its type, function, manufacturer and time current characteristics.
Tabulation of recommended settings and operating values for each function of each device.
Include on the graphs, relay characteristics, pertinent transformer, motor and generator characteristics from the downstream HV device and including up to the largest outgoing LV circuit breaker/fuse for each final distribution board. Indicate manufacturing tolerances clearly showing the final grading margin.
The co-ordination study should demonstrate that all low voltage switchgear and controlgear assemblies to relevant parts of BS EN 61439 are compatible with the ratings of circuits to which they are connected, and with the installation conditions.
Ensure that the relevant fault current (short-circuit) rating of each switchgear and controlgear assembly is greater than or equal to the maximum prospective fault current at the point of connection to the system.
Ensure that the relevant design current does not exceed the rated current of the assembly, or rated current of a circuit of the associated assembly, taking into account applicable diversity and loading factors.

Submit the study as a bound report for approval by the CA. Upon approval by the CA, submit copies of the approved report together with soft copies of the project fault level calculations and discrimination study files in the approved software native format.

300.091 CONTROL, MONITORING AND INTEGRATION:
Provide an integrated system, interfacing with local control panels, local protection and BMS as detailed in the scope of works

Standards / monitoring and control protocols (refer to scope of works to determine those applicable to the particular project)
BS EN 61968
Profibus BS EN 62769
Profinet BS EN 62769
Modbus
Modbus over Ethernet
Wired interfaces to BS EN 61131-2

Metering Data
Relevant parts of BS EN 62056
Relevant parts of PD CLC/TS 50568
BS EN 61968-9
BS EN 50491-11
BS EN 13757 connectivity via:
Wired M-Bus, Wireless M-Bus, Public switched telephone network (PSTN),Local area network or Wide area network as described in the scope of works or as scheduled.

310.000 PRODUCTS/MATERIALS

310.011 SWITCHBOARD SCHEDULE:
Supply HV Ring main units as scheduled and as indicated on the drawings.

310.021 HV SWITCHGEAR AND CONTROLGEAR ENCLOSURES:
Enclosures to be cubicle or multi-cubicle type assembly.
Supply enclosure that provides protection in accordance with BS EN 60529
Indoors boards to be rated to IP31
External boards to be rated to IP65
Provide facilities on switchboards, not ring main units, to allow future extension of switchboards at either end.

310.022 ASSEMBLY CONSTRUCTION:
Supply floor standing, metal clad, separately compartmented structure comprising switchgear, controlgear and components as indicated on the schedule or on the drawings.

Material of enclosure to be steel. Supply doors with fastenings and provision for locking in closed position. Use covers which require special tools or mechanical key interlock for removal. Large removable covers to be provided with lifting handles and location brackets. Provide means of fixing to foundation or structure.
Ensure all switches and circuit breakers are operated by independent mechanisms and have a facility for manual operation.
Provide an enclosure to house voltage transformers and associated protection fuses where indicated. Secure access to enclosure by a padlock and mechanical interlocks to prevent access at all times that the transformer is in service. Provide engraved danger notices detailing the switching procedure for safe isolation and earthing of the equipment before gaining access to the enclosure.
Screw labels to outside of switchboards. Ensure that fixed panel or cubicle of withdrawable type units are fitted with label to identify circuit with wording identical to that on the withdrawable portion..
Provide cable termination chambers and terminals to accommodate cross-sectional area of cables as shown on the drawings.
Parallel cabling to be provided with individual terminal for each cable core.
Securely fix a copper earthing bar complying with BS EN 13601 the full length of the enclosure so that exposed conductive parts may be connected to the protective conductors. Ensure earth connection can be made to the assembly without damage to the finish coating. Make provision for armouring and metal sheath of all incoming and outgoing cables, including common and individual glanding plates, to be bonded to earthing bar.
Accessibility for inspection
Arrange for following operations to be performed when assembly is in service and under voltage.
Visual inspection of switching devices and other apparatus; settings and indicators of relays and releases; conductor connections and markings.
Adjusting and re-setting of relays, releases and electronic devices.
Replacement of fuse links.
Replacement of indicating lamps.
Fault location by voltage and current measuring.
Accessibility for maintenance.
Provide space between functional unit or group and adjacent functional units or groups. Provide retainable fastening means for parts likely to be removed for maintenance.
Short-circuit protection and short-circuit withstand strength as drawings. Co-ordinate short-circuit protective devices and short-circuit current arising from rotating machines as detailed in this section. For motor control centres this information is detailed in Work Section W60.
Ensure all equipment is fully interlocked for safe operation. Fit warning notices to all devices that can be damaged or cause harm to personnel or equipment if operated incorrectly.

310.031 ENCLOSURES FINISH:
Apply high standard finish to enclosure and supporting metalwork. Degrease metal and remove rust prior to applying finish.
Comply with paint manufacturer's recommendations regarding preparation, stoving times, temperatures, mixing of finishes, application and coat thickness.
Finish and colour as Manufacturer's standard unless otherwise stated in the schedules. When other than manufacturer's standard finish is specified samples of each paint system and for each colour shall be provided.

310.041 SWITCHGEAR:
Supply floor standing, metal clad, separately compartmented structure comprising switchgear, controlgear and components as follows.
Ensure all switches and circuit breakers are operated by independent mechanisms and have a facility for manual operation.
Standard – BS EN 62271-200
Enclosure
Provide an enclosure to house voltage transformers and associated protection fuses and current transformers where indicated.
Secure access to enclosure by a padlock. Provide engraved danger notices detailing the switching procedure for safe isolation and earthing of the equipment before gaining access to the enclosure.
Earthing bar
Securely fix an earthing bar made of copper to BS EN 13601 through full length of switchgear. Connect each end of bar to an earthing terminal. Bond all metalwork other than current carrying parts to earthing bar. Make provision for armouring and metal sheath of all incoming and outgoing cables to be bonded to the earthing bar.
Ensure continuity of protective circuits at all times.
Provide facilities to allow future extension of switchboard

Ensure all equipment is fully interlocked for safe operation. Fit warning notices to all devices that can be damaged or cause harm to personnel or equipment if operated incorrectly.

310.051 BUSBARS:
Busbar design
Supply triple pole, fully insulated as indicated on drawings.
Provide busbars having electrical characteristics to match switchgear and with a nominal current rating as shown on drawings.
Material
High conductivity solid copper in accordance with BS 159 and BS EN 13601. or
Tinned high conductivity solid copper in accordance with BS 159 and BS EN 13601.
Insulation
Insulate busbar unit length with non-hygroscopic insulation. Insulate busbar joints and connections to circuit-breakers and other units in accordance with BS 159.
Install busbars in separate compartment of switchgear with removable access covers along length. Provide identification and warning labels on access covers.

310.061 CIRCUIT-BREAKERS
Provide circuit-breakers of type and application as indicated on the schedule or drawings.
Standard – relevant parts of BS EN 62271, BS EN IEC 62271, BS IEC/IEEE 62271 and PD IEC/TR 62271 co-ordinated values.
Withdrawal
Provide automatic shutters to cover high voltage contact spouts when circuit breaker is removed from fixed compartment.
Operating mechanism
As indicated on the schedule.
Contact position indicator
Provide a mechanical indicator of contacts open or closed visible through window aperture in circuit breaker enclosure. Provide status indication of the circuit breaker by mimic on the front of the circuit breaker or relay display.
Trip mechanisms
Provide circuit breakers with manual trip facilities
Provide shunt trip mechanism, operating voltage as indicated.
Earthing
Provide an integral fault making earth switch with rated short-time withstand current as indicated for switchboard for circuit earthing and/or busbar earthing as indicated on the drawings.
Locking facilities
Provide facilities to padlock breakers and switches in the ON, OFF and EARTHED positions.
Testing facilities
Ensure the operation of the circuit breaker closing, tripping, interlocking, intertripping, protection devices, indicator lights, remote control, indication and alarm systems can be tested.
Provide facilities for secondary circuits to be operationally tested with circuit breaker isolated from main circuit.

310.070 SWITCHES:
Standard – relevant parts of BS EN 62271, BS EN IEC 62271, BS IEC/IEEE 62271 and PD IEC/TR 62271.
Manual operated fault making load breaking oil immersed fused switch to BS EN 62271-105 for ON/OFF control of an outgoing circuit with trip-all phase mechanism and striker pin fuses to BS EN 60282-1. Provide an interlock to prevent access to the fuses unless they are isolated from the incoming supply and the out going cable.
Provide neon live indication for ring feeders.
Provide facilities to padlock switches in the closed, open or earthed positions.
Disconnectors to BS EN 62271-102
Earthing switches to BS EN IEC 62271-102 or BS EN 62271-112 as relevant
Provide HV fuses to BS EN 60282-1.
Provide HV fuses for motor circuits to BS EN 60644.

310.081 SF6 COMBINED RING MAIN UNIT:
Provide where shown on the drawings the following components contained in a single tank charged with sulphur hexafluoride, complying with BS EN 60376, at a pressure recommended by the manufacturer.

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Two fault-make, load-break, ON/OFF/EARTH switches for control of the ring circuit.
Outgoing circuit (Tee-Off) circuit-breaker.
Fault making outgoing circuit (Tee-Off) earthing switch.
Emergency trip switch to isolate all HV switchgear.

Provide voltage presence indication (VPIS) and fault current indication systems on each RMU switch as scheduled.

310.092 PREFABRICATED (PACKAGED) SUBSTATION
Supply prefabricated substation to BS EN 62271-202
Degree of protection to BS EN 60529
IP 31 for indoors
IP 65 for outdoors
Switchgear
Provide switchgear and where appropriate transformer as indicated on the drawings.
Terminations
Make provision for termination and connection of cables and spare ways as indicated on drawings.
Supply insulated barriers or screens over all live metal and label for identification.
Access Doors
Fit access doors with internal hinges. Secure doors with quick acting barlock and high security padlock.
Covers
Each removable cover shall be secured by a minimum of 2No screws which can only be removed buy access to the inside of the transformer enclosure (once the transformer has been isolated).
Ancillaries
Mount inside each substation
Set of special operating tools
Spare fuse tray, equipped with spare fuses.
Finish
Treat metal enclosures prior to final painting to prevent rust.
Apply Manufacturer's standard finish unless otherwise indicated.
Treat interior with anti-condensation paint to reduce level of condensation by providing a thermal barrier between enclosure metalwork and internal air.
Heater
Equip enclosure with an anti-condensation heater rated at 65 watts complete with a switch, fuse, switching thermostat, high limit cut-off thermostat and all necessary wiring.
Base Unit
Supply purpose made base unit for fixing to foundation with suitable cable entry

310.101 INSTRUMENT PANELS:
Provide a panel to mount the instruments and meters with degree of protection and finish to match the associated switchgear.

310.111 PROTECTION DEVICES INTERPOSING RELAYS AND INTER-TRIPPING RELAYS:
Standard - BS EN 61810.
Housing
Flush panel mounting type.
House all protection relays in draw out cases unless otherwise agreed.
Manual reset type.
Contacts as required for operation plus one normally open and one normally closed contact.
Protection relay features - see drawings
Overcurrent tripping device - Provide overcurrent tripping device with overcurrent characteristic similar to BS 2692-2 high voltage cartridge fuse, sized to protect the equipment/load.

310.121 CURRENT TRANSFORMERS:
Standard

BS EN 61869-2
BS EN 60044-3 or BS EN 61869-4 Combined transformers

Provide where shown on the drawings separate current transformers for each protection device and instrumentation. Ensure current transformers provide appropriate accuracy and are compatible with over current factors, characteristics, performance and VA rating required for satisfactory operation of protection devices, instruments and meters indicated.
Ensure that current transformers are capable of withstanding maximum short-time withstand current of value and duration indicated for the switchgear.
Provide test links in secondary connections of all current transformers to facilitate testing of instruments, meters and protection devices.

310.131 VOLTAGE TRANSFORMERS:
Standard

BS EN 61869-3 voltage transformer.
BS EN 60044-3 or BS EN 61869-4 combined transformer.
BS EN 50482 instrument transformer

Supply fully encapsulated and impregnated dry epoxy resin type or oil-filled type with insulating oil in accordance with BS 148.
Performance
Provide transformer with accuracy class and VA rating to suit application.
Connect the secondary windings to outgoing terminals. Protect the secondary windings with cartridge fuses located outside the transformer enclosure, in an accessible position. Where more than one circuit is connected to the secondary winding, fuse each circuit separately.
Connect the star point of the 3 phase and one side of the single phase secondary windings of the transformer to the switchgear earth bar through removable bolted links.

310.151 INSTRUMENTS AND METERS:
Standards

Comply with BS EN 60051-1 for voltmeters, ammeters, watt meters, frequency indicators and power factor indicators.
Comply with relevant parts of BS EN 62053 or BS 7856 for kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters and BS EN 62053-23 or BS EN 60253-24 for VAR meters. Where a meter is to be used to measure the amount of electricity supplied for billing purposes, the meter must be of an approved type for electricity, by OFGEM. In addition, meters for domestic use shall be certified.

Protect wiring to voltmeters by separate fuses. Protect potential coils of watt meters, frequency indicators, power factor indicators and kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters by separate fuses.
Supply instruments and meters suitable for flush mounting and type, size and accuracy as indicated on drawings or schedule.
Ensure that indicating scales for all other instruments comply with BS 3693. Supply so that normal indication is 50% to 75% of full scale deflection.
Completely segregate all instruments and meters in instrument compartments.
Provide test link for energy meter testing within instrument compartment.

310.161 INDICATOR LAMPS:
Standard BS EN 60947-5-1
Supply lamps of same type throughout. Provide indicator lamps with lamp test facility
Alternating current indicator circuits- include integral double-would transformer for all indicator lamps on all a.c. indicator circuits.
Direct current indicator circuits - 24 V d.c.
Ensure indicator lamps of the same voltage are interchangeable.
For LED indicators, include a voltage suppressor on each LED.

Usage	Lamp Type
Switchboard	LED
Motor control centres	LED

Protect wiring to indicator lamps by separate cartridge fuses.

Ensure lens colours are selected in accordance with BS EN 60073.

310.165 AUDIBLE ALARMS:
Provide audible alarm system where specified.

310.181 TRIP/CLOSE SWITCHES AND CONTROL SELECTOR SWITCHES:
Provide isolation during repair and maintenance work in accordance with BS EN 62626-1.
Standard BS EN 60947-5-1

Provide a panel mounted heavy duty, spring return key operated trip/close switch on each circuit breaker fitted with electrically operated closing mechanisms.
Ensure contacts have a continuous rating of 10A minimum at between 30V to 250V ac and dc, and make and break duty rating of 30A at 250V ac or dc for a minimum period of 3 secs.
Where remote trip/close is required supply a panel mounted selector switch to select circuit-breaker for local or remote operation. Ensure that selection of remote or local closing does not prevent circuit-breaker tripping under fault conditions.

310.191 EMERGENCY TRIP, TEST AND AUDIBLE ALARM SILENCING PUSH BUTTONS:
Provide isolation during repair and maintenance work in accordance with BS EN 62626-1.
Supply mushroom actuator, latch type, emergency trip push buttons to BS EN 60947-5-1, coloured red, released by turning the actuator or means of a key.
Supply flush type push buttons for general use, test or audible alarm silencing.

310.201 HV CABLE BOXES AND CABLE TERMINATION:
Standard

Energy Networks Association Technical Specification 12-11.
Provide terminals and rigidly fix generally in accordance with BS 5372, ensure adequate access for tightening the termination.

310.211 CONTROL, INSTRUMENTATION AND INDICATION CABLE TERMINATION BOXES:
Provide separate cable termination boxes or a segregated cable termination box for the termination and connection of remote control, instrumentation, intertripping, alarm and indication cabling associated with each circuit-breaker or motor-starter. Where a segregated cable termination box is provided ensure the terminals within the box for each system are segregated. Ensure the terminals in each box are voltage segregated.

Locate the boxes at the back of the assemblies, ensure the boxes are clearly identified.
Group all remote control and indication wiring within the assemblies and connect to terminal blocks in the respective box.
Supply rail mounted type terminals blocks.
Provide the boxes with undrilled removable glanding plates.

310.221 COILS - VARIOUS APPLICATIONS:
Ensure coils for switching relays, contactors and other applications are capable of operating with a 20% drop in voltage without the armature or switching apparatus dropping out of position.

310.231 BATTERY CHARGER AND BATTERY UNIT:
Standards

BS EN IEC 62485-1 general requirements for secondary batteries and battery installations
BS EN IEC 62485-2 requirements for stationary batteries and battery installations

Function, Input Voltage and Frequency as Schedules or drawings.

DC Output Voltage drop at full load 2%
Operating temperature range -10°C - +45°C.
Charger type Thyristor or Transistor.
Battery type Nickel Cadmium (maintenance free).
Enclosure, sheet steel, IP31
Corrosion resistant epoxy paint or Manufacturer's standard.
Colour Manufacturer's standard.
Facilities

MCB input protection.

Float charge.
Battery over-discharge protection
Fuses for battery protection.
MCB's for outgoing circuits as indicated.
Automatic selection of boost charge.

Meters

Battery voltage.
Charge/discharge current (dual scale for float and boost).

Lamp indications

Supply on.
Supply fail (monitor input terminals).
Float charge.
Boost charge.
No charge (when supply is on).
Battery voltage low.
Battery voltage high.
Earth fault on output.

Common Alarm (connected to operate a relay with shrouded 230V 3A a.c. or 0.5A d.c. N/O-N/C volt free contacts, closed on any alarm, for remote indication circuit)

Supply failed.
No charge (when supply is on).
Battery voltage low.
Battery voltage high.
Earth fault on output.

310.241 FUSES:

Supply cartridge fuse links including fuse carrier, bases and associated components that comply with the following:-

For HV supplies BS EN 60282-1
For HV motor circuits BS EN 60644
For LV controls BS 88 / BS EN 60269 / BS HD 60269, fusing factor Category gG, unless otherwise indicated.

Use motor circuit fuses where indicated.

310.251 PADLOCKS:

Where specified provide each switchboard with sets of padlocks.
Provide non-interchangeable, high security five-lever type padlocks, unless otherwise indicated.
Provide each padlock with two keys complete with disc and ring. Engrave disc and padlock with suitable legend.
Provide wall mounted steel cabinet with hinged door for storing padlocks and keys on hooks. Supply case with finish to match switchboard.

310.261 TOOLS:

Supply a complete set of special tools, including a torque spanner, necessary for maintaining all the equipment, in a lockable hardwood case.

310.271 TRANSFORMER:

Synthetic liquid immersed

Standard

BS EN 50464
BS EN 60076 Power Transformers
BS EN 61558

Position

Supply transformers for ground mounting as indicated on the drawings

Core

Construct the core from double mineral oxide insulated high quality, cold rolled, grain orientated, stress relieved silicon iron alloy / steel laminations. Laminations shall be ‘step-lapped’, to reduce no-load losses and noise levels. Clamp the top and bottom yoke laminations between substantial steel channel sections and support the windings using insulation pieces sized to match duty of transformer.

Windings

Provide three phase, double wound windings, connected and marked to vector group reference Dyn 11 BS EN 60076 or as otherwise indicated on the drawings.
Manufacture windings from; LV copper foil with high quality cellulose insulation suitable for oil or synthetic liquid immersed transformers; HV round copper with a high polyester varnished insulating coating suitable for oil or synthetic liquid immersed transformers

Transformer filling

Mineral oil, class I and II to BS 148. or synthetic ester-based transformer fluid as scheduled

Rated lightning protection impulse withstand voltage (peak value):

75kV, unless specified otherwise in the schedules.

Tappings

Provide off-circuit tapping switch on higher voltage winding for a variation of +/-2.5% and +/- 5% of the primary voltage.

Control tapping switch by an externally operated hand wheel which can be locked in any of the positions and fitted with a tap position indicator.

Terminals for external conductors

Provide three pole porcelain bushings in a side mounted cable box for top or bottom HV cable entry.
Make terminals for neutral conductors on three-phase and neutral circuits same size as phase terminals.
Connect neutral terminal to a terminal in the LV cable box.

Cable boxes and terminal chambers

HV cable box

To suit type, number and size of cable as indicated on drawings.

LV termination

To suit type, number and size of conductors as indicated on the drawings.
Provide a disconnect chamber to facilitate cable testing.

Provide accessories as indicated on Schedule.

310.281 TANKS:

Supply tank for oil-immersed and synthetic liquid immersed transformer manufactured from welded mild steel to suit transformers identified in schedules, scope of works or drawings. Fit with plate or corrugated radiators finished with an approved paint system providing long term protection in polluted coastal environments. minimum of 3 coats. Top cover to be bolted and shaped to drain rainwater.

Construction

Free breathing type with oil tight gasket sealed joints or welded sealed type as scheduled.

Transformer filling

Synthetic ester-based transformer fluid as scheduled

Tank fittings

Anti-vandal breather pipe (to match the internal and external pressure) and expel moisture.
Lifting lugs.
Tank earthing terminal.
Drain Valve and Plug.
Filling Plug.
Rating and connection plate.
Additional fittings as scheduled.

320.000 WORKMANSHIP

320.011 FIXING:

Provide all fixing materials including where appropriate Unistrut or similar channels to ensure accurate alignment of switchgear. Provide such materials for incorporating into building works to meet the contract programme. Use cadmium or zinc electroplated bolts, nuts, washers and screws.

320.021 ACCESS AND SAFETY

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Ensure that clearance in front of switchgear, withdrawn circuit-breaker or control gear is compatible with operations and maintenance safety.
Ensure that access for maintainability, including access when equipment is withdrawn or otherwise opened for maintenance, is assessed, relevant to the maintenance activities to be performed, for conformity with a suitable standard for accessibility such as BS EN 547-1, BS EN 547-2 and BS EN 547-3.
Ensure appropriate screening and warning signs are provided were a safety hazard is anticipated.

320.030 MARKING:
Number terminals, cables and component parts to correspond with manufacturer's certified drawings.

320.040 INSTALLATION OF BUSBARS:
Tighten busbar joints and connections with a torque spanner in accordance with manufacturers recommendations.
Allow for expansion due to operating temperature conditions and load.

320.050 INSTALLATION GENERALLY
Install equipment in accordance with manufacturer's recommendations.

10000 NES VERSION V11 TEXT Dec 19 and V12 Dec 16

V20 – LV Distribution

Incorporates V12 (public utility supply)

PART 1 SYSTEM OBJECTIVES

100.011 PERFORMANCE OBJECTIVES
To provide the distribution of low voltage electricity from the supply authority's source to the building main switchboard and from the building main switchgear panel to and including the area distribution boards, sub-distribution board, motor control centres and specific items of mechanical plant.

On healthcare projects comply with all HTM's and HBN's pertinent to the nature of the project. In particular, compliance with HTM 06-01 and HTM 06-02 is required. In particular, compliance with HTM 06-01 Electrical services supply and distribution and HTM 06-02 Electrical safety guidance for low voltage systems is required.
To provide three phase power supplies to user points.
Refer to scope of works for primary and secondary sources of power.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO V20

300.000 PRODUCTS/MATERIALS

300.012 SWITCHBOARDS, DISTRIBUTION BOARDS
Refer to Y71

300.013 CABLES and SUPPORTS
Refer to Y61 and Y63

300.014 EARTHING
Refer to W51, which incorporates Y80 clauses for earthing and bonding components.

300.015 BUSBAR TRUNKING
Refer to Y62

<u>300.020</u> LV OVERHEAD LINES AND ARIEL CABLES (V12.300.020)
Provide erected poles and accessories for supporting aerial/catenary low voltage distribution cables, to suit application.

Poles
Standard BS 1990-1
Insulator fittings and pins for bare conductors
Standard BS 3288 parts 1&2. BS EN 61466 parts 1&2, BS EN 61284 and BS EN 60372
Overhead line conductors
Standard BS 7884 Copper
BS EN 61232 Aluminium clad steel
BS 215-1 Aluminium stranded
BS 215-2 Aluminium - steel reinforced
BS EN 50183 Aluminium Alloy
BS 6485 Covered conductors

300.081 CO-ORDINATION STUDY
Where required in the scope of works, carry out a complete protection grading and setting calculation of the complete electrical distribution system, including all connected equipment. Engage an independent Chartered Engineer specialising in electrical installation design to:
Undertake and verify the calculation.
Provide fault (short circuit) calculations for the distribution system as indicated on the drawings and a protective device co-ordination study to ensure that all protective devices are co-ordinated, to achieve full discrimination (unless specified otherwise). Base the study on the actual devices and cable lengths installed.
Prepare the fault calculations in accordance with BS EN 60909 and protective device study with an approved proprietary software package, by prior approval written calculations may be used for simple networks, include complete fault calculations for each proposed source and combinations thereof including motor, generator and UPS contributions.
Present the fault calculations including the following:
General description of calculations methods, assumptions and base per unit quantities selected.

V20 – LV Distribution

Evaluation of grading margins used.
Single line diagrams, source and electrical equipment characteristics (impedance data including X/R ratios, zero sequence impedances, inrush current characteristics, rated currents, design loads).
Calculation of peak and three phase symmetrical / asymmetrical prospective fault currents (short circuit and earth fault) at each switchboard, motor control centre and distribution board.
Typical calculations, tabulations of calculation quantities and results, verification of electrical equipment fault ratings.
Conclusions and recommendations

Carry out the protective device co-ordination study including the following:
Consideration of:
Short-circuits
Overloads
Residual currents
Possible fault currents in systems with semiconductors in accordance with Figure A53.1 of BS 7671 (IET Wiring Regulations)
Time-current co-ordination curves graphically indicating the proposed co-ordination for the system on log-log graph transparencies. Include on each sheet, a complete title and single-line diagram identifying the specific portion of the system covered.
A detailed description of each protective device (overcurrent and/or residual current) identifying its type, function, manufacturer and time current characteristics and tabulation of recommended settings.
Carry out adjustments of the protection settings to confirm that the requirements of the report, ensure that;
Selectivity is achieved throughout the network and select protective devices and settings accordingly.
electrical equipment is protected.
maximum disconnection times are achieved.
Time-current co-ordination curves graphically indicating the proposed co-ordination for the system on log-log graphs for short circuit and earth fault conditions. Include on each sheet, a complete title and single line diagram identifying the specific portion of the system covered.
A detailed description of each protective device identifying its type, function, manufacturer and time current characteristics.
Tabulation of recommended settings and operating values for each function of each device.
Include on the graphs, relay characteristics, pertinent transformer, motor and generator characteristics from the downstream HV device and including up to the largest outgoing LV circuit breaker/fuse for each final distribution board. Indicate manufacturing tolerances clearly showing the final grading margin.
The co-ordination study should demonstrate that all low voltage switchgear and controlgear assemblies to relevant parts of BS EN 61439 are compatible with the ratings of circuits to which they are connected, and with the installation conditions.
Ensure that the relevant fault current (short-circuit) rating of each switchgear and controlgear assembly is greater than or equal to the maximum prospective fault current at the point of connection to the system.
Ensure that the relevant design current does not exceed the rated current of the assembly, or rated current of a circuit of the associated assembly, taking into account applicable diversity and loading factors.

Submit the study as a bound report for approval by the CA. Upon approval by the CA, submit copies of the approved report together with soft copies of the project fault level calculations and discrimination study files in the approved software native format.

310.000 WORKMANSHIP

310.011 INSTALLATION:
Install equipment in accordance with manufacturer's recommendations.

310.012 TESTING and COMMISSIONING
Refer to Y81

V21 – General Lighting

Incorporating V41 (Street / Area / Floodlighting)

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide sub-circuit installations from the sub- distribution boards to provide general illumination and, where appropriate, emergency escape lighting.

100.021 DESIGN PARAMETERS
Standards
BS EN 12464-1 - Indoor workplaces.
BS EN 12464-2 – Outdoor work places
BS EN 12193 - Indoor and outdoor sports lighting
BS EN 17037 for daylight in buildings
BS 5489-1 - Roads and public amenity areas
Illuminance levels
Where not stated in the Schedule of Common Design Criteria (Schedule A13) or scope of works, ensure that the maintained illuminance levels meet but do not significantly exceed the CIBSE Code for Lighting (latest edition).
Dependant on Contractor design work required by the scope of works, comply with guidance in latest editions of appropriate SLL guides.
Ensure the initial circuit luminous efficacy for fixed lighting installations is in excess of:
- Ensure minimum colour rendering (R_a) is as CIBSE Code for Lighting.
- Ensure limiting glare rating is as CIBSE Code for Lighting.
- Ensure luminance limits as Table 2.4 of CIBSE Code for Lighting are not exceeded on DSE.
- Ensure the illuminance levels in offices achieve but do not significantly exceed 350-400 lux.
- Ensure the initial circuit luminous efficacy for fixed internal lighting installations is in excess of the following;
  - In office, industrial and storage areas 60 luminaire-lumens/circuit-Watt.
  - Install in dwellings light fittings which can only accept lamps of luminous efficacy more than 45 lumens per circuit-Watt and in excess of 400 lamp lumens.
- Install in dwellings, fixed external lighting fitting;
  - Of lamp capacity not more than 100 Watt with automatic switching off when there is enough daylight and when not required at night or
  - With sockets that can only be used with lamps of efficacy greater than 45 lumens per circuit-Watt.
- Ensure that the installed lighting has an average initial (100 hour) lamp plus ballast efficacy of not less than 50 lamp lumens per circuit-Watt.
- Ensure display lighting has an initial (100 hour) efficacy of not less than, including any transformers or ballast 22 lamp lumens per circuit Watt.

Ensure lighting scheme complies with the Building Regulations Approved Documents (AD) L1A, L1B, L2A, L2B and M and associated Building Services Compliance Guides as appropriate or equivalent in Scotland, Wales and Northern Ireland.
Calculate initial circuit efficacy as AD L2A or L2B, as appropriate.

Health Care Buildings
Provide general and task lighting as defined on the Activity Data Base and CIBSE Lighting Guide for Hospitals and Health Care Buildings.
Provide standby lighting derived from the secondary power supply within patient areas and clinical risk grades A and B (as described in HTM 06-01) to Grade A - the same level as normal lighting.
Provide standby lighting to Grade B (reducing lighting level to normal) in clinical risk Grade C (as described in HTM 06-01) areas.
Provide a minimum of two lighting circuits powered by at least two separate sources of supply in rooms categorised as clinical risk grades A, B and C (as defined in HTM 06-01) or Group 1 and Group 2 (as defined in BS 7671 IET Wiring Regulations).
Theatre operating lamps shall be connected to separate 3 hour battery units.
Emergency escape lighting shall be provided in accordance with BS EN 50172, BS 5266 and BS EN 1838.
Luminaires for use in clinical areas of hospitals and health care buildings to BS EN 60598-2-25:1995.

V21 – General Lighting

Use the recommendations in BRE DG 498 for lighting controls.

Contractor to commission the lighting installation in accordance with CIBSE Commissioning Code L : *Lighting* and allow for measuring illumination levels of installation prior to Handing Over, Measurements shall be carried-out in accordance with the SLL Code for Lighting, sections on Instruments and Field Surveys. Commissioning and measurements of lighting installations shall be performed by persons who have demonstrated their competence by passing the 'lighting industry commissioning scheme' operated by the Society of Light and Lighting, Electrical Contractors' Association or National Inspection Council for Electrical Installations.

Unless otherwise stated final lighting circuits shall be radial. Protective device rating and conductor size shall be based on the following:

	Protective device and rating (A)					
MCB	10			16		
Cable size (mm^2)	1.5	2.5	4.0	1.5	2.5	4.0
Maximum circuit length (metres)	20	30	50	10	20	30

Circuit maximum cable lengths reduced. Cable lengths based upon maximum voltdrop of 2% with Ib=0.75In.

Emergency lighting to BS EN 50172, BS 5266, BS EN 1838 and ICEL 1003
Maintain specified illumination level for a period of 3 hours without the use of mains electricity.

100.041 CONTROL REQUIREMENTS:
Refer to scope of works / schedule V21sch1 for control lighting systems / requirements for digital addressable lighting interface; comply with relevant parts of BS EN 62386 and BS EN IEC 62386.

Occupancy detection – refer to scope of works

Dimming
- Refer to scope of works and or schedules for details
- Ensure dimming system reduces rather than diverts the energy supply.
- Provide dimming photoelectric lighting controls to all areas where daylighting levels are sufficient to provide a significant proportion of the required design illuminance levels. Ensure that the sum of daylight and electric lighting always reaches the design level by sensing the total illuminance in the controlled area and adjusting the level of artificial light to meet the design requirements.
- Lighting control interface for dimming (Analogue voltage dimming interface for electronic current sourcing control gear) to BS EN IEC 63128

Ensure display lighting has separate dedicated circuits with controls separate from general lighting.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO V21

300.000 GENERAL

300.011 SYSTEM REQUIREMENTS:
Select lighting equipment suitable to meet system objectives and as indicated on the drawings and schedules.
Provide all emergency lighting circuits with local test key switch.
Emergency lamps to energise on failure of local lighting circuit unless otherwise stated.
Illuminate exit, emergency exit and escape route signs so that they are legible at all times, by lamps external to sign or lamps contained within sign as indicated on the drawings.

300.030 ELECTROMAGNETIC COMPATIBILITY
Ensure all equipment and systems are installed to provide electromagnetic compatibility within the systems and with any other systems installed in the same location.

300.050 INTEGRATED SYSTEM:
Where indicated provide integrated system as detailed in the scope of works.

310.000 PRODUCTS/MATERIALS

V21 – General Lighting

310.001 WIRING AND CONTAINMENT SYSTEM
Wiring within buildings to be carried out in single core insulated cable enclosed in conduit and or trunking as scheduled.
Trunking routes shown on drawings are primary routes only and all subsidiary trunking and conduits to be provided to form a complete containment system.

310.002 DISPLAY LIGHTING / FLEXIBLE LIGHTING SOURCES:
Refer to scope for project specific requirements
Standards
- Relevant parts of BS IEC 62595 and BS EN 62595 for display lighting units and LCD backlight units.
- PD IEC TR 62595-1-3 for lighting units with arbitrary shapes such as flexible lighting sources.

310.003 LUMINAIRES AND FIXTURES
Provide luminaires as scheduled and detailed in Y73 complete with means of fixing or supporting. Where installed in suspended ceiling ensure method of fixing is compatible with ceiling type.
Where luminaires incorporate thermoplastic diffusers comply with Building Regulations.

310.011 LIGHTING CONTROL EQUIPMENT
See also clause 100.041 and scope of works.
Where lighting control equipment is specified engage lighting controls specialist to develop the design, supply, install, commission and set to work the lighting control system.
Infrared systems to comply with BS 7693, IEC 61147.

320.000 WORKMANSHIP

320.010 WORK ON SITE:
Ensure all building works are complete and service connections provided.

320.021 INSTALLATION:
Install, commission and to set to work lighting equipment in accordance with manufacturer's recommendations, BS 7671, BS 5266-1 and CIBSE Commissioning Code L : L*ighting*.
Install infra-red transmission systems and co-ordinate the installation of infra-red systems in the same area in accordance with BS 7693.
Ensure luminaires are not installed where temperatures are likely to exceed manufacturers recommended maximum.
Ensure fluorescent luminaires are not used at temperatures below that specified by manufacturer.
Where batteries or indicators are located remote from the emergency luminaire the interconnecting wiring shall be fire-rated. Comply with BS 8519 and BS 5266-1.

320.031 QUALITY CONTROL:
Handle, store and install equipment and components of the lighting system in accordance with manufacturers recommendations. Obtain all equipment and components from a single source.
Inspect all equipment and components on delivery, before fixing and after installation, and reject and replace any that are defective. Record all commissioning, measurements and tests.

V22 – General Power

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide sub-circuit power installations from the sub-distribution boards terminating with socket outlets, fuse connection units and other outlet accessories.

100.020 DESIGN PARAMETERS
Unless otherwise indicated all final circuits for general LV power circuits shall comprise:

	Protective device and rating (A)						
MCB	20A		32A		20A		
Circuit type	Ring				Radial		
Cable size (mm^2)	2.5	4.0	2.5	4.0	2.5	4.0	6.0
Maximum circuit length (metres)	35	60	20	35	25	40	60

(Cable sizes are based upon a maximum volt drop of 2% with the circuit loaded to 50% of the cpd rating. For ring circuits a 0.67 current diversity has been used.)
Circuit lengths are taken to the furthest point of utilisation of the circuit for radial circuits or for the route length of the circuit for ring circuits.

On healthcare projects the electrical installation shall meet the requirements of BS 7671 IET Wiring Regulations and WHTM 06-01 as applicable.
The performance requirements of BS EN 60601-1 shall be considered in so far as how the electrical installation will affect any medical equipment compliant with that standard.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO V22

300.000 GENERAL

300.010 SYSTEM REQUIREMENTS
Select equipment suitable to meet system objectives and as indicated on the drawings and schedules.

300.030 ELECTROMAGNETIC COMPATIBILITY
Ensure all equipment and systems are installed to provide electromagnetic compatibility within the systems and with any other systems installed in the same location.

310.000 PRODUCTS/MATERIALS

310.005 WIRING AND CONTAINMENT SYSTEM
Wiring to be carried out in single core insulated cable enclosed in conduit and or trunking as scheduled.
Trunking routes shown on drawings are primary routes only and all subsidiary trunking and conduits to be provided to form a complete containment system.

310.006 POWER USING EQUIPMENT AND FIXTURES
Provide equipment as scheduled complete with means of fixing or supporting.

310.007 POWER TO MECHANICAL PLANT
Refer to W60 for details.
Provide fused connection unit adjacent to each item of local plant that is not fed from an MCC, final connection to be by the Controls Specialist.
Provide power to all MCC's, distribution boards etc supplied by the Controls Specialist.

320.000 WORKMANSHIP

320.010 WORK ON SITE:
Ensure all building works are complete and service connections provided.

320.021 INSTALLATION:
Install, commission and to set to work equipment in accordance with manufacturer's recommendations and BS 7671 IET Wiring Regulations.

V22 – General Power

320.031 QUALITY CONTROL:
Handle, store and install equipment and components in accordance with manufacturers' recommendations. Obtain all equipment and components from a single source.
Inspect all equipment and components on delivery, before fixing and after installation, and reject and replace any that are defective. Record all commissioning, measurements and tests.

V40 – Emergency Lighting

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide temporary illumination to escape routes, walkways, selected areas and signs by means of separate lighting systems in the event of failure of the normal lighting systems.
On healthcare project ensure compliance with WHTM 06-01 and BS EN 1838 and BS EN 50172 (BS 5266-8).

100.020 DESIGN PARAMETERS
Minimum lighting level to conform to the requirements of BS EN 1838 and BS EN 50172 (BS 5266-8).
Maintain specified lighting level for a period of 3 hours without the use of mains electricity
Unless otherwise indicated all final lighting circuits shall comprise

	Protective device and rating (A)					
MCB		10			16	
Cable size (mm^2)	1.5	2.5	4.0	1.5	2.5	4.0
Maximum circuit length (metres)	20	30	50	10	20	30

Circuit lengths are taken to the furthest point of utilisation of the circuit, plus the length of switch lines.

100.040 CONTROL REQUIREMENTS
Provide all emergency lighting circuits with local test key switch.
Emergency lamps to energise on failure of local lighting circuit unless otherwise stated.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO V40

310.000 GENERAL

300.011 EMERGENCY LIGHTING SYSTEM:
Standards
BS EN 50172 (BS 5266-8) for emergency escape lighting systems.
BS 5266-2 for low mounted way guidance systems for emergency use.
BS 5266-4 for design, installation, maintenance and use of optical fibre systems.
BS 5266-5 for component parts of optical fibre systems.
BS 5266-6 for photoluminescent systems for emergency way guidance.
BS EN 13032-3 for photometric data
BS EN 1838 for emergency lighting applications.
BS EN 50171 for central power supply systems.
BS EN 62034 for automatic test systems for battery powered emergency escape lighting.
BS 5266-1 for general recommendations and guidance for the emergency lighting in premises other than dwellings.
SLL CIBSE LG12/15 for emergency lighting in general.
SLL CIBSE LG2 for hospitals and health care buildings.
BS EN 12193 for additional considerations for emergency lighting in sports venues
Any Local Authority specific requirements.

300.020 ILLUMINATION OF SIGNS:
Illuminate exit, emergency exit and escape route signs so that they are legible at all times, by lamps external to sign or lamps contained within sign as indicated on the drawings.

300.030 INTEGRATION, CONTROL AND MONITORING:
Provide an integrated system where detailed in the scope of works / schedules.
Equipment to be controlled / monitored should interface with BMS, the fire detection and alarm system or the building's Supervisory control and data acquisition system via:
Local outstations / control panels
Supervisory control and data acquisition system via:
Local outstations / control panels
Fire detection and alarm system:
Ensure interfaces to fire detection and alarm system comply with the relevant parts of BS 5839 and BS 7273.
Ensure relevant equipment complies with BS EN 50130-4.

V40 – Emergency Lighting

300.040 SOFTWARE:
Where appropriate, obtain on behalf of the end users all appropriate licences, permissions, copyright waivers, rights of use and the like from the owners of the software rights. Ensure that the end user is properly registered with the software supplier for support and appropriate updating. Provide documentation for application software in accordance with BS ISO/IEC 26513 and BS ISO/IEC 26514.
Ensure that, as far as practicable, all software is commercially available off-the-shelf.
Ensure that any programmable configuration, customisation, and bespoke software, is developed, tested and commissioned using relevant processes and procedures complying with BS ISO/IEC/IEEE 12207 or BS ISO/IEC/IEEE 15288, supported by a quality management system meeting the requirements of BS EN ISO 9001.

310.000 PRODUCTS/MATERIALS

310.011 LAMPS FOR EMERGENCY LIGHTING:
As indicated on the drawings and schedules.

310.021 SELF-CONTAINED EMERGENCY LUMINAIRE SYSTEM AND EQUIPMENT
Provide green LCD luminaire healthy and red LCD luminaire fault (where specified) indicator in accordance with BS EN 60598-2-22 and BS EN 60073 (coding principles for indicators).

310.026 LOW MOUNTED WAY GUIDANCE SYSTEMS FOR EMERGENCY USE
Standards BS 5266 Parts 1, 2, and 5, BS EN 50172, and BS EN 60598-2-22.

310.027 OPTICAL FIBRE EMERGENCY LIGHTING SYSTEM
Standards BS 5266-4 and BS 5266-5

310.030 CENTRAL BATTERY EQUIPMENT:
Standard BS EN 50171 and ICEL 1009 and as indicated on the drawings and schedules.
Refer to schedule V40sch for project specific requirements.

310.040 BATTERY CHARGERS:
Standards - BS EN 60335-2-29, (battery chargers for household and similar applications), relevant parts of BS EN 60146, (semiconductor converters), BS EN IEC 62485-2 (stationary secondary batteries and battery installations - safety requirements), BS EN 50171 (central power supply systems) and ICEL 1009:2000
Type - as scheduled.

310.050 MAINS FREQUENCY CENTRAL INVERTERS:
Standards - relevant parts of BS EN 50171, BS EN IEC 62040-1 and ICEL 1009:2000

310.060 ANCILLARIES:
Provide ancillaries in accordance with the appropriate standards and regulatory authority requirements.

320.000 WORKMANSHIP

320.011 INSTALLATION:
Install, test and commission emergency lighting system and luminaires in accordance with the relevant parts of BS 5266, BS EN 50172 (BS 5266-8), BS EN 1838 and BS 7671 (IET Wiring Regulations).

320.012 REMOTE BATTERY AND INDICATOR CONNECTIONS
Where batteries are located remote from the luminaire the interconnecting wiring shall be fire-rated in accordance with BS 5266-1

320.020 SELF-CONTAINED LUMINAIRES:
Ensure self-contained luminaires are not installed where temperatures are likely to exceed manufacturers recommended maximum.
Ensure fluorescent luminaires are not used at temperatures below that specified by manufacturer.

320.030 EQUIPMENT:
Install equipment in accordance with manufacturer's recommendations.

V40 – Emergency Lighting

320.040 QUALITY CONTROL:

Record all commissioning measurements and tests and site modifications to hardware or software, and revise operating and maintenance instructions accordingly.

Manage configuration of software settings, data and design, in accordance with an appropriate Configuration Management Plan (CMP), complying as necessary with BS EN ISO 9001, BS ISO 10007, BS ISO/IEC/IEEE 12207 and BS ISO/IEC/IEEE 15288.

Provide configuration details along with the operation and maintenance manual on hand-over.

Manage information security of systems, software and data during design, implementation and commissioning in line with BS EN ISO/IEC 27001.

W30 – Data Transmission

PART 1 SYSTEM OBJECTIVES

Refer to SBUHB ICT Specification

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide systems to control the movement of personnel into defined spaces.
Select and install all equipment to ensure compliance with BS 8300 Parts 1&2 as appropriate (Design of an accessible and inclusive built environment. Buildings. Code of practice).

PART 3 SPECIFICATION CLAUSES SPECIFIC TO W40

300.000 GENERAL
Refer to scope of works for project particular requirements.

300.010 SYSTEM REQUIREMENTS:
Select security detection components and equipment, suitable to meet system objectives requirements.

300.020 ACCESS CONTROL SPECIALIST:
Use an access control specialist for design development, supply, installation and testing and commissioning of the complete access control installation in accordance with BS EN 60839-11-1.
Ensure the specialist is approved by the National Security Inspectorate to carry out the work on the access control system to NSI (National Security Inspectorate) Gold Standard unless detailed otherwise in the scope of work.

300.040 ELECTROMAGNETIC COMPATIBILITY:
Ensure all equipment and systems are designed and installed with due consideration to good EMC practice, and in line with the EMC requirements of relevant standards including BS 7671, BS 4737 series, BS EN 50310, BS EN 50174-1, BS EN 50174-2, and BS EN 50174-3.
Ensure all equipment complies with EMC Regulations, carries the CE Mark, and is suitable for the electromagnetic environment in which it is to be used, for the service to which it is to be put.

300.070 EQUIPMENT:
Provide equipment for operation in the environment specified in the schedule of Common Design Criteria A13sch and/or the scope of work for the particular project.
Ensure components forming part of, and/or controlling electrically controlled exit systems on escape routes comply with BS EN 13637.
Select and install components to ensure compliance with The Equality Act 2010 as amended, and BS 8300 Parts 1&2.

300.080 INTEGRATED SYSTEM:
Where specified on the Drawings, Schedules or scope of works, combine with other systems to provide an integrated system.

Ensure systems and components forming part of, and/or controlling electrically controlled exit systems on escape routes comply with BS EN 13637. Ensure interfaces to the fire detection and alarm system comply as necessary with relevant parts of BS 5839 and BS 7273.

300.090 SOFTWARE:
Obtain on behalf of the end users all appropriate licences, permissions, copyright waivers, rights of use and the like from the owners of the software rights. Ensure that the end user is properly registered with the software supplier for support and appropriate updating. Provide documentation for application software in accordance with BS ISO/IEC 26513 and BS ISO/IEC 26514.
Ensure that, as far as practicable, all software is commercially available off-the-shelf.
Ensure that any programmable configuration, customisation, and bespoke software, is developed, tested and commissioned using relevant processes and procedures complying with BS ISO/IEC/IEEE 12207 or BS ISO/IEC/IEEE 15288, supported by a quality management system meeting the requirements of BS EN ISO 9001.

310.001 PRODUCTS / MATERIALS (NES 310.010 – 310.080)
Refer to the scope of works for project specific equipment / systems.
Select and install components to ensure compliance with The Equality Act 2010 as amended and relevant part of BS 8300.
Standards - as appropriate to the project specific systems, including, but not limited to the following:
Entry phone access system – BS EN 50486

Electrically operated door locks – BS EN 60730-2-12 or BS EN IEC 60730-2-12
Power operated doors / gates
BS EN 12453, BS EN 12604, BS 7036-0, BS EN 16005, BS EN 12635, BS EN 14637, BS EN 60335-2-95, BS EN 60335-2-103,
Health and Safety Executive Safety Notices FOD WSW 1-2010 and FOD 7-2010, BS EN 12978
Door closers – BS EN 1154
Vehicle parking control equipment – relevant parts of BS 6571
Standby power supplies for controllers
BS EN 50131-6 for intruder alarm and hold-up system specific components.
BS EN 54-4 for power supply equipment where BS 5839-series applies (fire detection and alarm systems for buildings)
BS EN IEC 62485-series for secondary batteries and battery installations.

320.000 WORKMANSHIP

320.010 WORK ON SITE:
Ensure that all building works are completed and service connections are provided.

320.020 INSTALLATION:
Install, commission and set to work equipment in accordance with manufacturer's recommendations and BS 7671.

320.030 QUALITY CONTROL:
Handle, store and install equipment and components of the access control systems in accordance with the manufacturer's recommendations.
Obtain all equipment and components from a single source.
Inspect all equipment and components on delivery, before fixing and after installation and reject and replace any which are defective.
Record all commissioning measurements and tests.
Manage configuration of software, settings, data, and design, in accordance with an appropriate Configuration Management Plan complying as necessary with BS EN ISO 9001, BS ISO 10007, BS ISO/IEC/IEEE 12207 and BS ISO/IEC/IEEE 15288.
Provide configuration details along with the operation and maintenance manual on hand-over.
Manage information security of systems, software and data during design, implementation and commissioning in line with BS EN ISO/IEC 27001.

W42 – Closed Circuit Television

PART 1 SYSTEM OBJECTIVES

100.011 PERFORMANCE OBJECTIVES
To undertake detail design and provide, install, test and commission a fully functioning CCTV system capable of interfacing with other IT systems in the building(s).
On healthcare projects the closed circuit television system and components provided in compliance with it, will deliver the whole hospital policies and be compliant with all Department of Health (NHS Estates) documentation, including, but not limited to WHTM's and WHBN's pertinent to the nature of this project.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO W42

300.010 CLOSED CIRCUIT TELEVISION (CCTV) SYSTEM:
Standards as applicable to the scope of works.
BS 7958 – Closed circuit television (CCTV) management and operation.
BS 8418 – Installation and remote monitoring of detector-activated CCTV systems.
Relevant parts of BS EN 62676 and BS EN IEC 62676 – Video surveillance systems for use in security applications.
Third party quality assurance standard
National Security Inspectorate (NSI)
Design CCTV system as detailed in the scope of works / system description
CCTV system coverage.
Ensure system provides effective and adequate viewing of areas indicated on the drawings at light levels
Bright sunlight down to
4.0 lux unless detailed otherwise in the scope of works.
Internal daylighting down to 100 lux.
Artificial illumination provided at indicated area.
Night viewing using camera mounted infrared projectors.
Night viewing down to 0.5 mlux if necessary with use of image intensifier.
National Security Inspectorate (NSI) approved
Video transmission system
Relevant parts of BS EN IEC 62676 and BS EN 62676 series as applicable,
CCTV system monitoring
Ensure all human-machine interfaces and displays to comply with The Equality Act 2010 as amended, BS 8300-1 and BS 8300-2.
Provide means of selection and recording for system monitoring
Ensure digital CCTV streams are encrypted
Ensure protection system displays and controls to be installed in control rooms are designed, located and commissioned taking into account the requirements of the following standards and the operational needs of users.
BS EN ISO 11064-1
BS EN ISO 11064-3
BS EN ISO 11064-5
BS EN ISO 11064-7
BS EN 29241-2, and relevant parts of BS ISO 9241 and BS EN ISO 9241.
Where described in the scope of work s/ system description, provide an integrated system operating with the systems described.

300.020 CCTV SYSTEM SPECIALIST:
Engage a CCTV specialist to develop design, supply, install, commission and set to work a complete CCTV system.
Ensure the CCTV specialist is approved by the National Security Inspectorate
Gold Standard unless detailed otherwise in the scope of works.

300.030 ELECTROMAGNETIC COMPATIBILITY:
Ensure all equipment is compatible, and does not adversely affect, nor is adversely affected by, any other equipment installed in the same location.
Ensure all systems are designed and installed with due consideration to good EMC practice, and in line with EMC requirements of relevant standards including: BS 7671, BS EN 50310, and BS EN 50174.
Ensure all equipment complies with the EMC Regulations (2006), carries the CE Mark, and is suitable for the EM environment in which it is to be used, for the service to which it is to be put.

W42 – Closed Circuit Television

300.040 SOFTWARE:
Obtain on behalf of the end users all appropriate licences, permissions, copyright waivers, rights of use and the like from the owners of the software rights. Ensure that the end user is properly registered with the software supplier for support and appropriate updating. Provide documentation for application software in accordance with BS ISO/IEC 26513 and BS ISO/IEC 26514.
Ensure that, as far as practicable, all software is commercially available off-the-shelf.
Ensure that any programmable configuration, customisation, and bespoke software, is developed, tested and commissioned using relevant processes and procedures complying with BS EN ISO 12207 or BS ISO/IEC/IEEE 15288, supported by a quality management system meeting the requirements of BS EN ISO 9001.

300.050 SAFETY:
For equipment mounted at height, ensure that there is a safe method of access to facilitate installation and maintenance in accordance with applicable health and safety legislation.
Ensure that there is an accessible means of isolation for safe maintenance of electrical equipment, in accordance with the Electricity at Work Regulations 1989.

310.000 PRODUCTS/MATERIALS

310.010 CCTV CAMERAS:
Standard · BS 8418.

310.030 CAMERA CONTROL EQUIPMENT:
Standard BS 8418.

310.100 CCTV MONITORS:
Display compatible with BS EN ISO 9241-303.
Standby/Off power consumption conforms to BS EN 50564.

310.110 CCTV RECORDING, PLAYBACK AND PRINTING:
Standard
BS EN 62676-4
BS EN 55020.
BS EN 55032

310.190 CCTV NOTIFICATION SIGNS:
Provide CCTV notification signs as current legislation and industry recommendations.
Standard
BS ISO 3864-1
BS ISO 3864-3
BS ISO 3864-4
BS ISO 17398
BS EN ISO 7010

310.220 LOUDSPEAKERS:
Standard
BS EN 60268-5
BS 6840-13

320.000 WORKMANSHIP

320.010 CCTV SYSTEM INSTALLATION:
Install the CCTV system in accordance with the manufacturers' recommendations, BS 7958 and National Security Inspectorate (NSI) approved requirements, codes of practice and guidance.

320.020 CCTV SYSTEM COMMISSIONING:
Demonstrate that the CCTV system meets the specified requirements and record results. Provide documented CCTV demonstration, as part of the operation and maintenance manual.
Carry out demonstration using test objective as:

W42 – Closed Circuit Television

NSI approved standards and codes of practice.
BS EN 62676-4 - Video surveillance systems for use in security applications. Application guidelines.

320.030 QUALITY CONTROL:
Handle, store and install equipment and components of the radio/TV system in accordance with the manufacturer's recommendations.
Inspect all equipment and components on delivery, before fixing and after installation and reject and replace any which are defective.
Record all commissioning tests and site modifications to hardware and software, and revise operating and maintenance instructions accordingly.
Manage configuration of software, settings, data and design, in accordance with an appropriate Configuration Management Plan complying as necessary with BS EN ISO 9001, BS ISO 10007, BS ISO/IEC/IEEE 12207 and BS ISO/IEC/IEEE 15288.
Provide configuration details along with the operation and maintenance manual on hand-over.
Manage information security of systems, software and data during design, implementation and commissioning in line with BS EN ISO/IEC 27001

320.040 CCTV SYSTEM DOCUMENTATION:
Prepare National Security Inspectorate (NSI) approved certification on completion, as part of the operation and maintenance manual.

320.050 TRAINING:
Provide operator training for the CCTV system operators.
Provide training for CCTV system maintenance staff.

W50 – Fire Detection & Alarm

PART 1SYSTEM OBJECTIVES

100.011 PERFORMANCE OBJECTIVES
To provide detection and alarm systems serving to enhance safety and reduce loss by the detection of fire, enabling an audio/visual alarm to be given so that emergency actions may be taken.
On healthcare projects installations to be compliant with all Department of Health (NHS Estates) documentation, including, but not limited to WHTM's and WHBN's pertinent to the nature of this project. In particular ensure compliance with DH WHTM 05-02 and WHTM 05-03.
The fire alarm system shall provide detection and alarm functions in overall conformity of the premises to BS 9999.
The fire alarm system shall provide detection and alarm functions in overall conformity of residential buildings to BS 9991.

100.020 DESIGN PARAMETERS
Comply with the following as appropriate to the particular project requirements
BS 5839-1 - non domestic premises
BS 5839-6 - domestic premises
BS 5839-8 - emergency voice communications systems
BS 6266 - Fire protection for electronic equipment installations

Voice Alarm Systems

Voice Alarm Systems shall be capable of relaying clear intelligible speech for fire and other alarm messages, in addition to alert and evacuation fire alarm tones, simulating an electronic fire alarm sounder (frequency to be <1,000Hz). The alarm shall be broadcast on a zone by zone basis, or groups of zones, including all zones.

The audibility levels shall be as follows;
Minimum : As recommended in BS 5839-8 and BS EN 50849
Preferred : 70 to 75dB(A)
Maximum : 120dB(A)

A minimum speech intelligibility index (STI) of 0.5 shall be achieved.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO W50.

300.000 GENERAL

300.011 TYPE OF SYSTEM:
See scope of works and / or schedules for Type, Detection Category (or Grade for domestic systems) and Voice Alarm Type
Provide means of testing wiring of each zone, detection loop or alarm circuit of system.
Provide means of disabling zones or individual detectors as specified.
Provide a fully monitored system in accordance with the relevant parts of BS 5839 and BS EN 54. Include all end of line and other necessary circuit elements to facilitate monitoring.

Refer to schedules for project particular details

300.015 ELECTROMAGNETIC COMPATIBILITY:
Ensure all equipment is compatible and does not adversely affect, nor is adversely affected by any other equipment installed in the same location.
Ensure all systems are designed and installed with due consideration to good EMC practice and in line with EMC requirements of relevant standards including: BS 7671; BS EN 50310; BS EN 50174-series.
Ensure all equipment complies with the EMC Regulations (2016), carries the CE Mark and is suitable for the EM environment in which it is to be used, for the service to which it is to be put.
Ensure all relevant fire alarm equipment complies with BS EN 50130-4.

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300.017 SOFTWARE:
Obtain on behalf of the end users all appropriate licences, permissions, copyright wavers, rights of use etc. from the owners of the software rights. Ensure that the end user is properly registered with the software supplier for support and appropriate updating. Provide documentation for application software in accordance with BS ISO/IEC 26513 and BS ISO/IEC 26514.
Ensure that, as far as practicable, all software is commercially available off-the-shelf.
Ensure that any programmable configuration, customisation and bespoke software is developed, tested and commissioned using relevant processes and procedures complying with BS ISO/IEC/IEEE 12207 or BS ISO/IEC/IEEE 15288, supported by a quality management system meeting the requirements of BS EN ISO 9001.

300.041 CONTROL SYSTEM:
Standard
BS 5839-6 Annex B.
BS EN 54-2
BS EN 54-4
BS EN 54-25 for components using radio links
See Scope of Works and Schedules for type of control system.

300.045 VOICE ALARM SYSTEM
Standard
BS EN 54-16
BS 5839-8
BS 6259 as appropriate (planning, installation, testing and maintenance of sound systems)
Connection to Fire Alarm System in accordance with relevant parts of BS 5839.
Intelligibility of speech messages of sound system equipment to BS EN 60268-16.
Unless specified otherwise the voice alarm system shall transmit a common 'Voice alarm system fault', particular to each voice alarm rack, for any fault condition, which may occur within each voice alarm system.
Emergency sound system at sports venues to BS 7827

300.046 EMERGENCY VOICE COMMUNICATION (EVC) SYSTEM
Standard - BS 5839-9
Access for maintenance / software programming to BS EN 54-2.

300.050 EXPLOSIVE OR FLAMMABLE ATMOSPHERES:
Where fire alarm equipment or wiring is installed in areas where explosive or flammable atmospheres occur comply with BS EN IEC 60079 /BS EN 60079.

300.081 REMOVAL OF TRIGGER DEVICE:
Provide precautions against removal of trigger devices.
Use trigger devices that are removed only by a special tool.
Use trigger devices with bases that provide circuit continuity with trigger device removed.
Ensure that, where alarm sounders use same wiring as trigger device, removal of trigger device does not affect operation of alarm sounder.

300.100 REMOTE CENTRE:
Make provision to send signal to remote centre where specified.

300.110 FIRE ALARM SPECIALIST:
Engage a specialist to develop the design, supply, install, commission and set to work the fire alarm system.

300.115 VOICE ALARM SYSTEM SPECIALIST:
The Fire Detection and Alarm Specialist shall engage a Public Address and Sound Amplification Specialist to develop design, supply, install, commission and set to work a voice alarm and sound distribution system in accordance with BS 5839-8, BS EN 60849 and BS 6259.

300.120 INTEGRATED SYSTEM
Where specified on the Drawings or Schedules, combine with other systems to provide an integrated system.
Security detection and alarm / social alarm in dwellings in accordance with clause 9.1.5 of BS 5839-6.

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Ensure interfaces comply as necessary with relevant parts of BS 5839 and BS 7273.

310.000 PRODUCTS/MATERIALS

310.011 MANUAL CALL POINTS:
Standard
BS EN 54-11
Mounting as scheduled

Degree of Protection to BS EN 60529 as scheduled
Operation
Manual Call Point activation response within 3 seconds.
Manual operation
Key switch.
Break glass with anti-fragmentation film.
Thumb pressure

310.021 AUTOMATIC DETECTORS
Provide automatic fire detectors from the same manufacturers and with common facilities.

Plug in bases.
Common base for all detector types.
Visible activation indicator.
Visible remote indication for detectors concealed in roof spaces etc.
Label detector bases with address number (where static addressing is used)
Mount detectors in floor voids on brackets to facilitate proper functioning of these detectors.

Position detectors in accordance with BS 5839 to take account of air movement

For combined sounder/sensors, removal of sensor not to inhibit sounder.

310.031 HEAT DETECTORS:
Standard
Point type BS 5446-2 - heat alarms for dwellings
BS EN 54-5 - heat detectors

Line type BS EN 54-28 - non-resettable line-type heat detectors
310.041 SMOKE DETECTORS:
Standard
Point type
BS EN 14604 (Residential applications)
BS EN 54-7 - using scattered light, transmitted light or ionization
BS ISO 7240-15 - using smoke and heat sensors
Aspirating type
BS EN 54-20
Optical beam type
BS EN 54-12

310.051 RADIATION (FLAME) DETECTORS:
Standard
Point type
BS EN 54-10

Characteristics as scheduled.

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310.061 MULTI-SENSOR FIRE DETECTORS:
Standard
Point detectors with a combination of smoke and heat sensors: BS EN 54-29
Point detectors with a combination of carbon monoxide and heat sensors:
BS EN 54-30
BS ISO 7240-8
Point detectors using a combination of smoke and carbon monoxide, and optionally heat sensors: BS EN 54-31
Carbon monoxide fire detectors to use an electro-chemical cell in combination with a heat sensor.

310.071 SOUNDERS:
Standard
Comply with BS 8456 - code of practice for design and installation of directional sounder evacuation systems
BS EN 54-3

310.081 FIRE ALARM CONTROL AND INDICATING EQUIPMENT (CIE):
Standard
BS 5839-1 and BS EN 54-4
BS 5839-6 Annex B (Residential applications).
BS EN 54-2
Functional requirements
Standard functions and additional functions as scheduled.

310.083 SLAVE STATUS UNITS (EXTINGUISHING SYSTEMS):
Refer to work section S70, S71 or S72 / relevant schedules for extinguishant system details.
Install slave status units outside all secondary exits or entrances to the protected area(s).
Ensure each panel houses a four-way status indicator with the visual indication the same as extinguishant control unit.
Ensure each panel is complete with a key-switch for mode selection and break glass push button manual release call point.
Ensure they are wired for priority enabling key-switch selection to be repeated at the other units, system isolated to have priority manual, which in turn has priority over automatic mode.

310.085 VOLT FREE CONTACTS (EXTINGUISHING SYSTEM CIE):
Refer to work section S70, S71 or S72 / relevant schedules for extinguishant system details.
Include in the Extinguishant Control Panel all necessary volt free change-over contacts all rated at one amp.
First coincidence contacts are required for:
- Signal to main fire alarm panel.
- Signal to B.M.S.
- Shut off fans and close smoke dampers
- Shut down air handling units.

Second coincidence contacts are required for:
- Signal to main fire alarm panel.
- Signal to B.M.S.
- Shut off fans and close smoke dampers
- Shut down air handling units.
- Emergency power off electrical supply system.

Additional contacts are required for
- Gas extinguishant released / sprinkler system filled with water, as appropriate.
- Common fault condition signal to the main fire alarm panel.

310.086 HOLD OFF FACILITY (EXTINGUISHING SYSTEMS):
Refer to work section S70, S71 or S72 / relevant schedules for extinguishant system details.
Install 'Hold Off' facilities at all exits from within each protected room(s).
Ensure that the operation of any hold off unit will stop the pre-charge timer and isolate the second stage sounders and reset the timer to zero which is to be maintained whilst the button is depressed.
Release of the button will reinstate the timer cycle delay for the full 30 seconds. This facility must be capable of being repeated multi-shot.

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310.091 REPEATER PANEL:
Standard
BS EN 54-2
BS EN 54-4

310.101 MIMIC PANEL:
Standard
BS EN 54-2

310.110 ANCILLARY SERVICES CONTROL:
Make provision to open or close circuits of ancillary services by means of relay or similar device as scheduled.
Standard
BS EN 54-2

310.115 INPUT/OUTPUT DEVICES
Standard
BS EN 54-18

310.121 POWER SUPPLIES:
Standard
BS 5839-1
BS EN 54-4

310.131 REMOTE INDICATOR MODULE
Standard
BS EN 54-2

310.141 LINE ISOLATOR MODULE
Standard
BS EN 54-2

310.145 SHORT CIRCUIT ISOLATORS
Standard
BS EN 54-17

310.151 VISIBLE ALARMS:
Standard
BS EN 54-2
BS EN 54-23

310.161 ZONE MONITORING UNIT:
Standard
BS EN 54-2

310.171 AUTOMATIC RELEASE MECHANISM:
Standard
BS 5839-3
BS 7273-4 - actuation of release mechanism for doors
BS EN 14637 - electrically controlled hold-open systems for fire/smoke door assemblies.

310.191 VOICE ALARM LOUDSPEAKERS:
Standard
BS 5839-8
BS EN 54-16
BS EN 54-24
Speakers used in conjunction with voice alarm systems shall suit the functional surveillance method employed, each loudspeaker shall be fitted with a capacitor to block dc signals.

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Voice alarm circuit wiring shall be glanded directly into the speaker enclosure and terminated into a terminal block fixed to the enclosure. Separate terminals shall be provided to allow the incoming and outgoing conductors to be terminated independently. Terminals shall be suitable for a maximum conductor size of 2.5mm^2. A flying lead shall be provided between the incoming / outgoing cable terminal box and the speaker assembly terminal block.

Speaker tapings shall be pre-wired to a 'fixed' terminal block, mounted to the speaker assembly. The terminal block shall be provided with 'links' to allow the speaker output tapping to be changed.

310.201 VOICE ALARM MICROPHONES :
Standard
BS 5839-8
BS EN 54-16

310.211 VOICE ALARM MESSAGE GENERATORS:
Standard
BS 5839-8
BS EN 54-16
Level range -3dB 200 Hz to 5.5 Hz.

310.221 VOICE ALARM AND INDICATING CONTROL EQUIPMENT:
Standard
BS 5839-8
BS EN 54-16

Functional requirements
Reception, control and relaying of signals from fire detection and alarm systems and fire microphones.
Indication, warning of signals and system statuses.
Generation, amplification and distribution of messages to loudspeakers.

310.231 VOICE ALARM POWER SUPPLIES:
Standard
BS 5839-8
BS EN 54-4
BS EN 54-16

310.241 EMERGENCY VOICE COMMUNICATION MASTER STATIONS:
Standard
BS 5839-9

310.251 EMERGENCY VOICE COMMUNICATION OUT STATIONS:
Standard
BS 5839-9

310.261 EMERGENCY VOICE COMMUNICATION SYSTEM POWER SUPPLIES:
Standard
BS 5839-9

310.271 RADIO FIRE DETECTION AND ALARM SYSTEMS
Ensure all components using radio links comply with BS EN 54-25.

320.000 WORKMANSHIP

320.010 QUALITY CONTROL:
Handle, store and install equipment and components of the fire detection and alarm system in accordance with BS 5839 and the manufacturer's recommendations.
Obtain all equipment and components from a single source.
Inspect all equipment and components on delivery, before fixing and after installation and reject and replace any which are defective.

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Record all commissioning tests and provide the certification required by BS 5839-1.
Provide manufacturers certificates of equipment design to an approved quality management system and CIE component selection.
Record all commissioning measurements and tests, site modifications to hardware or software, and revise operating and maintenance instructions accordingly.
Manage configuration of software, settings, data and design, in accordance with an appropriate Configuration Management Plan complying as necessary with BS EN ISO 9001, BS ISO 10007, BS ISO/IEC/IEEE 12207 and BS ISO/IEC/IEEE 15288.
Provide configuration details along with the operation and maintenance manual on hand-over.
Manage information security of systems, software and data during design, implementation and commissioning in line with BS EN ISO/IEC 27001.

320.020 SMOKE DETECTOR INDICATORS:
Fit smoke detector indicators external to doors, where zone is divided into rooms.

320.031 MANUAL CALL POINTS:
Wire manual call points to initiate zone alarms as indicated on drawings

320.041 RECORD DRAWINGS AND OPERATING INSTRUCTIONS:
Provide instructions on use of installation to person responsible for use of premises. Supply the user with a logbook and certificate of installation and commissioning in accordance with BS 5839-1, Appendix F and G.
Provide record drawings for maintenance and record purposes, showing locations of equipment and accessories, sizes and routes of cables, and connection diagrams for junction boxes and distribution cases.
Provide circuit diagrams of fire alarm system and its components.

320.050 CABLE INSTALLATION:
Plan and install all fire detection and alarm system cables in accordance with BS 5839-1 and the cable manufacturer's recommendations.
Run cables point to point without tees or spurs.
Design loop load (current and device count) not to exceed 80% of cable / loop capacity.
Mark all terminals with polarity and loop / circuit reference.

W51 – LV Earthing & Bonding

Incorporates Y80 (Earthing and Bonding Components)

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide systems for the transfer of electric current to earth, to protect personnel, buildings, structure, plant and equipment in the case of an electrical fault within the supply system and from interference from electro-magnetic fields and electro-static forces.
On healthcare projects comply with all Department of Health (NHS Estates) documentation including, but not limited to HTM's and HBN's pertinent to the nature of the project. In particular, compliance with BS 7430, BS 7671 Section 710 and HTM 06-01.

300.000 PART 3 SPECIFICATION CLAUSES SPECIFIC TO W51

300.010 STANDARDS
As defined in the scope of works, carry out or complete the design, installation, inspection and testing of an earthing and bonding system for the low voltage electrical installation in accordance with Electricity Safety, Quality and Continuity Regulations 2002, Electricity at Work Regulations 1989, BS 7671, BS 7430 and local Distribution Network Operator (DNO) requirements.
Confirm with the DNO that, in the event of a fault in the high voltage network, the resulting transfer Earth Potential Rise (EPR) to the low voltage electrical installation can be achieved at a safe level. If the safe level cannot be met, control measures should be provided to eliminate risk of injury.
Ensure the potential rise in telecommunications circuits due to power system earth faults is limited, as per BS 6701
For requirements of separate or combined high voltage and low voltage electrical installation earthing, see W56.
For functional requirements of information technology and telecommunication systems, to be installed within the building (now or in the future), see BS EN 50174-1, BS EN 50174-2 or BS EN 50174-3 and BS EN 50310.
Ensure that the integrity of the structural steelwork will not be subject to any detrimental influences by any stray DC current flowing in the earthing and bonding system or suitable measures have been taken to avoid it.

300.030 PME INSTALLATIONS:
Provide protective conductors for TN-C-S (PME) Systems where specified

300.032 COMMON BONDING NETWORK (CBN):
Where appropriate, form a Common Bonding Network for information technology equipment by equipotential bonding of metalwork throughout the building. Carry out work to the Common Bonding Network in accordance with BS 7671, BS EN 50174-1, BS EN 50174-2 or BS EN 50174-3 and BS EN 50310. Include in the CBN but not limited to
- Steel structural frames.
- Reinforcement bars in concrete.
- Metallic roof coverings.
- Ceiling grids.
- Services
- Dry risers.
- Water pipes.
- Air ductlines.
- Gas services.
- Power cable containment

300.034 USE OF BUILDING ELEMENTS:
Ensure that building and structural elements used as items in or bonded to the Common Bonding Network are designed and erected in accordance with BS EN 50174-1, BS EN 50174-2 or BS EN 50174-3 and BS EN 50310 as well as their appropriate constructional specification or code of practice. Ensure that all connections to building and structural elements are waterproof and corrosion protected to a degree appropriate to their exposure. A risk assessment on detrimental influence in weather and corrosion protection would be required.

300.036 MESH-BONDING NETWORK (MESH-BN)
Where appropriate, carry out work to achieve a MESH-BN in accordance with BS EN 50174-1, BS EN 50174-2 or BS EN 50174-3 and BS EN 50310.

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Form MESH-BNs in areas indicated on the drawings or detailed in the scope of works

300.040 EXISTING INSTALLATIONS:
Check earth continuity conductors and loop impedance values of existing installation. Report defects and elements not in accordance with BS 7671 (IET Regulations) before connecting new or modified installations to existing supply.

300.050 SOIL TESTS:
Where specified carry out soil tests in accordance with BS 1377 to establish soil electrical resistivity and soil analysis as required.
Apply one or more acceptable industry practice testing method to carry out soil resistivity tests in accordance with the requirements of BS 7430.

300.060 RISE IN POTENTIAL IN TELECOMMUNICATIONS CIRCUITS:
Ensure the potential rise in telecommunications circuits due to power system earth faults is limited, as BS 6701.

300.070 EXCHANGE OF INFORMATION:
Consult with the electricity supply company regarding the earthing arrangements of the installation. Construct the earthing system to the requirements of BS 7430 and BS 7671 /electricity supply company. Ensure any part of the earth fault current path provided by the electricity supply company or others is suitable for the operation of the earth fault protection to be installed. Obtain the agreement and permission of undertakings providing services which are to be bonded to the earthing system.

300.081 EARTH FAULT RELAYS:
Ensure system compatible with earth fault relays on electrical system as specified elsewhere.

310.000 PRODUCTS AND MATERIALS

310.010 CLEAN (LOW NOISE) EARTH DISTRIBUTION (Y80 3010)
Install clean earth distribution in double insulated cables from earth electrodes to equipment points. Mount all busbars with insulators and separately from other earthing systems.

310.020 MAIN EARTH TERMINAL:
Provide earth bar at incoming electrical service position, for each switchboard.
Bond earth terminals and metallic structure of switch and control gear and plant.
Connect each earth terminal to all other earth terminals by a ring conductor sized as BS 7430 and BS 7671.
Location
Adjacent to main switch panel.
Mounting
Mount earth bar on insulated supports located at 300mm centres for 25mm bar and 450mm centres for 50mm bar, giving 50mm clearance at rear of bar.
Material
Manufacture earth busbars from hard drawn, high conductivity copper bar.
Substation Earth busbar
75 x 13mm cross section 600mm minimum length.
Building Earth bar
25 x 6 mm minimum for incoming live conductor not exceeding 50mm2 and 50 x 6 mm minimum for incoming live conductor over 50mm2.
Drill clearance holes, one for each cable plus 30% spare holes (two minimum) at 50mm minimum centres through bar for connection of cable lugs. Ensure clearance holes are minimum necessary size to maintain adequate lug/bar contact.
Size the MET and protective earthing conductors in accordance with BS 7671

310.030 MAIN EARTH TERMINAL CONNECTIONS / SUBSTATION EARTH BAR:
Connect separately each main earth conductor and main equipotential bonding conductor to main earth terminals.
Terminate circuit protective conductors on switchboard earthing bar.
Terminate conductors with compression type lugs suitable for bolting direct to bar or solder lugs suitable for bolting direct to bar

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Extend separate protective conductor from main earth terminal to main switch/switch panel served by incoming main cable or
When main cable is provided by Electrical Supply Company, extend separate protective conductor from Main Cable armouring gland or direct earth terminals or PME earth installed by supply Company to main earth terminal.
Provide terminations on each Substation main earth bar as appropriate for
HV Switchgear frame earth (bare copper tape).
LV Switchgear frame earth (bare copper tape).
Transformer frame earths (bare copper tape).
Transformer neutral earths (insulated copper cable).
LV Switchboard neutral busbars (insulated copper cable).
Earthing conductor to minimum 2 groups of electrodes.
Connect telecommunications and data equipment in accordance with BS 6701.

310.060 NEUTRAL/EARTH CONNECTION:
Provide earth leakage protection system and position neutral/earth connection at main switchboard unless otherwise indicated.

310.070 CLEAN (LOW NOISE) EARTH BAR:
Where specified provide clean earth bar.
Mounting
Mount earth bar on insulated supports located at 300mm centres for 25mm bar and 450mm centres for 50mm bar, giving 50mm clearance at rear of bar.
Material
Manufacture earth busbars from hard drawn, high conductivity copper bar.
Drill clearance holes, one for each cable plus 30% spare holes (two minimum) at 50mm minimum centres through bar for connection of cable lugs. Ensure clearance holes are minimum necessary size to maintain adequate lug/bar contact.
Terminations
Connect each conductor and tape separately to earth bar.
Connect telecommunications and data equipment in accordance with BS 6701.

310.075 PARALLEL EARTH CONDUCTORS (PEC):
Where specified elsewhere in this specification provide parallel earth conductors to all information technology cable routes in accordance with BS EN 50174-2.

310.080 TRANSFORMER OR GENERATOR EARTH ELECTRODE SYSTEMS:
Provide separate electrode systems which each low voltage generator or transformer to achieve an earth electrode resistance that is as low as practicable. The earth electrode system for LV transformers or generators not interconnected with HV systems shall be designed to achieve a target resistance of 10Ω (but not exceeding 20Ω) in accordance with BS 7430, with separate main earthing conductors for each transformer or generator, and an additional spare electrode system for test purposes.
Where a common HV/LV earthing system is provided, the combined earthing system shall ensure the stress voltage and touch voltage requirements of BS EN 61936-1, BS EN 50522 (including National Annex NA.2) and BS 7671 are met in respect of the earthing arrangement(s) of LV system(s) to be supplied. Bond all electrode systems together using a ring conductor. Connect electrode systems to ring conductor via links or disconnecting joints for test purposes.

310.090 INSULATED ISLAND GLANDS:
On cables to switchboards provide insulated island glands to facilitate testing.

310.100 MICS CABLE TERMINATIONS:
Provide manufacturer's seals incorporating protective conductors at each termination, where glands are used or not, and connect conductors to conduit box, adaptable box or equipment box earth terminals.

310.110 FRAME EARTH LEAKAGE:
Where frame earth leakage devices are used for phase to earth protection, connect two earthing conductors as BS 7430, one to the framework of the switchgear and main earth bar via current transformer or other devices, the other to cable sheaths and earthing devices, insulated where necessary.

W51 – LV Earthing & Bonding

310.120 PORTABLE EARTH CONNECTIONS:
Provide tape loops for the connection of portable earths where appropriate

310.130 CEILING SUPPORTS:
Bond main supports to exposed conductive parts of electrical installation where appropriate (based on risk assessment).
Holes
Drill or punch holes in main supports in positions indicated to receive terminal screws.
Use holes in main supports for terminal screws.
Terminals
Connect bonding conductors to supports through holes with tinned copper cable lugs or tags secured to support with brass screws, washers, nuts and locking device.
Connection
Connect bonding conductors to supplementary bonding conductors in cable trunking:
Using crimp type connectors.
Include ceiling supports in CBN.

310.135 RAISED FLOOR SUPPORTS:
Bond main supports by extraneous conductive parts where appropriate (based on risk assessment).
Holes
Drill or punch holes in mains supports in positions indicated to receive terminal screws.
Use holes in main supports for terminal screws.
Terminals
Connect bonding conductors to supports through holes with tinned copper cable lugs or tags secured to support with brass screws, washers, nuts and locking device.
Connection
Connect bonding conductors to supplementary bonding conductors in cable trunking
Using crimp type connectors
Include floor and floor supports, in accordance with BS EN 50174-2, in
CBN.
MESH-BN

310.140 SAFETY EARTHING:
Provide safety earthing in accordance with BS 6626, and HSE guides INDG 372 & HSG 230

310.150 TELECOMMUNICATIONS FUNCTIONAL EARTH:
Provide functional earth in accordance with BS 6701 and BS EN 50310.
All cables shall be cream and labelled with telecommunication functional earth.

310.210 CONDUCTORS: (Y80 2010)
Use earthing conductor-Minimum dimension to BS 7430, BS EN IEC 62561-2 Table 1
Current density 50A/mm^2.
Form Strip generally or rod.
Stranded conductor where appropriate
Material
Copper
Use Aluminium only where agreed with Contract Administrator
Coverings
Generally none.
Use LS0H or where thermoplastic wiring systems are employed PVC may be used. Colour as indicated where specified
Accessories
Use proprietary cast gun metal accessories, fixings, clamps and couplings with phosphor-bronze bolts, nuts and washers. Use adhesive fixings only when approved by Contract Administrator.

310.220 CONDUCTOR JOINTS: (Y80 2020, 3040)
Provide waterproof protection at joints subject to moisture.
Joint copper tapes by

tinning before assembly and riveting with two minimum copper rivets. Overlap straight joints by length equivalent to twice (minimum) tape width. Overlap both sides of main tape at tee joints or
naval brass bolts or copper rivets (two minimum) and sweat solid whole joint or
Brazing, using zinc-free brazing metal with melting point at least 600ºC or
Thermic welding or
Cold pressure welding.

Joint aluminium tapes by
Welding to BS EN 1011-4

Joint circular rods as tapes using through coupler.

Joint stranded conductors with compression joints to BS EN 61238-1.

For bolted connections use crimp type lugs compressed by automatic tool to achieve correct pressure and crimp depth.

Use phosphor bronze bolts, nuts and washers to make connections between conductors and equipment

310.230 **TAPE FIXING DEVICES:** (Y80 2030)

Standard - BS EN 62561-4 for lighting protection system conductor fasteners.

Secure bare copper tape to structure with corrosion resistant proprietary fixing devices which avoid piercing tape and ensure 3mm (minimum) clearance of tape from structure. Space fixings at 450 mm maximum centres for vertical conductors, 1,000mm for horizontal.

310.240 EARTH ELECTRODES: (Y80 2040A-E)

Standards as appropriate to the particular specification:

BS 7430 and BS 7671 (IET Wiring Regulations).

Relevant parts of BS EN 62305 where a lightning protection system is present.

BS EN IEC 62561-2 for lightning protection earth electrodes

Material, minimum size as BS 7430, BS EN IEC 62561-2

Form /types as described in the scope of works

Rods - use high tensile strength steel cored molecularly bonded copper sheathed rods with threads rolled on to rods. Sheath thickness 0.25mm (minimum).

Rod Diameter - 15 mm – nominal

Building or structural element earth electrodes

Foundation earth electrodes

Earth electrode couplings

Use silicon bronze alloy, counter bored to completely enclose rod threads. Ensure rods meet in centres of coupling.

Use high strength driving cap in contact with driven rod.

Strip.

Stranded conductor.

Plates - Proprietary item.

Earth electrode tape

Interconnect electrodes using bare copper tape or stranded copper cables.

Location

Locate electrodes not less than 2m distant from building/structure protected, and away from telecommunication and pilot cables and metallic fences.

Barriers

Provide permanent non-conducting barriers to BS 7430 at 2m radius around any electrode liable to produce a voltage gradient of more than,

(V/m) as indicated.

Driving

Drive rods vertically into ground with purpose designed electric hammer. (Where impenetrable strata encountered at shallow depth, drive at 30º to horizontal).

Depth of rod

2.4 m (2 x 1.2) minimum below finished ground surface.

Depth of Electrode heads

Locate electrode heads just below ground level.

Spacing

Where electrodes are installed in a group ensure minimum distance between electrodes is twice depth of rods. Where rods for 'clean' earth are installed ensure distance from any other system rods is six times depth of 'clean' rods.

Tape Depth

Install interconnecting or electrode tape 750mm below finished ground level or as ground conditions allow, rising vertically at each electrode.

Connect groups of electrodes to main earth conductor via bolted link in inspection pit as BS 7430 for test purposes.

Earth electrodes in draw pits

Provide concrete cover, permanently labelled, for electrodes installed through cable draw pit bases

Main earth conductor cover tiles

Provide plastic identification tape over complete external lengths of main earth conductors.

Permanent test electrodes

Provide permanently located test electrodes where indicated

General

Ensure that materials and dimensions of earth electrodes have adequate mechanical strength and are selected to withstand corrosion such that the mechanical integrity of the structural element is not impaired, and the possible increase in earth electrode resistance is minimised.

Where an earth electrode consists of parts that must be connected together, ensure connections are made by welding, pressure connectors, clamps or other suitable mechanical connectors.

Ensure earth electrodes intended to minimise touch voltage, to exposed-conductive-parts and extraneous-conductive-parts, in the event of a broken protective earth and neutral (PEN) conductor in the public supply network, are designed with consideration of, as a minimum, the likely loads in the installation, the relevant network conditions, and the design guidance in IET Guidance Note 5: Protection Against Electric Shock.

310.245 SOIL CONDITIONING AGENT (Y80 2040)

Provide soil conditioning agent only where design indicates necessary

Conditioning agent to be suitable for application.

310.250 **EARTH ELECTRODES FOR CATHODICALLY PROTECTED STRUCTURES:** (Y80 2050)

Provide earth electrode for cathodically protected structures to BS EN 13636 for buried metallic tanks and related piping and BS EN 15112 for well casings as indicated.

310.260 EARTH ELECTRODE CLAMPS: (Y80 2060)

Connect conductor to electrode head using heavy duty purpose made silicon aluminium bronze body connector clamps or leaded gunmetal body connector clamps, and high tensile phosphor bronze bolts.

Standard BS EN 12163

310.271 EARTH ELECTRODE INSPECTION FACILITIES: (Y80 2070, 2080)

Provide enclosure for each connection between earth conductor and associated earth electrode system. Install so that top of removable inspection cover is flush with finished ground or floor level. For internal locations where the electrode passes through water retaining structure provide puddle flange and sealing gland to BS EN 62561-5 suitable for anticipated water pressure, to prevent moisture penetration and duct from enclosure to adjacent wall for conductor. Ensure enclosure provides adequate access for testing purposes. Inscribe cover with legend `EARTH'.

Provide pit details for builder's work.

After installation of electrode drain all water from pit.

Use concrete, galvanised steel embedded in concrete or polycarbonate as indicated on drawings. Cover to suitable for anticipated loading and to accept finish, where applicable.

310.272 BUILDING ELEMENTS:

Ensure reinforcing bars are in good electrical contact by welding, unless otherwise indicated on the drawings.

310.310 CIRCUIT PROTECTIVE CONDUCTORS: (Y80 2110)

Material as appropriate

Insulated cable

Use LS0H insulated single core cables or

PVC single core cables (where thermoplastic wiring systems are employed)

XLPE Single core to BS 7211.
Metallic screwed conduits (excluding flexible).
Metallic trunking with tinned copper links.
Armouring and/or metallic sheathing of armoured cables.
Armouring of armoured cables where armouring includes copper strands to improve earth conductance.
Integral conductor of multi-core cable.

Size Provide protective conductors sized in accordance with BS 7671 (IET Regulations) 543.1.4 and Table 54.7 or as indicated.

310.320 EARTHING CLAMPS:
Use clamps complying with BS 951, for bonding pipes and lead sheathed cables.

310.340 TEST LINKS: (Y80 2140)
Provide two test links, in connections between main earth conductors and earth busbar. Fabricate each from two additional sections of earth busbar. Mount one section on stand-off insulators matching earth busbar; use remaining section as removable test link. Secure 12mm high tensile brass studs to fixed sections of busbar and drill corresponding clearance holes in test links and provide brass washers, nuts and locking devices to secure frame/neutral earthing and test links.

310.350 LUGS/TAGS: (Y80 2150)
Provide lugs or tags to enable connection of bonding conductors to equipment earth terminals.

310.361 PROTECTIVE CABLE TERMINATIONS: (Y80 2160, 3030 and 3040)
For bolted connections use crimp type lugs compressed by automatic tool to achieve correct pressure and crimp depth.
Make connections between tape and equipment using high tensile grade brass bolts with brass nuts, washers and locking devices or phosphor bronze bolts, nuts and washers where connections are liable to corrosion.
Provide waterproof protection at joints subject to moisture. Joint stranded conductors with compression joints to BS EN 61238.

310.380 MAIN EARTH CONDUCTOR – WARNING TAPES: (Y80 2180)
Provide green/yellow PVC tapes labelled "EARTHING CONDUCTOR" over complete external lengths of main earth conductors at 300mm depth below finished ground.

320.000 WORKMANSHIP

320.010 INSTALLATION OF EARTHING SYSTEM:
Carry out installation of earthing system in accordance with BS 7671 (IEE Regulations), BS 7430 and BS EN 50310.

320.015 DISSIMILAR METALS: (Y80 3020)
Ensure, where dissimilar metals are used for system, that purpose made jointing materials are used such that corrosion and deterioration of the electrical connection are not caused. Ensure bonding connections to other metal parts of building are electrolytically compatible with those metal parts. Use the following guidance when earthing and bonding connections comprise dissimilar materials.
BS 7430 Table 9.
BS EN 62368-1 Annex N.

320.020 WORK ON SITE:
Ensure that all building works are completed and service connections are provided,

320.030 QUALITY CONTROL:
Handle, store and install all equipment and components of the earthing system in accordance with the manufacturers recommendations.
Inspect all equipment and components on delivery, before fixing and after installation and reject and replace any which are defective.
Test and commission the system in accordance with BS 7430, BS 7671 and BS EN 50310 and as specified elsewhere in the scope of works. Record all test measurements.

320.040 MAIN AND SUPPLEMENTARY PROTECTIVE BONDING:
Bond to main earth terminal all extraneous-conductive-parts of the installation in accordance with BS 7430, BS 7671, BS EN 50310 and relevant parts of BS EN 50174, and BS EN 62305 as appropriate.
Ensure that any of the following services are bonded for each building or equipotential zone:-
Water installation pipes.
Gas installation pipes.
Fuel oil installation pipes.
Air ductlines.
Heating pipework.
Chilled water pipework.
Exposed metallic structural parts of the building.
Lightning protection systems
The metallic sheath of telecommunications cables entering the building.
Connection of the lightning protection system to the protective equipotential bonding system shall be made in accordance with BS EN 62305.
The consent of the owner / operator of telecommunications services shall be obtained prior to making connections to metallic sheaths of cables.
In locations that supplementary equipotential bonding is specified bond all simultaneously-accessible exposed-conductive-parts of fixed equipment and extraneous-conductive-parts in accordance with BS 7671 as applicable.
Bond bathrooms and shower rooms to BS 7671, Section 701.
Extraneous-conductive-parts may be used as supplementary bonding conductors where they satisfy BS 7671
Bond to non-current carrying parts of electrical installation in associated spaces to BS 7430.
Use strip or stranded conductor as appropriate.
Use clamps to BS 951 for bonding of pipes.

320.060 LOW VOLTAGE SHEATHS AND ARMOUR:
Bond the sheaths and armour of low voltage cables solidly to earth at both ends unless otherwise indicated in accordance with BS 7671 and BS 7430.

320.070 METALLIC FENCING:
Bond to earth any metallic fencing enclosing earth electrical system in accordance with BS 7430.

320.080 IDENTIFICATION: (includes Y80 2170 and Y80 2190)
Ensure the function of each protective and functional earthing and bonding conductor is identifiable at its termination points.
Use an appropriate cable marking system, to mark conductors in accordance with the cable schedule.
For circuit protective conductors:
Use numbered and/or lettered plastic cable sleeves to indicate circuit numbers and phases of corresponding phase conductors.
Ensure conductors are connected to earth bar in same sequence as phase and neutral conductors.

Identify at substation, switchboard and building earth bars each protective, bonding and earthing conductor to appropriately identify the function of the conductor.
Label earth bar "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE" with wall mounted laminated plastic tablet engraved in 10mm high red letters on white ground.
Provide a permanent label durably marked in letters 4.75mm minimum height "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE", in visible position, at each bonding conductor connection to extraneous conductive parts.

320.090 GENERATORS:
Provide separate earth electrode system, completely independent of supply earth system where incoming supply is not derived from Consumer's own transformers.
Connect star point of generator to earth electrode system as generator manufacturer's recommendations and to BS 7430.
Bond generator star point and metal framework to Local Electricity Supply Company earthing point.

320.100 EARTHING OF MOBILE GENERATOR:

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Bond the generator frame, all exposed metalwork, underframe or chassis and all protective conductors, to BS 7430, to form common reference point. Connect generator star point to this common reference. Provide a separate connection from this reference to the load by a fifth cable core or separate single cable.

320.110 EARTHING OF LV/LV TRANSFORMERS:
Earth transformers in accordance with BS 7671 and BS 7430.
Connect the neutral of the LV/LV transformer to one point only. Use the transformer star point if the system is 3-phase. Earth neutral as detailed in the scope of works or on the drawings

320.120 EARTHING OF MOBILE UNITS OR TRANSPORTABLE PLANT:
Install earthing of mobile or transportable units to BS 7671, Section 717 and BS 7430.
Comply with manufacturer's instructions, and BS 7430, for the earthing of mobile and transportable units with on-board generators, including static inverters.
Earth the source via a liquid resistor to limit the rise in potential of the plant to 50V under earth fault conditions. Use screen and armour of trailing and fixed cables as earth path from plant to source. Ensure all cabling and switchgear is suitable for impedance - earthed systems.

320.130 EARTHING OF CONSTRUCTION SITE ELECTRICAL SYSTEMS:
Earth construction site electrical systems to BS 7430, BS 4363 and BS 7375 and BS 7671 Section 704.

320.140 EARTHING OF CARAVAN PARK ELECTRICAL SYSTEMS:
On appropriate projects, install earthing of caravan park electrical systems to BS 7671, Section 708. Do not extend a PME or TN-C-S system to a caravan supply socket outlet.
For caravans supplied by a TN-S system use high integrity circuit protective conductors for the supply to caravan supply socket outlet.
High Integrity CPC type - Duplicated

320.150 EARTHING OF MARINA ELECTRICAL SYSTEMS:
On appropriate projects, install earthing of marina electrical systems to BS 7671, Section 709. Ensure all conductors subject to tidal and wave movement are arranged and of materials to avoid the deleterious effects of that movement. Do not extend a PME or TN-C-S system to a boat supply socket outlet. Do not use any aluminium or mineral insulated metallic clad cables as protective conductors. Use no joints in protective conductors except at properly protected enclosures. Bond all metalwork on pontoons or landings which may come into contact with the electrical system to the system protective conductor. Provide fuelling point bonding conductors and connection to the system protective conductor so that boats may be bonded before a fuel connection is made, and disconnected after the fuel connection is broken.

320.155 EARTHING OF ELECTRICAL SYSTEMS FOR ONSHORE UNITS OF ELECTRICAL SHORE CONNECTIONS FOR INLAND NAVIGATION VESSELS:
On appropriate projects, install earthing of systems for onshore units of electrical shore connections for inland navigation vessels to BS 7671 (IET Wiring Regulations), Section 730. Ensure all conductors subject to movement on floating landing stages are arranged and of materials to avoid the deleterious effects of movement on the landing stage. Do not extend a PME or TN-C-S system earthing terminal to a vessel supply socket outlet. Do not use any aluminium or mineral insulated metallic clad cables as protective conductors. Use no joints in protective conductors except at properly protected enclosures. Bond all metalwork on pontoons or landings which may come into contact with the electrical system to the system protective conductor. Provide fuelling point bonding conductors and connection to the system protective conductor so that vessels may be bonded before a fuel connection is broken.
Where a fixed onshore isolating transformer is used to prevent galvanic currents circulating between the hull of the vessel and conductive parts on the shore, ensure the protective conductor of the circuit supplying the transformer is not connected to the protective conductor of the secondary.

320.160 EARTHING OF ELECTRICALLY SUPPLIED STREET FURNITURE:
Install earthing to street furniture in accordance with BS 7671 (IET Wiring Regulations) and BS 7473.
TN-S systems

Use cable with separate phase neutral and protective conductors to supply street furniture.

Ensure on the load side of the protective device separate phase, neutral and protective conductors are used.

Bond conductive parts of the street furniture to the earthing terminal within the equipment. Connect the street furniture incoming supply protective conductor to the same earthing terminal.

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TN-C-S / PME systems

Comply with the latest version of Energy Networks Association (ENA) Engineering Recommendation G12 "Requirements for the Application of Protective Multiple Earthing to Low Voltage Networks".

Use cables with separate neutral and earth for private installations, and where specified for local authority installations.

Ensure use of combined neutral and earth cables is limited to street lighting and road signs rated 500 W or less, supplied by a distribution network operator or where specified for a street lighting authority.

Do not bond small items not likely to come into contact with exposed or extraneous conductive parts or earth.

On circuits feeding more than one item of street furniture, provide an earth electrode of 20ohm or less resistance at the last or penultimate item of furniture on the circuit.

Where an electrode resistance of 20 ohm cannot be achieved, provide earth electrodes at each item of furniture.

Where the supplier's earth terminal is not used or TT systems

Install a protective earth electrode system at the source of supply in accordance with BS 7430 and BS 7671 (IET Wiring Regulations).
Use cable with separate phase neutral and protective conductors to supply the street furniture, with the protective conductor connected to the earth electrode. Ensure on the load side of the protective device separate phase, neutral and protective are used.
Bond conductive parts of the street furniture to the earthing terminal within the equipment. Connect the street furniture incoming supply protective conductor to the same earthing terminal.

320.170 EARTHING OF ELECTRICAL SYSTEMS IN HAZARDOUS AREAS:
Install earthing of electrical systems in hazardous areas to BS 7671 (IET Wiring Regulations), BS 7430 and relevant parts of BS EN IEC 60079 / BS EN 60079.

Use the recommendations in APEA Design, Construction and Modification, Maintenance and Decommissioning of Filling Stations (4th edition), at petrol filling stations.
Use the recommendations in APEA Design, Construction and Modification, Maintenance and Decommissioning of Filling Stations (4th edition,) in hazardous areas.

320.180 OVERHEAD LINE EARTHING:
Earth overhead line plant in accordance with BS 7430 and the Electrical Safety, Quality and Continuity Regulations 2002. Do not earth or bond insulator steelwork unless so directed.

320.190 EARTHING OF PHOTOVOLTAIC (PV) SYSTEMS:
Earth PV electrical systems to BS 7671, Section 712.

320.200 EARTHING OF MEDICAL LOCATION SYSTEMS:
Earth medical location electrical systems to BS 7671, Section 710 and HTM 06-01.
Ensure supplementary bonding systems for medical locations:
Maintain a voltage between simultaneously accessible exposed-conductive-parts (including earth contacts of socket-outlets and equipotential bonding connection points) and/or extraneous-conductive-parts under all conditions, including faults, of less than: AC 25 V or DC 60 V.
Have a maximum resistance between simultaneously accessible exposed-conductive-parts (including earth contacts of socket-outlets and equipotential bonding points) and/or extraneous-conductive-parts that does not exceed 0.2 Ω

W52 – Lightning and Surge Protection

Incorporates Y80

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide systems for the protection of buildings, structures, towers, exposed metal work and any projection above the general roof level from lightning.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO W52

300.000 GENERAL

300.010 STANDARDS:
Provide risk assessments in accordance with relevant part of BS EN 62305, state the results for Human Life, Services to the Public, Cultural Heritage and Economic Values where applicable.
Provide an external lightning protection system (LPS) in accordance with the risk assessment results and BS EN 62305 and BS 7671 (IET Wiring Regulations).
Provide an internal lighting and surge protection system (LSPS) in accordance with the risk assessment results and BS EN 62305 and BS 7671 (IET Wiring Regulations).
Provide lightning protection connection components complying with BS EN 62561-1, BS EN 62561-2 and BS EN 62561-3. Surge protection to achieve an Installation Overvoltage Category of CAT II or CAT I as appropriate to the connected equipment, in accordance with BS 7671 (IET Wiring Regulations) and BS EN 62305-3.
Provide lightning protection earthing enhancing components complying with BS EN 62561-7.
Provide lightning protection system for churches in accordance with the recommendations of the English Heritage and Ecclesiastical Insurance Group, Lightning Protection for Churches.
In health care premises comply with HTM and HBN requirements, and CIBSE Guide K.
Provide earth soil electrical resistivity test results using a recommended method in BS 7430.
Surge protection to achieve an Installation Overvoltage Category of CAT II or CAT I as appropriate to the connected equipment, in accordance with BS 7671 (IET Wiring Regulations) and BS EN 62305-3.

300.020 USE OF BUILDING ELEMENTS:
Ensure that building and structural elements used as items in or bonded to the lightning protection system are designed and erected in accordance with BS EN 62305 as well as their appropriate constructional specification or code of practice. Ensure that all connections to building and structural elements are waterproof and corrosion protected to a degree appropriate to their exposure. Use BS EN 62305-3 Annex E as a code of practice for the design and construction of the LPS.
Where building structural and/or foundation steelwork are to be used as lightning current conduction paths, the electrical continuity, EMC separation distance and cross-section area of the element shall meet the requirements of BS EN 62305.

300.030 LIGHTNING AND SURGE PROTECTION SPECIALIST:
Engage a specialist to carry out the design, installation, testing and commissioning of the lightning and surge protection system (LSPS). Refer to scope of work for detail requirements.

300.040 APPROVALS:
Where applicable obtain the approval of all authorities concerned for the installation of the lightning and surge protection system. Comply with the regulations of all concerned authorities for the installation and connection of public utility services to a common earth termination network, comply with agreements made with bodies concerned with adequate separation distance from other services connected to a common earth termination network.

300.050 REGULATIONS AND AGREEMENTS
Comply with the regulations of all concerned authorities for the installation and connection of public utility services to a common earth termination network, comply with agreements made with bodies concerned with adequate separation distance from other services connected to a common earth termination network.
For telecommunication services comply with relevant part of BS EN 50174

300.060 EARTHED EQUIPOTENTIAL BONDING OF SERVICES:
Provide Earthed Equipotential bond for relevant metallic services in or on the structures in accordance with BS 7671 and BS EN 62305-1, BS EN 62305-3 and as indicated in the Schedules and Drawings.

W52 – Lightning and Surge Protection

300.070 PROTECTION OF ELECTRONIC EQUIPMENT:
Protect electronic equipment against lightning induced EMC and over-voltage surges in accordance with BS 7671 and relevant parts of BS EN 62305.

300.110 EXISTING INSTALLATIONS:
Check soil resistivity and earth electrode resistance of existing installation. Report defects and elements not in accordance with BS EN 62305 before connecting new or modified installations.

310.000 PRODUCTS/MATERIALS

310.001 MATERIALS GENERALLY:
Use materials and installation methods in accordance with BS EN 62305, BS 7671, and BS 7430.

Conductors shall be annealed copper strip (unless specified otherwise) or hard drawn copper rod, unless specified otherwise.

310.005 AIR TERMINATIONS: (Y80.2010A)
Standard BS EN IEC 62561-2 (other than natural conductors)
Horizontal or self-supporting air terminations, material, type (strip or rod) and covering as indicated on drawings.
Where appropriate use building elements (natural conductors) as part of the air termination in accordance with BS EN 62305-1, BS EN 62305-3, and BS EN 62305-4.

310.006 DOWN CONDUCTORS:
Standard BS EN IEC 62561-2 (other than natural conductors)
Materials as indicated on drawings.
Where appropriate use building elements (natural conductors) as down conductors, main terminations in accordance with BS EN 62305-1, BS EN 62305-3, with non-ferrous bonding points built as Figure E.7 for reinforcing bars.
Ensure reinforcing bars are in good electrical contact by welding, unless otherwise indicated on the drawings.

310.007 TAPE FIXING DEVICES: (Y80.2030A)
Standard BS EN 62561-4 for lighting protection system conductor fasteners.
Secure lightning protection tape to structure with corrosion resistant proprietary fixing devices which avoid piercing tape and ensure 3mm (minimum) clearance of tape from structure.
Space fixing 450 mm max on vertical conductors, 1,000 mm horizontally.
Material for lightning protection systems - non-conducting.
Material for system earthing - bronze

310.008 CONDUCTOR JOINTS: (Y80.2020, 3030, 3040)
Standard BS EN 62561-1
Provide waterproof protection at joints subject to moisture.
Joint copper tapes by
tinning before assembly and riveting with two minimum copper rivets. Overlap straight joints by length equivalent to twice (minimum) tape width. Overlap both sides of main tape at tee joints or naval brass bolts or copper rivets (two minimum) and sweat solid whole joint or
Brazing, using zinc-free brazing metal with melting point at least 600ºC or
Thermic welding or Cold pressure welding.
Dimensions - To BS EN IEC 62561-2 minimum for lightning protection system
Joint aluminium tapes by
Welding to BS EN 1011-4.
Joint circular rods as tapes using through coupler.
Joint stranded conductors with compression joints to BS EN 61238.
For bolted connections use crimp type lugs compressed by automatic tool to achieve correct pressure and crimp depth.
Use phosphor bronze bolts, nuts and washers to make connections between conductors and equipment.

310.011 TEST JOINTS: (Y80.2020)
Standards - BS 7671, BS EN 62561-1, relevant parts of BS EN 62305

Provide test joint at each down conductor readily accessible from ground level.
Use proprietary components of cast gun-metal with phosphor-bronze bolts, nuts and washers.

310.012 EARTH ELECTRODES: (Y80 2040)
Standards - BS 7430, relevant parts of BS EN 62305, BS EN IEC 62561-2 and BS 7671 (IET Wiring Regulations) as appropriate to the particular specification. Form - Roll threaded rod.
Earth electrodes in draw pits
Provide concrete cover, permanently labeled, for electrodes installed through cable drawpit bases.
Material, minimum size as BS EN 62561-2
Molecularly bonded copper clad steel rods to BS EN IEC 62561-2.
Accessories
Rod to tape clamp or U-bolt clamp. Accessories sized to suit earth rod and connector.
Rods
Use high tensile strength steel cored molecularly bonded copper sheathed rods to BS EN 62561-2 with threads rolled on to rods. Sheath thickness 0.25mm (minimum).
Rod Diameter 15 mm - nominal.
Earth electrode couplings
Use silicon bronze alloy, counter bored to completely enclose rod threads. Ensure rods meet in centres of coupling.
Use high strength driving cap in contact with driven rod and couplings of compatible material fully enclosing the rod threads.
Earth electrode tape
Interconnect electrodes using 25x3mm bare copper tape or stranded copper cables.
Location
Locate electrodes not more than 2m distant from building/structure protected, and away from telecommunication and pilot cables and metallic fences.
Locate electrodes as indicated on drawings.
Driving
Drive rods vertically into ground with purpose designed electric hammer. (Where impenetrable strata encountered at shallow depth, drive at 30° to horizontal).
Depth of rod 2.4m (2 x 1.2) minimum below finished ground surface.
Depth of Electrode heads
Locate electrode heads just below ground level.
Spacing
Where electrodes are installed in a group ensure minimum distance between electrodes is twice depth of rods. Where rods for 'clean' earth are installed ensure distance from any other system rods is six times depth of 'clean' rods.
Tape Depth
Install interconnecting tape 750mm below finished ground level, rising vertically at each electrode unless ground conditions dictate otherwise.
General
Ensure that materials and dimensions of earth electrodes have adequate mechanical strength and are selected to withstand corrosion such that the mechanical integrity of the structural element is not impaired, and the possible increase in earth electrode resistance is minimised.
Where an earth electrode consists of parts that must be connected together, ensure connections are made by welding, pressure connectors, clamps or other suitable mechanical connectors.
Ensure earth electrodes intended to minimise touch voltage, to exposed-conductive-parts and extraneous-conductive-parts, in the event of a broken protective earth and neutral (PEN) conductor in the public supply network, are designed with consideration of, as a minimum, the likely loads in the installation, the relevant network conditions, and the design guidance in IET Guidance Note 5: Protection Against Electric Shock.

310.013 EARTH ELECTRODE CLAMPS: (Y80 2060)
Connect tape to electrode head using heavy duty purpose made silicon aluminium bronze body connector clamps or leaded gunmetal body connector clamps, and high tensile phosphor bronze bolts to BS EN 12163.

310.014 EARTH ELECTRODE INSPECTION FACILITIES: (Y80 2070, 2080)
Standard BS EN 62561-5
Provide enclosure for each connection between down conductor and earth electrode. Install so that top of removable inspection cover is flush with finished ground level. For internal locations where the electrode passes

through water retaining structure provide puddle flange and sealing gland to BS EN 62561-5 suitable for anticipated water pressure, to prevent moisture penetration and duct from enclosure to adjacent wall for conductor. Ensure enclosure provides adequate access for testing purposes. Inscribe cover with legend `Lightning Protection Earth'
Provide pit details for builder's work.
After installation of electrode drain all water from pit.
Use concrete, galvanised steel embedded in concrete or polycarbonate as indicated on drawings. Cover to suitable for anticipated loading and to accept finish, where applicable.

310.015 SOIL CONDITIONING AGENT (Y80 2040)
Provide soil conditioning agent only where design indicates necessary.
Conditioning agent to be suitable for application.

310.021 BUILDING ELEMENTS:
Use building elements as natural conductors in accordance with BS 7671 and BS EN 62305-3 using Annex E as a code of practice for design, construction and test.
Ensure reinforcing bars are in good electrical contact by welding, unless otherwise indicated on the drawings.

310.031 LIGHTNING PROTECTION SYSTEM BONDS:
Standard BS EN 62561-1
Provide bonds between lightning protection conductors and building elements, exposed structural steelwork, and external plant using corrosion resistant proprietary components and fixings.

310.041 DECORATIVE FINIALS:
Provide proprietary solid copper air terminals with cast gun-metal terminal base or purpose made finial as drawings.

310.051 SURGE PROTECTION DEVICES:
Standard BS EN 62305.
Enclosure protection BS EN 60529, IP31 for internal applications and IP54 externally.
Protect equipment against the risk of permanent failures or damage due to surges by considering the withstand voltage Uw as defined by BS EN 60664-1 (see BS 7671 Table 443.2)
Standard - PD IEC/PAS 60099-7, DD CLC/TS 50539-22 and BS EN 61643-11.
Selection method DD C LC/TS 50539-22, DD CLC/TS 61643-12.
Select SPD type and association protective devices in accordance with BS 7671 (IET Wiring Regulations)
Refer to scope of works for – System earthing type, location category, system exposure, transient performance, passive state performance and other details.
Classification of SPD to DD CLC/TS 50539-22, BS EN 61643-11

320.000 WORKMANSHIP

320.010 INSTALLATION:
Install the lightning and where applicable the surge protection system and its element in accordance with the manufacturers recommendations and BS EN 62305, BS 7671 (IET Wiring Regulations) and the earthing and bonding elements to BS 7671 and BS 7430.
In churches install in accordance with recommendations in the English Heritage and Ecclesiastical Insurance Group, Lightning Protection for Churches.
For healthcare premises also comply with the recommendations given in the HTM and HBN documents, and CIBSE Guide K.

320.016 DISSIMILAR METALS: (Y80.3020)
Ensure, where dissimilar metals are used for system, that purpose made jointing materials are used such that corrosion and deterioration of the electrical connection are not caused. Ensure bonding connections to other metal parts of building are electrolytically compatible with those metal parts. Use the guidance given in BS 7430 Table 9 and BS EN 62368-1 Annex N when bonding dissimilar materials.

320.020 WORK ON SITE:
Ensure that all building works are completed and service connections are provided.

320.030 QUALITY CONTROL:

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Handle, store and install all equipment and components of the lightning protection system in accordance with the manufacturers' recommendations and BS EN 62305, BS 7430, BS 7671 and appropriate parts of BS EN 62561.
Inspect all equipment and components on delivery, before fixing and after installation and reject and replace any which are defective.
Test and commission the system in accordance with BS EN 62305 BS 7430, BS 7671 and as specified. Record all test measurements.

320.040 EARTHED EQUIPOTENTIAL BONDING:
Bond or isolate building structural elements and metallic services as BS EN 62305, BS 7430 and BS 7671.
Refer to scope of works and drawings for further details.

320.050 LABELLING:
Provide and fix system labels as required by BS EN 62305, BS 7671, BS 7430 and relevant parts of BS EN 50174 (IT cabling installation).

320.055 SURGE PROTECTION DEVICES:
Install surge protection devices in accordance with BS 7671, BS EN 50174, DD CLC/TS 50539-22 and BS EN 61643-11 and the manufacturer's recommendations.

320.056 RESIDUAL CURRENT DEVICES:
Install residual current devices suitably coordinated with surge protection devices in accordance with BS 7671, BS EN 50174, DD CLC/TS 50539-22 and BS EN 616143-11 and the manufacturer's recommendations to avoid nuisance tripping.

320.060 INSTALLATION RECORDS:
Prepare system records to BS EN 62305, BS EN 50174 and BS 7430 including the following items:
As installed drawings detailing:-
Nature of soil
Earth resistivity measurement.
Earth electrode resistance.
Details of earth electrodes and lightning earth termination network

320.070 MAINTENANCE:
The Lightning and surge protection system (LSPS) shall be designed and installed with ease of carrying out maintenance - test points and access to lightning and earthing elements should be provided.
Carry out maintenance as required by BS EN 62305 for the defects liability period and provide proposal for continuing maintenance

W56 – HV Earthing & Bonding

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide systems for the transfer of electric current to earth, to protect personnel, buildings, structure, plant and equipment in the case of an electrical fault within the supply system and from interference from electro-magnetic fields and electro-static forces.

The system shall be compliant with all Department of Health (NHS Estates) documentation including, but not limited to HTM's and HBN's pertinent to the nature of this project. In particular, compliance with BS EN 50522, BS 7430, BS 7671, HTM 06-01, HTM 06-02 and HTM 06-03 is required.

100.021 DESIGN PARAMETERS:
Consider the appropriate standards HTM 06-01, HTM 06-02 and HTM 06-03, BS EN 61936-1 and BS EN 50522.
Provide an earthing and bonding system which ALARP (As low as reasonably practicable) eliminates the risk of electrical shock (including micro-shock) from the electrical system internal or external HV sources under all conditions.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO W56

300.000 GENERAL

300.010 STANDARDS:
Carry out the design, installation, inspection and testing of an HV earthing and bonding system for the electrical installation in accordance with Electricity, Safety, Quality and Continuity Regulations 2002, Electricity at Work Regulations 1989, BS 7671, BS 7430 and BS EN 50522, BS EN 61936-1 and local Distribution Network Operator (DNO) requirements.
Confirm with the DNO that, in the event of a fault in the high voltage network, the resulting transfer Earth Potential Rise (EPR) to the client's electrical installation can be achieved at a safe level. If the safe level cannot be met, control measures should be provided to eliminate risk of injury.
Ensure the potential rise in telecommunications circuits due to power system earth faults is limited, as per BS 6701
For requirements of separate low voltage electrical installation earthing, see W51.
For running separate HV earth cables alongside information technology and telecommunication circuits, the requirements of BS EN 50174-1, BS EN 50174-2 or BS EN 50174-3 and BS EN 50310 shall apply.
Ensuring that the integrity of the structural steel works of the establishment will not be subject to any detrimental influences by any stray DC current flowing in the earthing and bonding system or suitable measures have been taken to avoid it.

300.034 USE OF BUILDING ELEMENTS:
Ensure that all connections to building and structural elements are waterproof and corrosion protected to a degree appropriate to their exposure. A risk assessment on detrimental influence in weather and corrosion protection would be required.

300.040 EXISTING INSTALLATIONS:
Check and verify EPR (earth potential rise), earth continuity conductors and loop impedance values of existing installation. Report defects and elements not in accordance with BS EN 50522, BS 7430 and BS 7671 before connecting new or modified installations to existing supply or a new supply.

300.050 SOIL TESTS:
Carry out soil tests in accordance with BS 1377 to establish the following soil characteristics

- pH.
- Redox potential (V).
- Moisture content (%).
- Dissolved salts
- Chloride.
- Organic acids.

Apply one or more acceptable industry practice testing method to carry out soil resistivity tests in accordance with the requirements of BS 7430.

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Obtain a multilayer soil model.

300.060 RISE IN POTENTIAL IN TELECOMMUNICATIONS:
Ensure the potential rise in telecommunications circuits due to power system earth faults is limited, as BS 6701

300.070 EXCHANGE OF INFORMATION:
Consult with the local DNO regarding the HV earthing arrangements of the installation. Construct the earthing system to satisfy the safety criteria of BS EN 50522. Ensure any part of the earth fault current path provided by the DNO or others is suitable for the operation of the earth fault protection to be installed. Obtain the agreement and permission of undertakings providing services which are to be bonded to the earthing system.

300.100 SURGE PROTECTION:
Protect surge protection in accordance with BS EN 61936-1 as necessary.

310.000 PRODUCTS/MATERIALS

310.020 MAIN EARTH TERMINAL:
Provide an adequately sized earth bar at incoming electrical service position, for each switchboard.
Bond earth terminals and metallic structure of switch and control gear and plant.
Connect each earth terminal to all other earth terminals by a conductor sized as BS EN 50522, BS 7430 and BS 7671.
Location · Adjacent to main HV switch panel or as indicated on drawings.
Mounting
Mount earth bar on insulated supports located at 300mm centres for 25mm bar and 450mm centres for 50mm bar, giving 30mm clearance at rear of bar.
Drill clearance holes, one for each cable plus 30% spare holes (2 minimum) at 50mm minimum centres through bar for connection of cable lugs. Ensure clearance holes are minimum necessary size to maintain adequate lug/bar contact.
Size the main earth bar in accordance with the stated BS and BS EN standards.

310.030 MAIN EARTH TERMINAL CONNECTIONS:
Connect main earth conductors and main equipotential bonding conductors to main earth terminals.
Terminate circuit protective conductors on switchboard earthing bar.
Terminate conductors with
Compression type lugs suitable for bolting direct to bar.
Extend protective conductor from incoming main cable gland direct to main earth terminal.
Extend separate protective conductor from main earth terminal to main switch/switch panel served by incoming main cable.
When the mains supply cable is provided by the DNO, extend separate protective conductor from Mains Supply Cable armouring gland or direct earth terminals.
Bond all main equipment and plant to an earth terminal, connected to the bonding ring or radial conductor(s).
Where appropriate, provide torque record of the bonding connections.

310.040 SUBSTATION EARTH BAR:
Mounting - Mount earth bar on insulated supports located at 300mm centres for 25mm bar and 450mm centres for 50mm bar, giving 50mm clearance at rear of bar.
Insulators - Mount busbar on stand-off porcelain insulators securely fixed to wall or Impact resistant moulded plastic.
Terminations -Connect each conductor and tape separately and allow spare holes (minimum 2) for future connections.

310.050 SUBSTATION MAIN EARTH BUSBAR TERMINATIONS:
Provide terminations on busbar for each substation main earth conductor and:
HV switchgear frame earth (bare copper tape).
Transformer frame earths (bare copper tape).
Transformer neutral earths (insulated copper cable).
Earthing conductor to minimum 2 groups of electrodes.
Future cable/tape terminations
25% of above terminations subject to four minimum.

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310.060 REF AND CT NEUTRAL/EARTH CONNECTION:
Where appropriate, provide residual earth leakage (REF) protection system and position neutral/earth current transformer connection.

310.080 TRANSFORMER OR GENERATOR HV EARTH ELECTRODE SYSTEMS:
Provide an HV earth grid/electrode system, with a low earth resistance value to restrict the EPR and Touch Voltage to a safe level. Connect separate main earthing conductors for earthing HV-LV transformer or HV generator, and an additional spare electrode system for test purposes. Bond all electrode systems together using a ring conductor. Connect electrode systems to the ring conductor via links or disconnecting joints for test purposes.
Where a common HV/LV earthing system is provided, the combined earthing system shall ensure the stress voltage and touch voltage requirements of BS EN 61936-1, BS EN 50522 (including National Annex NA.2) and BS 7671 are met in respect of the earthing arrangement(s) of LV system(s) to be supplied.

310.090 INSULATED ISLAND GLANDS:
On cables to switchboards provide insulated island glands to facilitate testing.
On cables to prevent EPR to be transferred to or from the DNO.
The contractor should provide the maximum induced voltage in the cable

310.110 FRAME EARTH LEAKAGE:
Where frame earth leakage devices are used for phase to earth protection, connect 2 earthing conductors as per BS 7430, one to the framework of the switchgear and main earth bar via current transformer or other devices, the other to cable sheaths and earthing devices, insulated where necessary.

310.120 PORTABLE EARTH CONNECTIONS:
Provide tape loops for the connection of portable earths

310.140 SAFETY EARTHING:
Provide safety earthing in accordance with BS 6626 and HSE guides INDG 372 & HSG 230.

320.000 WORKMANSHIP

320.010 INSTALLATION OF EARTHING SYSTEM:
Carry out installation of earthing system in accordance with BS EN 50522 and BS 7430.

320.030 QUALITY CONTROL:
Handle, store and install all equipment and components of the earthing (and if appropriate, lightning protection) system in accordance with the manufacturer's recommendations and;
BS 7430
BS 7671
BS EN 61936-1
BS EN 50522
BS EN 60325
Inspect all equipment and components on delivery, before fixing and after installation and reject and replace any which are defective.
Test and commission the system in accordance with BS 7671, BS EN 50522, BS 7430 and BS EN 60325 as specified.
Record all test measurements.

320.050 HIGH VOLTAGE CABLE SHEATHS AND ARMOUR:
Bond the sheaths and armour of high voltage cables solidly to earth
3 core cable - at both ends.

320.070 METALLIC FENCING:
Bond to earth any metallic fencing enclosing earth electrical earthing system in accordance with BS EN 50522 and BS 7430.

320.080 IDENTIFICATION:

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Use numbered and/or lettered plastic cable sleeves to indicate circuit numbers and phases of corresponding phase conductors.
Ensure conductors are connected to earth bar in same sequence as phase and neutral conductors.
Identify at substation, switchboard and building earth bars each protective, bonding and earthing conductor. Provide labels on bars adjacent to each conductor.

320.090 GENERATORS:
Provide separate earth electrode system, completely independent of supply earth system where incoming supply is not derived from consumer's own transformers.
Connect star point of generator to earth electrode system as generator manufacturers recommendations to BS EN 50522 and BS 7430.
Bond generator star point and metal framework to local DNO earthing point with means of disconnection for testing purposes.
Size of earthing and bonding leads as indicated elsewhere in this specification

320.100 EARTHING OF MOBILE GENERATOR:
Bond the generator frame, all exposed metalwork, underframe or chassis and all protective conductors, to BS EN 50522 and BS 7430, to the earth system to form common reference point. Connect generator star point to this common reference. Provide a separate connection from this reference to the load by an integral cable core, or metallic armour, or separate single cable.

320.110 HIGH VOLTAGE SYSTEM EARTHING:
Install HV system earthing to BS EN 50522 and BS 7430. Connect all exposed conductive parts of system to earth via protective conductors. Provide earth fault relay to detect currents of 10% - 15% of full load current.
Provide earth loop impedance path by earthing and bonding to achieve operation of the earth fault relay at this current. Ensure extraneous conductive parts of the system are in direct contact with all simultaneous accessible conductive parts, if necessary by bonding or connection to the common steelwork structure. Connect the neutral of the MV system to one point only. Use the generator or supply transformer star point. Earth neutral as described in scope of works.
Use the resistor or reactor as necessary to limit fault current to not more than 1.5 times the full load current of the largest unit in the system (for 5s or 10s as necessary). Ensure if direct earthing is used the earth fault current is of the order necessary to operate the protective devices and does not produce unacceptable electromagnetic stresses. For delta connected sources use an earthing transformer between the phases and earth. For multiple power sources use switchgear to ensure single point earthing under all operating conditions.

W60 – Central Control / Building Management System

PART 1 SYSTEM OBJECTIVES

This work section is derived from the BSRIA Standard Specification for BMS – Application Guide AG 9/2001. It must be read in conjunction with all the appropriate work sections, schedules, **controls drawings** and Y reference specifications. Particular attention should be made to A 37 for Operation and Maintenance Manuals / training requirements and to Y51 for Commissioning and handover requirements.
Refer to Y60 for conduit and cable trunking
Refer to Y61 for cables and wiring
Refer to Y63 for support components – cables
Refer to Y71 for switchgear and distribution boards
Refer to Y72 for contactors starters and drives
Refer to Y92 for motors
Refer to W51 for LV earthing and bonding

Controls drawings
The Controls tender drawings show schematic details of all main plant items and associated control components. They indicate the conceptual arrangement of the plant with each item identified together with a description of the controls operation and details of the associated interlocking. Where terminal units are included on the controls diagrams they show the "typical" control requirements for each unit. The Controls Specialist shall establish actual quantities of terminal units and associated control components from the detail design drawings and/or equipment schedules before production of Controls Logic diagrams as defined in work section A31 or A64 or A64D of this specification.

100.011 PERFORMANCE OBJECTIVES:
To provide a control system for the operation of services and equipment, the collection of information on operational settings and status, and where appropriate, process data for the management and operation of the building.

To provide all power wiring and containment to mechanical plant from main distribution boards or MCC's, all power wiring and containment to lighting in packaged mechanical plant such as air handling units, all control wiring / containment (including local controls serving plant not controlled by the BMS – eg local extract fans) and all interlocks between plant and safety systems including automatic shut off valves in gas supplies.

To install final power supply wiring / containment between local mechanical plant and fused spurs provided by the electrical contractor (including fan coil units, local fans, window mounted fans, local heaters etc)

To make all digital and analogue control interfaces between the BMS and packaged plant, energy / utility services meters and motor inverter drives as detailed on the Controls diagrams and individual plant schedules and elsewhere in the specification. Any apparent discrepancy between the specification / plant schedules and drawings shall be drawn to the attention of the Contract Administrator before or with the tender submission. Otherwise the Contractor shall be deemed to have made the maximum allowance within their tender.

For all buildings with a total usable floor area greater than 1000m^2 and as described in the scope of works, provide all necessary software and hardware for automatic readings of all energy and utility supply meters. The software shall be capable of real time analysis of the data. The consumption data shall presented as profiles and reports to enable consumption data to be audited against targets and consumption profiles.

To hard wire interlocked chilled water primary pumps with chiller controls to prevent operation of the chiller if the pumps are not operating.

100.020 DESIGN PARAMETERS:
Controls/BMS supplier/installer shall provide a schedule of site conditions including security, cleanliness, weather protection etc. that must be maintained before equipment is delivered.

100.023 OPERATING CONDITIONS:

Unless otherwise indicated equipment shall be suitable for operating within the following environmental ranges:-
Operator facilities - located in general office areas

	Temperature	-	10ºC to 35ºC
	Humidity	-	20% RH to 80% RH
Operator facilities	located in plant areas, and Outstations		
	Temperature	-	0ºC to 50ºC
	Humidity	-	10% RH to 90% RH
Electrical environment	:as associated with building services plant room areas.		
	:protected against effects of conducted and radiated interference to IEC 801 Part 3 (1984) and Part 4 (1988)		
Dust and dirt	:as associated with the indicated location of the equipment.		

The overall installation shall be capable of maintaining conditions within the following accuracies:

Temperature	+/- 0.5 °C
Humidity	+/- 5% RH

100.024 POWER SUPPLIES:
The supply to the distribution boards/MCC's shall be 400 Volts, 3 phase, 50 Hertz, 4 wire, TN-S.
Unless otherwise indicated ensure all control equipment operates normally from a power supply of:
Voltage - 230V +10%/-6%
Frequency - 50Hz +/- 1%

100.025 EXPANSION
Arrange system to allow 25% expansion without redundancy.(ie: by addition rather than replacement of hardware), without compromising the BMS system's functionality or speed of operation.

100.026 COMMISSIONING
Commissioning requirements for the automatic controls systems / BMS are given in clause 350.000 and work section Y51. (also refer to A33 or A64 or A64D).

PART 3 SPECIFICATION CLAUSES SPECIFIC TO W60

300.000 GENERAL

300.010 SYSTEM REQUIREMENTS:
Select control components and equipment, suitable to meet system objective requirements. Ensure that system safety complies with:
- BS EN 61508-series for control of systems where an assessed safety integrity level is required.
- BS EN ISO 13849-1 and BS EN ISO 13849-2 for safety-related components of control systems.
- BS EN 13850 for design of emergency stop functions.
- BS EN 61511-1 for functional safety of programmable controllers.

Comply with BS EN 15500-1 for electronic individual zone control equipment.
Comply with relevant parts of BS EN 60730 for automatic electric controls.
Comply with the following standards for building automation and control systems (BACS) components:
- BS EN ISO 16484-2 for hardware
- BS EN ISO 16484-3 for functions

Comply with the requirements of the relevant parts of BS EN 50491, and BS EN 63044/BS EN IEC 63044 appropriate to the project, for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS).
Install all switches, controls, outlets and meters and all other items that require access in accordance with the relevant part of BS 8300: Design of an accessible and inclusive built environment.
Ensure that the system is designed and implemented to comply with BS EN 16947-1 and PD CEN/TR 16947-2 for overall alarming, fault detection and diagnostics, reporting, monitoring, energy management functions, functional interlocks and optimizations to set and maintain energy performance of buildings.

300.020 CONTROL SYSTEM:
Provide a Building Management System (BMS) to meet the particular requirements detailed in the scope of works and / or control strategy diagrams and schedules. Scope to include, equipment design,
development of design, supply, installation, commissioning, setting to work, operator training, fine tuning and seasonal commissioning during the defects period.
Supply and install control equipment to provide a means of controlling and indicating the performance of other systems within set criteria and varying their criteria as required from a central location.

300.030 CONTROLS SPECIALIST:
Use a controls specialist to design, supply, install, test and commission complete controls / BMS installation.

300.051 COMPRESSED AIR:
Where required the compressed air plant is specified in work section S30. Ensure the compressed air is available to pressure, quantity and cleanliness requirements to suit the control devices.

300.060 CONTROL COMPONENTS MANUFACTURER:
Unless otherwise indicated use control components and equipment from one manufacturer throughout.

300.091 FINISHES:
Ensure all equipment is designed to common installation practices. Provide all equipment as a matching suite.

300.100 ELECTROMAGNETIC COMPATIBILITY:
Ensure all monitoring system equipment is compatible, and does not adversely affect any other equipment installed in the same location.
Ensure all systems are designed and installed with due consideration to good electromagnetic compatibility (EMC) practice, and in line with EMC requirements of relevant standards including:
- BS 7671 (IET Wiring Regulations)
- BS EN 50310 for earthing and bonding in relation to communications system components
- BS EN 50174-series for communications and control cabling
- BS EN 61000-6-7 and BS EN 61000-1-2 as relevant for EMC in relation to functional safety

Ensure all equipment complies with BS EN 50130-4 where relevant.
Ensure fire alarm interface equipment complies with BS EN 50130-4 where relevant.

300.130 INTEGRATED SYSTEM:

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Provide integrated system combining the sub-systems as scheduled or described in the scope of works into the BMS.
Ensure interfaces comply as necessary with relevant parts of BS 5839 and BS 7273.

300.132 BREEAM / WELL REQUIREMENTS:
On applicable projects and as detailed elsewhere, comply with BREEAM requirements below to suit the type of construction and scheme.
Provide the following unless detailed otherwise elsewhere.
A plasma screen for wall mounting installation in the building reception.
Software within BMS, to give as a minimum, a real-time display of
How much energy is being generated from all renewable energy systems and how much non-renewable energy is being consumed. Information to be gathered from all pulsed output energy usage over the same period.
Energy usage/generation of past year or month.
If a rainwater collection or grey water collection system is installed, how much water has been collected over a previous time period and what contribution this makes to the building overall usage over the same period.
BREEAM New Construction 2018 requirements
Comply with Issue ID Man 04 Commissioning and handover
Comply with Issue ID Man 05 Aftercare
Comply with Issue ID Ene 02 Energy monitoring
Comply with Issue ID Wat 02 Water monitoring
Comply with Issue ID Wat 03 Water leak detection
Comply with Issue ID Pol 01 Impact of refrigerants
BREEAM Refurbishment and Fit-out 2014 requirements
Comply with Issue ID Man 04 Commissioning and handover
Comply with Issue ID Man 05 Aftercare
Comply with Issue ID Ene 02 Energy monitoring
Comply with Issue ID Wat 02 Water monitoring
Comply with Issue ID Wat 03 Water leak detection
Comply with Issue ID Pol 01 Impact of refrigerants

Where the building is being assessed to the WELL Building Standard v1 comply with feature
Comply with feature 18 Air Quality Monitoring and Feedback
Comply with feature 23 Advanced Air Purification

310.020 GENERAL REQUIREMENTS - ELECTRICAL SAFETY:
Ensure that the BMS complies with the following legislation:
The Electrical Equipment (Safety) Regulations 2016
The Construction Products Regulations 2013
The General Product Safety Regulation 2005
Ensure that the BMS installation complies with BS 7671.
Ensure that control panels comply with:
Relevant parts of BS EN 61439-series.
BS EN 60204-1 where the control panel is classed as Machinery in accordance with the Supply of Machinery (Safety) Regulations 2008 as amended.

310.020 GENERAL REQUIREMENTS - ELECTRICAL SAFETY:
Ensure that the BMS complies with the following EC Directives
Low Voltage Directive 73/23/EEC and amendments 93/68/EEC.
Construction Products Directive 89/106/EEC.
General Product Safety Directive 92/59/EEC.
Ensure that the BMS installation complies with BS 7671 Electrical installations in buildings.
Ensure that control panels comply with BS EN 61439-1 Low-voltage switchgear and control assemblies.

310.030 GENERAL REQUIREMENTS - ELECTRICAL SUPPLY:
Ensure that the BMS can be supplied with electricity conforming to:
The Electricity Safety, Quality and Continuity Regulations 2002 (as amended); and
BS EN 50160 Voltage characteristics of electricity supplied by public distribution systems; and

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Additional voltage drop within the consumer's electrical installation according to BS 7671 (IET Wiring Regulations).

310.051 GENERAL REQUIREMENTS - EMERGENCY RESTORATION PROCEDURES
Ensure that the BMS fully restores all control and monitoring functions following an emergency shut down period.
Ensure that the start delay times can be adjusted according to the magnitude of the load.
Ensure that the system restart does not cause unsafe operating states.

310.061 GENERAL REQUIREMENTS - UNINTERRUPTIBLE POWER SUPPLY FACILITY:
Uninterruptible power supply facility requirements - As work section V32 or detailed in scope of works.
310.070 GENERAL REQUIREMENTS - TIME SYNCHRONISATION:
Ensure that all time-dependent BMS components are time synchronized.
Ensure that the BMS can automatically handle daylight saving adjustments including changes between British Summer Time (BST) and Greenwich Mean Time (GMT)
Ensure that the BMS can accommodate time adjustments such as leap years and leap seconds.
Refer to scope of works for any project specific detailed requirements.

310.080 GENERAL REQUIREMENTS - SYSTEM SECURITY:
Standard - IET Code of Practice for Cyber Security in the Built Environment.
Provide, as a minimum, operator access for the following levels based on user's login credentials
Level 1 - Ability to display all point data.
Level 2 - Ability to display all point data and to initiate data logging functions.
Level 3 - Ability to display all point data; to initiate data logging functions; and to change set points and time schedules.
Level 4 - Ability to display all point data; to initiate data logging functions; to change set points and time schedules; and to change control strategies and schematic/graphics functions and password assignment.
Ensure that appropriate credential-based operator and maintenance technician access is set up for clients, servers and field controllers.
Login access type to be via password unless detailed otherwise in the scope of works
Manage information security of systems, software and data during design, implementation and commissioning in line with BS EN ISO/IEC 27001.
Ensure that the BMS software is protected from unauthorised entry.
Ensure that the BMS can be maintained by a service provider with BS EN ISO/IEC 27001 and BS ISO/IEC 20000-1.

310.091 GENERAL REQUIREMENTS - SYSTEM SOFTWARE:

SOFTWARE DEVELOPMENT:
Prior to commencing the development of project specific software confirm the following information

: operating system, revision and issue number
: other packaged software to be provided, revision and issue number
: availability and cost of any further appropriate packaged software not specifically specified.
: functional description of any software needed to be written for "The Works", procedure for its preparation and development period. Provide summary of previous experience of writing similar software.
: details of software support service available to client, where future software would be written and how charged.

Demonstrate the operation of all software for conformity with the specification prior to installation.
Procedures for modifying the configuration, graphics pages and parameters shall allow alterations and additions to be made systematically without the need to shut down the BMS or any Engineering Systems.
All software shall support, without modification, the future addition or removal of outstations or points up to the practical limit of the installed software.

Obtain on behalf of the end users all appropriate licences, permissions, copyright waivers, rights of use and the like from the owners of the software rights. Ensure that the end user is properly registered with the software supplier for support and appropriate updating. Provide documentation for application software in accordance with BS ISO/IEC 26513 and BS ISO/IEC 26514.
Ensure that, as far as practicable, all software is commercially available off-the-shelf.

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Ensure that any programmable configuration, customisation, and bespoke software, is developed, tested and commissioned using relevant processes and procedures complying with BS ISO/IEC/IEEE 12207 or BS ISO/IEC/IEEE 15288, supported by a quality management system meeting the requirements of BS EN ISO 9001.Ensure that IT industry standard operating systems are used.
Ensure that copies of all BMS vendor-specific software are held by an independent third party and that this software can be released to the client.
Ensure that the ESCROW Agreement is completed and signed.
Use communications protocol to relevant parts of BE EN 14908.

310.093 GENERAL REQUIREMENTS - CHOICE OF CONTROL STRATEGY:
Where detailed control strategies are not provided or where design development of the control strategies provided in the tender documents is required, ensure that the selected control strategies are appropriate for the building services systems and their intended application.
Ensure that selected control strategies are robust and not over complex.
Where a novel control strategy is to be implemented, ensure that testing/evaluation is performed to confirm its suitability.
Ensure that on project where a detailed control strategy is not provided, wherever possible selected control strategies are based on those provided in the BSRIA Library of System Control Strategies: AG 7/98.

310.095 GENERAL REQUIREMENTS - DESIGN FOR COMMISSIONABILITY:
Ensure that the BMS specification details required for commissioning are made available to the BMS commissioning engineer.
Ensure that all field controllers, sensors and controlled devices are easily accessible and can be removed for testing and future maintenance.
liaise with the mechanical contractor to ensure that air handling units are provided with appropriate access doors.
Ensure that access is available to all control devices. Comply as appropriate with:
BS EN 547-series.
BS 7671 (IET Wiring Regulations) requirements for maintenance gangways
Ensure that the requirements of the following documents are met:
Space and Weight Allowances for Building Services Plant - Inception Stage Design. BSRIA. TN 9/92.
Space Allowances for Building Services Distribution Systems - Detailed Design Stage. BSRIA. TN 10/92.
Ensure that sensors are installed correctly in order to give representative readings.
Ensure that reference labels are attached to each control device.

310.097 GENERAL REQUIREMENTS - DESIGN FOR MAINTAINABILITY:
Ensure that a full O&M manual is prepared which reflects any system changes made during the installation and commissioning stages.
Ensure that adequate access to BMS equipment and components is provided.
Ensure that all components and wiring are identified by a consistent numbering system

310.100 GENERAL REQUIREMENTS - SYSTEM SUPPORT:
Ensure that a viable strategy is in place to fully support the BMS for a minimum of 10 years from the date of practical completion.

310.110 OPERATOR CLIENT / SERVER - OPERATIONAL CHARACTERISTICS:
Ensure that the control of plant is independent of the operator workstation.
Ensure that no data of a control nature is transferred between field controllers via the client / server, i.e. data relating to control strategies.
Ensure that the client / server can communicate with all addressable field controllers.
Provide complete system integrity such that the network of field controllers will continue to fully operate following a failure of the client / server.
Ensure that the appropriate control strategy configuration data can be downloaded to all addressable field controllers.
Provide a means of displaying and modifying each addressable field controller's control strategy, time schedules and set-points via the client / server.
Allow the operator to re-schedule plant operation times. Ensure that re-scheduling can be applied globally to a number of items of plant at one or more sites (or one or more controllers on one site) as selected by the operator.
Ensure that the client / server incorporates a data storage management system that warns against impending on-

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line storage overflow and allows for data archiving to, and retrieval from, off-line non-volatile media. Ensure that the operator is prompted at pre-defined intervals to carry out the data archiving procedure.
Ensure that it is possible to perform a complete backup of the plant comprising control strategies, set-points and logged data to the server.
Where neither network-attached storage (NAS) storage area network (SAN) or cloud storage are utilised to backup purposes by the system, provide an electronic data archival device that uses readily available non-volatile media that is appropriate for long term storage of system software, configuration data and logged data (including alarm data).
Allow the transfer of data from the system memory and other storage devices to the archive mediums, and vice versa for the preparation of reports.
Ensure that the system can be fully restored from backup data..

310.115 BMS SERVER EQUIPMENT:
Refer to scope of works for detailed requirements.
Standards
BS EN ISO 16484-3
BS EN 60950-1
BS EN 62368-1
Approach - Physical server unless detailed otherwise in scope of works
Administrator interface by Remote desktop, or Local user interface or UK QWERTY keyboard.
Ensure that the processor speed of each server (or server farm) meets the data processing requirements.

310.121 CLIENT DISPLAY EQUIPMENT:
Supply and install a head end PC or PC's as specified in the scope of works and in the locations described in the scope of works or as indicated on the drawings.
Standard - BS EN ISO 16484-2, BS EN 60950-1, BS EN 62368-1
Client
PC, or Laptop or mobile device as detailed in the scope of work / system description.
Processor
Ensure that the processor speed of each client meets the data processing requirements.
Ensure that the processor speed is such that any significant delays in processing system are eliminated.
User Access
Provide a UK QWERTY keyboard with full upper/lower case ASCII key-set, numeric keys and mouse.
Where required Incorporate a touch-screen facility in place of a keyboard. Where this is the case also provide a keyboard connection and associated functionality.

Tenderers to confirm with tender make and specification of equipment they are proposing for each of the operator facilities.

310.125 PRINTER(S):
Standard
BS EN 60950-1
BS EN 62368-1
Ensure that the printer can print all monitored and logged data (including graphs of logged data); all point data (hard and soft); control logic and plant/building schematics in colour; alarm data/text; and system help text.
Ensure that the automatic printing of alarm data can be switched on/off.
Ensure that alarm data can be routed to specific clients and/or individual operators as identified by their specific logon information.
Ensure that the printer has a minimum output of four pages per minute.

310.131 SYSTEM MONITORING AND LOGGING FUNCTIONS:
Ensure that all monitored point data can be displayed at the client. Ensure that analogue, digital and soft-points can be displayed simultaneously.
Ensure that all changes made by the operator (eg set-point changes) can be logged and identified by both operator and date/time stamp.
Provide a facility to allow the display, at the client, of 'real time' data superimposed on plant schematics with a refresh rate not exceeding 20 seconds.
Ensure that a minimum of six 'real time' data points can be displayed simultaneously, in the form of data plots, with a time delay not exceeding 20 seconds.

Provide a facility to allow the monitoring and display, on the same 'page', of common criteria/plant functions.
Ensure that any hard or soft-point log can be displayed and stored on the client.
Ensure that logs can be set up from the client and that logging times and logging intervals are user adjustable between 1 second and 24 hours or when the value changes by an amount greater than an adjustable hysteresis threshold.
Provide central operator facility with the ability to select points to be logged by the system.
Total number of logging channels available for each outstation not to be less that 20% of the total physical points on that outstation or as indicated.
Outstation memory shall be sufficient to log the equivalent of 5 days data at 15 minute intervals for 20% of the total number of physical points on the outstation.
Flexibly allocate logging memory to the points selected including to "soft" or "virtual" points.
When a log is set up allow for the following
: error indication if the maximum logging channels are exceeded
: the ability to specify the frequency and duration for which the data value is to be stored.
Each logged value shall be associated with
: point reference
: unit of measurement
: date and time measured
The system shall be able to export this information to other software packages including Microsoft Excel and Word format.
Provide a facility to allow the simultaneous display of different logged data. Ensure that this function is operator adjustable.

310.141 GRAPHICAL USER INTERFACES:
Comply with relevant standards including the following where appropriate.
BS EN 61082-1 for general schematic and information presentation
BS EN 60073 for indications and actuator states
ISO 7000/IEC 60417-series, IEC 60617 and ISO 14617-series for symbols in general.
BS 1553-1 for piping systems and plant symbols and schematics
BS 1553-2 for power generating plant symbols and schematics
BS 1553-3 for compressing plant symbols and schematics
BS 1635 for fire protection system symbols and schematics
BS 4737-5.2 for intruder alarm system symbols and schematics
BS EN 1861 for refrigerating system and heat pump symbols and schematics
Provide graphics as defined in the scope of works. The graphics shall be dynamic, and to show the following as a minimum.
Water and air temperature set points, and actual values, valve and damper positions, filter status, minimum and maximum air flows in VAV systems, plant operational status (ie on/off/alarm), metering actual data.
Provide a software library of plant schematics and symbols, the format/contents of which should be confirmed with the specifier based on samples.
Provide a facility to allow the operator to generate additional schematics and symbols using readily available drawing formats.
Ensure that the system can accommodate the addition of 20% extra graphics 'pages'.
Provide a facility to allow the operator to modify plant schematics and to generate new ones. New elements for schematics to be available on a Tool Palette and the association with data points in controller outstations to be made using drag-and-drop.
Ensure that graphics can be displayed in a layered approach (building layout graphics down to plant subsystems and components). Ensure that the operator can modify the structure of the layered approach.

310.150 USER INTERFACE - HELP AND ASSISTANCE:
Provide a facility to allow the display of help text covering all operator functions and system fault conditions.
Provide a facility to allow the display (including a hard copy) of points list (hard and soft-points) and control strategy logic schematics.

310.160 INTEGRATION WITH THIRD PARTY MANAGEMENT SOFTWARE:
Energy monitoring and targeting software
Provide a facility to allow the direct transfer of recorded energy consumption and external air temperature readings from the BMS to the monitoring and targeting software. Ensure that real time data is available in a standard database format (e.g. SQL, ODBC, etc).

Maintenance management software
Provide a facility to allow the direct transfer between the BMS and the maintenance management software of plant run hours; number and frequency of plant starts; critical alarms requiring immediate attention; and maintenance (non-critical) alarms.
Ensure that real time data is available in a standard database format (e.g. SQL, ODBC, etc).

310.170 SYSTEM ALARMS:
Standards
BS EN 62682
Engineering Equipment and Materials Users Association publication No. 191 “Alarm Systems: A Guide to Design, Management and Procurement”.
Ensure that alarms are displayed on a rolling basis in chronological order.
Ensure that the operator can acknowledge alarms, including muting of audible or flashing annunciators.
Provide a facility to silence audible alarms or inhibit flashing annunciators without performing alarm acknowledgement.
Ensure that alarms can be inhibited for reasons of time and/or priority as selected by the operator.
Ensure that the BMS can be configured to avoid fleeting alarms, i.e. ensure that alarms can accommodate start-up and shutdown delays.
Ensure that the operator can alter the limits at which the measured values cause alarms to be triggered.
Ensure that alarms can be limited to the source items(s) of plant.
Ensure that alarm limits can accommodate sliding limits, e.g. set-point changes.
Ensure that alarms can be differentiated by means of alarm type and identification.
Ensure that alarms can be prioritised (including a high priority that will be annunciated regardless of other activity) and a low priority or information status that is only annunciated on demand.
Ensure that the time taken to receive alarms does not exceed 5 seconds
Ensure that visual, audible and printed annunciation of alarms, or any combination of these, can be selected by the operator.
Ensure that the reception and acknowledgement of alarms can take precedence over other operations. However, ensure that the reception of alarms does not hinder user log-in.
Allow the user to acknowledge alarms individually and on a group basis. Acknowledgement should include muting or flashing annunciators.
Provide distinction between active alarms whose conditions are not cleared and unacknowledged alarms.
Provide an alarm-latching facility with manual reset.
Ensure that alarm data provides condition identity; condition value; alarm source; alarm time and date; and acknowledgement status.
Ensure that the alarm file can be sorted by the above criteria.
Allow alarms to be automatically redirected to other user interfaces.
Provide sufficient data storage capability for the storage of alarms.
Ensure that any stored alarm data can be analysed in conjunction with other monitored conditions or stored logged data.
Ensure that an alarm review facility is available.
Allow the display of stored alarm data based on user definable selection criteria.
Ensure that the operator can define the requirement for acknowledgement of alarms; a time programme for annunciation of alarms to different destinations; and text messages associated with alarm conditions.
Ensure that critical alarms can be relayed by SMS text message and/or email to a distribution list of operators. The definition of a 'critical alarm' is to be wholly adjustable by the administrator.

310.175 FIELD CONTROLLERS - GENERAL:
Standard
BS EN ISO 16484-2 for hardware
BS EN 15500-1 for electronic individual zone equipment
Casing material – rigid plastic

310.180 FIELD CONTROLLERS - MODES OF OPERATION:
Ensure that the field controllers perform all control actions independently of the operator workstation.
Ensure that all field controllers can operate independently and in real time following a failure of the BMS communication network.
Ensure that field controllers can operate with the loss of shared data through the use of default values and final

data reading before the loss of network communications.
Provide operator interfaces

310.190 FIELD CONTROLLERS - PHYSICAL CONSTRUCTION:
For internal plant room applications, construct field controller enclosures to give a minimum degree of protection to IP54 in accordance with BS EN 60529. Where the field controller is fitted inside a control panel that is protected to IP54 then the field controller protection can be reduced to IP41. For external applications, construct field controller enclosures to IP65.
Where an enclosure is to be provided ensure that field controller enclosures are lockable.
Ensure that modular construction is used for field controllers. Ensure that this allows the removal and replacement of devices without the need for rewiring of field wiring.
Ensure that I/O modules can be removed and replaced without the need to power down the entire modular system (i.e. I/O modules are hot-swappable).

310.200 FIELD CONTROLLERS TERMINATIONS:
Use terminals of the screw down clamp-type fixed to purpose made mountings.
Segregate into groups terminals of different voltage bands (in accordance with BS 7671).

310.220 FIELD CONTROLLERS - CONTROLLER INPUTS:
Ensure that the interfaces for the field controllers are appropriate for gathering data from sensors and devices. Ensure that the following requirements are met.

Universal inputs
Variable currents (4-20 mA), variable voltages (0-10V), variable resistances or volt-free contacts.
Ensure that the scaling tables, necessary to process inputs configured as type analogue, are resident at the field controller.
Ensure that a minimum and maximum limit value can be defined for each analogue input. Ensure that each limit is associated with a configured response.
Ensure that the field controller can detect open or closed circuit faults and raise an alarm on the operator workstation.
Ensure that the configuration tables necessary to process inputs configured as type digital are resident at the field controller.
Ensure that the configuration tables necessary to process inputs configured as type multi-state are resident at the field controller
Digital inputs
As derived from volt-free contacts (max 24 volts/20mA). Allow the interface to be selected to monitor a normally open or normally closed circuit.
Ensure that the routines necessary to process the digital inputs are resident at the field controller.
Pulsed inputs
As derived from volt-free contacts (max 24 volts/20mA) at a pulse frequency of up to 32Hz.
Ensure that the routines necessary to process pulsed inputs are resident at the field controller.
Ensure that the field controller has the following capabilities.
Storage of cumulative totals daily; weekly; monthly; yearly; and continuously.
Operator re-set facility of cumulative totals via the operator workstation.
Facility to combine counts from separate pulsed inputs.
Ability to calculate the number of pulses per unit time through addition and/or subtraction.
Ability to compare the number of pulses with preset limits on the basis of total number of pulses per unit time and the time required for a total number of pulses.
Ability to convert pulsed readings into quantifiable values.
Alarm facility based on a user-defined limit being exceeded.
Ensure that the inputs which are used to monitor fluctuating pulse rate (eg maximum demand meter for electricity) have operator adjustable limits.
Ensure that when data for pulsed inputs is recorded, the record includes both the pulse count and logging intervals for cumulative counts.
Run-time totals
Include run-time totalling routines to enable the operator to record cumulative run-time for each item of plant selected.
Provide the operator with the option to set a different maximum run-time for each item of plant selected.
Ensure that when the maximum run-time has been reached an alarm is signalled to the operator.

Ensure that the operator workstation can be used to interrogate field controllers for a point-by- point summary of run-time totals and run-time limits.
Ensure that it is possible for the user to set an initial value of hours run other than zero.
General
Ensure that all inputs can be scanned at intervals not exceeding 1 second.
Refer to the scope of works / schedules for any special requirements for time-critical control applications.
Ensure that all inputs are protected against spurious out-of-range signals including those caused by contact noise or bounce.
Ensure that errors introduced by the analogue to digital conversion of inputs do not exceed 0.1% of the analogue value.

310.230 FIELD CONTROLLERS - CONTROLLER OUTPUTS:
Ensure that isolation between controllers and networks meet the requirements of BS EN 63044 - series.
Ensure that the field controllers' interfaces are capable of providing control signals to actuators and switching devices.
Ensure that routines are configurable, such that one or more events may be enabled in direct response to any defined logical relationship between the status of a number of physical or soft- points.
Ensure that in the event of power failure, output devices can be driven to their preset, fully open/closed position.
Provide the following interface characteristics:
Analogue output. As variable currents (4-20mA) or as variable voltages (0-10V). Ensure that it is possible to characterise analogue outputs in order to obtain a near linear response from the controlled items of plant.
Digital output. Ensure that digital outputs can be selected as 'normally closed' or 'normally open'.
Ensure that errors introduced by the digital to analogue conversion of outputs do not exceed 1 LSB.
Ensure that the field controller is capable of receiving feedback signals which allow the comparison between an output signal to a controlled device and its actual condition.

310.240 FIELD CONTROLLERS - POSITIVE FEEDBACK:
Ensure that the field controllers can include routines necessary to confirm that specific items of plant are functioning correctly. Ensure that this can be performed by monitoring physically separate but functionally related sensors, switches or transducers.
Ensure that an alarm is raised if the expected response has not been established by a pre-set time following switching on of plant. Ensure that it is possible to operate any specified standby plant. Provide the operator with a facility to adjust the pre-set time delay.
Ensure that the field controllers are capable of using measured feedback from an actuator position to give a percentage open reading.

310.250 FIELD CONTROLLERS - DATA MONITORING AND LOGGING:
Ensure that hard and soft-points associated with a field controller can be logged.
Ensure that the BMS operator can set the start/stop times and logging frequency at the operator workstation.
Ensure that logging is selectable between fixed periods or on a rolling basis.
Ensure that each log can be defined in terms of log identification (point identification); units; and date/time stamp.
Ensure that the operator can select all physical and soft-points for logging.
Ensure that the field controller has sufficient memory to log the equivalent of seven days data at 15 minute intervals for 50% of the total number of physical points on the field controller.
Ensure that the log data is to be automatically uploaded to the operator workstation / system server and stored in a standard database format (e.g.SQL, ODBC).

310.260 FIELD CONTROLLERS - ENVIRONMENTAL CONDITIONS:
Ensure that field controllers are suitable for operating normally within the following environmental ranges:
Temperature 0 to 50°C
Relative humidity 10% to 90% non-condensing.
Ensure that the field controllers will operate in the electrical environment associated with building services plant rooms.
Ensure that the field controllers are protected against the effects of moisture, dust, dirt and gases.

310.271 FIELD CONTROLLERS - INTERNAL POWER BACKUP:
Provide internal power backup
Ensure that a rechargeable battery or capacitor, if specified, can hold the controller's volatile memory for a minimum period of 72 hours.

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Ensure that a non-rechargeable battery, if specified, can maintain the controller's clock function for a period of two years.
Ensure that the battery is easily replaceable.
Ensure that the interval between battery maintenance inspections is not less than 12 months.

310.280 FIELD CONTROLLERS - MEANS OF CONFIGURATION:
Ensure that the field controllers can be fully configured directly via a laptop type computer and via the operator workstation.
Ensure that the field controllers can be configured through the use of a configuration interface with full upload and download capability.
Ensure that configuration details can be easily altered by system operators.
Ensure that access to make configuration alterations is restricted to operators with access authority through the use of passwords.
Ensure that any battery monitoring functions defined in the Particular Inspection can be met.

310.291 FIELD CONTROLLERS - USER INTERFACES:
Ensure that all field controllers can be accessed through the use of portable computers.
Ensure that access allows the display of all configuration details associated with the field controller along with:
- Password protection for access with a minimum of two access levels.
- Ability to display all point data (both hard and soft).
- Ability to initiate and display logged data.
- Ability to display and alter set-points and time schedules.
- Ability to make alterations to control strategies.

As defined in the scope of works or schedules provide a panel-mounted operator interface to interrogate the field controllers. Ensure that the interface includes the ability to:
- Provide password protection for access with a minimum of two access levels.
- Display all physical point data.
- Display and alter set-points and time schedules.
- Display the current date and time.
- Review and acknowledge alarms.
- Display logged data in graphical format, with overlaying of up to 8 logs on a single graph.

310.295 DEDICATED CONTROLS - OPTIMISERS:
Standard - BS EN 12098-2.

310.296 DEDICATED CONTROLS - COMPENSATORS:
Standard - BS EN 12098-1, BS EN 12098-3

310.297 DEDICATED CONTROLS - TIME SWITCHES:
Standard BS EN 60730-2-7.
Provide time switches with minimum of 24 hours mains failure reserve facility.

310.301 OCCUPANT CONTROLS - GENERAL:
Ensure that the specified occupant controls can be linked to, and communicate over, the BMS communications network.
Ensure that the occupant controls can control the relevant items of plant.
Ensure that the status of each occupant controller can be viewed and overridden via the operator workstation.
Ensure that each occupant controller has a service port available that allows a laptop type computer to be connected using a suitable wired service tool. It shall be possible to disable the service port function via the password protected configuration settings for the occupant control.
When connected using the service port all controllers in the entire BMS network are to be accessible via the laptop type computer.
Ensure that the occupant controls allow:
- Adjustment by the occupants of the set-points.
- Definition, and adjustment by the BMS operator, of high and low limits for each set-point control.

Provide a facility to allow the global alteration of set-point and high/low limits via the operator workstation.
Provide an override facility to allow plant operation during out of hours occupation.
Ensure that the occupant controls are intuitive to use and clearly labelled.
For temperature control ensure that hot/cold and/or red/blue indication is used for the occupant interface.

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For fan speed control ensure that fan fast/slow indicators are used.
Ensure the +/- symbols are not used without clarification of the controlled function.
Wall/desk mounted

310.320 OCCUPANT CONTROLS - OFFICE IT/INTRANET BASED:
Ensure that the occupant controls are TCP/IP compatible.

310.330 CONTROL FUNCTIONS AND ROUTINES - GENERAL:
Provide a facility to automatically cycle selected actuators through their full range of movement outside normal operating periods with a periodicity set by the operator (in addition to normal automatic or manual control). Ensure that the cycle finishes as one complete operation. Ensure that any alarm conditions raised during the operation are inhibited as necessary.
Provide a facility to drive actuators to their open or closed positions at the end of plant operating periods.

310.340 CONTROL FUNCTIONS AND ROUTINES - BASIC CONTROL FUNCTIONS:
Ensure that configuration routines necessary for direct digital control (DDC) are resident at the field controllers.
Provide DDC of plant through algorithms giving proportional plus integral plus derivative control (PID).
Provide two-position control.
Provide raise-lower or three-point control.
Allow the selection of either proportional control (P) or proportional and integral control (P+I) or proportional and integral plus derivative control (P+I+D) modes independently for each relevant item of plant. Ensure that proportional, integral and derivative action times can be adjusted by the user.
Allow the combination of more than one control loop by 'cascading', i.e. using the output signal from one control loop as the input signal to another control loop.
Ensure control routines provide for bumpless transfer capability when switching from manual mode to automatic mode.
Ensure that the control routines are capable of controlling the individual plant items listed
Provide a comprehensive programmable facility using a simple and easy to use program strategy tool that allows comprehensive debugging and live editing of control strategies.
If a comprehensive programmable facility is not available then a micro function block based tool may be supplied providing the following requirements are met:

Provide logic modules covering
- Logical combination of digital variables.
- Logic timer module.
- Logic readback module.
- Logic counter module.
- Logic delay module.
- Logic hours run module.

Provide the following logic functions:
- AND.
- NOT AND (NAND).
- NOT OR (NOR).
- OR.

Provide the following function modules as a minimum:
- Filter (applies exponential filter with gain to input signal).
- Rescale from (rescales an input of 0 to 100 to a user defined output and limits at these values).
- Rescale to (rescales the input to the output of 0 to 100 and limits at 0 and 100).
- Limit at (limits the output at user specified values).
- Limit to (limits the output to 0 or 100 percent at values specified by the user).
- Logarithm of input; Square root of input; Add to input; Multiply by input; Divide by input.
- Minimum (to select the minimum value from two or more inputs);
- Maximum (to select the maximum value from two or more inputs);
- Average (to calculate the average value from two or more inputs).
- Analogue gate (digital signal switches output between two analogue input signals).
- Comparator (to compare two inputs, when input X is greater than input Y output of one is produced otherwise the output is zero).
- Enthalpy (to calculate the enthalpy value from a temperature input and humidity input).
- Hysteresis (changes a digital state if the input changes outside a defined band).

Analogue to digital converter (to change analogue value to binary).
Provide comprehensive debugging and live editing of control strategies.

Ensure that the program strategy tool (whether comprehensive or Macro function block based) is not restricted to the use of the systems integrator but is available for suitable trained administrators via the operator workstation.

310.350 CONTROL FUNCTIONS AND ROUTINES AND CONTROL INTERLOCKS:

Ensure that the BMS is capable of providing all control functions, routines and interlocks detailed in the scope of works, schedules and controls drawings.

Where the following standard control routines are required (as detailed in the schedules, scope of works or controls drawings) the BMS shall be capable of providing the functions detailed in BSRIA Application Guide AG 9/2001. (Part A clauses 5.3 to 5.11 inclusive)

Frost protection (see clause 310.351)
Building/plant protection
Safety interlocks
Time schedules
Plant start/stop control
Sequence control
Plant rotation control
Optimum start for heating and cooling systems
Weather compensation
Lighting control

Safety interlocks

Ensure that all safety interlocks are hardwired and have precedence over all other control functions.
Ensure that safety interlocks can only be reset manually and locally (not from the operator workstation).
Ensure that all hardwired safety interlocks have corresponding software interlocks to prevent cascading nuisance alarms.
Ensure safety interlocks operate when plant selector switches are in 'Hand' or 'Auto' mode.
Ensure safety interlocks operate when frequency inverters are selected in 'Local' or 'Auto' mode at the inverter keypad.
Ensure safety interlocks comply as appropriate with:
BS EN 61508-series for control of systems where an assessed safety integrity level is required.
BS EN 13850 for design of emergency stop functions.

Variable volume pumped systems

Control strategy to include regime to fully open and close all 2 port valves in the system on a timed basis to ensure water treatment chemicals are circulated through all terminal units on a regular basis.

310.351 FROST PROTECTION OF BUILDING SERVICES SYSTEMS AND BUILDING FABRIC

Provide frost protection routines to operate plant, pumps and / or fans and necessary control valves in order to protect building services systems and their components from frost damage.

Provide the following two stages of protection:

When the outside temperature falls to the operator set minimum frost-protection temperature, the selected pumps start and circulation is established through pipework systems and their components including all air handling unit coils in locations where the outside air temperature could be below the minimum frost protection temperature. This shall include fully opening two port control valves and motorising 3 port control valves to flow to the coil. Allow the operator to pre-select which plant is to be started. The automatic standby plant is to operate on failure of the duty plant.

Ensure that when the return temperature falls below the operator pre-set minimum, the full frost-protection facility is initiated. Ensure that for heating systems, the heat source is turned on and operated to maintain the return flow temperature above the pre-set minimum. Ensure that specified protective devices activate for other liquid systems.

Provide a facility to allow frost protection to be logged together with data and time.

Provide protection routines to operate the plant in order to protect the building fabric and its contents against the effects of low internal temperatures and of condensation.
Ensure that if the internal air temperature falls below the pre-set protection temperature, the heating system and related plant is turned on and heat supplied to maintain the air temperature at or above the protection set-point temperature.
Ensure that the building/plant protection routine overrides other control functions unless otherwise specified.
Ensure that protection operates whenever the normal heating is switched off.

310.440 SYSTEM COMMUNICATIONS - GENERAL:

Ensure that the system communications allows the full transfer of monitored, logged, alarm, backup and configuration data between the operator workstation and addressable field controllers.
Ensure that the communication protocol selected seeks to achieve error-free data transfer. Ensure that the protocol includes an error detection check; includes an error correction and/or re-try technique; limits re-transmission; and raises an alarm condition on failure.
Ensure that the available bandwidth is sufficient to avoid excessive delays in transmitting data

310.450 SYSTEM COMMUNICATIONS - COMMUNICATION DEVICES:

Ensure that connections to telecommunication systems complies with BS 6701.
Provide an ADSL link.

310.460 SYSTEM COMMUNICATIONS - COMMUNICATIONS PROTOCOLS:

Arrange the digital data interchange systems using open system protocol.
Possible applicable standards – refer to scope of works for details
BS EN 61158-2 (fieldbus).
Profibus (BS EN 62769-series)
Profinet (BS EN 62769-series)
Modbus
Modbus over Ethernet
KNX (BS ISO/IEC 14543-series)
BS EN ISO 16484-5 (BACnet)
BS EN 14908-1, BS EN 14908-2, BS EN 14908-3 and BS EN 14908-4 (LonWorks).
Metering data exchange:
Smart metering:
BS EN 62056-series Electricity metering data exchange
BS EN 50491-11 HBES smart metering user display
PD CEN/TR 16061 smart gas meters
PD CEN/CLC/ETSI TR 50572 Functional reference architecture for communications in smart metering systems
PD CLC/TS 50568-4 and PD CLC/TS 50568-8 Electricity metering data exchange
BS EN 61968-9 system interfaces for utility metering interface and control
Ensure that the selected field level protocol can:
Run on the required communications media.
Provide a communications throughput sufficient for the intended application.
Provide appropriate network topology options.
Allow sufficient maximum physical segment length.
Allow sufficient maximum number of nodes for each physical segment and the logical network.
Provide sufficient maximum distance between nodes.
Make use of off-the-shelf network devices such as repeaters, bridges and routers.
Allow control devices to be powered from the network if defined in the scope of works
Ensure that the protocol is compatible with fully developed network configuration and management tools.

310.470 SYSTEM COMMUNICATIONS - DIRECT INTEROPERABILITY:

Ensure that each of the protocol's objects and attributes are consistent with the achievement of the specified level of direct interoperability.
Ensure that each of the protocol's arrangements for physical connection, data packaging, network management and error detection/correction are the same.

310.480 SYSTEM COMMUNICATIONS - GATEWAYS:

Ensure that the gateway can

Transfer the specified maximum number of points.
Limit loss of functionality to the level specified.
Add functionality where specified.

Ensure that the specified contingency and alarm measures in response to a failure of the gateway are met.
Ensure that the gateway can be modified in response to any future changes relating to the type and amount of data transferred over it.
Clearly define who has contractual responsibility for the implementation of the gateway.

310.490 SENSORS AND DETECTORS - GENERAL:
Ensure that all signals are compatible with interfaces fitted to associated field control devices.
Ensure that the performance of the sensors and detectors are not adversely affected by variations in power supply conditions in accordance with BS EN 50160 (with additional voltage drop in the electrical installation defined in BS 7671), or by anticipated conducted and radiated electromagnetic disturbances for the electromagnetic environment in which the sensors and detectors are to be used.
Ensure that connections to sensors and detectors are of a screw down clamp type or self-locking connectors.
Ensure that sensors, detectors and meters are installed in accordance with the manufacturer's instructions and recommendations.
Ensure that calibration conditions for meters are fully documented in the O&M manuals and clearly marked on or adjacent to the meters.
Ensure that any calibration and maintenance requirements for sensors, detectors and meters are documented in the O&M manuals.
Interface detectors and sensors with controllers and indicators via amplifiers or transmitters, where necessary.
Provide calibration certificates for all sensors used on projects where there is a validation requirement.

310.500 SENSORS AND DETECTORS - TEMPERATURE SENSORS:
Standard BS EN 60730-2-9 and BS EN 14597 where appropriate.
Sensors shall not drift by more than 0.1 °C per year, and have a hysteresis value of less than 0.05%.
Off/On thermostats for general applications shall be metal with sensor accuracy of +/- 0.5 °C and volt free contacts for derivation of low voltage status signals
Time constant
Space/outside air temperature - 300s still air.
Duct air temperature - 120s @ 1m/s.
Water - 30s @ 1m/s.

Ensure that temperature sensors comply with the minimum requirements of the following table.

Temperature sensors - minimum requirements

Fluid	*Temperature range °C*	*Sensor accuracy °C*
Air	-10 to +40	+/- 0.5
Flue gas	+30 to + 850	+/- 3.0 (0.75% of FSD above 450^{0}C)
Chilled Water	-10 to + 30	+/- 0.25
Water	-10 to +150	+/- 0.5

310.501 AIR THERMOSTATS - ROOM TYPE:
Standard - BS EN 60730-2-9.

310.505 AIR SENSOR - INSERTION TYPE:
Use proportional type insertion sensor.
Sensor
Averaging type temperature sensor for mounting overface of air flow in an air-handling unit or in ductwork adjacent to a heating coil.
Thermistor type temperature sensor, minimum stem length 200mm for mounting in the air flow or distribution ductlines.

310.510 SENSORS AND DETECTORS - HUMIDITY SENSORS:
Standards - BS EN IEC 60730-2-13
Provide humidity sensors as follows:

no need to recalibrate within a period of at least 12 months
response time of less than 30 seconds
hysteresis value of less than 3% of the measurement range
drift not exceeding 5% of the measurement range per year
useful life span of not less than 3 years

Ensure that humidity sensors comply with the minimum requirements of the following table.

Humidity sensors - minimum requirements

Sensor	*Humidity range*	*Sensor accuracy*
Humidity	10 to 90%	+/- 5% RH

310.520 SENSORS AND DETECTORS - AIR VELOCITY SENSORS:
Standard - BS EN 60730-2-15.
Ensure that air velocity sensors comply with the minimum requirement of the following table.

Air velocity sensors - minimum requirements

Sensor	*Sensor range*	*Sensor accuracy*
Pitot static tube	3 to 80 m/s	+/- 2% of reading
Thermo-electric anemometer	0 to 20 m/s	+/- 3% of reading or +/- 0.1 m/s whichever is greatest

310.530 SENSORS AND DETECTORS - AIR PRESSURE SENSORS:
Ensure that air pressure sensors are manufactured from stainless steel and comply with the minimum requirements of the following table.
Air pressure sensors - minimum requirements

Sensor	*Sensor range*	*Sensor accuracy*
Air pressure	-	+/- 2% of reading

310.535 SENSOR AND DETECTORS - FLOW SENSORS:
Standard – BS EN IEC 60730-2-15 or BS EN 60730-2-15.

310.540 SENSORS AND DETECTORS - FLOW METERS:
Ensure that meters comply with the minimum requirements of the following table.
Flow meters - minimum requirements unless scheduled otherwise.

Meter	*Meter range*	*Meter accuracy*
Fuel flow meter	0 to 10 Hz	3% of reading
Water flow meter	less than 5:1	2% of reading
Electricity meter	-	1.5% of reading

Where a meter is used to measure the amount of energy supplied for billing purposes, the meter must be approved and stamped by NMO (National Measurement Office) or approved under the European Measuring Instruments Directive (MID 2004/22/EC).

310.545 SENSORS AND DETECTORS - LEVEL SENSORS
Provide level detectors as indicated.
Use stainless steel capacitance electrodes with PTFE insulation for liquids with minimum conductivity of 0.01 S/m.
Use stainless steel conductivity electrodes.
Use float type to BS EN IEC 60730-2-15 or BS EN 60730-2-15.
Provide indicator showing measured value at sensor. Calibrate indicators.

310.546 SENSORS AND DETECTORS – OTHER SENSORS:
CO sensors
BS EN 50291-1 for manufacture and testing of detectors designed for domestic premises.
BS EN 50292 for selection and installation of detectors in domestic premises.
CO_2 sensors.
Operating principle – NDIR (non dispersive infra red)
Measurement range – 0-2000 ppm, numerical resolution 1ppm
Accuracy - +/- 1% measurement range; +/- 5% of reading (within +/- 10^{0}C calibration temp)
Annual zero drift - <=/- 0.3% measurable range

Response time – 20s with tube connection at 0.1l/min
Operating temperature 0-50^{0}C

Combustible gases

BS EN 50271 for apparatus using software and/or digital technologies and BS EN 50194-1 for combustible gases in domestic premises.
Equipment for use in explosive atmospheres to be in accordance with BS EN 60079-29-1 and installed in accordance with BS EN 60079-29-2

Toxic gases

Design, performance functionality and testing in accordance with BS IEC 62990-1
BS EN 50271 and relevant parts of BS EN 45544 series for electrical apparatus for the detection and measurement of toxic gases using software and/or digital technologies.

Oxygen

BS EN 50271 and BS EN 50104

310.550 SENSORS AND DETECTORS - SENSOR TIME CONSTANTS:
Ensure that the following sensor time constants are met.

Table 6 BSRIA AG9 Sensor time constants

Measure medium	*Time constant*
Space/outside air temperature	300s still air
Duct air temp	120s @ 1m/s
Water	30s @ 1m/s
Relative humidity	300s @ 1m/s
Light	Instantaneous
Flow - water	5s
Flow - liquid fuel or gas	5s

310.555 TRANSMITTERS:
Use transmitters to interface between sensor and controller, utilizing only one sensor.
Resistance thermal device (RTD) to BS 1041-3
Resistance thermal device (RTD) to BS EN 60751.
Thermocouple to BS EN 60584-series type .

310.561 AIR FLOW VELOCITY SENSORS / DETECTORS
Where indicated, provide multi - point, integrating measuring devices in ductwork.
The units shall be suitable for the level of filtration to be provided and complete, comprising as a minimum,
a frame work to allow it to be built into the ductwork system,
all transducers, signal processors etc, to enable it to produce a signal in a form required by the BEMS (0-10 V, 4-20mA).
in-built calibration equipment for any on board electronics
display of the sensed flow at the grid
The number of sensing points shall be capable of measuring the flow to an accuracy of +/- 5% of the sensed system volume (over the full range of operating volumes on variable volume systems) to a minimum velocity of 1.5m/s..

310.610 AIR THERMOSTATS – ROOM TYPE
Standards BS EN 60730-2-9; Type as indicated and to suit application.

310.640 AIR THERMOSTATS - FROST PROTECTION TYPE:
BS EN 60730-2-9.
BS EN 14597
For space mounting use frost protection thermostats with temperature range of 0-20ºC and with SPST switching action and electrical rating of 20 amps resistive.
For heater battery protection use frost protection thermostats consisting of a gas filled sensing element and a bulb, a directly adjustable set point and switching differential.
For compensated systems use external frost type thermostats with proportional type sensor, the whole unit being weather-proofed.
Ancillaries
Start up switching and indication

Manual or automatic reset facility as detailed in the scope of works or control strategy diagrams.

310.645 WATER IMMERSION THERMOSTATS:
Standards - BS EN 60730-2-9, BS EN 14597
Use proportional type immersion thermostats with rigid sensing elements ensuring 50mm minimum length is immersed. Use separable pockets, screwed 15mm BSP.
Install pockets in positions indicated.

310.650 HUMIDISTATS:
Differential – 4% RH
Accuracy – 3% RH

310.700 ACTUATORS:
Include position feedback devices suitable for connection to the BMS.
Ensure that actuators incorporate a disconnection device to allow manual operation of the valve or damper in the event of actuator failure.
Where line voltage actuators are used, provide local means of isolation by manual isolator or plug and socket connection.

310.705 ACTUATORS - SOLENOID TYPE:
Standard - BS EN 60730-2-8 for electrically operated water valves up to DN 50.

310.710 ACTUATORS - ELECTRONIC TYPE:
Standards
BS EN 60730-2-8 for electrically operated water valves up to DN 50.
BS EN IEC 60730-2-14 for electric actuators
BS EN 1349 and relevant parts of BS EN 60534 for actuators fitted to industrial process control valves from DN 15 up to DN 1200.
Use low voltage, high torque, electronic type actuators, including mounting brackets, adjustable linkages and necessary attachment devices.
Control mode – as described in controls narratives
Actuators, together with linkages, shall operate smoothly from fully open to fully closed positions without binding and with adequate torque to overcome resistances of bearings and fluid flow.

Clearly mark linkages with clamping position so that after maintenance or replacement the mechanism can be easily restored to its correct operating position.
Fit visual position indicators.
Electrically and mechanically protect actuators against the effects valve or damper seizure.
Incorporate disconnection device to allow manual operation in the event of actuator failure.
Where indicated or necessary for correct system operation provide a position feedback device connected to Controls/BMS.

310.716 ACTUATORS - ELECTRIC MOTOR:
Standard
BS EN IEC 60730-2-14 for electric actuators
Provide thermal overload protection with manual reset option.
Electrical requirements
Integral terminal strip or DIN plug and socket connections C/W two end of travel limit switches, with adjustable cam operation for motor de-energisation.
Mechanical requirements
Manual override, geared to prevent backdrop, position indicator.
Enclose to IP65 minimum.

310.805 MOTORISED VALVES / ACTUATORS:
Type – As described in controls narratives
Standards
BS EN 60730-2-8 for electrically operated water valves up to DN 50
BS EN 1349 and relevant parts of BS EN 60534 or BS EN IEC 60534 for industrial process control valves from DN 15 up to DN 1200

Pressure Independent Control Valve (PICV) - tested in accordance with BSRIA BTS 1/2012.
Ancillaries
Position indicator, Locking device, control device and linkage mechanisms and as required to match control function

Actuating motive power - to match control system

Valve/actuator combinations shall be capable of closing off fully. In the case of 2 port control, this shall be against the full closed head of the installed pump.

General ancillaries - Positioners, locking device and lever for manual operation / control failures

The failure position of control valves shall be as follows:
Humidifiers, heating to HWS calorifiers, and items fed by steam- closed to load (i.e. spring return)
Heating and cooling coil and frost protection - open to the load or mid-position
Others - mid-position

310.905 MOTORISED DAMPERS AND SHUTTERS:
Use motorised control dampers manufactured and installed in accordance with DW/144.

310.906 RELAYS:
Use demountable relays of the totally enclosed type having at least one spare set of changeover contacts.
Electrical terminals to be shrouded and screw down clamp
Provide indicator tags/LEDs to indicate energised state. Provide manual actuation for test purposes.

320.000 INSTALLATION

320.050 FIXING AND CONNECTION - CABLING
Plan and install all building management monitoring systems cables in accordance with the cable manufacturer's recommendations.
Label and record all monitoring cables
General
This part of the specification covers extra-low voltage wiring (as defined by BS 7671), i.e. signal and data communications wiring. For power wiring refer to relevant “Y” sections of this specification.
Install all cabling in accordance with BS EN 50173-series, BS EN 50174-series and BS 7671 (IET Wiring Regulations).
All cabling must be adequately protected from the environment through which it passes to avoid the possibility of mechanical damage and electromagnetic interference.
Install cabling and conduits associated with sensors in a manner that prevents spurious transfer of moisture and heat etc from external sources to sensing devices.
Ensure that all wiring is carried out in a neat manner by skilled operatives. Clip wiring to form a loom and route it to avoid interference with the correct operation or maintenance of other components.
Cable type and application
Ensure that the types of cable installed do not prejudice satisfactory operation of the BMS.
Ensure that the type of cables, installation and planning comply with the BMS manufacturers recommendations and the project's electrical specification.
Ensure that the cross-sectional area of cables is sufficient to ensure that sensor circuit resistance limits are not exceeded.
Ensure that the method of installation and routing of cables does not compromise the satisfactory operation of the BMS.
Ensure that the minimum separation distances between data/analogue signal cables and cables of other services (including) power cables comply as relevant with BS 7671 and BS EN 50147 series.
Identification
Ensure that all cables have identification sleeves at their terminations which combine the requirements of BS 7671 with those for specific circuit identification. Ensure that the identification is consistent with the relevant wiring diagrams.

320.060 FIXING AND CONNECTION - USE OF EXISTING CABLE AND WIREWAYS:
Confirm by testing or obtain appropriate certificates from original suppliers that any existing means of network communication is of a suitable standard for satisfactory operation of the BMS.

Ensure that any tests performed comply with relevant parts of BS EN 50174.
Ensure that the potential corruption of data cannot arise from:
Other installations not connected to, but in close proximity to, the route of existing cabling
Other electrical services using existing cabling
Other adjacent cabling.
State in writing at the time of tender whether or not existing cabling is suitable.

320.070 FIXING AND CONNECTION - CONNECTION TO PLANT AND CONTROL EQUIPMENT:
General
Provide all devices and terminals necessary to connect the BMS to items of plant and control equipment.
Take account of any existing services that have to remain in continuous operation. Provide for approval, an installation and commissioning plan that identifies how the BMS equipment can be installed an commissioned without disrupting the operation of the existing building services.
Where plant and control equipment are supplied by others, provide the adequate interface and integration (physical and functional) needs for installation and commissioning requirements. Provide this information in time and in sufficient detail to enable any other installers and their suppliers to incorporate the BMS connection facilities before delivering their equipment to site.
Where plant is subject to warranty by others, obtain clearances in writing from those concerned that the proposed modifications do not invalidate the warranties.
Ensure that modifications carried out as a result of the contract are fully documented and do not affect the satisfactory operation of safety devices connected to any plant or systems affected directly or indirectly by the BMS works. Carry out proving tests to the satisfaction of the Project Supervisor.
Ensure that the use of existing relays, contactors, starters and switches as part of the BMS installation is fully documented.
Safety interlocks
Provide interlocks as scheduled to establish and maintain safe/pre-determined plant conditions under all modes of operation including loss, reduction and restoration of power.
Ensure that all safety hard-wired interlocks are wired to failsafe on loss of power, or on relay coil failure, or on open circuit, eg cable breakage.
Ensure that all interlocks use voltage-free contacts and AC or DC 24V relays and field wiring.
Complete all wiring and testing of all hard-wired safety interlocks to ensure safe and/or sequenced operation of the plant before the BMS is set to work. Arrange interlocks to prevent unsafe or out of sequence operation of the plant by the BMS.
Ensure that plant does not operate using the BMS until all interlocks have been tested to the satisfaction of the Project Supervisor.
Manual control
Provide manual control facilities to enable plant maintenance/facilities staff to operate essential plant in the event of BMS failure and for routine test purposes. Ensure that the facilities include:
Start/stop operation of the plant.
Automatic operation of motorised control devices such as valves and dampers, etc if the BMS is operating.
Manual setting of motorised control devices such as valves and dampers, etc if the BMS has failed.
Ensure that the manual control facilities do not override safety devices or hard-wired interlocks.
Volt-free contacts
Ensure that the contact materials are suitable for use in the installation and at the required voltages and currents.
Use screw down or locking spade terminals for electrical connections to volt-free contacts.
Relays
Use demountable relays of the totally enclosed type.
Use relays with circuit arrangement printed on top.
Use screw down clamp or locking spade-terminals, and ensure they are shrouded.
Use relays with LED or flag indication of coil status.
.Signalling from starters
Provide additional contacts for signalling and remote operation purposes as scheduled
Control equipment
Obtain advice from the relevant supplier when additional facilities are to be fitted to control equipment supplied by others.
Use the knockouts, cable routes and terminals, etc incorporated into the design of control devices.
Packaged plant

Ensure that connections to packaged plant are made within the packaged plant control panel. Fit an additional enclosure where this is not possible. Ensure that all connections between the BMS and packaged plant are 24V maximum.

320.080 FIXING AND CONNECTION - ADDITIONAL PROVISIONS FOR RETROFIT INSTALLATIONS:

Arrange for any necessary control modifications to existing plant to be carried out by the original supplier (with the exception of starter panels). Give the supplier details of the requirements for connection of equipment to the BMS. State the name of the supplier in the Tender together with a priced schedule for the necessary work.

Where details of existing plant are not available from the original supplier or from record documents, provide a specialist conversant with the particular type of plant to carry out any necessary modifications. Provide the specialist with the details of the BMS connections required. State the name of the specialist in the Tender together with a priced schedule for this work. Advise the Project Supervisor of any difficulties with connections.

Advise in writing at the time of tender of any potential delay to the contract arising from the difficulty of providing the necessary BMS connections to the plant.

Use existing relays and volt-free contacts where feasible.

Fit auxiliary contacts to contactors, etc where adequate space is available. Install additional relays if the space is not adequate.

Obtain advice from the original supplier when additional facilities are to be fitted to existing control equipment.

Use the control manufacturer's standard accessories to provide any additional contacts, limit switches and potentiometers, etc.

Use the knockouts, cable routes and terminals, etc incorporated into the design of control devices wherever possible. Obtain approval from the Project Supervisor for ad hoc fixings and modifications to control devices before action is taken on site.

320.091 CABINETS FOR BMS EQUIPMENT DESIGN AND CONSTRUCTION:

Construct BMS equipment enclosures to give the minimum degree of protection to IP54 and IP 55 in wet plant rooms, unless scheduled otherwise, in accordance with BS EN 60529. Where the enclosure is fitted inside another panel (eg a motor control center to IP 54 or 55) the protection can be reduced to IP41. For external applications, construct enclosures to IP 65 unless scheduled otherwise.

Ensure that access doors are of a rigid construction and mounted on stout metal hinges capable of supporting the full weight of the open door. Ensure that doors will not sag or drop when open. Fit doors with stout locking handles to prevent access by unauthorised personnel.

Allow safe access to the BMS equipment where the BMS equipment is incorporated into another control panel without having to isolate the panel.

320.101 CONTROL PANELS - DESIGN, CONSTRUCTION & INSTALLATION:

Refer to schedules or scope of works for control panel type, internal separation, input power supply and electrical ratings.

Standards

BS EN 63044-series for controllers

Relevant parts of BS EN 61439-series where the control panel forms part of switchgear and/or controlgear as defined in the standard

BS EN 60204-1 where the control panel may be considered to form part of machinery as defined in the Supply of Machinery (Safety) Regulation 2008 as amended

BS EN 60529 for ingress protection

BS 7671 (IET Wiring Regulations)

BS EN 62208 for enclosures

Control panel design

Ensure that the layout of control panels reflects the layout of the plant being served. Ensure that indicators and controls for associated plant are grouped.

Ensure that all doors on panels containing exposed dangerous voltages are provided with interlocked isolators such that the door cannot be opened except with the isolator in the 'off' position. Ensure that isolation complies with BS 7671 (IET Wiring Regulations).

Ensure that equipment that requires on-line adjustment and testing by non-electrically qualified personnel is accessible and usable without interrupting the supply or overriding safety interlocks. Ensure that in general, field controllers are not located within control panels where isolation is necessary to gain access.

Design panels to maintain all components within their environmental tolerance limits taking into account ambient environmental conditions. Install fans with thermostatic control and air extract grilles and air intake grilles with replaceable filters where mechanical ventilation is required to control the environmental conditions.

Ensure that the specified ingress protection (IP) ratings are maintained.

Service conditions

Ambient air temperature to relevant parts of BS EN 61439.

Suitable for ambient air temperature for outdoor installations where required.

Altitude to relevant parts of BS EN 61439.

Suitable for use at altitudes above 1000m where required.

Electromagnetic compatibility

Environment A to BS EN 61439-1 (industrial)

Environment B to BS EN 61439-1 (domestic and light industrial)

Control panel construction

Construct control panels inside buildings to IP54 and IP 55 in wet plant rooms. For external applications, construct enclosures to IP65 unless scheduled otherwise.

Where the enclosure is fitted inside another panel (eg a motor control centre to IP 54 or 55) the protection can be reduced to IP41.

Construct the panels using sheet steel, folded and seam welded to form a rigid self-supporting structure. Ensure that bracing and stiffening is used as necessary to take the weight of internal components and control assemblies. Ensure that no sharp corners are present.

Ensure that control panels weighing more than 50 kg including installed components are fitted with eyebolts to facilitate delivery and installation.

Ensure that panels are provided with adequate undrilled and/or detachable gland plates of sufficient size and strength to accept glands for all types of cable conduits and cable trunking intended for termination within the panel.

Arrange all wiring within the panel in looms and/or perforated trunking. Ensure that all cables are run continuously from terminal to terminal without intervening joints.

Ensure that all terminations are fully shrouded, recessed or otherwise protected against accidental contact to at least IP 2x / IP xxD

Ensure that where live equipment cannot be isolated it is covered with a perspex shield carrying appropriate warning labels in addition to specified shrouding.

Ensure sufficient spare capacity in cable ways and trunking to comply with BS 7671.

Ensure that flexible looms are used to connect door mounted to interior-mounted components such that wires will not weaken or break with repeated door openings. Arrange the loom to avoid pinching or looping when the door is closed and ensure that it is fully supported at each end.

Locks to be multipoint locking system with T-handle / key unless scheduled or described otherwise in the scope of works.

Internal wiring

Standard

BS 6231 polyvinyl chloride (PVC) insulated or BS EN 50625-3-41 low smoke zero halogen (LSZH)

BS 6701, BS EN 50173-series and BS EN 50174-series for telecommunications cables

Identification of conductors - Comply with the following standards, as relevant:

BS EN 60445 core standard for identification of conductors

BS 7671 for wiring forming part of the electrical installation

BS EN 60204-1 for control panels that are classed as a component of machinery in accordance with Supply of Machinery (Safety) Regulations 2008

BS EN 61439-series for switchgear and controlgear assemblies

BS 6701, BS EN 50173-series and BS EN 50174-series for telecommunications cables

Identification of earthing and bonding conductors

Ensure protective conductors are coloured cream and labelled in accordance with and BS 7671 and BS EN 60445.

Ensure dedicated telecommunication functional earth conductors are identified and labelled in accordance with BS 6701.

Ensure combined protective earthing and functional earthing conductors are identified primarily as protective conductors.

Control wiring

Segregate control and auxiliary contact wiring from power circuits and data communications circuits.

Provide electrical separation for voltages of different bands in accordance with BS 7671, BS EN 60204-1 and BS EN 61439- series as relevant.

Contain control wiring in slotted plastic trunking

Take account of thermal effects of grouping when routing power wiring.

Wire termination practice

Identify every wire at each end with a unique wire number according to the control panel drawings and cable schedule. Wire numbers may be formed from numbers and uppercase letters. Ensure the system

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used cannot be confused with alphanumeric conductor function identification requirements of BS EN 60445 and BS 7671.
Terminate wiring intended for screw terminals with ferrules to prevent damage to conductors, and facilitate fault finding and maintenance replacement of components.
Arrange all wiring within the panel in looms and/or perforated trunking. Ensure that all cables are run continuously from terminal to terminal without intervening joints.
Ensure sufficient spare capacity in cable ways and trunking to comply with BS 7671 (IET Wiring Regulations).
Ensure that flexible looms are used to connect door mounted to interior-mounted components such that wires will not weaken or break with repeated door openings. Arrange the loom to avoid pinching or looping when the door is closed and ensure that it is fully supported at each end.
Provide DIN-rail mounting for equipment and terminate to.
BS EN 60715 dimensional type designation as agreed by the designer:
Ensure steel DIN-rails are manufactured and finished in accordance with Appendix A to BS EN 60715.
Location
Do not locate outstations within control panel compartments where isolation is necessary to gain access.
Control panel labelling
Ensure that all panels and individual panel sections are provided with exterior labels to BS EN ISO 7010 and BS 7671 (IET Wiring Regulations) indicating the voltage within the panel along with clear warnings of risk and instructions for isolation. Display requirements for informing the BMS supervisor and/or disabling alarms prior to isolation of control circuits.
Label all switches, controls and indicators on control panels as to function and associated plant.
Fix a notice to the front of the panel warning of the need for isolation elsewhere if the panel does not totally control the electricity supply to associated plant.
Identify all cables with permanently fixed alphanumeric labelling system. Ensure that the numbering corresponds to the numbers fixed to the terminals. Ensure that identification and coding matches that used on the design drawings, schematics and schedules.
Lights
Use LEDs
Use lens colours in accordance with BS EN 60073.
Audible alarms
Ensure that operation of any starter trip lamp, safety circuit lamp or alarm lamp operates a common audible alarm with mute and test facilities and terminals for remote alarm signal.
When an alarm condition has had the audible alarm muted, ensure that terminals for a remote 'alarm accepted' light are energized. The audible alarm circuit and terminals for remote alarm signal must still be capable of indicating another fault occurring even though original fault has not been cleared. The test facilities are to test momentarily both the audible alarm and alarm indicator lamps, whilst the push button is depressed.
Use alarms that interface with a sensor or controller to sense set-point and measured value. Provide adjustable upper and lower limits on face of unit. Provide unit with indicating lamps to show which limit has been exceeded. Provide each unit with connections for remote alarm.
Surge and transient suppression
Ensure surge arrestors are fitted for star-connected and star-delta started motors to limit peak voltage to 1200 V.
Ensure transient suppressors in the form of resistor and capacitor networks are fitted across starter contactor coils.
Controlgear
Terminals for external conductors
For main power circuits, accommodate cross-sectional area of copper cables in accordance with BS EN 61439-1, Appendix A.
Size neutrals on 3-phase supplies to take account of harmonic content (triple-n's) where relevant, with a minimum of the full current-capacity of the corresponding phase conductors.
For control and auxiliary circuits, provide terminal blocks suitable for DIN rail mounting on top-hat rails dimensional type TH 37-7,5 to BS EN 60715.
Accessibility for inspection
Arrange for following operations to be performed when assembly is in service and under voltage.
Visual inspection of switching devices and other apparatus, settings and indicators of relays and releases, conductor connections and markings.
Adjusting and re-setting of relays, releases and electronic devices.
Replacement of fuse links and indicating lamps.
Fault location by voltage and current measuring.
Accessibility for maintenance

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Provide space between functional unit or group and adjacent functional units or groups. Provide retainable fastening means for parts likely to be removed for maintenance.
Use barrier protected sub-sections for each functional unit or group.
Use compartments for each functional unit or group.
Removable parts and withdrawable parts
Degree of protection of assembly after removal or withdrawable of part as manufacturer's standard.
Mounting – As scheduled or detailed in the scope of works
Site modification
Do not make site alterations unless authorised. Where site modifications to assemblies are authorised make in accordance with manufacturer's certified drawings and instructions. Ensure that modifications made comply with type test certificate obtained for arrangement of components.
Provide document pocket inside the control panel, complete with full control panel schematic and wiring schedule.

320.102 FIREMAN'S OVERIDE FAN CONTROL PANEL

Supply and install a fireman's override fan control panel as specified in the scope of works or as indicated on the drawings.
Provide plant switches required are located under a breakglass panel which has a budget lock (ie one which accepts the keyed base of a firemans axe).
Switches shall be configured by plant as Override On/Normal/Override Off. An indicator lamp shall be provided for each position. The colour of the panel shall be agreed with the CA. Allow for stainless steel panel with all text etched and coloured. Panel to be recessed. Size / finish to match fire alarm panel as Architect's details.

320.110 SENSORS - GENERAL:

Ensure that sensors can be removed for testing and maintenance.
Ensure that a tight-sealing test hole is provided adjacent to every duct sensor. Ensure that Binder test points, or similar, are provided for pipe sensors.
Provide a sufficient length of spare cable so that the sensor can be removed without disconnecting the wiring.
Mark and record the location of concealed sensors (e.g. in false ceilings and shafts, etc).
Provide a labelling plate for each sensor.
Take account of the active and inactive sections of a sensor probe.
Take into account the effects of orientation on the functioning of the sensor.
Take into account:
Minimum/maximum ambient temperature.
Ambient humidity.
Vulnerability to spray water and/or vibration.
Explosion protection.
External influences.

320.120 TEMPERATURE SENSORS:

Pipe-mounted immersion sensors
Ensure that the full active length of the sensor is immersed in water.
Install sensors against the direction of flow.
Install at the correct angle.
The sensor should be installed diagonally in a bypass pipe or in a bend if the active length of the sensor probe is longer than the diameter of the pipe.
Allow an adequate space between the sensor and the obstruction so that the sensor can be removed from the immersion pocket.
Ensure that immersion pockets are made from stainless steel of the appropriate pressure rating.
Ensure that immersion pockets are filled with a heat conducting compound.
A test point or an additional immersion pocket, adjacent to the sensor, should be provided for test purposes.
An adequate distance (10 x pipe OD) between the mixing point and the sensor should be provided when mixing water at different temperatures to take account of stratification.
Surface temperature sensor - water
Ensure a smooth clean contact surface and fill the space between the sensor and the pipe with a heat conductive compound to improve thermal conductivity.
Immersion sensors for air (ducts)
The full active portion of the sensor probe should be exposed to the air flow.
Ensure that the active portion of the probe is located central to the airflow.

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A test hole should be provided adjacent to every sensor with plug when not in use.
Probe-type sensors should not be used in areas where stratification can occur, eg downstream of heating and cooling coils, etc (see averaging sensors).
Sensors which are positioned near to coils should be shielded against the radiative heat transfer.
Return air duct sensors should be located near to the occupied space to avoid heat gain or loss and radiant effects influencing readings.
Sensors must be positioned in an area of representative air flow. This applies to all duct sensors but particularly the return air sensor which may be located in the ceiling plenum.
The likely cleanliness of the air should be considered when selecting sensors.
Sensors representing zone temperature should be offset to account for heat gains e.g. space temperature stratification or if light fixtures are used as the return air path.
Sensors should only be used in return air ducts where air is continuously extracted.

Capillary sensors with probes

The device head must be higher than the sensor probe.
The sensor probe should be tilted downwards.
The ambient temperature at the device head must always be higher than the temperature to which the sensor probe is exposed.
The sensor element must always point downwards. The capillary should not form a U-shape.
The capillary should not be bent too tightly (radius of bend 50mm).

Averaging sensor (for use in ducts/AHU)

Allow a distance of at least 50 mm between any heat exchanger and the sensor.
The entire length of an averaging sensor must be fully inside the air-duct.
The sensor element must be evenly distributed over the full cross-section and adequately secured to prevent vibration.
The sensor element should be installed in the air flow, downstream of the eliminator plate when air washers are used for humidification.

Frost protection thermostat

Leave a spare capillary loop of 20 cm to enable sensor testing outside the duct/unit.
The measuring head and the test loop of the thermostat must be located inside the ductwork and downstream of the heat exchanger if the ductwork is outdoors or in an unheated space.
The capillary should be installed in the air flow, downstream of the first heating coil exposed to frost. The capillary must be installed diagonal to the heat exchanger pipes or in a serpentine manner at right angles to the pipes.

Room sensor

Sensors should be installed at a height of 1.5 m in occupied spaces and at least 50 cm from any adjacent walls.
Where room sensors have an adjustable dial they shall be mounted at 1.2m
The sensor should be located in an area representative of the entire control zone.
The sensor should be located away from heat sources, e.g. office IT equipment.
The sensor should be located in the area it controls.
Sensor locations near air currents generated by diffusers or openable windows, for example, should be avoided.
The sensor must not be exposed to direct solar radiation.
Avoid external walls except were unavoidable. Use insulated backplates.
Avoid recesses and alcoves.
The conduit entry points to the sensor wall box should be sealed where there is a risk of air from another zone flowing over the sensor element.
Do not install near or under lamps or above radiators.
Avoid chimney walls.
Do not install directly adjacent to doors.
Do not install behind curtains.
Do not fit to walls concealing hot-water pipes.

Outdoor air temperature sensors

Do not install on facades affected by significant rising heat, or facades which will be heated by solar radiation (fix sensors to a north-facing wall or use solar shields).
Avoid chimney walls and other walls subject to high internal heat gains.
Do not install under eaves.
Do not install above windows.
Do not install above ventilation extracts.

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Ensure accessibility for inspection/verification
An alternative to an external mounting is to locate the sensor in the AHU intake duct. This should ideally be upstream of the intake damper and on AHU plant which run continuously (24/7). Where this is not possible it must be a suitable distance before re-circulated air and mechanical devices to avoid their effects.

320.130 HUMIDITY SENSORS:

Humidity sensor/stat. - duct

The air velocity in the vicinity of the sensor must not exceed 10 m/s (a perforated steel plate cover can be used).
The sensor must not be located in deadlegs (super-saturation can occur in areas where there is no air flow).
A test hole must be provided downstream of the sensor, plugged off when not in use.
The sensor should be positioned beyond the spray distance of humidifiers.

Humidity sensor/stat. - room

The sensor should be installed at a height of approximately 1.5 m in the occupied space and at least 50 cm from the adjacent wall.
Avoid locations where the sensor will be exposed to direct solar radiation.
Avoid external walls except were unavoidable. Use insulated backplates.
Avoid alcoves and recesses.
Do not install near lamps or above radiators.
Do not fit to chimney walls.
Do not fit directly adjacent to doors.

320.140 PRESSURE SENSORS:

Pressure - general

Pressure sensors are affected by orientation.
The pressure tubes must be provided with a binder point near the device head for test purposes.
The connection must be fitted with a bypass with a stop valve to avoid overload on one side when manipulating the sensors and to enable zero calibration. Isolating valves should also be fitted.
The sensor should be installed on a vibration-free surface or vibration-proof base.
The pressure-tapping point must not be located in turbulent air flow. Provide 6 x OD upstream and 6 x OD downstream of straight duct or pipe without obstructions.

Pressure - air

Probes for measuring static pressure should be installed parallel to the flow.
The differential pressure measuring tube should be correctly sized.
The tapping point should not be located where it will be affected by obstructions to the flow.

Pressure - liquids

Use a damping coil to avoid transferring vibrations (horizontal loops to avoid trapped air bubbles and condensate).
The device must always be installed in a location which is lower than the sensing point.
Do not measure at the top of a pipe (trapped air, bubbles) or at the bottom (dirt).

Pressure - gases

When measuring vapour gases the device must always be installed in a location which is higher than the sensing point.
Measure at the top of the pipe to prevent condensate from entering the pressure tube.

320.150 FLOW VELOCITY/FLOW RATE SENSORS:

Differential pressure for flow monitoring - liquids

There should be no stop valves or balancing valves between the sensing points on the pipework.

Differential pressure for flow monitoring - air

Ensure a steadying zone upstream and downstream of the orifice plate/flow grid, etc.
The flow or differential pressure must not be monitored where there is a variable resistance such as a filter or fan, etc.

Velocity sensors

Sensors should be positioned at an adequate distance from bends, tees, fans and coils such that the centre line velocity is representative of the average velocity.
A single point sensor should be located at a distance from the centre of the duct equal to 0.25 x the duct radius.

Wilson flow grid

Averaging velocity sensors across the duct, e.g. Wilson flow grid or multi-point averaging pitot tubes, should be used where the minimum separation distance from a flow disruption is not available. Ensure that the Wilson flow grid is sized correctly for each duct size.

320.160 INDOOR AIR QUALITY SENSORS:

CO_2 and mixed-gas sensors - room mounted

Ensure that the sensor is located in a representative location, e.g. on an open wall 1.5 to 3 m above the floor.

Ensure that the sensor is not mounted in niches or bookshelves or behind curtains.

Ensure that the sensor is not located where people are continuously present (within 1 or 2 metres).

CO_2 and mixed-gas sensors - duct mounted

Ensure that the sensor is located in the return air duct as close as possible to the room extract point(s).

Ensure that the sensor is located in the vertical position.

Ensure the correct orientation of the duct probe with respect to the airflow.

Ensure that the sensor is not installed in a vertical position with the head at the bottom.

320.170 ACTUATORS:

Securely mount actuators to rigid members, free from vibration or distortion in accordance with manufacturer's recommendations. Select mounting positions to require minimum linkages, and to avoid angular drive to operating levers. Allow access for servicing and replacement.

Ensure that actuators and linkages for valves and dampers operate smoothly from fully open to fully closed without binding and with adequate torque to overcome the resistance of the actuator mechanism and the flow and to provide the specified close off ratings.

Ensure that linkages are clearly marked with the clamping position such that after maintenance or replacement the mechanism is able to operate correctly.

Fit actuators with visual position indication.

Actuators shall have tamperproof reversible clockwise and anti-clockwise mode selection.

Ensure that there is sufficient space above the actuator so that it may be removed for testing or maintenance.

Include position feedback devices suitable for connection to the BMS.

Ensure that actuators incorporate a disconnection device to allow manual operation of the valve or damper in the event of actuator failure.

Ensure that actuators are electrically and mechanically protected from the effects of valve or damper seizure.

Use 24v actuators wherever possible. Where line voltage actuators are used, provide local means of isolation by manual isolator or plug and socket connection.

Ensure that, during commissioning, valve actuators are fitted in a fully closed/bypass position where they are being fitted to valves which push against a spring.

320.180 VALVES:

General

Ensure that valves have the correct authority without excessive pressure drop.

Ensure that valve bodies are suitable for the medium, the temperature and the pressure of the fluid system.

Ensure control valves have a close-off pressure rating higher than the circuit pressure design.

Ensure that valves will pass the required flow at a pressure drop within the maximum differential pressure rating of the valve.

Check for out-of-balance forces, particularly during operation of a three-port valve.

Where possible ensure that valves are not installed with their spindles in the horizontal position. If valves cannot be installed with their spindles in the vertical position ensure that they are as near as possible to the vertical.

Ensure that valves are not installed with the actuator at the bottom.

Modulating valves

The following additional considerations apply for modulating valves:

Ensure system operating pressures, test pressures, pump heads and pressure drops through heat exchangers and associated pipework are known before control valves are selected.

Select 3 port valves to provide a minimum authority of 0.5 for diverting applications and 0.3 for mixing applications.

Select 2 port valves to provide a minimum authority of 0.3

Select valves with port characteristics appropriate for the intended function.

Ensure that all modulating control valves are selected for equal percentage or linear characteristics according to system type, to provide near linear characteristics between the valve position and heating/cooling power as delivered to the air or water-based system.

Ensure that the rangeability of the selected valves is large enough to provide stable control under low load conditions.

Combined pressure independent 2 port control valves (PICV)

Select, install and commission valves to provide the functions of flow limitation, modulating control and differential pressure control within a single valve body.

The valve manufacturer shall provide test results for each type and size of PICV to be used on the project in accordance with BSRIA Test Method for Pressure Independent Control Valves BTS 1/2012.

Limiting minimum operating pressure – 20Kpa.

For PICVs with a k_v value less than 0.4, a flushing drain should be incorporated in the pipework between the terminal unit and the PICV.

All PICVs' shall have an equal percentage control characteristic, be sized such that the design flow is within the setting range of the valve and be capable of closing against a maximum differential pressure that is greater than the pump head.

Type – Full stroke where the control and flow setting functions are separated within the valve and the full stroke of the valve is available for control (unless scheduled otherwise)

Valve characteristic/control - Equal percentage modulating (unless scheduled or described otherwise elsewhere in this specification).

Duties - To suit terminal unit design flow rates as detailed in equipment schedules.

Standard

Relevant parts of BS EN 60534

Valve leakage class to BS EN 60534-4 when shut off - IV.

Materials:

Body - DZR brass.

Globe or ball - brass.

Stem - brass.

O-Ring/diagram - EPDM rubber.

Springs - stainless steel.

Features - Facility to measure pressure drop across valves at commissioning.

Actuator - 0-10V proportional electric for modulating control or 3 point floating control.

320.190 VALVE SIZING REQUIREMENTS:

All types of valves and applications

Parameter - Body pressure rating.

Requirements - To exceed system test pressure.

All 2-port valves

Parameter - Close-off pressure rating.

Requirements - To exceed pump or system full differential pressure.

All 3-port valves

Parameters - Close-off pressure rating.

Requirements - To exceed out of balance pressures

All types of valves and applications

Parameters - Maximum leakage coefficient.

Requirements - 0.05% kv.

2-port isolation valves

Parameters - Pressure drop at full flow.

Requirements - Select at line size for minimal pressure drop.

2-port modulating valves

Parameters - Pressure drop at full flow.

Requirements - Select kv value for a minimum authority of 0.3, not to exceed 50 kPa.

3-port modulating valves

Parameters - Pressure drop at full flow.

Requirements - Select kv value for 30% - 50% authority against coil or circuit pressure drop.

Isolation valve

Parameter - Characteristic.

Modulating valves (plant valves and zone reheater coil valves)

Parameters - Characteristic.

Requirements - Equal percentage.
Modulating valve (fan coil units)
Parameters - Characteristic.
Requirements - Equal percentage (preferred) or linear.
Modulating valves (independently pumped mixing and injection circuits)
Parameter - Characteristic.
Requirements - Linear.
PICV's – refer to clause 320.180.

320.200 DAMPERS:
Provide visual position indicators on all damper actuators installed so that they can be seen from the plantroom floor.
Ensure that damper characteristics are as linear as possible.
Ensure that modulating dampers are sized correctly to give adequate authority.

320.210 COMMUNICATION NETWORKS - GENERAL:
Ensure that all addressable control devices can be addressed over the communications network.
Ensure that the bandwidth and subsequent speed of communications is sufficient to meet the requirements of the selected manufacturer's BMS equipment.
Ensure that no cross corruption of data occurs when the BMS shares a communication network with other IT-based systems. Ensure that permission has been given by the IT manager to connect BMS components onto the IT network. Comply with the organisation's IT strategy for connection of devices to the IT data network, including allocation of IP addresses.
Ensure that network testing, identification and documentation comply with BS EN 50173-services and BS EN 50174-series.
Ensure that all network devices such as routers and bridges are compatible with the network and are capable of operating such that the required throughput of data is achieved.
Install communication networks in accordance with BS EN 61918.
Assess the network performance for business-critical functions in accordance with BS EN 61907.

320.220 COMMUNICATION NETWORKS - STRUCTURED CABLING:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Ensure that the selected BMS components are suitable for operating on the structured cabling system.
Ensure that the selected BMS topology (star wired, chained or bus-based) is appropriate for the structured cabling system.
Ensure that each addressable BMS device can be addressed over the structured cabling system.
Where BMS components are specified to be powered from the structured cabling system ensure that the power available is sufficient. Ensure that overheating of the structured cabling system will not occur.
Ensure that any changes to the structured cabling system are reflected in updated documentation.

320.230 COMMUNICATION NETWORKS - INTRANET AND INTERNET APPLICATIONS:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Ensure that the BMS is compatible with relevant security techniques in accordance with BS ISO/IEC 27032
Ensure that the BMS devices to be directly connected onto the Intranet/Internet are TCP/IP compatible.

320.240 COMMUNICATION NETWORKS - MAINS-BOURNE SIGNALLING:
Comply with the requirements of BS EN 50065-1.
Provide the necessary equipment to ensure that there is no mutual interference between the signaling system of the electricity utility and mains-borne signaling of the BMS.

320.250 COMMUNICATION NETWORKS - RADIO COMMUNICATIONS:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Ensure that the radio transmitter/receiver and the BMS components are adequately powered.
Ensure that radio communications devices and associated BMS components are easily accessible to allow the change of batteries.
Ensure that the attenuation of radio signals does not hinder effective data communications.

320.260 INTEGRATION WITH FIRE DETECTION SYSTEMS - GENERAL:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:

Ensure approval from the relevant Fire Prevention Officer or Building Control Officer.
Ensure that the requirements of BS 5839-1 are not compromised.
Ensure that the fire detection system can operate autonomously and will not be affected by any failure of the BMS.
Ensure that the BMS will not be affected by any failure of the fire detection system or fails safe as appropriate.
Ensure that the loss of electrical power to the BMS will have no adverse effects on the fire detection system.
Ensure that a full cause and effect testing programme is developed in conjunction with the fire alarm company.
Ensure that the integrated system is fully commissioned.
Ensure that the contractual responsibilities of the various parties responsible for the integrated system are fully defined.

320.270 INTEGRATION WITH FIRE SYSTEMS - INTEGRATION DETECTION FOR MONITORING:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Uni-directional systems
Provide the display of fire alarm detector status information on the BMS operator client indicating the location of fire detector heads or zones, along with their respective status
Ensure that a fire alarm condition automatically displays the appropriate building graphic/schematic along with relevant detector head status or zone status.

320.280 INTEGRATION WITH FIRE DETECTION SYSTEMS - INTEGRATION FOR CONTROLS:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Provide fail-safe, hard-wired interlocks using volt-free contacts between the BMS field controllers and items of plant listed in schedules.
Use volt-free contacts and AC or DC 24V interlocks.
Use relay logic and/or microprocessor-based logic.
Ensure that building services control actions operate correctly in response to the status of the fire detection system.

320.290 INTEGRATION WITH SECURITY DETECTION SYSTEMS - INTRUDER ALARM SYSTEMS:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Provide the display of security sensor/detector or zone status information on the BMS operator client.
Provide any building graphics/schematics on the BMS operator workstation indicating the location of security sensors/detectors or zones along with their respective status.
Ensure that a security alarm condition can automatically display an appropriate building graphic/schematic along with the relevant sensor/detector status.
Ensure that any time delay in receiving security alarm data at the operator workstation client does not exceed the manufacturer's recommendations.

320.300 INTEGRATION WITH SECURITY DETECTION SYSTEMS - ACCESS CONTROL SYSTEMS:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Provide the display of access control status on the BMS operator client.
Provide on the BMS operator workstation building graphics/schematics indicating the location of access control devices along with their respective status.
Ensure that an alarm condition or an access control system can automatically display the appropriate building graphic/schematic along with the relevant sensor/detector status.
Ensure that no configuration of access cards is possible via the BMS.
Ensure that building services control actions operate correctly in response to the status of the access control system.

320.310 INTEGRATION WITH LIGHTING CONTROL SYSTEMS:
Where specified in the scope of works, schedules and controls drawings comply with the following requirements:
Ensure that the following functionality is provided:
Switching of lighting zones in accordance with zone occupation times as set on the BMS.
Switching of lighting zones in accordance with occupancy sensing and light level sensing where this is provided by the BMS.
Monitoring of lighting zones.
Monitoring of lamp run hours.
Raising of an alarm on lamp run hours exceeding the specified maximum.
The ability to override zones.
Ensure that re-definition of zones cannot be performed via the BMS.

W60 – Central Control / Building Management System

Direct interoperability – Ensure that the requirements of clause 310.470 are met.
Gateway link - Ensure that the requirements of clause 310.480 are met.

330.330 CONTROLS CIRCUITS:
Supply Voltage - Ensure control circuits are DC (negative-earth) or AC 230 V sourced from common single-phase supply. Control circuits from single-phase supplies derived from different phases shall not be used in the same enclosure.

330.340 CONTROL CIRCUITS TRANSFORMERS:
Provide control circuit transformers to supply power at voltages to suit control components.
Standards
Use transformers in accordance with BS EN IEC 61558-1 and either BS EN 61558-2-2 or BS EN 61558-2-6, and provide an external label of approved type and size.
Protection - Primary and secondary fuses

340.000 WORKMANSHIP:

340.010 GENERAL:
Install pipeline control components in accordance with manufacturer's instructions.
Install ductline control components in accordance with DW/144 and manufacturer's instructions.
Install control components in accordance with manufacturer's recommendations, in positions indicated.

340.020 APPEARANCE:
Arrange, support and clip all control wiring, pneumatic tubes and capillaries to present a neat appearance, with other services and the building structure.

340.030 INSULATION:
Where control components are incorporated in insulated pipelines, ductlines or equipment, provide details for approval of method proposed to insulate component.

340.040 SUPPORTS:
Arrange supports for control components to ensure no strain is imposed on components.

340.050 ACCESS:
Arrange control components to ensure adequate access for operation and maintenance.
Comply as relevant with BS EN 547-series and BS 7671 (IET Wiring Regulations) requirements for maintenance gangways.

340.080 POWER OPERATED CONTROLS:
Install power operated controls in accordance with manufacturer's instructions and relevant standards.

340.090 ELECTRIC MOTOR ACTUATORS:
Securely mount actuators to rigid members, free from vibration or distortion in accordance with manufacturer's recommendations. Select mounting positions to require minimum linkages, and to avoid angular drive to operating levers. Allow access for servicing and replacement.

340.100 SENSORS/CONTROLLERS:
Install sensors/controllers in accordance with manufacturer's instructions, in accessible locations. Install wall mounted components, where indicated.

340.105 TEMPERATURE SENSOR LOCATION:
Internal

Install temperature sensors: out of sources of draughts; away from doors and sources of heat or cooling; away from sources of water / sinks; out of the reach of direct sunlight; not in partitioned offices; approximately 1500 mm above floor; in a position which will not be covered.

They should also be coordinated with the Architect's furniture drawings to ensure they are not blocked or covered.

The Contractor shall ensure that the conduit to the back of the sensor is completely sealed.

External

W60 – Central Control / Building Management System

Out of the reach of direct sunlight; away from any heat sources, exhaust, open windows; in a safe, tamperproof location.

340.110 ANCILLARIES:
Install ancillaries in accordance with manufacturer's instructions.

340.120 ENCLOSURES:
Install enclosures where indicated, providing space for access and maintenance.

340.121 PACKAGED PLANT:
Make all digital and analogue control interfaces between the BMS and packaged plant as detailed on the Controls diagrams and individual plant schedules and elsewhere in the specification.
Make connections to packaged plant within the plant control panel. Where insufficient space within such panels fit a further enclosure to the plant to accommodate the connections.

340.122 PANELS, WIRING AND WIRE WAYS:
Install all Panels, wiring and wire ways as described in the appropriate reference specifications.

Other than in individual starters and the interlocks from local isolators, the control circuit voltage shall not exceed 110 Volts ac (55-0-55). Where control circuits are taken outside the enclosure to remote equipment use 24 Volts maximum.
Where modifying existing installations, agree the detail of the above with the S.O.

340.130 BUILDING MANAGEMENT SYSTEM INSTALLATION:
Install commission and set to work building management system in accordance with the manufacturer's recommendations.

340.140 BUILDING MANAGEMENT SYSTEM CABLE INSTALLATION:
Plan and install all building management monitoring systems cables in accordance with the cable manufacturer's recommendations.
Label and record all monitoring cables

340.150 BUILDING MANAGEMENT SYSTEM QUALITY CONTROL:
Handle, store and install equipment and components of the building management system in accordance with the manufacturer's recommendations.
Inspect all equipment and components on delivery, before fixing and after installation and reject and replace any which are defective.
Record all commissioning tests and site modifications to hardware or software, and revise operating and maintenance instructions accordingly.
Inspect installed and operational functions of Building Automation, Controls and Technical Building Management System including its configuration in accordance with BS EN 16946-1.
Manage configuration of software, settings, data and design, in accordance with an appropriate Configuration Management Plan complying as necessary with BS EN ISO 9001, BS ISO 10007, BS ISO/IEC 12207 and BS ISO/IEC/IEEE 15288.
Provide configuration details along with the operation and maintenance manual on handover.
Manage information security systems, software and data during design, implementation and commissioning in line with BS EN ISO/IEC 27001.

340.160 CONTROL SYSTEM FUNCTION CHARTS:
Prepare function charts for the control system in accordance with BS EN 60848. Obtain approval for function chart before design of system hardware or writing control software.

350.000 COMMISSIONING:
Commission in accordance with CIBSE Commissioning Code C. Refer to section Y51 for BMS commissioning and seasonal commissioning requirements.
Undertake and manage integrated commissioning in accordance with CIBSE Commissioning Code M: Commissioning Management

Perform interface testing with all other logically-connected systems
Perform whole building integrated testing as scheduled or described in the scope of works.
Perform black building integrated testing as scheduled or described in the scope of works.

W60 – Central Control / Building Management System

The BMS / controls specialist shall assist with seasonal commissioning during four separate occasions with three monthly intervals during the defects liability period in the first year after handover unless scheduled or detailed otherwise elsewhere in this specification.

360.001 **DEMONSTRATION AND HANDOVER:**
Refer to General scope of works for project particular requirements and section Y51 and “A” sections of the specification for standard clauses for BMS witnessing requirements, operator training and post-handover checks.
Refer to work section A37 or A64 or A64D for requirements for BMS O&M manual.

360.040 **SOFTWARE:**
Ensure that a copy of the configuration software is securely held both on and off-site.
Ensure that, as alterations are made to the configuration software, all previous versions of the software are securely archived.
Ensure that all credentials are transitioned to the operation and maintenance organisation(s) at handover.

10000 Ref NES Text Dec 19

Common Workmanship Clauses

Y41 – Fans

1000 GENERAL

Standards

Provide fans manufactured and tested in accordance with appropriate British Standards.
With regard to safety requirements, comply with BS EN 60335-2-80 where applicable.
Fans for smoke and heat control to be in accordance with BS EN 12101-3
Fans for use in potentially explosive atmospheres / flameproof zones to be in accordance with BS EN 14986 and relevant parts of BS EN 13463 or BS EN ISO 80079 and relevant parts of BS EN IEC 60079 / BS EN 60079 series and be compliant with the ATEX directive.
Inline and chimney outlet exhaust fans to comply with BS EN 16475-2
Kitchen extract fans to comply with BESA DW / 172.

Fans driven by electric motors with electric input between 125W and 500kW should comply with EC Regulation 327/2011 with regard to ecodesign requirements.
Comply with EU regulation 1253/2014 for small packaged ventilation units comprising fan(s), heat recovery system, filters and controls (or a combination of these components) up to 1000m^3/hr with regard to ecodesign requirements.

1005 APPROVED FIRMS:

Select fans from Quality Assured firms registered under CAME scheme, unless otherwise indicated.

1011 DESIGN DUTIES:

Air Volume

Ensure scheduled volume is provided when operating against resistance of system corrected for changes between specified and selected component resistances.

System Resistance

Adjust scheduled resistance to compensate for actual resistance of selected components and any changes made by the contractor to the ductwork layout, quantities and types of bends etc from that indicated on the tender drawings

Operating Point

Select operating point on pressure/volume curve to provide stable and efficient operation. Fans shall be selected to give the lowest possible noise rating having regard to their duty and type.
Whenever possible the fan supplier shall select fans over the range of air flows where the efficiency is not less than 85 % of the optimum efficiency in accordance with Annex E in BS EN ISO 12759.

Guaranteed Performance

Provide fan performance figures in accordance with:
BS EN ISO 5801 for all types except those designed solely for air circulation.
BS 848-9, ISO 13348 for tolerances, methods of conversion and technical data presentation.
BS EN ISO 13350 for testing of jet fans.

Quoted fan duties are based on pressure losses external to the fan unit and on the equipment air side pressure losses as scheduled in Y41sch.
Before ordering the fans, the contractor shall adjust the fan static pressures to suit pressure drops of actual components used in the systems
Adjust fan heads if changes are made to ductwork routing or arrangement in preparation of installation drawings or details.
Quoted fan duties include the following commissioning allowances:-

	Low Pressure Systems	Medium & High Pressure Systems
On Flow Rates	10 %	5%
On Head	20%	15%

Allow for a pulley and belt change on belt driven fans and impeller change or angle adjustment on direct drive fans.

1020 PROTECTION:

Protect casings, impellers and shafts against corrosion. Protect bearings against dirt and moisture.

Y41 – Fans

1061 FAN MOTORS

Comply with reference section Y92 clauses.

1065 FAN MOTOR STARTERS

Incorporated in Controls - reference W60.
Comply with reference section Y72 clauses.
Fit variable speed drives to all fans rated at more than 1.1kW and as scheduled.

2000 PRODUCTS/MATERIALS

2010A OPERATING CONDITIONS:

Installation arrangement as shown on drawings.
Configuration

Parallel or series operation as shown on drawings.

Sound Power Level

Select fan, motor, drive and speed control system not to exceed sound power levels or sound pressure levels scheduled or specified elsewhere. Provide sound power data in accordance with BS EN ISO 5136 and parts 1-4 of BS ISO 13347
Select plant that does not have a distinguishable, discrete, continuous noise or give rise to distinct impulses.

Air Density

Relate fan performance to air density 1.20kg/m3.

Temperature Range

Minimum to maximum operating temperatures –10°C to 40°C or as scheduled / indicated.

2010B POTENTIALLY EXPLOSIVE ATMOSPHERES

Constructional requirements:
The constructional requirements for fans constructed to Group IIG (of explosion groups IIA, IIB and hydrogen) categories 1, 2 and 3, and Group IID categories 2 and 3, intended for use in explosive atmospheres shall be in accordance with BS EN 14986 and relevant parts of BS EN IEC 60079 / BS EN 60079 and BS EN ISO 80079.
Ambient atmosphere pressure:
Absolute pressure ranging from 0.8bar to 1.1bar.
Temperature range:
Minimum to maximum operating temperatures of -20^{0}C to 60^{0}C inlet gas temperature, -10% to +20% of nominal gas flow.

2020A CONSTRUCTION AND HANDLING:

Casings

Construct rigid casing free from drumming under operating conditions.
Flange dimensions to BS EN ISO 13351
Supply in sections as required for access or handling.

Safety Standards

BS EN 60335 – 2 – 80 for the safety of electric fans for household and similar Purposes.
BS EN ISO 12499 – for guarding

Rotating assemblies

Balance in accordance with relevant parts of BS ISO 21940.

Shafts and hubs

Machine impeller bosses and shafts to BS 4500 and key in accordance with BS 4235-1. Hold impeller to shaft with set screw or taper lock fitting.

Shaft bearings - Sealed for life.

Drives and guards

Provide guards over shaft, couplings and rope in accordance with BS EN ISO 12100 for general principles of design and HSE requirements.
Material - galvanized or sheet steel.

Lifting

Provide lifting eyebolts or similar facilities on fans or sections heavier than 20kg.

Y41 – Fans

2031 TESTING:
Provide results of aerodynamic performance tests in accordance with BS EN ISO 5801, BS 848-1; noise tests in accordance with parts 1-4 of BS ISO 13347 and /or BS EN ISO 5136 as appropriate and fan balancing and vibration measurements in accordance with BS ISO 14695, BS 848-6.
The minimum energy efficiency requirements for fans driven by electric motors with electric input between 125W and 500kW should comply with EC Regulation 327/2011.

2050A MATERIALS - GALVANISED SHEET STEEL:
Construct casing from galvanised sheet steel in accordance with BS EN 1S0 1461, BS EN 10326, BS EN 10327.or BS EN 10143 unless scheduled otherwise.

2060z MOTOR:
Speed
Single, two or variable speed, as indicated.
Standards
Where variable speed drives are fitted to direct drive fans, ensure the drive meets the safety requirements of BS EN 61800-5-1. Comply with Y72 and Y92 clauses
Options:
When fan is handling saturated or corrosive air, provide motor ventilation to clean air,

2065 DRIVE / COMMISSIONING ALLOWANCES:
Direct, or belt driven as scheduled.
Provide belt driven fans with two or more belts. Belt drives shall comply with BS 3790.
For each belt driven fan provide a change of belts and drives (to be sized after balancing the system). Allow for changing belts and drives and recommissioning fan and rechecking system as necessary.
For each direct drive, adjustable pitch, axial fan, allow for a change of pitch angle (to be determined after balancing the system). Allow for recommissioning each system after the fan blade pitch change.
Refer to schedules for commissioning allowances included in duties.

2070A AXIAL FLOW FANS:
Fan impeller and casing aerodynamic efficiency
Manufacturer's standard to achieve overall efficiency of the fan, motor and drive combination scheduled or detailed elsewhere in the project particular specification.
Operation
Single; two in series; or multi-stage contra- rotating as indicated.
Bearings
Provide bearings suitable for mounting and direction of flow as shown on drawings.
Impellers
Fixed pitch; or adjustable pitch as indicated.
Casing - enclosing impeller and motor.

2080A SINGLE INLET SINGLE WIDTH CENTRIFUGAL FANS:
Fan impeller and casing aerodynamic efficiency
Manufacturer's standard to achieve overall efficiency of the fan, motor and drive combination scheduled or detailed elsewhere in the project particular specification.
Operation - single.
Impeller Design
Supply fan with impeller to suit operating conditions indicated.
Casing - single inlet single width.
Mounting - channel frame.
Drain
Fit drain connection at lowest point of scroll as indicated.

2080C DOUBLE INLET DOUBLE WIDTH CENTRIFUGAL FANS:
Fan impeller and casing aerodynamic efficiency
Manufacturer's standard to achieve overall efficiency of the fan, motor and drive combination scheduled or detailed elsewhere in the project particular specification.
Operation - single.
Impeller Design

Supply fan with impeller to suit operating conditions indicated.
Casing - double inlet double width.
Mounting - channel frame.
Drain
Fit drain connection at lowest point of scroll where as indicated

2090A PROPELLER FANS:
Fan impeller and casing aerodynamic efficiency
Manufacturer's standard to achieve overall efficiency of the fan, motor and drive combination scheduled or detailed elsewhere in the project particular specification.
Drives
When motor spindle is extended for mounting blade hub, connect motor to casing, diaphragm plate or mounting ring with support arms.
Impellers
Supply profile blades designed to give uniform airflow.
Mountings
Support fans on plate with circular opening sized and
Located in accordance with fan manufacturer's requirements.

2100A MIXED FLOW FANS:
Fan impeller and casing aerodynamic efficiency
Manufacturer's standard to achieve overall efficiency of the fan, motor and drive combination scheduled or detailed elsewhere in the project particular specification.
Operation - single.
Provide bearings suitable for mounting and position indicated on drawings.

2200z CONSTRUCTION OF SMOKE EXTRACT FANS AND NATURAL VENTILATORS (U14 300.021):
Ensure smoke extract fans and ventilators are constructed so that when in use no flames or hot gases are deflected directly onto an adjacent structure.
Ensure materials used in the construction of the smoke extract fans and ventilators do not add to the fire risk of the building, nor contribute to a fire during use.
Construct smoke extract fans and ventilators from material defined in BS 476-4 as non-combustible.
Ensure smoke extract fans and ventilators with insulation material, plastic louvres, flaps, sheets or slopes have a Class 1 spread of flame rating when tested in accordance with BS 476-7 and are classified as `does not readily sustain ignition' to BS 476-12.
Powered smoke and heat exhaust ventilators (fans) shall comply with BS EN 12101-3.

3000 ACCESSORIES

3010 INSPECTION DOORS - AXIAL FANS:
Fit air-tight inspection doors giving access to drive motors and other components requiring regular servicing or maintenance.

3020 INSPECTION DOORS - CENTRIFUGAL FANS:
Fit air-tight doors in scroll and cover.

3030 INSPECTION DOORS - PROPELLER FANS:
For diaphragm mounted fans fit an air-tight inspection door positioned to give access to drive, or other sub-components requiring regular servicing or maintenance.

3040 INSPECTION DOORS - MIXED FLOW FANS:
Fit air-tight doors giving access to drive motors and other components requiring regular servicing or maintenance.

3041 ACCESS PANELS – KITCHEN EXTRACT FANS
Access panels fitted to the casing shall be the full width of the impeller and located to facilitate cleaning and maintenance.

Y41 – Fans

3050A **GUARDS:**
Provide guards in accordance with BS EN ISO 121000.
Fit safety guards on air inlet and air outlet connections where these are freely accessible to personnel in accordance with BS EN ISO 12449, BS 848-5.
Provide bird guards unless fans are protected elsewhere (eg by birdguards at louvres).

3060z **CONNECTIONS TO DUCT:**
Provide flexible connections unless otherwise indicated.

3070A **GUIDE VANES - AXIAL FANS:**
Supply fan with integral downstream guide vanes. Or guide vane unit fitted upstream, or as otherwise indicated.

3080 **GUIDE VANES - CENTRIFUGAL FANS:**
Fit automatically controlled inlet guide vanes to inlet of fan.
Provide an actuating device for each set of inlet guide vanes.

3090 **GUIDE VANES - MIXED FLOW FANS:**
Fit automatically controlled guide vanes.

3100z **SHUTTERS:**
Fit shutters to prevent reverse flow through fan.
Back draft shutters or motorized shutters as indicated.

3110 **AIR FLOW SENSORS:**
Fit air flow sensors on twin fan units to sense fan failure and provide automatic changeover to standby fan.

3120 **ACCESS:**
Provide access via hinged casing or as otherwise indicated.

3141 **SPEED CONTROLLER:**
Where provided, ensure speed controllers are matched to fans.

3150 **STANDBY MOTOR:**
Provide standby motor as indicated.

4000 **WORKMANSHIP**

4010 **LOCATION:**
Install fans in positions indicated, in accordance with manufacturer's instructions and recommendations in CIBSE TM 42 Fan Application Guide.

4020 **ATTITUDE:**
Mount impeller shaft horizontally unless otherwise indicated.

4030 **ALIGNMENT:**
Ensure fan is installed aligned to allow optimum air flow path.

4040 **TESTING:**
Ensure fan is isolated from installation during air leakage testing of ductwork.

4051 **DRAIN CONNECTION:**
Fit trap to drain connection at lowest point of scroll on centrifugal fans unless otherwise indicated.

10000 Based on NES Y41text Dec 19

Y46 – Grilles/ Diffusers/ Louvres

1011 **PERFORMANCE:**
Air Supply
Unless detailed otherwise elsewhere in this specification, schedules or drawings, the maximum mean air velocity in the occupied zone shall comply with category B thermal environment in accordance with BS EN ISO 7730 (PPD<10%) table A5.
eg for offices and other mainly sedentary spaces : Cooling 0.19m/s; Heating 0.16m/s.
Blades - Supply grilles and diffusers with blade profile to ensure correct aerodynamic performance and minimal noise generation.
Louvres - Ensure air velocities through face area of louvres minimises "carry-over" of rain, snow or other precipitation into ducts, shafts or plant rooms and ensure louvres are tested in accordance with BS EN 13030 and are the subject of on-going factory production control auditing. Performance classes to BS EN 13030 are as scheduled in Y46sch1.

1020z **SIZE / FIXINGS GENERALLY**
All sizes indicated are 'nominal'. Provide site dimensions of all louvres, diffusers and grilles before manufacture. Ensure integration and co-ordination with ceiling details, other drawings and with ceiling grid site setting out as indicated on the architects drawings.

1030 **NOISE LEVELS:**
Ensure sound power levels or room NR / NC levels indicated are not exceeded. Ensure accessories for grilles and diffusers have low noise generation characteristics, and cause minimum disturbance to airflow.

1033 **PROTECTIVE WRAPPING:**
Apply protective wrapping to exposed architectural finishes prior to despatch to site.

1035 **TESTING:**
Manufacturer's catalogue / selection data to be based on laboratory testing / rating of air terminal devices in accordance with the following standards as appropriate to the particular types of devices to be installed:
BS EN 12238 - aerodynamic testing, mixed flow under isothermal conditions
BS EN 12239 - aerodynamic testing, low velocity for displacement applications under non-isothermal conditions
BS EN 16445 - aerodynamic testing, mixed flow under non-isothermal conditions
Provide air terminal devices tested in accordance with, BS EN ISO 5135 for determination of sound power levels
Comply with BS EN 13030 for performance testing of louvres subjected to simulated rain.

Where mock up testing is required, measure air velocity / flow rates, temperatures and sound pressure levels in accordance with BS EN 15726. Refer to schedule Y51sch1.

1041 **ELECTRICAL BONDING TERMINAL:**
Ensure an electrical bonding terminal suitable for connection of a bonding conductor with cross-sectional areas in the range 2.5mm^2 to 10mm^2 is provided on metal grilles, diffusers and louvres where indicated.

2000 **PRODUCTS/MATERIALS**

2009 **MOUNTING:**
Grilles
Flanged screw fixings - Used on the following grille types: fixed blade, adjustable blade, egg crate, non-vision
Concealed fixings - Used on the following grille types: mesh, linear
unless otherwise indicated
Diffusers
Flanged screw fixings - Used on the following diffuser types: punkah louvre
Hidden screw fixing - Used on the following diffuser types: circular, linear, straight line fixed louvre
Rear suspension brackets - Used on the following diffuser types: perforated face, adjustable curved blade, straight line fixed louvre, high induction, laminar flow panel
Internal concealed fixings - Used on the following diffuser types: linear lighting/air module, straight line fixed louvre
Hidden bayonet fixing - Used on the following diffuser types: extract/exhaust valve

Y46 – Grilles/ Diffusers/ Louvres

unless otherwise indicated

Louvres

Side screw fixings.

or Rear angles or cleats.

or As otherwise indicated.

2010A GRILLES - FIXED BLADE TYPE:

Secure blades within flanged mounting frame or core collar.

Provide support mullions to ensure blade stability.

Style, blade rows and air pattern control as indicated on schedule or drawings.

Fix blades at an angle to the horizontal

Grilles to be complete with Allen key operated opposed blade damper unless scheduled otherwise.

2020A GRILLES - ADJUSTABLE BLADE TYPE:

Pivot blades within flanged mounting frame and retain blades in set position by tensioners external to the airstream.

Allow each blade in a row of blades to be individually adjustable.

Grilles to be complete with Allen key operated opposed blade damper unless scheduled otherwise.

2030A GRILLES - MESH TYPE:

Core material

Cellular, expanded or perforated as indicated on schedule or drawings.

Frame

Flange mounting frame or plate flange as indicated on schedule or drawings.

Fixing

Permanently fixed or designed for easy removal, as indicated.

Grilles to be complete with Allen key operated opposed blade damper unless scheduled otherwise.

2040z GRILLES - EGG-CRATE TYPE:

Core material - Aluminium or plastic or as otherwise indicated.

Style – With frame or as otherwise indicated.

2042 GRILLES - SECURITY TYPE:

Comply with requirements of the Ministry Of Justice Prison Service Specification and / or the Home Office Police Custody Design Guide.

Type - High security unless scheduled otherwise

Unless scheduled otherwise:

Material - 3mm thick mild steel plate.

Perforations - 3mm dia at a 5mm pitch.

Grilles to be complete with Allen key operated opposed blade damper.

2050 GRILLES - LINEAR TYPE:

Type and blade angle – as scheduled

Supply linear type grilles with one row of parallel blades. Secure blades within mounting frame or opening.

Grilles to be complete with Allen key operated opposed blade damper unless scheduled otherwise.

2060A GRILLES - FLOOR TYPE:

Supply linear type floor grilles with one row of parallel blades.

Permanently set at angle indicated. Incorporate bar reinforcement.

Loading - in accordance with BS EN 13264 as scheduled or detailed elsewhere in this specification.

Type and Core type / details as scheduled

2070A TRANSFER GRILLES - SIGHTPROOF NON-VISION TYPE:

Supply sightproof non-vision grilles with one set of blades.

Fix within a flanged mounting frame or a core box unless otherwise indicated.

2070B TRANSFER GRILLES - LIGHTPROOF NON-VISION TYPE:

Supply lightproof non-vision grilles with two sets of blades.

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Fix within a flanged mounting frame or a core box unless otherwise indicated.

2070C TRANSFER GRILLES - FIRE RESISTANT NON-VISION TYPE

Supply grilles comprising Zintec steel frame with an intumescent core and two steel grilles, colour as indicated or scheduled.

Comply with the requirements of BS 9999.

Fire resistance tests for wall, ceiling or floor mounting types in accordance with BS EN 1364-5 or BS 476-22.

Fire resistance tests for door mounting types in accordance with BS 476-22.

Fix as indicated in accordance with the manufacturer's recommendations.

2070D TRANSFER GRILLES - FIRE RESISTANT NON-VISION TYPE WITH SMOKE CONTROL FACILITY:

Supply grille assembly comprising Zintec steel frame with an intumescent core with damper and actuator assembly to automatically close in the event of an alarm, power failure or damage to wiring. Units to be complete with steel cover grilles, colour as indicated or scheduled.

Comply with the requirements of BS 9999.

Fire resistance tests for door mounting types in accordance with BS 476-20 and BS 476-22.

Smoke leakage tests for smoke shutter type through door sets to be in accordance with BS 476-31.1.

Fix as indicated in accordance with the manufacturer's recommendations.

2070E TRANSFER GRILLES - ACOUSTIC TYPE TO REDUCE CROSS TALK:

Material - aluminium extrusion.

Unit to form a labyrinth airway lined internally with acoustic damping media. Cores to be enclosed within a flanged frame with sealing gasket.

Fix within door or partition in accordance with the manufacturer's recommendations.

2080A CONE TYPE CIRCULAR DIFFUSERS:

Supply circular diffusers manufactured to ensure rigid and smooth outer cone or frame, and inner assembly.

Space all cones to ensure even distribution of air flow with minimum resistance and noise, and to allow easy cleaning.

Cone type

Fixed or adjustable deflection cone type as indicated. Inner assembly to move vertically by vertical sliding action or rotation.

2080B PLAIN FACE OR PAN TYPE CIRCULAR DIFFUSERS:

Supply circular diffusers manufactured with a smooth circular adjustable face plate to give a 360° air pattern and inner adjustable control disc assembly.

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2090A DIFFUSERS - LINEAR SLOT TYPE:
Adjustable 1 way, 2 way or vertical projection continuous slot type
Supply single unit or continuous length linear diffusers manufactured with one or more rigid and smooth line slot units with parallel bars and partitions.
Fit closing caps at ends of single or multiple continuous length units.
Provide continuous lengths complete with locating pins or strips with keys to ensure correct alignment of abutted ends.
Air Controller - Fit each slot with device indicated.

2090B DIFFUSERS - HIGH INDUCTION BARREL SLOT TYPE:
Supply high induction linear slot diffusers. Provide polymer control air blades / barrels capable of providing alternating air flow direction every 150mm.
Air control blades to be factory set to scheduled requirement, but be adjustable for site commissioning.
Fit closing caps at ends of single or multiple continuous length units.
Provide continuous lengths complete with locating pins or strips with keys to ensure correct alignment of abutted ends.
Provide each diffuser with plenum box incorporating suspension points and circular side entry air supply spigots. Fit each plenum with air control damper device unless scheduled otherwise.

2100 DIFFUSERS - PERFORATED FACE TYPE:
Supply perforated face diffusers with rigid and smooth inlet spigot expanded to butt and seal against easily removable framed perforated front panel. Incorporate back deflectors above front panel, set to give required performance.
Supply type and profile of framed perforated front panel to mount flush with surrounding false ceiling panels.

2110A ADJUSTABLE CURVED VANE DIFFUSER:
Supply diffusers manufactured from curved cross sectional profile parallel blades pivoted at each end within flanged mounting frame. Ensure that each vane is individually adjustable to give directional control of airstream. Retain vanes in set position by tensioners external to airstream.

Control ways as indicated on drawings or schedules.

2130B FIXED LOUVRE LINEAR DIFFUSER WITH REMOVABLE CORE:
Supply diffusers manufactured from louvre type parallel blades permanently set and securely fixed within frame.
Supply core frames which are easily removable from flanged mounting frame.
Control ways as indicated on drawings or schedules.

2140A JET AIR NOZZLE DIFFUSERS:
Supply diffusers manufactured with adjustable core. Supply core in the form of a rotatable sphere with circular outlet nozzle, the whole retained by a flanged cup allowing manual or motorised change of discharge air pattern as scheduled to give a high velocity jet with adjustable discharge angle of -30° to +30°.
Incorporate tapped ring for duct mounting, complete with felt, foam rubber or plastic sealing ring and fixing bolts or screws. When connecting to ends of flexible ducting, fit rigid flanged extension collar.

2140B DRUM JET TYPE DIFFUSERS:
Supply diffusers manufactured with adjustable core. Supply core in the form of a rotatable cylinder with a rectangular outlet nozzle, the whole retained by a flanged frame allowing manual change of discharge air pattern to give an adjustable high velocity jet, by adjustable integral vertical blades giving a discharge angle adjustable between -30° to +30°.
Incorporate tapped ring for duct mounting, complete with felt, foam rubber or plastic sealing ring and fixing bolts or screws. When connecting to ends of flexible ducting, fit rigid flanged extension collar.
Where scheduled incorporate manually adjustable horizontal front air pattern control blades for jet air dispersion and throw length control.

2140C JET TYPE NOZZLE WITH SWIRL UNIT:
Supply diffusers manufactured with adjustable core. Supply core in the form of a rotatable sphere with circular outlet nozzle with the whole retained by a flanged cup allowing manual or motorised change of

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discharge air pattern as scheduled to give a high velocity jet, with adjustable discharge angle of -30° to +30°.
Incorporate swirl unit air control blades and cap for two-step reduction of the throw distance.

2140D JET DIFFUSERS WITH REVERSIBLE / ROTATABLE CORE:
Supply diffusers manufactured with reversible and rotatable core (through 180°). Core to be reversible to provide either a straight core for "jet" setting or diffused core for "air diffusion pattern".
Diffuser spigot to be capable of 360° rotation within the mounting plate to enable jet direction adjustment.

2150 DIFFUSERS - LINEAR LIGHTING/AIR MODULAR TYPE:
Supply diffusers complete with connecting unit for installation behind module flanges, ensuring neat and unobtrusive appearance.
Fit plenum box with integral independent air volume regulating vanes to direct an equal air velocity along complete length of connecting air diffuser slot. Ensure easy access from below to regulating vanes. Retain vanes in set position by tensioners external to air stream.
Fit spigot, suitable for flexible ducting joint connection to plenum box.
Ensure that supports are independent, and do not depend upon module casing or flanges.

2160 LAMINAR FLOW PANELS:
Supply laminar flow panels suitable for use in clean rooms, laboratories and operating theatres. Panels to be complete with a low free area (typically 15%) perforated discharge plate at the face of the diffuser complete with rear plenum box and spigot entry. Fit baffle within the plenum box to distribute air evenly and achieve the laminar air pattern.

2170B HIGH INDUCTION SWIRL DIFFUSERS:
Supply high induction diffusers with either fixed blades or variable geometry comprising either manually adjustable air control blades or actuated blades using wax filled cylinder or electric motor as scheduled. Units to use rotary motion in discharge air pattern to accelerate mixing.

2172A CIRCULAR SWIRL FLOOR MOUNTED DISPLACEMENT DIFFUSERS:
Unless scheduled otherwise, supply die cast aluminium diffusers suitable for fitting into a pressurised floor void with standard floor tile thicknesses up to 50mm. Swirl element to be made of polymer and adjustable for horizontal or vertical air discharge.
Unless scheduled otherwise each diffuser to be complete with dirt trap.

2174A WALL OR FREE STANDING LOW VELOCITY DISPLACEMENT DIFFUSERS:
Unless scheduled otherwise, units to be complete with galvanised steel perforated front panel, minimum thickness 1.25mm and galvanised steel casing. Provide an air distribution plate or proprietary air scoops with nozzles located behind the front panel.
Finish to be powder coated or polyester-epoxy painted.
For recessed units recess the front panel into a rigid frame and fix with screws unless scheduled otherwise.

2174B FLOOR MOUNTED LOW VELOCITY DISPLACEMENT DIFFUSERS:
Supply recessed floor diffusers for installation in a pressurised floor or connected to ductwork via a plenum box as scheduled.
Loading - in accordance with BS EN 13264 as scheduled or detailed elsewhere in this specification.
Diffuser to be a tile replacement unit for raised floor system complete with an air distribution plate with nozzles fitted behind a perforated sheet steel front panel (minimum thickness 3mm), welded onto a framework.

2180DIFFUSERS - SUPPLY/EXHAUST VALVE TYPE:
Supply diffusers incorporating intake ring and adjustable valve disc assembly.
Provide bayonet type fixing for purpose made mounting ring with plastic foam sealing gasket.
Provide setting template.
Spinning disc to be powder coated steel.

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Adjust valve to required setting and lock valve in required position.

2185 FABRIC AIR DUCT DISTRIBUTION DEVICES:
Supply fabric air distribution devices complete with all necessary stiffening devices, facilities for jointing sections, support system, suspension rails and fixings.
Manufacturer to provide full performance data for devices selected including air flow rate, pressure loss, throw etc.
The facilities shall be designed to prevent condensation and dust build up.
Shrinkage to be limited to 1% when washed in accordance with the manufacturers recommendations unless scheduled otherwise.
Materials to be classified for reaction to fire in accordance with BS EN 13501-1. Classes acceptable are A1, A2 or B having smoke emission classification of s1 and production of flaming droplets/particles classification of d0.
Test methods (reaction of fire)
BS EN ISO 1182 (non-combustibility test), BS EN ISO 1716 (determination of the gross heat of combustion), BS EN ISO 11925-2 (ignitability of product) and BS EN 13823 (product exposed to thermal attack by a single burning item) as appropriate.

2190A LOUVRES - EXTERNAL AIR SUPPLY/EXTRACT TYPE:
Provide louvres which have been tested in accordance with BS EN 13030, and which are the subject of ongoing factory production control auditing.
Performance and classification to BS EN 13030
Ensure louvres perform to water penetration class at a face / core velocity as scheduled.
Ensure louvres achieve a coefficient of discharge class as scheduled.
Construction
Construct louvre frame and aerodynamically profiled louvre blades from galvanized mild steel or aluminium.
Provide integral drainage channels.
Retain infill on louvre blades by perforated sheet of galvanized mild steel or aluminium.
Screen
Fit a bird-screen using mesh no coarser than 12mm, across inside face of louvres.
Fit an insect-screen using mesh no coarser than 3mm, across inside face of louvres only where scheduled.
Quality assurance
Ensure manufacturers are a firm of Assessed Capability to BS EN ISO 9001 and produce louvre to relevant Quality Assessment schedule.
Installation
Install louvres strictly in accordance with the manufacturer's instructions.

2200 LOUVRES/SCREEN WALLING:
Provide louvres which have been tested in accordance with BS EN 13030, and which are the subject of ongoing factory production control auditing.
Performance and classification to BS EN 13030
Ensure louvres perform to water penetration class at a face / core velocity as scheduled.
Ensure louvres achieve a coefficient of discharge class as scheduled.
Construct with mullions into which blades are fitted and provide blades with aerodynamic profiles and integral drainage channels. Mount assembly within frame. Ensure louvre system is integrated with weather louvres and incorporates doors with concealed hinges and frames. Where necessary provide mitred corners and slope louvres.
Ensure adequate space for access and maintenance of louvres and associated equipment is provided.
Screen
Fit a bird-screen using mesh no coarser than 12mm, across inside face of louvres.
Fit an insect-screen using mesh no coarser than 3mm, across inside face of louvers as indicated
Ensure manufacturers are a firm of Assessed Capability to BS EN ISO 9001 and produce louvre to relevant Quality Assessment schedule.

Y46 – Grilles/ Diffusers/ Louvres

Install louvres strictly in accordance with the manufacturer's instructions.

2210A GALVANISED STEEL:
Galvanize steel in accordance with BS EN 10346, or BS EN 10143 and

2210B ALUMINIUM:
Use aluminium sheet/extruded aluminium produced to relevant parts of BS EN 485, BS EN 515, and BS EN 573 or relevant parts of BS EN 755

2220A GRILLE AND DIFFUSER CONSTRUCTION:
Ensure grilles and diffusers are robust and mounting frame flanges on square and rectangular terminals have mitred corners. Fit a rubber or plastic foam sealing strip or gasket to rear face of flange.
Diffusers
Ensure face of diffuser outer cone or frame is completely smooth.

Finish
Powder coat finish to an RAL colour specified as indicated or specified by the Architect.

2230A LOUVRE CONSTRUCTION:
Ensure louvres are robust. Incorporate in purpose made sub-frame. Provide drip sills.

2252 ACOUSTIC LOUVRES: (NES Y45 2120B)
Performance
Provide acoustic louvres as indicated, to meet performance indicated when producing a static pressure loss within that scheduled for the specified air flow.
Provide certified acoustic performance data measured in accordance with relevant parts of BS EN ISO 10140.
Ensure louvre withstands specified wind loads and prevents ingress of rain.
Construction
Construct louvre frame and aerodynamically profiled louvre blades from galvanized mild steel.
or aluminium.
or as otherwise indicated.
Provide integral drainage channels.
Provide acoustic infill which is inert, fire proof, inorganic, vermin proof and non-hydroscopic.
Acoustic infill to be wrapped with woven glass scrim cloth or 'Melinex' to prevent migration of particles into the airflow / protect the infill. Full account of the reduction in performance of the acoustic louvre brought about by the addition of the infill protection shall be made when selecting silencers to meet the required performances.

"Melinex" polyester film to be provided in front of the infill in the following applications unless scheduled otherwise:
Systems serving clinical areas in healthcare applications
Systems serving clean rooms
Systems where cleaning is required including kitchen extract
Systems where the acoustic louvre will be handing moisture or chemically laden air

Retain infill on louvre blades by perforated sheet of
galvanized mild steel.
or aluminium.
or as otherwise indicated.
Arrangement
In breakdown form for site assembly.
or In modular panel form.
or For assembly on site to form an enclosure complete with roof and door.
or As otherwise indicated.
Screen
Fit a bird-screen using mesh no coarser than 12mm, across inside face of louvres.
Fit an insect-screen using mesh no coarser than 3mm, across inside face of louvers as indicated.

Y46 – Grilles/ Diffusers/ Louvres

Quality assurance
Ensure manufacturers are a firm of Assessed Capability to BS EN ISO 9001 and produce louvre to relevant Quality Assessment schedule.

3000 ACCESSORIES

3010A OPPOSED BLADE VOLUME CONTROL DAMPERS :
Balance and tension operating mechanisms to give positive setting for blade positions from fully open to fully closed.
Local blade operation
Supply device for operating the damper blades through face or side of grille/diffuser as indicated.
Remote blade operation
Supply and install proprietary remote control unit with all necessary brackets and linkage at the control unit. Provide label at the control unit to indicate function.

3040A BUTTERFLY VOLUME CONTROL DAMPERS:
Operate via a simple hooked wire key connecting with a lug on the underside of each plate; or by a loose key locating into a control mechanism.

3051 `IRIS' TYPE VOLUME CONTROL DAMPERS:
When in fully open setting ensure that unit inside diameter is equal to full internal diameter of air diffuser spigot, or ducting branch connection.
Operation
By loose key, unless otherwise indicated.

3060A FIXED AIR FLOW DEFLECTORS:
Direct airstream evenly from main ducting into branches or spigots serving air grilles and diffusers by using a number of equally spaced curved blades linked together.

3060B ADJUSTABLE AIR FLOW DEFLECTORS:
Direct airstream evenly from main ducting into branches or spigots serving air grilles and diffusers by using a number of equally spaced curved blades linked together.

3070 BLANKING PLATES:
Supply blanking plates to restrict projection of air flow from a particular section of grille or diffuser. Ensure that indicated dimensions or angles in degrees are maintained.

3080 PERFORATED BAFFLE PLATES:
Cover full width or depth of plenum box and extend beyond each side of air inlet to ensure even air distribution. Position centrally relative to plenum box air inlet.

3090 PERFORATED SCREENS:
Fit perforated screens behind grille volume control devices to equalize air flow and pressure. Contain perforated sheet within rigid surrounding frame, incorporating fixing brackets or lugs.

3100 CEILING OR WALL MOUNTED PLENUM BOXES:
Supply single plenum box or series of plenum boxes butted together to form continuous length, as indicated. Ensure sturdy and rigid construction with circular inlet spigots 65mm minimum length.
Incorporate at least four drilled angle brackets, or flat bar lugs, for securing to, or suspension by rods or wires from building or other construction.

3110 FLOOR MOUNTED PLENUM BOXES:
Supply single plenum box or series of plenum boxes butted together to form continuous length, as indicated. Ensure sturdy and rigid construction with circular inlet spigots 65 mm minimum length. Ensure box base material and reinforcement is able to withstand pressures of concrete handling and pouring when casting into floor slab.
Incorporate at least four drilled angle brackets, for fixing to slab soffit, or building ragged ties when casting into a floor slab.

Y46 – Grilles/ Diffusers/ Louvres

3120A HINGED LOUVRE ACCESS PANELS AND DOORS:
Incorporate purpose made access panels or doors within body of louvres, manufactured from compatible materials.
Use hinged access panels or doors of single or double style and with front or rear locking facilities.

3130z SPARES:
Supply 5 loose keys, suitable for adjusting each size and type of grille, or operating accessories.

4000 WORKMANSHIP

4010 GRILLE/DIFFUSER LOCATION:

Fit at terminal air supply, extract and transfer points indicated, in accordance with the manufacturers' recommendations and HEVAC Guide to Air Distribution Technology for the Internal Environment.

4020 LOUVRE LOCATION:
Fit at system main air intake and discharge points, as indicated.

4030 ACCESSORIES:
Supply all grilles, diffusers etc with OBDs unless indicated otherwise. Fit other accessories to each grille and diffuser in accordance with manufacturer's instructions and as indicated.

4040 CONNECTION TO DUCTWORK:
When connecting directly to duct spigot, secure grille mounting frame or flange with screws, or bolts and nuts, to returned flange, with filled in corners, at end of duct spigot.

4050z INSTALLATION IN BUILDERSWORK:
Ensure outer edge of grille mounting frame or flange extends on all sides beyond the joint between any builders work frame and surrounding building construction.
Ensure grilles are sealed to building fabric - including ceilings, to prevent air leakage from pressurized rooms to voids above.
Fix louvres to building fabric in accordance with the manufacturers' recommendations using face flange.
or Building in lugs.
or Rear studs.
or Masonry frame - supply only for fixing by others.
or As otherwise indicated.

4060A TRANSFER GRILLES:
Where transfer points are located in partitions or walls, prevent through vision by fitting a fixed blade grille on both faces of partition or wall. Connect cavity wall or partition transfer grille assemblies with ducting sleeve or collar extending between grilles.

4060B TRANSFER GRILLES WITH FIRE DAMPER OR WITH FIRE DAMPER + SMOKE CONTROL DAMPER
Where transfer points are located in partitions or walls, prevent through vision by fitting a fixed blade grille on both faces of partition or wall. Connect cavity wall or partition transfer grille assemblies with ducting sleeve or collar extending between grilles.
Incorporate fire damper in fire compartment wall transfer grille assembly.
Comply with the manufacturer's installation instructions and any control / wiring requirements in W60 and/or W50 and schedules / scope of works.

Y46 – Grilles/ Diffusers/ Louvres

4070 **INSTALLATION OF FABRIC AIR DUCT DISTRIBUTION DEVICES:**
Ducts to be delivered to site in sealed polyethylene bags and stored on site in a dry, dust free environment in accordance with the manufacturer's recommendations.
Do not crush or bend devices.
Install devices and join sections in accordance with the manufacturer's recommendations.
Commission system in accordance with the manufacturer's recommendations.

4075 **FIXING:**
Provide details of fixing method for all grilles, diffusers, louvres and other terminal devices for approval.

10000 BASED ON NES Y46 Dec 19

Y51 – Testing & Commissioning of Mechanical Services

1000 **GENERAL**
Undertake inspection and commissioning of the building services systems in accordance with The Building Regulations Approved Documents L1 & L2 and relevant CIBSE / BSRIA commissioning codes.
Where an existing system has been extended or modified, then, unless noted otherwise in the scope of works, the complete system shall be re-commissioned. For example if a new prime mover has been installed or the original prime mover up rated in an air or water system and the system has been extended to serve additional terminals.
Appoint a commissioning manager / Specialist Commissioning Agent and undertake Commissioning Management in accordance with CIBSE commissioning code M.
The Contractor shall review all designs to ensure that systems are commissionable in accordance with the codes of practice detailed in Y51. If additional facilities are required the Contractor shall advise the designer prior to commencing work on site.

Produce and issue a notice to the local authority at the end of the commissioning that shall declare that a commissioning plan has been produced and followed and the commissioning results confirm that the performance of the engineering systems is in accordance with the original design. Where deviations / excursions from the design have been agreed with the designers / and client these shall be documented in the notice.
During the commissioning stage systems shall not be left running / unattended without Contractor attendance on site eg overnight or during weekends. Should a component failure occur the engineering services shall be configured to safely shut down.
Where required carry out Seasonal Commissioning in accordance with clause Y51 3025 as defined in clause Y51 1002 (in accordance with the requirements of BREEAM if required) and scheduled in in A31sch1 or A31sch2 and Y51sch3.
For Dry Riser and Wet Rise firefighting mains; where identified elsewhere within this specification or required by the local fire brigade, comply with the requirements of BS 9990 Clause 7.2 for protection of buildings under construction.

BREEAM projects – requirements:
Refurbishment and Fit Out 2014 and BREEAM New Construction 2018 requirements
Comply with Issue ID Man 04 Commissioning and Handover
Comply with Issue ID Man 05 Aftercare
Comply with Issue ID Ene 02 Energy Monitoring
Comply with Issue ID Wat 02 Water Monitoring
Comply with Issue ID Wat 03 Water Leak Detection
Comply with Issue ID Pol 01 Impact of Refrigerants
Refer to schedules and scope of works for project specific requirements.

1002 **DEFINITIONS**
The following definitions, some extracted from BSRIA Guides BG2/2010 and BG49/2013, and BREEAM New Construction 2018 and shall apply to all systems.

Capacity Tests

The proving that the capacity of installed plant and equipment items meets the specified duty.

Commissioning

The advancement of an installation from the stage of static completion to working order to specified requirements. For pipework distribution systems it includes the setting to work of an installation and the regulation of flow rates.

Design Criteria

The measurements and quantities selected as the basis for the design of a system.

Performance Criteria

The specified, numerically quantifiable, characteristics and tolerances to be achieved by the system.

Y51 – Testing & Commissioning of Mechanical Services

Performance Testing

The proving that the installed system can maintain the specified, numerically quantifiable, characteristics and tolerances to be achieved by the system.

Fine Tuning

The adjustment of a system where usage and system proving has shown such a need.

Pre-Commissioning Checks

Specified systematic checking of a completed installation to establish its suitability for commissioning.

Pressure and Leakage Testing

The measurement and recording of pressure retention, and fluid losses or gains in the plant Equipment, distribution ways and terminals.

Regulation

The process of adjusting the rates of fluid flow in a distribution system to achieve specified values.

Setting to Work

The process of setting a static system into operation.

Static Completion

The state of the system, when it is installed in accordance with the drawings and specification, ie being clean and ready for setting to work. In the case of water systems this includes flushing, cleaning, pressure and leakage testing, filling and venting.

System Proving

Measuring, recording, evaluating and reporting on the seasonal performance of the systems against their design values.

Testing

The measurement and recording of specified quantifiable characteristics of an installation or parts thereof.
NOTE: This includes off-site testing.

Environmental testing

The measurement and recording of internal environmental conditions including temperature, humidity and noise levels (with artificial loads applied and using instruments independent of the BMS where indicated).
The measurement of external noise levels
Refer to scope of work and Y51sch2 for details.

Seasonal Commissioning or Commissioning – implementation (as defined in BREEAM 2018 NC for one credit)

For Complex systems with a specialist commissioning manager
The following seasonal commissioning responsibilities will be completed over a minimum 12 month period, once the building becomes occupied:

Complex systems with a specialist commissioning manager

- Identify changes made by the owner or operator that might have caused impaired or improved performance.

Y51 – Testing & Commissioning of Mechanical Services

- Test all building services under full load conditions, i.e. heating equipment in mid-winter, cooling and ventilation equipment in mid-summer and under part load conditions (spring and autumn).
- Where applicable, carry out testing during periods of extreme (high or low) occupancy.
- Interview building occupants (where they are affected by the complex services) to identify problems or concerns regarding the effectiveness of the systems.
- Produce monthly reports comparing sub-metered energy performance to the predicted one.
- Identify inefficiencies and areas in need of improvement.
- Re-commission systems (following any work needed to serve revised loads), and incorporate any revisions in operating procedures into the operations and maintenance (O&M) manuals.

Where specialist building services systems such as fume cupboards, microbiological safety cabinets and a cold storage system are present then the assessor must ensure that these systems are included in the specialist commissioning agent's responsibilities

Simple systems (naturally ventilated) – with an external consultant/facilities manager.

- Review thermal comfort, ventilation, and lighting, at three, six and nine month intervals after initial occupation, either by measurement or occupant feedback.
- Identify deficiencies and areas in need of improvement.
- Re-commission systems and incorporate any relevant revisions in operating procedures into the O&M manuals.

2000 STATIC TESTING

2010z PRESSURE TESTING PIPEWORK - GENERAL:
Comply with procedures given in BESA Guide to Good Practice for Site Pressure Testing of Pipework. (TR/6) Ensure safety precautions detailed in HSE Guidance Note GS4 Safety in Pressure Testing are adopted.
Isolate components that cannot withstand the test pressures. Isolate these as near to the component as possible.
Provide a blanked connection to accommodate a check gauge in addition to the accurate gauge fitted to section under test.
Test concealed or buried pipework and ductlines before any permanent covering is applied.

Carry out works test for individual items of equipment as detailed in the work sections of this specification
Advise appropriate personnel, in advance, of the time tests may be witnessed.
Agree test pressure and duration for water mains with local water authority.

2012 PRESSURE AND LEAKAGE TESTING - AIR DUCTLINES:
Carry out air pressure and leakage testing on air ductlines in accordance with DW/143, DW/144 or DW/154 as appropriate and as indicated in section Y30.

2015 PRESSURE AND LEAKAGE TESTING - BUILDER'S WORK SHAFTS, VOIDS, ENCLOSURES AND FLOOR VOIDS / PLENUMS:
Ensure all builder's work shafts, voids and enclosures are pressure and leakage tested, and signify acceptance of standard and integrity of construction, prior to pre-commissioning of engineering installations.
Pressure test floor plenums / voids using a specialist building airtightness tester ATTMA registered to level 2 using ATTMA standard TS L2 and BSRIA BG65/2016 – Floor Plenum Air tightness Guidance and Testing Methodology.
Maximum value of plenum air leakage to be 0.7l/s/m2 of floor area at a test pressure of 50Pa or 5% of the air volume flow rate supplied to the plenum.
Maximum raise access floor leakage to be 1.0l/s/m2 of floor area without carpets at a test pressure of 50Pa

2020 PRESSURE TESTING - WATER CIRCULATING AND SUPPLY SYSTEMS AND STEAM AND CONDENSE LINES:

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Carry out Hydraulic Pressure Testing as described in BESA Guide to good Practice for Site Pressure Testing of Pipework (TR/6). Test section by section for one hour, as the work proceeds and prior to application of thermal insulation as follows.

Operating gauge pressure less than 3.5 bar, test gauge one and a half times the maximum working pressure.

Operating gauge pressure 3.5 - 7.0 bar, test gauge pressure twice the maximum working pressure.

Operating gauge pressure greater than 7.0 bar, test gauge pressure 14.0 bar or one and a half times the maximum working pressure, whichever is the greater.

Comply with BESA TR/20 part 8 for steam and condensate systems.

2030B PRESSURE TESTING - UNDERGROUND PIPEWORK:
Test to a gauge pressure twice the operating pressure or 7 bar, whichever is the greater, for 4 hours.
Test pre-insulated bonded steel pipe systems for district heating in accordance with BS EN 13941-2
Test pre-insulated non bonded pipe systems in accordance with the system manufacturer's recommendations.
Test pre-insulated bonded flexible pipe systems in accordance with the system manufacturer's recommendations

2042 PRESSURE AND LEAKAGE TESTING - WATER SERVICES INSTALLATIONS:
Inspect and test water services installations in accordance with relevant parts of BS EN 806 and BS 8558 and to the requirements of the Local Water Undertaking.
Ensure the provisions laid down in BESA TR/6 Site Pressure Testing of Pipework for testing underground CWS mains are carried out.

2050 PRESSURE TESTING - FIRE RISERS:
Undertake static pressure tests followed by flow and pressure tests in accordance with BS 9990. Demonstrate to Fire Brigade when tests are satisfactory.
On completion of the static test check operation of the non-return valves integral within the inlet breeching unit by using the static pressure exerted by the full water capacity of the riser.
For Wet Riser pipework undertake static water pressure test to a pressure not less than the system closed valve pressure exerted by the wet riser pump set when designed to operate at the flow and pressure defined in BS 9990. Ensure pressure is maintained for a minimum period of 15minutes.

2055 PRESSURE TESTING - REFRIGERANT PIPEWORK:
Comply with relevant Institute of Refrigeration (IOR) Safety Code of Practice for refrigerant used in the installation and BS EN 378-2.
Test refrigerant pipework using the strength test procedure as detailed in Clause R6.4 of the CIBSE Commissioning Code R: 2002. Test refrigerant pipework using the leak test procedure as detailed in Clause R6.5 of the CIBSE Commissioning Code R: 2002. Test refrigerant pipework using the deep vacuum test method as detailed in Clause R6.6 of the CIBSE Commissioning Code R: 2002

2062 PRESSURE AND LEAKAGE TESTING - GAS PIPEWORK OTHER THAN MEDICAL GASES:
Pressure test and commission gas infrastructure pipework (external to buildings) in accordance with BS EN 12327
Carry out a pneumatic leak test on natural gas pipework followed by a pneumatic pressure test as described in BSEA TR/6 Site pressure testing of pipework.
For Natural gas systems, Purging and soundness testing shall only be carried out by authorised persons in accordance with the Institutions of Gas Engineers Publication IGE/UP/1 "Soundness Testing and Purging of Industrial and Commercial Gas Installations".
Test records shall be kept based on IGE/UP/1 requirements and prepared to provide a record of satisfactory witnessed tests and procedures for soundness testing and purging.

For small low pressure natural gas systems comply with IGE/UP/1A and for domestic natural gas systems comply with IEG/UP1B

For other systems (such as gaseous fire protection systems), carry out a pneumatic leak test followed by a pneumatic pressure test as described in BESA Guide to Good Practice for Site Pressure Testing of

Pipework (TR/6). Upon their completion, pressure/leak test the areas to be protected to ensure that their leakage characteristics are as assumed in the specialist's design.

2065 PRESSURE TESTING - OIL PIPEWORK:
Test oil pipework installation in accordance with relevant part of BS 5410 to suit the application and TR/6 Site pressure testing of pipework. BESA. Guide to good practice.

2072 PRESSURE AND LEAKAGE TESTING - PIPED MEDICAL SERVICES:
Test to requirements of Hospital Technical Memorandum 02-01 Part A.

2075 TESTING CONDENSE AND OVERFLOW SYSTEMS:
Test condensate drainage systems from cooling coils and any overflow pipework / drainage pipework from plant in accordance with BS EN 12056-2 and BESA TR/6 Site pressure testing of pipework.

2082 PRESSURE AND LEAKAGE TESTING - SOIL, WASTE, VENTILATION, ANTI-SIPHON AND RAINWATER PIPEWORK:
Test section by section as the work proceeds and subsequently on completion with all sanitary fittings fixed and working.
Submit systems to two separate tests, Air test and Hydraulic Performance test in accordance with BS EN 12056 – 2.
Siphonic rainwater pipework shall be flow and positive pressure tested in accordance with manufacturer's recommendations and BS 8490.

2090 PRESSURE TESTING - UNDERSLAB DRAINAGE:
Test section by section as the work proceeds and subsequently after completion of backfilling and compaction to the satisfaction of the Engineers and the local Authority.
Individually test sections which will be permanently embedded in the structure or concealed in ducts or voids.
Submit sections to two separate tests Water test and Test for Straightness and Obstruction in accordance with BS EN 752 and BS EN 1610.

2100 VACUUM SYSTEM TESTING:
Test medical and laboratory vacuum systems in accordance with HTM 02-01 Part A and the vacuum system manufacturer and / or specialist's recommendations.

2102 TESTING WIRING INSTALLATIONS:
Ensure all electrical installations associated with the system, are tested in accordance with BS 7670 IET Wiring Regulations before any plant is run.

2112 TESTING RECORDS:
Keep a systematic record of tests. Submit samples of test record sheets for agreement prior to testing. Obtain signatures of nominated witnesses to tests. Distribute records as indicated in specification section A33.

3000 COMMISSIONING

3002 COMMISSIONING PROPOSALS
Submit proposals for commissioning as indicated in specification work Section A33 or A64 - General Engineering Technical Items. Use commissioning specialists who are members of The Commissioning Specialist Association (CSA).

3012 CLEANING DUCTWORK SYSTEMS:
Clean ductwork before plant is first run, using access openings in ductwork. Carry out cleanliness checks and procedures listed in CIBSE Commissioning Code Series A Air Distribution and BSRIA Guide BG49/2013 Commissioning Air Systems. Also refer to specification section Y30, clause 4091 and schedule Y30sch1 regarding ductwork internal cleanliness.

3014 CLEANING PIPEWORK SYSTEMS:

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Flush and clean all pipework systems before the plant is first run. Carry out flushing procedures listed in CIBSE Commissioning Code W: Water Distribution Systems and BSRIA Guide BG29/2012 Pre-commissioning cleaning of pipework systems and the requirements of specification section Y25.

3020 COMMISSIONING CODES:
Carry out commissioning of installations in accordance with the procedures, checks and tolerances given in the BSRIA Application Guides for water systems and air systems to achieve the standards set in the CIBSE Commissioning Codes.

3025 SEASONAL COMMISSIONING (or Commissioning –implementation)
Provide appropriately qualified personnel and all necessary equipment and materials to execute the seasonal commissioning works. The same organisation / team that carried out the original construction works shall undertake the seasonal commissioning.
A schedule of suitable working periods and essential services to be maintained during any work will be provided by the building operator.
A programme for the works shall be provided at least 1 month prior to the start date. This should account for any phased handovers, cause as little disruption as possible and ensure essential services are maintained.
The works shall comply with all statutory and client specific Health and Safety requirements.
Any performance deficiencies found during seasonal commissioning shall be corrected.
All seasonal commissioning shall be carried out in accordance with the project commissioning specification, an approved method statement, manufacturers' guidelines and the day-to day operational requirements of the building users.
Record all seasonal commissioning works and after completion of the works update all building documentation including O&M manuals, Building Manual, Building Log book, Building User Guide and the Building Information Model (BIM). Any changes made to the systems during the works shall be clearly identified.
BREEAM New Construction 2018 requirements
Comply with Issue ID Man 04 Commissioning and Handover.
Comply with Issue ID Man 05 Aftercare.
BREEAM Refurbishment and Fit Out 2014 requirements
Comply with Issue ID Man 04 Commissioning and Handover.
Comply with Issue ID Man 05 Aftercare

3031 COMMISSIONING WATER DISTRIBUTION SYSTEMS:

Preliminary checks
Carry out checks and procedures as detailed in CIBSE Commissioning Code W.
Ensure system is statically complete as defined in BSRIA Guide BG2/2010 Commissioning of water systems in buildings
Use pre-commissioning checklist from BSRIA guide BG2/2010
Setting to work and regulation
Set to work and regulate water distribution systems in accordance with CIBSE Commissioning Code W and BSRIA Guide BG2/2010 Undertake an initial scan of the system and document the results. Follow guidance for commissioning of variable flow water systems in CIBSE KS9 (Commissioning variable flow pipework systems)and BSRIA BG2.
Measurement
Use instruments for measurement generally as detailed in BSRIA Guide BG2/2010
For each belt driven pump provide a change of belts and drives (to be sized after balancing the system). Allow for changing belts and drives and recommissioning pump and then rechecking system as necessary to achieve the specified duty.

For each direct driven pump (both single pumps and twin headed pumps) without inverter or other speed control, allow for a change of impeller (to be sized after balancing the system). Allow for changing impeller and recommissioning pump and then rechecking system as necessary to achieve the specified duty.

Commission district heating pipe systems using thermally insulated bonded single and twin pipe systems in accordance with BS EN 13941-2 Annex E.

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Commission district heating / cooling systems in accordance with the manufacturer's recommendation.

3041 COMMISSIONING AIR DISTRIBUTION SYSTEMS:
Preliminary checks
Carry out checks and procedures as detailed in CIBSE Commissioning Code A, Section A1.
Ensure system is statically complete as defined in BSRIA Guide BG49/2015 Commissioning of air systems.
Use pre-commissioning checklist in BSRIA guide BG 49/2015
Verify the fitness for purpose of installed systems before, during and after hand over in accordance with BS EN 12599 as required.
Setting to work and regulation
Set to work and regulate air distribution systems in accordance with CIBSE Commissioning Code A and BSRIA guide BG 49. Undertake an initial scan of the system and document the results.
Measurement of air flow
Use instruments for measurement and methods of measurement detailed in BSRIA Guide BG 49/2015 and CIBSE commissioning code A.

Undertake tests and checks to ventilation and air conditioning systems generally in accordance with BS EN 12599 in order to verify the fitness for purpose of the installed systems before, during and after handover. Method statement to include relevant checklists from BS EN 12599.

Where scheduled, undertake measurements in the occupied zone in air-conditioned / ventilated rooms, including the following: airflow, air velocities, temperatures and sound pressure levels in accordance with BS EN 15726.

For each belt driven fan provide a change of belts and drives (to be sized after balancing the system). Allow for changing belts and drives and recommissioning fan and rechecking system as necessary.
For each direct drive, adjustable pitch, axial fan, allow for a change of pitch angle (to be determined after balancing the system). Allow for recommissioning each system after the fan blade pitch change.

Undertake works and checks generally in accordance with BS EN 12599: *Ventilation for buildings - Test procedures and measurement methods to hand over air conditioning and ventilation systems* - in order to verify the fitness for purpose of the installed systems before, during and after handing over. Method statement to include relevant checklists from BS EN 12599.

3051 COMMISSIONING BOILER PLANT:
Follow the procedures laid down for carrying out Preliminary Checks and Start Operation in accordance with CIBSE Commissioning Code B and manufacturer's instructions.
Apparatus and Instruments
Use Apparatus and Instruments detailed in CIBSE Commissioning Code B, Appendix BA1 Apply tolerances defined in Appendix BA1.

Commission the combustion aspects steam boiler plant in accordance with the principles outlined in CIBSE Commissioning Code B. Follow the procedures in the relevant parts of BS EN 12952 and BS EN 12953 for testing, commissioning and acceptance tests of steam boiler plant.
The boiler manufacturers in accordance with a method statement, which has been approved by the client's insurance inspectors and the CA, must commission steam boiler plant.

3052 COMMISSIONING STEAM SYSTEMS:
Commission steam systems in accordance with:
The boiler manufacturer, specialist steam equipment manufacturers' and water treatment specialist's recommendations
The CSA (Commissioning Specialists Association) Technical Memorandum - TM7

Steam boiler plant
Combustion aspects of steam boiler plant to be commissioned in accordance with the principles outlined in CIBSE Commissioning Code B.
Follow the procedures in the relevant parts of BS EN 12952 and BS EN 12953 for testing, commissioning and acceptance tests of steam boilers and ancillary plant.

The boiler manufacturers must commission steam boiler plant in accordance with a method statement, which has been approved by the client's insurance inspectors and the Contract Administrator.

3055 COMMISSIONING OF GAS PLANT AND SYSTEMS:
Commission gas fired plant on industrial and commercial premises in accordance with IGEM/UP/4.
Commission gas infrastructure (external to buildings) supply systems in accordance with BS EN 12327.
Undertake all completion and commissioning procedures detailed in Section 17 of IGEM/UP/2 edition 3 and provide new gas pipework commissioning checklist based on Appendix 16 in UP/2.
Provide a scheme for inspection, testing and maintenance of the gas installation for inclusion in the O&M manuals to ensure continued integrity.

3061 COMMISSIONING REFRIGERATING SYSTEMS:
Comply with relevant Institute of Refrigeration (IOR) Safety Code of Practice for refrigerant used in the installation and BS EN 378-2.
Commission refrigerating systems in accordance with CIBSE Commissioning code R.

3081 COMMISSIONING PLANT ITEMS AND OTHER SYSTEMS:
Where no CIBSE or BSRIA manuals are published that cover the commissioning of specific plant items or other systems submit detailed proposals and comply with the manufacturers' recommendations for setting to work.

3091 INSTRUMENTS AND GAUGES:
Ensure instruments are correctly calibrated. Record details of instruments on record sheets.

Submit evidence of correct calibration of instruments to be used in connection with commissioning and testing.

3101 AIR SYSTEMS COMMISSIONING RECORDS TO BSRIA GUIDE BG 49/2015:
Keep a systematic record of commissioning results and distribute as indicated.
For air systems.
A record of the initial scan of the system shall form part of the commissioning results. These results shall be included in the Operation and Maintenance manuals.
Use record sheets as detailed in BSRIA Guide BG 49/2015 Commissioning Air systems.

3102 WATER SYSTEMS COMMISSIONING RECORDS TO BSRIA GUIDE BG2/2010:
Keep a systematic record of commissioning results and distribute as indicated.
For water systems
A record of the initial scan of the system shall form part of the commissioning results. These results shall be included in the Operation and Maintenance manuals.
Use record sheets as detailed in BSRIA Guide BG2/2010, Commissioning of water systems.

3110 BMS COMMISSIONING - CONTROL SYSTEM SPECIFICATION DETAILS REQUIRED FOR COMMISSIONING:
Ensure that the following information is supplied to the commissioning engineer:
A network schematic providing a record of the overall control system architecture.
Schematics of the systems to be controlled indicating the location of sensors and actuators.
A written description of the configured control strategies.
Control strategy logic diagrams in the form of logic flow charts.
Set-points and other control settings such as initial default parameters for control loops relating to the control strategies.
Criteria relating to control accuracy and stability.
A points list including digital inputs/outputs and analogue inputs/outputs.
Control panel drawings.
BMS operator workstation graphics and associated point data displaying monitored conditions.
Trend logging archiving requirements and alarm routing.
The scope of operational and specified functionality of management software, e.g. utility monitoring and targeting software.
Functional requirements of any occupant interfaces.
Details of any hard-wired interfaces from, or to, other control devices.
Functionality and scope of data to be transferred over any gateway for use as part of an integrated system.

Functional profiles for any direct interoperability integration.
Ensure that the following is included in the BMS commissioning specification:-
A clear description of the division of responsibility between the various parties.
Off-site and on-site pre-commissioning procedures.
On-site commissioning procedures.
Requirements for assistance to air and water balancing testing (e.g. opening and closing control valves) and other plant tests where the controls need to be overridden.
A requirement for any point-by-point verification of correct operation.
Requirements for evaluation of control loop performance/loop tuning.
Requirements for the BMS operator workstation for assistance in the commissioning of plant.
Arrangement for the management of delays.
Phased completion requirements.
Requirements for demonstration/witness testing on the basis of a percentage of points or on a point-by-point basis. Ensure that the witnessing requirement includes the identification of those responsible.
Requirement for software/configuration data back-up.
Requirement for, and involvement in, any complete system and sub-system performance testing.
Requirement for system documentation.
Requirement for operator training requirements.
Requirement for post occupancy checks.

3112 COMMISSIONING OF ELECTRICAL INSTALLATIONS:
Refer to specification section Y81

Ensure all electrical installations associated with the system are tested and commissioned before any plant is run.

Carry out electrical checks listed in CIBSE Commissioning documents:-
Series A Air Distribution Systems - A1.5
Code W: Water Distribution Systems

3120 BMS COMMISSIONING – PRE-COMMISSIONING (inc NES clause 3140)
Ensure that the BMS is pre-commissioned to allow the building services plant to operate under "manual" running conditions.
Ensure that the control valves can be manually set in their fully open position to allow the balancing of pipework flows.
Ensure that dampers can be manually opened to allow the commissioning of air systems.

Ensure that as much pre-commissioning work as possible is performed off-site:
Ensure that the following is followed:

Pre-commissioning action	*Pre-commissioning off-site*
Control application software	Yes (final commissioning on-site)
User interface software	Yes (final commissioning on-site)
Control panels	Yes (final commissioning on-site)
Terminal units (fan coil units, etc)	Yes (final commissioning on site)
Wiring	No
Communications network	No
Sensors	No
Actuators	No
Integration gateways	Partial

Ensure that a record of all settings, set-points and offsets are maintained throughout the pre-commissioning period.
Ensure that all final physical adjustments to the field devices are indelibly marked.
Ensure that all packaged plant interfaced with the BMS is fully tested and commissioned by the manufacturer or installer.
Ensure that the BMS is pre-commissioned in accordance with the requirements of CIBSE Code C (Commissioning of automatic control systems).
Ensure that the BMS is pre-commissioned to allow the building services plant to operate under "manual" running conditions.
Ensure that the control valves can be manually set in their fully open position to allow the balancing of pipework flows.

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Ensure that dampers can be manually opened to allow the commissioning of air systems.

3130A BMS COMMISSIONING - PLANT READY FOR CONTROL SYSTEM COMMISSIONING
Confirm that the following plant commissioning has been performed before commencing the final BMS commissioning:
Water systems
Ensure the system is cleaned and flushed to remove any debris.
All regulating, isolating and control valves in place and operating correctly.
That all flow measuring devices are in place and in the correct location for accurate measurement (including pressure tappings).
The system is vented.
That the proportional balancing is completed to obtain the branch flow rates in the correct ratio to each other (or through the use of and setting of self-balancing valves).
That the pump flow rate has been adjusted to provide the specified flow rate.
Air systems
Debris has been removed from the air distribution system.
That dampers are in the correct location and fully functional.
That fire/smoke dampers open.
Test holes have been drilled and sealed with removable plugs.
That in-situ flow measuring devices have been installed.
Ductwork air leakage testing has been performed (if specified).
Completion of proportional balancing of regulating dampers so that terminals share the air flow in the correct proportions.
Regulation of the fan(s) to provide the specified flow rate.
Packaged equipment
Ensure that plant and controls have been fully commissioned and are functional, ready for integration with other plant/systems.
That control equipment inputs/outputs are in the specified format for connection to the main control system.
Confirm that the plant is commissioned in accordance with:
Air distribution systems, CIBSE Code A
Boiler plant, CIBSE Code B
Refrigeration systems, CIBSE Code R
Water distribution systems, CIBSE Code W
Commissioning of water systems BG2/2010, BSRIA
The commissioning of air systems in buildings, BG49/2015, BSRIA.

3151 COMMISSIONING BMS / AUTOMATIC CONTROL SYSTEMS
Carry out commissioning of Automatic Control Systems in accordance with Manual prepared by the controls equipment manufacturer. Carry out the Checking and Setting-Up procedure detailed in the CIBSE Commissioning Code C, Section C1.
Measurement
Carry out measurements in accordance with CIBSE Commissioning Code C, Appendix C2.1.
Ensure that the BMS is commissioned in accordance with the requirements of CIBSE Code C
Wherever possible load, prove and commission all software off-site.
Carry out all tests necessary to ensure the correct operational state of the installation. Load and prove all software. Set all variable parameters and switches to the appropriate values and settings to ensure compliance with the specification.
Prior to activating any BMS control of plant demonstrate all safety interlocks and ensure all fail safe conditions are implemented and operational.
Record values and settings of all variable parameters and switches set as part of the commissioning process. Include these records in Record Documents.
Indelibly mark all physical adjustments to BMS devices.

3152 BMS WITNESSING REQUIREMENTS: (NES clause A32 151.000 / W60 360.010))
The Contractor shall implement the following CA's witnessing requirements. Ensure that on-site commissioning staff facilitate the witnessing process.

Confirm that the BMS hardware is installed in accordance with Section W60.
Verify any operator software and associated graphics.
Witness completely the control of any main and/or critical items of plant along with a random sample of other points.

If less than 300 points, witness all points. Between 300 and 1,000 points witness 50% (minimum of 300 to be witnessed). If more than 1,000 points witness 20% (with a minimum of 500 points witnessed).
Reserve the right to witness 100% of the points if the failure rate is greater than 5%.
Witness a sample of specific functions, eg 10% of alarms and 10% of data logging.
Witness one of several identical items of plant in detail with the others witnessed on a random basis.
Verify the system security access.
Verify that all safety-related functions perform to that specified, eg plant shutdown on fire condition.
Verify all plant restarts according to that specified after building power failure and local power failure.
Witness all power meter data-points to ensure that they match the meters.
Ensure that trend logs are used when witnessing points in order to monitor the performance of control actions.
Verify the handover of all operating manuals and system documentation.
Verify the handover of backup copies of software.
Verify the completion of any specified system operator training.

3153 BMS - POST HANDOVER CHECKS: (Edited from NES clause A32 152.000 / W60 360.050)
Ensure that the following post-handover checks are performed:
Global level checks
Internal air temperature.
Relative humidity.
Ventilation levels
Energy consumption (ensure that the pulse-input counters match the meters).
Requirements associated with seasonal commissioning
Soft landings requirements
Check that each of the above meets the specified requirements.

System level checks
Control strategies. Check that any suspect control strategies are appropriate for the intended application. Check that the suspect control strategy has been implemented and commissioned correctly. Check that the control strategy is still appropriate for the intended use.
Network communications. Check that all relevant field controllers communicate properly. Check for correct sharing between controllers of relevant data and correct inter-controller operation.
Control set-points. Check that the set-points in question are correct and appropriate for the actual operating conditions.
Control loop settings. Check that the control loop settings result in accurate and stable control.
Check that all self-learnt characteristics are valid.
Occupant controls. Check that occupant controls work correctly.
Sub-system/component level
Sensors. Check the accuracy and location of any suspect sensors.
Actuators. Check that any suspect actuators operate correctly.
Dampers and valves. Check that there are no dampers and valves that are jammed and that they operate as intended

4000 PERFORMANCE TESTING (NES 251.050)

4010 SYSTEM PERFORMANCE TESTING / DEMONSTRATIONS:
Demonstrate the performance and control sequence, including the operation of all safety devices, of installations including single, standby, multi-duty plants and systems, and of plants specified for future use.

4015z TESTING OF RESIDENTIAL VENTILATION SYSTEMS:
Demonstrate the performance of residential ventilation systems through performance testing and installation checks in accordance with BS EN 14134.
Comply with the best practice requirements of BSRIA BG 46/2015 "Domestic Ventilation Systems – A Guide to Measuring Air Flow Rates"". For measurement of air flow rates use the unconditional method.

4020z PERFORMANCE TESTS, CAPACITY TESTS AND ENVIRONMENTAL TESTING:
Carry out performance and capacity tests and environmental testing for all systems and in all areas of the building to prove and demonstrate the performance of the systems and plant item duties.
Where applicable, on ventilation facilities correct the measured air flow rate when ambient measuring conditions are different from standard conditions in accordance with PD CEN/TS 17153.
Specific Fan Power Validation tests

After fitting clean filters, air handling systems to be commissioned under validation load. Measure the specific fan power SFP of each system for calculation of the building "as constructed" CO_2 emission rate.

Site performance testing of heating and cooling coils

Where specified in the scope of works or scheduled undertake in accordance with Commissioning Specialists Association guide TM10 – Site performance testing of heating and cooling coils.

For environmental testing, the minimum requirement is to test each room using the BMS (unless stated otherwise in Y51sch2) for at least 48hours during which period the temperature and Humidity (if controlled) set points must be varied at least twice to prove the correct responses of control systems and plant. Temperature / humidity logs shall be provided as a record of the testing.

Apply artificial loads to simulate sensible and latent gains. Use calibrated data loggers or chart recorders (independent of the BMS) in those areas detailed in the scope of works, or where indicated in schedule Y51sch2 or otherwise provide test arrangements to simulate the full range of operating conditions and duties.

Undertake system proving during the defects period by recording, evaluating and reporting on the seasonal performance of the systems against their design values. Ensure that both summer and winter maximum and minimum conditions are covered by the test results.
Carry out ambient air quality tests in accordance with BS EN 13528-1, BS EN 13528-2 and BS EN 13582-3 as scheduled.

Undertake measurements in the occupied zone in air-conditioned / ventilated rooms, including the following: airflow, air velocities, temperatures and sound pressure levels as scheduled or described in the scope of works / commissioning specification in accordance with BS EN 15726.

Carry out measurements of sound or noise levels in all internal and external areas of the building or project to demonstrate that the designed values are being achieved or not exceeded as appropriate.

4024 CONTROLS DEMONSTRATION AND VERIFICATION:

Demonstration and verification that the controls systems are fully operational, commissioned and deliverables have been made shall include, but not be limited to, the following:-

: Demonstration of operation of software prior to installation
: Audit of cabling and hardware installation
: Demonstration of physical and logical integrity of system, including demonstrating that sensors and actuators correctly connected and addressed.
: Demonstration of control actions, including operation of all safety devices
: Demonstration of sensor calibration
: Demonstration of successful system software commissioning, including reloading software and documented commissioning data from media and subsequent satisfactory operation.
: Verification of specified graphics
: Verification of satisfactory training of client's staff
: Verification of the handover of all specified operating manuals, documentation and drawings
: Verification of handover of back-up copies of software
: Verification of handover of consumable spares

4030z RECORDERS:

During performance, capacity and environmental testing provide recorders as necessary to demonstrate the system performance.

Following completion provide and maintain on free loan portable at least three seven day space temperature and relative humidity recorders, together with adequate charts.
Provide other recorders as agreed with the engineer.

4040 OTHER SYSTEMS

4040A RAINWATER SYSTEMS:

Demonstrate by flow tests that the systems give satisfactory performance.

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4040B SANITARY SYSTEMS:

Comply with performance tests given in BS EN 12056 – 2.

4040C HOT AND COLD WATER / BOOSTED COLD WATER SYSTEMS:

Demonstrate and record that outlets supply adequate rates of flow.
Demonstrate that the hot water temperature at each outlet to reaches 50°C (55°C in healthcare premises) within one minute of turning on the tap.
In installations where the HWS return is local to the outlet, demonstrate that the hot water temperature at each outlet to reaches 50°C in less than 30seconds

4040D FIRE FIGHTING / SMOKE & HEAT CONTROL SYSTEMS:

Comply with requirements of the local Fire Authority, with the appropriate sections of BS 9999 and BS 9990 and the appropriate systems standards detailed elsewhere in this specification.

Comply with BS 5306-1 for hose reels.

Dry Riser System; undertake flow and pressure test at the highest outlet .of a flow of 25l/s at a running pressure of 4 bar or as agreed with the fire brigade. On each valve outlet below highest outlet undertake full bore flow test to prove no impedance to valve outlet flow

Wet Riser System; Undertake flow and pressure test at each outlet of 25l/s at a running pressure of 8bar. Or as agreed with the fire authority.
Where requested by the engineer carry out proving test of the riser's intermediate isolation valves and pump suction and delivery valves. Where the valves are monitored undertake proving test of the monitoring system by means of closing each valve and witnessing the alarm signal at the central panel location.

Wet riser storage tank infill main where installed undertake flow test utilising inline flow meter.
Carryout proving test on the open and close operation of the storage tank infill float valves and prove operation of the storage tank high water level and low water level tank alarms and witness alarm signal at the alarm panel

On each pump undertake flow and pressure proving test utilising pump back to tank test line

Undertake pump automatic start test by lowering system pressure to below pump start pressure Test to be undertaken to each pump simulating standby pump operation by isolating lead pump and lowering system pressure..
Witness alarm signal of pump starting at alarm panel.

Simulate pump failure to prove pump failed signal on system alarm
On diesel pump set undertake '6 crank test' to simulate diesel pump failed to start signal.

4040E HYDRAULIC SYSTEMS:

Comply with requirements as indicated.

4040F MEDICAL GAS AND AIR SYSTEMS:

Comply with Health Technical Memorandum 02-01 Part A.

4040G LABORATORY AND INDUSTRIAL SYSTEMS:

Comply with requirements as indicated.

4040H GAS SYSTEMS:

Comply with the requirements of the local Authority.

Y51 – Testing & Commissioning of Mechanical Services

4040I **SILENCERS AND PLANT ACOUSTIC TREATMENT:**
Demonstrate by measured tests that noise criteria indicated have been achieved.
Sound pressure levels from equipment to be measured in accordance with BS EN ISO 16032.

4040J **ACOUSTIC ENCLOSURES:**
Demonstrate that measured air leakage complies with scheduled values.

4050z **PERFORMANCE TEST RECORDS:**
Keep a systematic record of tests. Distribute records as indicated in Section A33.

4062 **FINE TUNING:**
Carry out fine-tuning as required by the engineer.

10000 **NES**
Based on NES version Y51 – Dec 19

Y54 – Identification (Mechanical)

1010 **REQUIREMENTS:**
Identify all pipework, ductwork, equipment, appliances and ancillaries comprising the various systems.

1021 **NEW SYSTEMS:**
Comprehensively label and colour code throughout the works.
Any systems which have the same colour coding but serve different purposes (eg laboratory / Domestic hot and cold water services) shall have additional descriptive identification.

1030 **EXISTING SYSTEMS:**
Where identification details are incompatible with those required for new systems, obtain approval to mode of cross referencing.

1041 **COLOURS:**
To colour ranges given in BS 381C and BS 4800.

1045 **PERFORMANCE and DURABILITY:**
Ensure durability of all safety signage / identification is in accordance with BS ISO 17398

2000 **PRODUCTS/MATERIALS**

2011 **PIPEWORK IDENTIFICATION:**
Standards
Colour code and label to BS 1710.
Identification
Apply primary and secondary identification, to each pipe at least:
Once in every room or enclosed area.
At intervals not exceeding fifteen metres.
At every junction.
At every valve.
At every inspection and access position into service shafts, false ceilings, bulkheads etc.
Primary Identification
Apply colour bands, 300mm wide.
Secondary Identification
Apply colour bands, 50mm wide, and superimpose a legend identifying circuit, direction of fluid or gas flow, nominal pipe bore and, where appropriate, fluid or gas pressure.
Legends
Apply to colour bands by transfers of an approved type.

2021 **DUCTWORK IDENTIFICATION:**
Standards
Generally colour code and label to BESA Specification DW/144.
Identification
Apply primary and secondary identification, to each duct at least:
Once in every room or enclosed area.
At intervals not exceeding fifteen metres.
At every junction.
At every damper.
At every inspection and access position into service shafts, false ceilings, bulkheads etc.
Primary Identification
Apply colour bands, 300mm wide
Secondary Identification
For ducts with longest side or diameter up to and including 225mm. Paint colour bands 50mm wide and superimpose legends.
For ducts with longest side or diameter over 225mm. Paint or apply transfers to identification triangles, or triangular plates. Superimpose or incorporate legends.
Triangular Plates
Attach to buckle bands or stool pieces and fix to ducting, with apex indicating direction of airflow. Submit details of plates and fixings for approval before painting and marking. Use equilateral triangle of side 150mm minimum.

Y54 – Identification (Mechanical)

Legends

Apply transfers of an approved type to colour bands or triangles or triangular plates. Identify floor and space served, associated equipment reference and direction of airflow.

2030z PLANT AND EQUIPMENT IDENTIFICATION, LAMINATED PLATES:

Standards

Identify each item of equipment by name and, where appropriate, by agreed reference characters. Provide colour identification as called for in work sections and, in all cases, colour firefighting equipment red.

Plates

Use rectangular metal or laminated plastic, securely fixed to each item of equipment.

Lettering

Laminated plates, multi-coloured with outer layer removed for lettering. General labels to be white with black lettering.

Legends

Engrave plates with an approved text. Incorporate operating duty of equipment where this is not incorporated in other labelling.

2035 GRAPHICAL SYMBOLS FOR USE ON EQUIPMENT IN ACCORDANCE WITH BS EN 80416:

Graphical symbols for use on equipment to be created and applied in accordance with BS EN 80416-1, BS EN 80416-2, BS EN 80416-3.

2040z VALVES COCKS AND OTHER PIPELINE ANCILLARIES IDENTIFICATION:

Standards

Identify each valve, cock, stop valve, air vent, drain cock etc. with disk engraved with numerical reference and service. Except where exposed in occupied areas.

Discs

Securely attach metal or laminated plastic discs, minimum diameter 35mm, to each item. Discs to be white with black lettering.

Legends

Engrave discs with permanent characters, minimum height 6mm.

Incorporate in operating instructions relating to regulating valves and flow measuring Equipment, details of flow rate, pressure differential and setting.

2050z MEDICAL GAS TERMINAL UNITS:

Label and colour code to HTM 02-01, Part A.

Label and colour code small medical gas cylinders to BS EN ISO 407.

2060z LABORATORY OUTLETS:

Colour code and label pipelines and services to BS 1710.

Colour code and label taps and valves for use in laboratories to BS EN 13792.

2070 AIR VOLUME REGULATING AND CONTROL DAMPER IDENTIFICATION:

Standards

Identify each regulating and control damper except where exposed in occupied areas.

On ductwork dampers, clearly indicate commissioning set point.

Identification colours

Use primary and secondary identification colours of associated system for painted or self colour disks.

Discs

Securely attach metal or laminated plastic discs, minimum diameter 35mm, to each item.

Legends

Engrave disks with permanent characters, minimum height 6mm.

2080 INSTRUMENT IDENTIFICATION:

Standards

Identify each instrument by name and, where appropriate, by agreed reference characters.

Plates

Y54 – Identification (Mechanical)

Use rectangular metal or laminated plastic, securely fixed to each instrument.

Legends

Engrave plates with an approved text.

2091 DANGER AND WARNING NOTICES:

Hazardous Systems

Colour code and label hazardous systems and equipment to requirements of Health and Safety Executive Guidance Notes.

On natural gas systems, provide identification and warning notices and labels (including a notice adjacent to each main and emergency shut off valve) to meet the requirements of the Gas Safety (Installation and use) Regulations 1998 as amended / ACOP L56 (2018), and Institution of Gas Engineers and Managers (IGEM) requirements.

2105 SYSTEM IDENTIFICATION INSTALLATION CHARTS:

System Schematics

Supply and fix a referenced schematic diagram (or diagrams) of all systems as installed, including equipment and ancillary schedules. Show scheduled information on diagram.

Identify all items by appropriate reference characters.

Control Schematics

Supply for incorporation in O&M manuals a referenced schematic diagram (or diagrams) of all control systems as installed, including equipment and ancillary schedules. Show scheduled information on diagram. Identify all items by appropriate reference characters.

Location

Fix in each plant room or equipment room.

Finish

Plastic encapsulated chart.

10000 Based on NES Y54 text Dec 19

Y60 – Conduit & Cable Trunking

1010 STANDARDS / GENERAL:
Provide conduit and cable trunking in accordance with the relevant British Standards and in particular the requirements of BS 7671 Requirements for Electrical Installations (The IET Wiring Regulations).
Any conduit or trunking must support the function of the cabling system and provide protection, adequate separation distance and presentation as required by the cabling and EMC design.

1012 TRUNKING LAYOUT
Set out cable trunking as indicated on the drawings, making due allowance for any diagrammatic presentation. Provide all necessary offsets, bends, tapers, transformation pieces etc. required as trunking manufacturers standard accessories whether or not these are detailed.

2000 PRODUCTS/MATERIALS

2011 CONDUITS:
Use surface conduit or conduit concealed in building finishes as described in the Work Sections, Schedules or shown on the drawings. Minimum size of conduit shall be 20mm unless otherwise indicated.
Comply with relevant parts of BS EN 61386 including parts 1, 21, 22, and 23 as appropriate.
Buried conduit systems to BS EN 61386-24.
Use conduit from one manufacturer throughout. Use fittings to match conduit grade and finish.
For metal conduit use solid couplers to join lengths of conduit up to 25mm diameter, use oblong 'draw in' boxes to join lengths of conduit of 32mm, 1 1/2" and 2" diameter.
Electrical characteristics for metal conduit shall be electrical continuous.
For plastic conduit do not use slip joints, use expansion couplings where required.
Electrical characteristics for non-metallic conduit shall be electrical insulating.
Temperature classification of conduits shall be -5°+60°C
Conduits shall be non-flame propagating.
Resistance against ingress of water and solid foreign bodies shall be rated to BS EN 60529. minimum IP 31 for indoor use, IP65 for exterior.

2051 CONDUIT FITTINGS AND ADAPTABLE BOXES-METALLIC
For metal conduit use malleable iron conduit fittings, for external areas use malleable iron adaptable boxes and for internal areas use steel adaptable boxes.
Do not use factory made bends, inspection bends or inspection couplers except with 32 mm, 1½" and 2" conduits. Ensure fittings are same class and finish as associated conduit system. Supply covers for circular or adaptable boxes in the same material and finish as boxes. Use steel dome or cheese headed screws to secure covers for Class 2 finish. Use brass dome or cheese headed screws to secure covers with rubber gaskets for Class 4 finish. Limit number of entry holes within loop-in boxes to four.

The minimum size of an adaptable box shall be 100 mm x 100 mm x 50 mm.

Connections use couplers and externally screwed brass bushes to connect conduit to loop-in circular conduit boxes, switchgear, distribution boards, and adaptable boxes. Use flanged couplers with washers.

2061 CONDUIT FITTINGS AND ADAPTABLE BOXES - INSULATING :
Do not use factory made bends, inspection bends or inspection couplers. Use boxes and connections to suit size of conduit and method of jointing. Use heavy gauge, high impact rigid PVC conduit fittings.

Provide all boxes for supporting luminaires or other heavy devices with metal brackets or insert clips to provide a support independent of the box. Provide boxes for flexible conduit, accessories and luminaire connection with a brass earthing terminal and/or steel circular earthing ring.

2080 CABLE TRUNKING AND FITTINGS:
Comply with relevant parts of BS EN 50085. Use trunking of each type from one manufacturer.

2091 METAL SURFACE TRUNKING:
Type / finish – as scheduled
Steel Trunking - Comply with relevant parts of BS EN 50085
Extruded aluminium - Comply with relevant parts of BS EN 50085

Y60 – Conduit & Cable Trunking

Supply partitions and covers same material as trunking. Use trunking manufactured with inward return edge flanges and fitted with flange couplers which ensure that when the cover is removed a minimum of 80% of the nominal trunking or compartment width is available for access.

Resistance against ingress of water and solid foreign bodies shall be rating IP31 to BS EN 60529 for internal use.

Colour to be Manufacturers standard or to BS 4800 standard as scheduled.

Electroplated zinc having a minimum thickness of zinc coating of 0.0012mm inside and outside with additional coating of stoved or air drying paint, applied at least to the external surface.
Hot dip zinc coated steel to BS EN BS EN 10346 or BS EN 10143.

Fixings
Use purpose made brackets to fix to structural steel or suspension rods. Provide external fixing lugs where specified protection for the installation is IP44 or greater.

Fittings
Use bends, tees and angles of similar gauge, type and finish as trunking body and supplied by same manufacturer. Use standard fittings where possible. Where site fabricated fittings are necessary ensure they are comparable in construction and finish with system. Obtain prior approval in writing before site fabricating any fittings or special accessories.

Partitions and Covers
Ensure partitions are electrically continuous with the body of the trunking or provide a connector for a circuit protective conductor. Ensure gap between partitions and lids maintains segregation of circuits.

Joints
Use purpose made jointing pieces fixed with screws into captive nuts. Ensure screws do not protrude through the nuts. Ensure rigidity of trunking is maintained across joint. Ensure external dimensions of trunking are maintained and not reduced by more than 4% across joints between trunking lengths and/or fittings. Use purpose made fittings of the same manufacture where trunking connects to switchgear and distribution boards.

Provide flanges for connection of flush floor trunking to vertical trunking to maintain the cross sectional area of compartments with 50 mm minimum radius.

Maintain electrical continuity at each joint by a copper link, (tinned copper for galvanized trunking), fixed on outside of trunking, secured by screws, nuts and shake proof washers. Screws must not project through the nut. Make provision for continuity to be achieved without need to remove paint from ferrous metal where trunking has a painted finish.

Screws, Nuts, Washers
Do not use self-tapping screws. Use cheese or round head screws except where provision is made for the use of counter-sunk heads. Screws, nuts and washers to be made of brass or steel zinc coated to BS 7371-3 or BS 7371-6

Cable supports
Provide horizontal trunking with removable cable retainers or bridges to retain cables in situ. Provide vertical trunking with pin racks to support cables at 3000 mm maximum spacing. Use insulated pins or insulation sleeved pins on pin racks.

Lighting Trunking Cover
Provide cover strip to prevent ingress of foreign materials, locate cabling in place and act as closure strips between luminaires. Use trunking cover strip clipped into place in trunking body. The Cover strip is to match lighting trunking body or high quality colourfast extruded plastic as scheduled. Colour and shade to BS 4800 as indicated.

2101 FLUSH FLOOR STEEL TRUNKING:

Y60 – Conduit & Cable Trunking

Trunking material -sheet steel trunking to relevant parts of BS EN 50085. Degree of Protection Class 3. Provide flanges for connection of vertical trunking and temporary blanking plates.

Flushfloor cable trunking shall be manufactured from zinc coated sheet steel and shall comprise of a 1.5 mm minimum thickness body section with 3 mm double thickness walls and 3 mm lid section for 'standard duty lids and 5mm for heavy duty lids.

The trunking body walls shall be provided with a return flange to facilitate fixings and key the trunking into the screed. The compartment separators shall support to the lid and shall be provided with a PVC edging strip, which together with a hard rubber gasket on return edges shall eliminate drumming effect.

All bends, tees intersections and other accessories shall be factory manufactured and finished by the trunking manufacturer. Accessories shall be of a similar construction and finish to the main trunking.

All trunking sections and accessories shall form modules or whole multiples of modules of a size specified, except where special units are required to suit installation requirements. Lid shall be provided in one module lengths and fixed by 4 number countersunk head screws. Where specified, screw collars (of a finish to match to exposed edges of the trunkings) shall be provided to ensure that the fixings screws are flush with the applied floor finish.

At each module position within the trunking body, a brass earth terminal shall be provided within the power compartment.

All trunking bends, tees, intersections, service outlets and telephone distribution boxes shall be provided with recessed lids (to accept the specified floor finish). Where external carpet flanges are specified, they shall be adjustable.

2102 UNDERFLOOR STEEL TRUNKING

Trunking material Sheet steel trunking to BS 4678- 2, gauge of metal - relevant parts of BS EN 50085.

Degree of Protection Class 3.

Provide flanges for connection of vertical trunking and temporary blanking plates.

Unless specified otherwise, trunking shall be manufactured from 1.5mm minimum thickness body sections with 3mm double thickness walls and 3mm lid section.

The trunking body shall be provided with a return flange to facilitate fixings and 'key' the trunking into the screed.

All bends, tees, intersection and other accessories shall be factory manufactured and finished by the trunking manufacturer. All bends shall be of the accessible type unless specified otherwise. Accessories shall be of a similar construction and finish to the main trunking.

Trunking joints shall be provided with a saddle type coupler to prevent the ingress of screed, which shall screw fix to the base flange each side of the joint.

All bends, tees, intersections and service outlet boxes shall be of the dimensions and type specified, the depth of the box shall suit the minimum screed depth. The boxes shall be provided with an adjustable frame and recessed lid (suitable to accept floor finish). Lids shall be manufactured from 1.5 mm minimum gauge zinc coated steel and comprise of a pan plate forming the recess for the finish with a welded re-enforcing plate. Lids at service outlet boxes shall be hinged and lids at bends, tees and intersections shall be screw fixed with screws located in the corners of lids. At trunking connections a 'spout' coupler shall be provided which shall screw fix to the trunking body.

Boxes and frames / lids shall be supplied separately and all boxes shall be fitted with a blank plate to prevent ingress of screed during installation.

Y60 – Conduit & Cable Trunking

Rising bends shall be provided with an 50mm internal radius or gusset.

2103 SKIRTING AND DADO TRUNKING (STEEL)

Skirting and dado trunking body shall be manufactured from 1.2mm (minimum gauge) hot dipped galvanised sheet steel and covers from 1.2mm electrozinc coated sheet steel.

All bends, tees, inter sections and other accessories shall be factory manufactured and finished by the trunking manufacturer. Accessories shall be of a similar construction and finish to the main skirting trunking body / cover.

Joint cover strips shall be provided to secure cover section to the main body and prevent the ingress of dust and moisture.

All special non-standard bends, tees, inter sections and other accessories shall be factory manufactured. No site-manufactured accessories shall be permitted unless otherwise approved by the Engineers.

Outlet plates shall be supplied separately and all accessories plates shall be fitted with a blank plate to prevent ingress of dust and moisture.

Standard- relevant parts of BS EN 50085.

2111 SERVICE OUTLET BOXES:

Provide service outlet boxes and junction boxes constructed from sheet steel with same finish as trunking. Maintain continuity and segregation of compartments through boxes and fit flyovers where necessary. Provide service outlet boxes with separate and segregated access to outlets associated with each wiring compartment. Fit cable guard or grommet to each section. Incorporate spigots or adaptors on boxes for connection to trunking or conduit as appropriate. Make frames adjustable on each corner, recess lids as indicated. Manufacture frame and lids for service outlet boxes and junction boxes and suitable to accept type of floor covering specified.

Provide outlet plates for each low voltage compartment equipped as indicated on the drawings. Provide outlet plates for each information technology compartment that ensures the IT compartment and its outlet plate conform to the requirements of relevant parts of BS EN 50174 and of the IT system installer.
Provide blank outlet plates for any unused compartments.

2121 SERVICE POWER POLES:

Provide service poles and associated conduit or trunking fittings as shown on the drawings. Maintain continuity and segregation of circuits throughout. Provide outlet boxes with separate access to wiring compartments.

Standard	- BS EN 50085-2-4.
Material	- extruded Aluminium
Finish	- Manufacturer's standard
Style	- As scheduled or indicated on the drawings.
Fixings	- Free standing or complete with fixing brackets at top as indicated.
Accessories	- As scheduled or indicated on the drawings.

2131 SURFACE TRUNKING OF INSULATING MATERIALS:

Trunking to relevant parts of BS EN 50085. Material as indicated.
Material – as scheduled or described in scope of works or on drawings
Mechanical properties - trunking for medium mechanical stress.
Minimum storage and transportation temperature, minimum installation and application temperature and maximum application temperature - BS EN 50085-1, Tables 1-3
Electrical characteristics shall be electrical insulating.
Resistance to ingress of water and solid objects shall be minimum rating IP31 to BS EN 60529 for internal use.
Resistance against corrosive or polluting substances - medium protection.
Trunking shall be Non flame propagating.
Fittings

Use fittings from same manufacturer of trunking.
Use `snap-on' covers.
Use trunking fittings and accessories suitable for jointing by solvent welding.
Use proprietary cable retaining clips at 500 mm maximum intervals on trunking that exceeds 1.8 m in length. Where junctions occur ensure first clip is not more than 300 mm from junctions.

2141 UNDERFLOOR TRUNKING OF INSULATING MATERIALS:
Material Heavy gauge, PVC trunking to relevant parts of BS EN 50085.
Minimum storage and transportation temperature, minimum installation and application temperature and maximum application temperature - BS EN 50085-1, Tables 1-3

2151 SEPARATE OR MULTI-COMPARTMENT TRUNKING:
Use separate trunking or multi-compartment trunking for segregation of services. Ensure steel partitions have a provision for connecting a circuit protective conductor.

Provide separation of wiring as required by BS 7671 and the following:
low voltage circuits.
extra low voltage circuits.
communications/data.
emergency lighting.
fire alarm circuits.
incoming telephone circuits supplied by others.

2171 SUPPORTS AND FIXINGS:
Provide proprietary suspension systems comprising channel sections with return lips and compatible fixing accessories of materials to BS EN 10162 or BS EN 10210 and/or slotted angles to BS 4345.
Ensure support components for Class 4 conduit have the same finish method as the conduit carried out after manufacture. Ensure components in direct contact with conduit match profile of conduit.

Ensure all steel components such as studding, bolts and steel screws, bolts, nuts and washers are either cadmium plated and passivated or zinc electroplated to BS 7371 after manufacture. Do not use metal fixing components likely to deteriorate and/or cause damage through electrolytic action.

2176 WIRE ROPE SUSPENSION SYSTEM:
Where specified within the Scope of Works or Schedules, use proprietary Wire Rope Suspensions Systems which comply with BS EN 12385-1, BS EN 13411-3, BS EN 13411-4, DIN 3093, and BSRIA COP 22/2002. Wire Rope Suspensions to be suitable for the safe working load and comprise Stainless Steel grade 316 wire rope, Stainless steel grade 302 Spring fasters with fixings by loops, stud (permanently fixed to wire rope length) or toggle as appropriate. The installation shall comply with BSRIA COP 22/2002 and 'solid' stud type suspensions shall be provided at maximum spacing of 20m, with a minimum of one in any straight run.

3000 WORKMANSHIP

3011 GENERAL:
Ensure entire system is electrically and/or mechanically continuous, to BS 7671.

Fire barriers
Comply with the requirements of BS 7671 wherever the conduit or trunking passes through the perimeter of a fire compartment (wall, floor or ceiling).
Install all fire stopping systems in accordance with the manufacturer's written instructions.
Install and inspect fire stopping systems in accordance with Building Regulations and ASFP Code of Practice TGD 17.

Appearance
Arrange conduit, trunking and ducting to present neat appearance, parallel with other service runs and lines of building construction, except where in screed or in-situ concrete. Ensure plumb vertical runs.

Cable installation

Install cable in conduit, trunking or equipment enclosures only when completely erected throughout its length.
Do not use framework of partitions or similar unless indicated.

Building expansion and settlement
Make provision in conduit and trunking at expansion and settlement joints to allow for movement of building structure. Provide circular through or adaptable boxes no more than 300 mm either side of expansion or settlement joints for conduit crossing. Join boxes with flexible steel conduit.

Quality
Cut conduit clean and square with axis. Remove any burrs prior to erection. Site form 90o in conduit wherever practical or use circular or adaptable boxes. Construct bends and sets cold with a bending machine. Do not apply heat when forming sets or bends. Use bending tools complying with British Standards appropriate to conduit material. Ensure no indentation or reduction in cross sectional area occurs during installation. Use correct tools to assemble conduit. Ensure no tool marks or damage to components occurs.

3021 LAYOUT:
Ensure the maximum circuit lengths and groupings of cables indicated are not exceeded.
Where dimensions are not indicated select trunking and conduit sizes in accordance with manufacturer's recommendations, BS 7671 (IET Wiring Regulations), and latest edition of Guidance Note 1 Selection and Erection published by the IET.

3031 SPACING:
Install conduit, trunking and equipment clear of other services. Measure distance from external surface of any thermal insulation. Notify instances where minimum clearance cannot be achieved and bond items concerned.
Minimum general spacings between conduits, trunking and equipment and
insulated steam services - 300 mm.
other services excluding steam - 150 mm.
above central heating radiators - 1000 mm.
Ensure separation is in accordance with manufacturer's recommendations, BS 7671 (IET Wiring Regulations), latest edition of Guidance Note 1 Selection and Erection published by the IET and relevant parts of BS EN 50174 for InformationTechnology cabling installation.

3040 CONDENSATION PREVENTION:
Install conduit and trunking systems to ensure internal condensation does not affect operation of associated circuits. Provide drainage points in accordance with BS 7671.
Where conduit passes through external wall between two areas of different ambient temperatures or in other locations likely to cause condensation, install a conduit or adaptable box. After wiring fill box with inert, permanently plastic compound with high insulation value.

3051 PROTECTION AND REPAIR OF STEEL COMPONENTS:
Paint joints of conduit and minor damages to finish of conduit and trunking, including metal support systems, immediately after erection or after damage occurs.
Use paint compatible with finish as follows:-
For galvanised finish, use two coats zinc rich paint.
For black enamelled finish, use two coats of good quality, air drying, black enamel paint.
Remove grease, oil, dirt and rust before applying protective paint.
Notify serious damage and repair or replace as instructed.

3060 EQUIPMENT CONNECTIONS:
Where surface mounted equipment is installed in conjunction with concealed conduit work, terminate concealed conduit at flush mounted conduit or adaptable box. Drill back of equipment, bush for back entry and mount equipment to conceal back box.
Connect to fixed equipment via conduit box located adjacent to termination point, using either solid or flexible conduit as indicated for final connection to equipment terminations.
Use conduit box as cable change point to facilitate changed wiring locally to adjacent equipment.

Y60 – Conduit & Cable Trunking

Connect trunking to equipment by specially fabricated connectors or by couplers and externally screwed brass bushes.

3070 CLEANING BEFORE WIRING:
Clean inside of conduits and trunking with swabs immediately before wiring.

Inspect all components and remove any foreign matter, fit temporary plugs to open ends of conduit and trunking to prevent ingress of water and solid material.

3081 WIRING:
Comply with BS 7671 when wiring installations. Segregate circuits as indicated.
Ensure draw wires are left within empty conduits for use of specialist installers. Use draw wires comprising galvanized soft iron wires or nylon tapes with fitted eyelets.

For concealed conduit ensure system is installed to enable re-wiring to be carried out from boxes for fittings or accessories only. Draw-in boxes will only be permitted with prior permission in writing.
Do not use tallow or any other substances to facilitate drawing-in of cables.

3090 BUILDERSWORK:
Ensure conduit is not concealed until work has been inspected and approved.
Obtain permission before horizontally chasing walls.
Ensure that conduit and fittings buried in concrete or behind plaster are protected against corrosion or electrolytic action prior to rendering.
Ensure conduit concealed in wall chases is covered by plaster and/or rendering to minimum depth of 12 mm.

4000 WORKMANSHIP FOR CONDUIT

4010 DRAW-IN BOXES:
Provide draw-in boxes in conduit at maximum intervals of 10 metres or after bends and/or sets totalling 180 degrees.

4020 INSTALLATION OF CAST IN OR BURIED CONDUIT:
Ensure cast-in conduits are firmly secured to reinforcing steelwork and that accessory and/or conduit boxes are secured so they do not move during subsequent building operations.

Ensure there is no blockage immediately shuttering is removed. Check there is no mechanical damage to conduit in floor screed prior to screeding. Fix securely before screed is poured. Provide temporary protection to conduits until screeds are laid. Ensure minimum amount of cross-overs occur dependent upon screed depth. Do not install draw boxes in floors.

Do not install conduits in screeds in areas indicated, within site blinding or in main structural slabs unless prior permission in writing is obtained.

4030 CONDUIT BOXES:
Ensure that wherever conduit boxes are cast in, the face of the box is flush with the face of the concrete or plaster. Fit circular conduit boxes with extension rings to ensure a flush face with plaster or concrete or where terminal blocks are to be accommodated.

Ensure fixing holes are countersunk where material thickness allows or use round head screws to prevent damage to cables and remove burrs before cables are drawn in. Use a minimum of two screw fixing for standard circular conduit boxes and four screws for large conduit boxes and adaptable boxes up to 150 mm x 100 mm. Use back outlet boxes where surface conduits pass through walls, to outside accessories or lighting points.

Secure switch boxes and socket boxes using countersunk steel screws where provision is made for them or if not use round head screws, along with plug inserts. Recessed boxes shall be finally grout in position prior to plastering or screeding.

Y60 – Conduit & Cable Trunking

4040 FIXING CONDUIT:
Support conduit in accordance with manufacturer's recommendations, BS 7671 (IET Wiring Regulations), and latest edition of Guidance Note 1 Selection and Erection published by the IET. . Ensure conduit is not under mechanical stress. Fix conduit boxes independently of conduit. Make allowance for any additional mechanical loading supported by conduit boxes. Where protection is specified as IP44 or greater ensure fixings of conduit boxes are suitable to maintain degree of protection.

Use following methods of fixing conduit:-

LOCATION	TYPE OF FIXING
Floor screeds	Saddles or crampets
Buried in plaster or render	Saddles or crampets
Above false ceilings	Saddles
Surface	Saddles

4050 FLEXIBLE AND PLIABLE CONDUIT:
Use flexible conduit for final connections to motors, other equipment subject to vibration or adjustment and to thermostats, motorised valves and similar items mounted in pipelines or ducts. Use sufficient length between equipment and circular through box at end of conduit run (minimum 450 mm) to allow necessary full range of withdrawal, adjustment or movement.

Use solid type adapters to terminate flexible conduit. Use PVC covered flexible conduit where installed externally, exposed to weather or in any position where ingress of moisture or condensation may occur.

4060 SCREWED STEEL CONDUIT:
Use materials clean and free from defects, rust, scale and oil. Obtain prior permission in writing for use of materials subject to remedial work before erection. Repair any damage caused by threading, bending or erection by painting with zinc rich paint before any rust occurs.
Ensure length of thread on conduit matches that in conduit couplers, fittings or equipment with no thread exposed after erection except at running couplers. Ensure conduits butt inside couplers. Use lubricant when cutting threads.

Use minimum number of running couplings
For running couplings in Class 2 conduit, use coupler and locknut. Paint exposed thread with zinc rich paint.
For running couplings in Class 4 conduit, use three piece conduit unions.

4070 NON-METALLIC CONDUIT:
Comply with manufacturer's instructions for bending, setting and jointing of conduit.
Use plastic conduit only where indicated. Do not install conduit when ambient working temperature is or will be below -5°C or above 60°C.
Use solvents recommended by manufacturer of conduit when using solvent welded joints and ensure spigots enter full depth of sockets. Hold joints rigid and in position until weld sets. Remove excess solvent before surface damage occurs.
Use slip joints as necessary, but not exceeding 6 metres on straight lengths to allow for expansion and contraction over temperature variation as indicated. Use semi-mastic adhesive where expansion joints are formed.
Where fitments do not have shaped or smooth conduit entries connect with male bushes and external couplings. Ensure special care is taken to prevent mechanical damage or warping to conduit where mechanical loads are imposed on conduit system, e.g. lighting fittings.

4080 UNDERGROUND INSTALLATION:
Where buried below ground, use Class 4 conduit. Do not use any buried conduit boxes unless prior permission in writing has been obtained. Wrap conduit with PVC self-adhesive tape, half lapped. Extend taping 150 mm beyond point where conduit leaves ground.

Install circular through conduit boxes at the end of the tape. Fill conduit boxes after cable installation with inert, permanently plastic compound with high insulation value, and wrap in PVC self-adhesive tape.

5000 WORKMANSHIP FOR TRUNKING

Y60 – Conduit & Cable Trunking

5010 **MANUFACTURE OF TRUNKING:**
Take measurements on site before producing drawings for manufacture of trunking.

5020 **ACCESS:**
Arrange trunking to allow access to wiring. Locate covers on top or sides of trunking if practicable. Arrange access so covers are on a continuous face and cables can be laid in throughout the length of the trunking. Notify where either condition cannot be achieved.

5031 **FIXING TRUNKING:**
Ensure trunking is independently fixed and supported from building fabric. Obtain approval for proposed fixings/supports.
Support trunking in accordance with manufacturer's recommendations, BS 7671 (IET Wiring Regulations), and latest edition of Guidance Note 1 Selection and Erection published by the IET. Use two fixings minimum at intervals, not exceeding 800mm or 225 mm from accessories, which shall be independently fixed.

5041 **STEEL TRUNKING:**
Install steel trunking in accordance with the manufacturers requirements and those of BS 7671. Use trunking to avoid multiple parallel conduit runs, subject to approval.
Cut trunking clean and square with axis, prepare ends and remove burrs and sharp edges. Ensure inside of trunking is free from anything liable to damage cables either during installation or after covers are fitted. When trunking is held in a vice, ensure surfaces remain undamaged and components are not warped. Avoid tool marking or damage to trunking system components.
Use folding bars when bending trunking fabric to site form junctions and angles. Ensure corners are neat and metal on either side of corners is not distorted. Do not form flanges by cutting or bending trunking material.
Form circular holes over 6 mm diameter in trunking body using correctly sized punch sets. Use twist drill for holes up to 6 mm maximum diameter.
Use only factory formed openings for accessories. Line unprotected apertures in trunking with PVC or nylon edging strip. Fit ends of runs with removable blanking plates.
Ensure connections are not made to covers unless indicated or approval obtained. Provide fixed section of cover projecting 25 mm either side of fabric where trunking passes through wall, floors or ceiling.
Fit cable retaining straps at 500 mm intervals except where cover is on top.

5051 **UNDERFLOOR AND FLUSH FLOOR TRUNKING INSTALLATION:**
Trunking shall be cut to length by the manufacturer where possible, however, site cutting by the Electrical Trade Contractor may be necessary to suit site installation conditions (using a bench mounted saw / disc, to ensure a square cut). Trunking lengths and accessories shall be provided complete with coupling pieces and aluminium earth links.

Lay underfloor and flush floor trunking straight and level, flush floor trunkings shall be laid on a levelling screed. Adjust height of services outlets, junction boxes and flush floor trunking to suit top of screed level. Ensure that spaces below trunking are free from voids and correctly packed. Prevent ingress of screed by masking where necessary.
Ensure trunking levelling and alignment is carried out in co-operation with person(s) responsible for confirming location and finish of floor levels.
Immediately following installation of trunking fit temporary covers to service outlets, junction boxes and flush floor trunking, joints between lids, and lids and body shall be sealed by an approved tape. Fit temporary blanking plates over open connections to vertical trunking. Retain temporary covers until permanent covers are installed.
At trunking ends a suitable end cap shall be provided.

Trunkings shall be thoroughly cleaned of steel and brass particles and swabbed through prior to the installation of cables.
Ensure underfloor trunking systems are fully rewirable to final circuit outlets.
Connect conduits only at inspection or other easy access points.

5052 **SKIRTING AND DADO TRUNKING**

Y60 – Conduit & Cable Trunking

Skirting trunking shall be cut to length by the manufacturer where possible, however site cutting by the Electrical Sub Contractor may be necessary to suit site installation conditions conditions (using a bench mounted saw / disc, to ensure a square cut).. Trunking lengths and accessories shall be provided completed with coupling pieces and tinned copper earth links.
The trunking body shall be placed direct onto the wall and fixed into place with roundhead screws at top and bottom at regular intervals not exceeding 800mm or 225mm from accessories which shall be independently fixed.
Prior to wall and floor finishes outlet plates shall be fitted with blanking plates. On completion of the finishes the blank plates shall be removed and the accessories (i.e. socket) fitted.
At trunking ends a suitable end cap shall be provided.
The trunking shall be thoroughly cleaned of steel and brass particles and swabbed through prior to the installation of cables.

5060 **TRUNKING OF INSULATING MATERIAL:**
Comply with manufacturer's instructions. Do not install trunking where ambient temperature is below -5ºC or working temperature is above 60ºC.
Use solvents recommended by trunking manufacturer when making solvent welded joints. Remove excess solvent before surface damage occurs. Hold joints rigid and in position until welds set.
Use manufacturer's standard radiused bends, connector tees, off-sets, end plates and component parts of trunking system assembly.
Ensure no type of trunking other than that specified is installed without approval.
Trunking may be substituted for conduit at certain positions subject to approval.

10000 NES Y60 TEXT Dec 19

Y61 – Cables & Wiring

1011 CABLE MANUFACTURER / CABLES CERTIFICATION:
Use new cables, delivered to site with seals intact, manufactured not more than one year prior to delivery, labelled with manufacturer's name, size, description, BS number, classification, fire classification to BS EN 50575 and BS EN 13501-6, length, grade and date of manufacture.

Ensure all cables are certified in accordance with the Construction Products Regulation (CPR) as required by BS 7671 (IET Wiring Regulations) and BS 6701. (Applicable to all 2000 series Products /Materials clauses)

For power and auxiliary cables, and other cables outside the scope of BS 6701

Ensure all cables meet at least either BS EN 60332-1-2 or BS EN 13501-6 EuroClass E_{ca}, or higher rating as indicated on the relevant cable schedule

Ensure cables to be installed where the risk of flame propagation is high (for example, cables that are bunched or are used in long vertical runs), or in a fire propagating structure, or run in a fire segregated compartment, meet at least either BS EN 60332-1-2 plus the relevant part of the BS EN 60332-3 series, or BS EN 13501-6 EuroClass D_{ca}, or higher rating as indicated on the relevant cable schedule.

Ensure cables encroaching on or run in escape routes meet at least either BS EN 13501-6 EuroClass $D_{ca\text{-}s2}$, or the relevant part of BS EN 60332-3 series plus achieve at least 60 % light transmittance when tested to BS EN 61034-2, or higher rating as indicated on the relevant cable schedule.

For telecommunications, information technology, communications and similar cables

Ensure all cables within the scope of BS 6701 and BS EN 50575 meet BS EN 13501-6 EuroClass E_{ca}, or the requirements of BS EN 60332-1-2, except for cables intended for installation into pathways that are hidden below floors, behind walls, or to which access is limited, which are to meet at least BS EN 13501-6 EuroClass C_{ca}-s1b,d2,a2.

All power cables shall have an independent CENELEC cable certification by the designated body for the country of manufacture to confirm their compliance with Harmonised Standards, British Approvals Service for Electric Cables (BASEC) is the preferred designated body, alternatively fire rated cables may be certified by the LPCB.

1020 CABLE CERTIFICATION MARKING:
Mark all types of power cable with CENELEC cable certification marking or if included in British Approvals Service for Cables (BASEC) in accordance with BASEC Regulations.

1031 CABLE RECORDS:
Keep records of cable drum numbers and supporting information, mark information on record drawings, indicating precise location of each length of cable, and submit copies of manufacturer's cable test certificate.

1032 CABLE DESCRIPTIONS IN SCHEDULES
See Y61 Schedules for particular requirements of cables.

2000 PRODUCTS/MATERIALS

2005 LSOH SHEATHING:
Supply cables with Low Smoke Zero Halogen (LSOH) sheathing, tested in accordance with relevant parts of BS EN 60754 (parts 1 and 2) and relevant parts of BS EDN IEC 60332 and BS EN 60332.

2011 FLEXIBLE MULTI-CORE CABLES AND INDUSTRIAL CABLES:
All flexible cables and industrial cables shall have copper conductors and be rated at 300/500V for single phase and standard duty applications and 450/750V for three phase and industrial/heavy duty applications, unless otherwise indicated. Performance characteristics shall be suitable for the application.
Standard – relevant parts of BS EN 50525 to suit types scheduled.

2021 STANDARD WIRING AND POWER CABLES:
All wiring and power cables shall have copper conductors unless otherwise indicated. All cables shall have a voltage rating and performance characteristics suitable for the application. For multicore cables the conductors shall be circular up to 16mm^2 and shaped over 16mm^2 unless otherwise indicated. LSF means Low Smoke and corrosive gas emission compound.

Y61 – Cables & Wiring

Standard BS 7211 - thermosetting insulated and thermoplastic sheathed cables for voltages up to and including 450/750 V for electric power and lighting and having low emission of smoke and corrosive gases when affected by fire (class 1 solid copper conductors)

2031 STANDARD MEDIUM VOLTAGE (MV&HV) POWER CABLES:
All power cables shall have copper conductors unless otherwise indicated. All cables shall have a rated voltage and performance characteristics suitable for the system.
Unless indicated otherwise, voltage ratings cables shall be selected for Category A in accordance with BS 6622 (phase to earth faults shall be disconnected from the system within 1 minute).

2041 MINERAL INSULATED WIRING AND POWER CABLES:
Standard – BS EN 60702-1
All conductors shall be copper unless otherwise indicated. All cables shall have an outer sheath as indicated. 500V light duty cables shall be used for sizes up to 2.5mm^2, 750V heavy duty cables for sizes over 2.5mm^2 to 25mm^2 and 750V heavy duty single core cables for over 25mm^2 unless otherwise indicated. Outer sheath colours shall be:-

Red	-	Fire Alarms
White	-	Emergency Lighting
Orange	-	Other Services

Fire performance standards - BS 5839-1, BS 6387 BS 8519 as appropriate.

2051 CONTROL AND AUXILIARY CABLES:
All conductors to be copper unless otherwise indicated.
Standards - BS EN 50288-7, BS 5467, BS 6346, BS 6724, BS 7211, BS 7629, BS 7846, BS 7870, BS EN 50288-7 as appropriate to the particular project / schedules.

Fire performance standards - BS 5839-1, BS 6387, BS 8519, BS EN 50200 as appropriate to the particular project / schedules.

2071 STANDARD COMMUNICATION CABLES:

For outdoor or underground use:

Standards BS EN 50288-7, BS EN 60708, BS EN 62012-1 as appropriate.

2075 CABLES FOR RESIDENTIAL TELECOMMUNICATION:
Standard: BS EN 50441 parts 1-4.
Sheath material:
LSOH - BS EN 50290-2-27.
BS EN 50290-2-22.

2080A STANDARD COAXIAL CABLES:

Standards Relevant parts of BS EN 50117 and BS 61196

CAI cable types to BS EN 50117, CT 100, CT 125, CT 165, as appropriate. Provide cables with CAI benchmarking status.

2080B STANDARD RADIATING COAXIAL CABLES (LEAKY FEEDER) FOR WIRELESS NETWORKING (WIFI):
Standard -BS EN 61196-4
Characteristic impedance -50 Ohm
Operating frequency 2.4 Ghz or 5.0 Ghz

2091 OPTICAL FIBRE CABLES:
Standards
Relevant parts of BS EN 60794.
Parts BS EN 60794-2 for Indoor cables.

Parts BS EN 60794-3 for outdoor cables.
Quality assessment of indoor cables to BS EN 187103
Standard indoor optical fibre cables for data communications to BS EN 60794-2-10, BS EN IEC 60794-2-11 and BS EN 187103.
Refer to schedules / scope of works for category of multimode fibre to BS EN 60793-2-10
Fibres to relevant parts of BS EN 60793 / BS EN IEC 60793
Fibre optic interconnecting devices and components to BS EN 61300, BS EN 62148, BS EN 62664-1-1 and PD IEC/TR 62627-03-03.

2101 INFORMATION TECHNOLOGY OR SPECIALIST SYSTEMS CABLES
Provide IT or Special Systems cables in accordance with the system suppliers' specification.
Structured Wiring: Refer to work section W70 for cable category and details.
Standard – relevant parts of BS EN 50173 and relevant parts of BS EN 50288
Termination reference EIA/TIA TSB-40
Common construction – Multi pair; unshielded (UTP)
Information Technology cables:
Standards-BS EN 50090-9-1, BS EN 50098-1, BS EN 61196, EIA/TIA 568.
LAN - Ethernet - reference BS ISO/IEC/IEEE 8802-3.

2170 PRE-FABRICATED WIRING SYSTEMS – SYSTEM REQUIREMENTS AND MANUFACTURING
Also refer to clause Y61 4210 for Cable installation, schedule Y61sch3 for details and V22 for scope of works.

Standards

The requirements for fixed wiring installations in accordance with BS 7671 (IET Wiring Regulations).

The safety requirements of BS 8488

BS EN 61535 for installation couplers and distribution blocks.

BS EN 61984 for connectors associated with LV switchgear and controlgear to BS EN 61439-series

BS 5733 or BS EN 61439 for connecting, terminating, coupling and branching points where BS EN 61535 is not applicable.

BS 6701 and BS EN 50174-series for assemblies incorporating information technology and similar cables.

Systems shall comprise of Home Run cables, Master Distribution Boxes (MDB's), extender cables, connectors, fused tees and luminaire flex tees.

Refer to Schedule Y61sch3 for details of the system.

Connectors

All connections with the exception of those to be terminated within the distribution boards shall be pre-terminated into 'snap-fit' plug and socket connectors

Different distinct types of connectors (colour coded and keyed) shall be used on MDB ports and extender cables to differentiate between circuit ratings (generally lighting circuit shall be rated at 20A and power circuits rated at 20A or 32A), to prevent different rated circuits being interconnected.

Connectors shall incorporate a locking mechanism to prevent accidental disconnection, and shall be maintenance-free, screwless, without terminal blocks. The minimum degree of protection in accordance with BS EN 60529 shall be:

IP31 in areas only accessible to skilled and instructed persons as defined in BS 7671.

IP41 in all other areas.

Cables

Ensure cables are selected in accordance with BS 7671 (IET Wiring Regulations)

Ensure cables cater for grouping and other relevant correction factors required by BS 7671 (IET Wiring Regulations) based on the number of circuits and circuit ratings.

Ensure home run and extender cables incorporate separate circuit protective conductors for each circuit.

Home Runs and Extender cables shall incorporate separate circuit protection conductors for each circuit.

On metallic sheathed systems, the sheath shall be earthed and provide full 360-degree bonding onto the casing of the connectors.

Ensure pre-fabricated wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

Where pre-fabricated wiring systems incorporate signal wiring for building control systems, it shall be ensured that the type of signal cable used is suitable for the system protocol and combination with the LV circuit wiring. The assembly shall meet the safety requirements of BS 7671 for separation of different voltage bands, and the requirements of BS 7671 and BS EN 50174-series for segregation and separation for electromagnetic compatibility. Arrangement of signal cables shall maintain the required network topology and not exceed maximum network lengths.

MDB's shall comprise of a steel enclosure with output ports located around the perimeter, external fixing lugs shall be provided to prevent damage to the internal wiring.

Cables are to be continuity and polarity tested at the works and each passed cable assembly is to be serial numbered with the recorded data detailed on the product. Once integrated into the works the Pre-Fabricated wiring shall be fully re-tested as part of the fixed installation in accordance with Chapter 61 of BS 7671.

All wiring systems for circuits where protective conductor currents may exceed 10 mA shall comply with Regulation group 543.7 of BS 7671.

3000 ACCESSORIES

3011 CABLE GLANDS:
Standard BS 6121-1, BS EN 62444
Cable glands shall be suitable for the type of cable, environment and mechanical forces present all glands shall incorporate a method of cable retention. Metallic glands to be brass except where aluminium gland plates are provided where nickel plated brass glands shall be used, include shroud (LSOH for cables with LSOH sheath) and for metallic sheathed or armoured cables shall incorporate armour locking ring and earth tag for protective connection to earth.

Y61 – Cables & Wiring

Cable type	Application	Cable type	Gland type				
			Material	Cable retention	Ingress Protection to BS EN 60529	Type to BS EN 6121-5 Annex A	Environment
Unarmoured, Flexible;	Indoors	Wiring and power; control and auxiliary; and communications	Non-metallic	Class A	IP54	Type A1	Indoor
	Outdoors			Class A	IP66	Type A2	Outdoor
Armoured cables	Dry Indoors	Wiring and power; control and auxiliary;	Metallic	Class A	IP54	Type B	Dry Indoors
	Indoors				IP54	Type B	Indoors
	Outdoors		Metallic	Class A	IP66	Type C	Outdoor

Where a cable gland or armour gland is required which has resistance to extreme conditions not covered by the requirement specified in BS EN 62444 or BS 6121 (e.g. resistance to chemical attack, resistance to ingress of water in deluge conditions, resistance to strong ultraviolet light), advice should be sought from the gland manufacturer.
Cable glands used with fire performance cables shall be such as to minimize the probability of early failure in the event of fire.
Cable glands shall be certified to relevant parts of BS EN IEC 60079/BS EN 60079 for hazardous areas.

3021 CABLE SEALS AND GLANDS - MINERAL INSULATED CABLES:
Comply with BS EN 60702-2
Use seals and glands for mineral insulated cables in accordance with BS EN 60702-3, recommended or supplied by cable manufacturer for the type and temperature rating of the installation classification.
Gland type shall be cable grip type, externally threaded with lock washer and nut. Seal type shall be Self-threading pot and the pot closure shall be as manufacturer's standard for type of seal specified.
Pot sealant compound / glazing flux shall be suitable for the temperature rating required and environment.
Use Medium Temperature seals (150°C) for terminations associated with life safety equipment.
Cable glands shall be certified to BS EN 60079-14 for hazardous areas.
Gland shroud material and shroud colour to match cable sheath.

3031 VOLTAGE SURGE SUPPRESSORS FOR CABLES:
Provide voltage surge suppressors in accordance with cable and equipment manufacturer's recommendations. Suppressors shall be suitable for the rated voltage, connection arrangement and characteristics for the load concerned.
Standard
BS CECC 42200

3035 CABLE CLEATS AND CABLE TIES:
Use cable cleats to BS EN 61914.
Use cable ties to BS EN 62275.

3041 CABLE TERMINATING AND JOINTING SOCKETS:
Unless otherwise indicated all cables shall be terminated using approved cable lugs, ferrules, and spade type connections to suit the terminal arrangements of all devices, instruments and equipment.
Standard
Compression to: BS EN 61238-1
Clamping units to: BS EN 60999
Telecommunication and data cable IDC to : BS EN 60352-3

3051 INSULATING TAPE/OVER SLEEVING AND HEAT SHRINK SLEEVING:
Shall be of same material as the cable insulation.

Tape to BS 419
Standard
BS 3858
Relevant parts of BS EN 60454

3061 CABLE JOINTS AND TERMINATIONS:
Use cable joints as supplied and approved by cable manufacturer for the application and installation involved.
Standard
BS 7888
BS 7197 for performance of bonds
BS EN 50393
BS EN 61442
BS EN 60998
Core sleeving – relevant parts of BS EN 60684

3065A LIGHTING INSTALLATION COUPLERS:
Where scheduled or described in the scope of works, use only lighting installation couplers approved by cable manufacturers and to BS EN 61535 of rated voltage 230V and current rating 10A with rewireable or non-rewireable connections suitable for readily accessible locations with earth contact and for rigid or flexible cables.

3065B SMALL POWER INSTALLATION COUPLERS:
Where scheduled or described in the scope of works , use only small power installation couplers approved by cable manufacturers and to BS EN 61535 of rated voltage 230V and current rating 16A with rewireable or non-rewireable connections suitable for readily accessible locations with earth contact and for rigid or flexible cables.

3071 PAPER INSULATED CABLE ACCESSORIES
Use cable joints as supplied and approved by cable manufacturer for the application and installation involved.
Standard
BS 7197 for performance of bonds

3081 CONNECTORS FOR COAXIAL CABLES: (NES 261.200)
Connectors to be suitable for the application and to match the equipment.
Standards
Relevant parts of BS 3041, IEC 60169
Relevant parts of BS EN 60169
BS QC 221100
BS QC 221300
BS QC 221400
BS QC 222000

BS EN 61169-2 - 'Belling' or 'Standard 75Ohm TV' connector.
BS EN 60169-24 or BS EN IEC 61169-24 - Type F.

3091 OPTICAL FIBRE TERMINATIONS :
Terminations to be suitable for the application, fibre style, terminated fibre type and required installation characteristics.
Standard
BS EN 50377
BS EN 60874 series
BS EN 61754 series
BS EN 186110
BS EN 186150
BS EN 186160
BS EN 186220
BS EN 186230

BS EN 186260
BS EN 186270
BS IEC 60874 series

3101 OPTICAL FIBRE CABLE JOINTS
Joints shall be suitable for the style, and required installation characteristics.
Standard
BS EN 61073-1

3111 CABLE DUCTS:
Provide cable ducts as indicated on Schedules and drawings.
Standard
BS EN 61386-24 for conduit systems buried underground
All cable ducts and joints shall have a smooth internal bore.
Cable ducts for electricity cables shall be colour coded black. Cable ducts for other services shall be colour coded in accordance with Table 1 and Table 2 of NJUG Volume 2.
Cable ducts for the Distribution Network Operators shall be to NJUG Volume 2 unless supplied by the Distribution Network Operator.

3121 CABLE SLEEVES:
Supply and hand to others for installation non ferrous cable sleeves for incorporation into the structure where cables pass through fire compartment floors and walls. The contractor is responsible for sealing cable sleeves following installation of cabling, method of sealing to be appropriate to prevent water ingress and maintain fire integrity, as applicable. Sleeving to be in accordance with BS EN 60684.

3131 CABLE COVERS AND MARKERS
Cable covers are to be manufactured from concrete indented lettering warning of the danger electricity below.
Cable covers are to be wider than the width of the service cables that they are protecting.
Plastic warning tapes to be yellow with blue legend in accordance with BS EN 12613.

4000 WORKMANSHIP

4011 CABLE INSTALLATION - GENERAL:
Use and install cables only as directed in the appropriate standard or as directed by the manufacturer in writing. Lay cables in one length unless otherwise indicated. Obtain permission from supervising officer for all through joints, and where overall length requirement exceeds practical drum size.
Handle, install and dispose of cables on wooden drums in accordance with BS 8512.
Install cables when ambient temperature is 5°C or greater, using cables stored at or above this temperature for not less than 24 hours. (Refer to manufacturers' recommendations for bitumen covered cables etc).
Use drum stands, drum axles, fair leads, rollers, cable stockings and other equipment as recommended by the cable manufacturer and as appropriate to the method of installation. Ensure over sheaths are not damaged by abrasion or scuffing.
Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4012 CABLES INSTALLED EXTERNALLY

Where cables are installed externally and exposed to solar radiation, the Electrical Contractor shall ensure that the cables used are of a type which do not deteriorate as a result ultra-violet radiation. Additionally cable ladders or trays provided for power cables shall be fitted with ventilated covers to provide protection against solar radiation / gains.

4020 CABLE INSTALLATION IN LOW TEMPERATURES:
Install cables at lower installation temperatures when authorised by manufacturer in a written statement.
Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4030 INSTALLATION OF LSF CABLE:

Install LSF cables in accordance with manufacturer's instructions. Ensure ambient temperature is above 5°C. Ensure oversheaths are not damaged by abrasion or scuffing.
Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4030A INSTALLATION OF LSZH CABLES:
Install LSZH cables in accordance with the manufacturer's instructions, ensuring the ambient temperatures are above the minimum specified by the manufacturer.
Install LSZH cables so that they are not exposed to concrete or other substances containing products similar to lime.
Where LSZH cables are installed outside containment, directly on concrete floors (e.g. under raised floors in offices, control rooms or data centres) ensure suitable cable mat products with appropriate fire performance are used.
Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4031 CABLE ROUTING
Minimum spacings between cables and other services;
Insulated Steam Services 300mm
Other mechanical services (excluding steam) 150mm

The minimum spacings (taken from outside surfaces) between LV cables and containment for cables for telecommunications, control and other sensitive circuits (installed in air) shall be in accordance with A444 of BS 7671. For HV cables a minimum separation distance of 1,000mm to LV cables and 1,400mm to telecommunications, control and other sensitive circuits shall be provided.
Where cables are specified as being routed by 'diverse' routes, each cable shall be run along a route of low risk from fire or mechanical damage and where possible within separate fire compartments. Where cables enter common rooms, entries shall be separated by a minimum of 4m. Under no circumstances shall the cables forming both groups, be run on the same containment.

4040 INSTALLATION OF UNARMOURED CABLES
Install and use unarmoured cable to BS EN 50565-1, BS EN 50565-2 or the manufacturers written instructions.
Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4051 CABLE TRENCHES:
Cable trenches to be by others but supervision of all works is to be carried out by Electrical Contractor.
Work in adopted streets to comply with the New Roads and Streets Works Act 1991.
Carry out walk over survey of trench route, dig trial holes in any area considered to be potentially difficult.
Establish location of any other underground service adjacent to cable route.
Re-plan cable routes after survey and trial holes, Submit report of survey and trial holes. Carry out any instructed work to adjacent services. Set out cable trenches, excavate trench carefully setting aside any materials required for backfilling or reinstatement. Excess excavated material to be removed from site.
Minimum cover in cable trenches
HV cables 800mm; LV cables 500mm; communications cables 500mm; all cables 800mm under roadways.
Trench
Common trench for all underground services
Grade trench bottom to a maximum slope of 1:12.
Clear trench bottom of loose stones and place bedding to full width of trench.
Bedding - Riddled earth 6mm grid for cables; riddled earth 12mm grid for ducts; imported soft sand; or pea shingle for ducts.

Bedding thickness – 75mm; or 100mm for ducts.
Install cables or ducts. Haunch cables or ducts in bedding material to a minimum depth of 75mm above highest cable or duct.

Y61 – Cables & Wiring

Warning tapes to be installed in accordance with the following table :-

WIDTH→	up to 600mm	600-1000mm	1000-1400mm	1400-1800mm
DEPTH up to 500mm	1 tape at 200mm below ground level in the centre of the trench	2 tapes at 200mm below ground level horizontally spaced 400mm apart	3 tapes at 200mm below ground level horizontally spaced 400mm apart	4 tapes at 200mm below ground level horizontally spaced 400mm apart
DEPTH 500-800mm	1 tape at 200mm and 1 tape at 500mm below ground level in the centre of the trench	2 tapes at 200mm and 2 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart	3 tapes at 200mm and 3 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart	4 tapes at 200mm and 4 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart

Backfill trench using two layers 100mm thick hand rammed. Complete backfilling in layers and reinstate trench.
Backfill material – as excavated from trench.

4061 CABLE INSTALLATION IN TRENCHES:

Lay cables on newly prepared bedding. Ensure multiple layers of cable are separated vertically by a 50mm layer of hard rammed bedding material. Cover newly laid cables with 100mm of bedding material.

When using a power winch ensure tension on the cable is taken by element of the cable designed for that purpose; that is armour or conductor cores as appropriate and not plastic sheath, metal sheath or core insulation.
During hand pulling cable ensure no kinks are formed and that flaking when used is one in the correct direction.
Do not allow cable to twist during installation. Use swivels to connect pulling bond to cable stocking or equivalent fitting.
Check drum is suitable for jacking before commencing installation. If drum or reel is unsuitable for jacking, flake cable in correct direction in maximum size turns from drum or reel before commencing installation. Use skilled labour to supervise all unreeling, flaking or running of cable from a drum.
Lay cables in the formation shown, ensure spacing is not reduced below that indicated.
Bind trefoil groups at 1m intervals. Bind any associated earth or protective conductor to its cable or trefoil group at 1m intervals.
Space multiple cables in trenches in accordance with BS 7671.
Ensure installation radii and permanent bending radii are not less than those recommended by the manufacturer.
Do not lay cables to BS 7211 or BS EN 50525 direct in the ground

4071 CABLE DUCTS:

Duct work - Carry out all duct laying where specified.
Lay ducts, jointed in accordance with the manufacturer's instructions, in the formation shown on to newly prepared bedding.
Ensure that ducts slope no more than 1:60 vertically or 1:30 horizontally.
Ensure that pre-formed duct bends used at ends of duct routes meet the requirements of the cable manufacture for bending radii.
Construct manholes, draw pits and jointing chambers, as indicated.
Prove alignment of completed duct run by drawing through a mandrel of diameter 7mm less than nominal duct bore of minimum length 250mm. Clean completed duct run by drawing through a circular wire brush of diameter 12mm more than nominal duct bore.
Install in each empty duct a draw wire of corrosion resistant material of minimum breaking strength 550N.
Plug and seal all ducts on completion with proprietary duct plugs.

4080 CABLE INSTALLATION INTO DUCTS:

Install cables into newly proved and cleaned duct. Use lubricants, recommended by the cable manufacturer in writing, to assist drawing process.
Flake cable if drums or reels are not suitable for jacking. At intermediate draw pits with exit duct more than 15° off line of entry duct flake cable before entering or provide comprehensive system of corner plates, roller and blocks. Use the maximum practical size of turns when flaking and ensure direction of flake is correct.

Do not exceed manufacturer's installation tension on cable and ensure the pulling tension is taken on cable elements designed for that purpose, that is armour or conductor cores and not on other elements, such as plastic sheath or conductor insulation.
Do not allow cables being pulled into ducts to twist. Use appropriate swivel between pulling bond and cable stocking or similar appliance.
Bind trefoil groups of single core cables installed into a single duct at 1m intervals. Install earth or protective conductors into the same duct as the associated cable where practical, binding the two together through manholes, draw pits and jointing chambers. Pull all cables in one duct as a group. Ensure the group does not twist or cross over. Report any damage to cable sheath during installation and carry out any instructed work to remedy the damage.
Seal between cable and duct ends after cable installation. Ensure cable ends in jointing chambers are temporarily sealed where required.

4091 CABLE INSTALLATION IN CONDUIT AND TRUNKING:

Install cables so that they are orderly and capable of being withdrawn.
Arrange single core wiring generally using the loop-in method.
Trunking - In vertical trunking provide pin racks at 3m intervals. Use ties for all wires of the same circuit reference at 2m intervals. Mark ties at 10m intervals with circuit reference number.
Conduit - Provide cable clamps in conduit boxes at 10m intervals in vertical conduit.
Allow for full range of movement at building construction movement joints. Make all joints to wiring at terminal blocks in conduit boxes/adaptable boxes to suit cable size.
Where wiring is to be drawn into existing wired conduits, withdraw existing wiring and replace.
Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4100 CABLE INSTALLATION ON TRAY AND RACK:

Place cables side by side or as indicated, fix using cleats or metallic cable ties so that any cable may be individually removed.
Ensure that any cables not sitting on the top surface of the tray or rack are secured so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4111 CABLE SURFACE INSTALLATION:

Dress cables flat, free from twists, kinks and strain, and align parallel to building elements. When glands and clamps are not required, take sheathing of cables into accessory boxes and equipment and protect against abrasion using grommets or similar sharp edge protection.
Clearance as determined by fixing method unless otherwise indicated. Use metallic clips on cables with specified fire performance. Cable cleats to BS EN 61914.
Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4121 CABLE EMBEDDED INSTALLATION:

Dress cables flat, free from twists, kinks and strain, and align parallel to building elements. When glands and clamps are not required, take sheathing of cables into accessory boxes and equipment and protect against abrasion using grommets or similar sharp edge protection. Ensure plaster or screed over cable is a minimum of 12mm. Protect embedded cables (not complying with BS 8436) by metal capping.

4131 CABLE INSTALLATION - MINERAL INSULATED CABLES:

Straighten and dress cables using methods and tools recommended by cable manufacturer.
Use thermoplastic or LSF sheathed cables, colour and location indicated and where cables may come into direct contact with any material that may be corrosive to copper.
Fit temporary seals to mineral insulated cable end when cut.
Fit temporary seals to mineral insulated cable if the cable is left unterminated underground, or where the termination is not to be made within 12 weeks.
Allow extra length on installed cables for cutting back of moisture affected ends. Store mineral insulated cables in the form supplied by manufacturer.
Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4140 CABLE INSTALLATION - FLEXIBLE CORDS:

Grip cords securely at connections. Where they do not form an integral part of the connected accessory or equipment, provide separate proprietary cord grips.
Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).
Ensure that any cables not sitting on the top surface of a cable rack or tray are secured so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4151 CABLE JOINTING AND TERMINATING GENERALLY:
Ensure all joints and terminations are made by appropriately qualified cable jointers, using jointing materials, components and workmanship recommended by the cable manufacturer and the jointing accessory manufacturer. Install cable glands in accordance with BS 6121-5. Cold pour resin and heat shrink joints:
Cut all cable ends immediately prior to jointing or terminating. Seal cables left unconnected for more than 24 hours to prevent the ingress of moisture.
Seal plastic sheathed cables using proprietary shrink on end caps. Seal lead sheathed cables by a plumbed dressed lead cap with an air space to allow conductor movement.
Strip cables to bring out the cores and expose conductors, for the minimum length required for connection, to leave no exposed length of conductor after termination. Ensure that strands are not damaged when stripping cable cores. Twist strands together. Do not reduce number of strands. Secure all strands at terminations.
Clean armour thoroughly prior to joining or terminating.
At connections to equipment and switchgear without integral cable clamping terminals, use compression or solder type lugs for bolted terminal connections, of correct bore. Form all compression connections to components using tools that cannot be released unless the correct degree of compression has been achieved. Install and inspect compression and mechanical connectors in accordance with BS EN 60228 and BS 7609.
Bolt core terminations with lugs to equipment using washers or proprietary shakeproof devices. Provide separate bolted connection for each core.
For auxiliary and sub-circuit wiring do not bunch more than three cores at clamping terminals or bolted connections. Individual stranded cores should be twisted together and folded back to form a "U" where entering screw or clamp type terminals.
Mark cable conductor phasing, or other core identification, at each end of all cables, and at all joints, maintaining consistency of marking with any existing system.
Connect all cores, including multicore cable spare cores, at all joints and terminations. Bond any unused cores of multicore cables to earth at both ends, unless otherwise indicated.

4161 CABLE JOINTING AND TERMINATING - PAPER INSULATED CABLES:
Make cable joints and terminations using the material and methods recommended by the cable manufacturer. Employ only labour certified by cable manufacturer as qualified to make paper insulated cable joints. Cold pour resin and heat shrink joints
Ensure cores are insulated and separated using compatible materials. Keep all materials for paper insulated joints in sealed containers until used. Use only cable manufacturers approved jointing materials for type and application involved. Where proprietary mechanical glands and armour clamps are not used, use tinned brass wiping gland and armour clamp plumbed to sheath.

4171 CABLE JOINTING AND TERMINATING - ELASTOMER AND PLASTIC INSULATED CABLES:
Joint cables using glands of the type indicated, in accordance with the manufacturer's instructions. Use shrouds at all glands unless otherwise instructed, match material and colour of cable sheath.
At core connections to equipment without integral clamping terminals use compression lugs unless otherwise indicated.

4181 TERMINATING - MINERAL INSULATED CABLES:
Use terminations in accordance with BS EN 60702-2 and components and materials recommended or supplied by cable manufacturer.
Use seals of the maximum temperature rating indicated, with stub caps to the largest size available, with drilled caps and headed sleeves for larger sizes.

Use glands of type indicated, except at terminations to accessory boxes within a plaster or render finish, where cable clamps fixed to accessory box and firmly gripping cable sheath may be used. Use earth tail seals with sheath grip type accessory boxes.
Secure glands at equipment not provided with threaded entries using lock washers and locknuts or brass conduit bush. Use gland shrouds when plastic covered MI cables are used to the same colour and material as cable oversheath.
Using thermoplastic, PIB or LSF material tape to BS EN 60454 to match sheath, tape overall gland any bare copper sheath and form seal to cable sheath, under all shrouds.
Mark core sleeving with appropriate identification.
Install voltage surge suppressors in accordance with manufacturer's recommendations and, to BS 7671 Section 331-01-01 or as otherwise indicated.

4191 CABLE JOINTS - MINERAL INSULATED CABLES:
Joint mineral insulated cables using methods and materials recommended by cable manufacturer. Terminate cables in externally threaded glands using seals of temperature rating indicated. Join conductors using crimped connectors, as required.
Insulate connectors using thermoplastic tape to BS EN 60454, ensuring good seal to conductor sleeving. Make off glands into either end of internally threaded brass sleeve of correct size. Protect brass sleeve using heat shrink sleeve, unless otherwise indicated.

4201 COMMUNICATIONS COAXIAL, OPTICAL FIBRE AND DATA CABLE JOINTING AND TERMINATING:
Use methods approved by cable and accessory manufacturers. Employ only labour certified by acceptable body as qualified to make joints and terminations in the referenced cable. Obtain in writing approval of cable manufacturer for accessories not supplied by them.
Ensure cable protection mats are used in basket in which unarmoured copper cables are installed, where cable deformation may affect signal / data performance (e.g. Category 6 and Category 6a applications).
Identify cables using structured numbering scheme.
Install optical fibre cables in accordance with BS EN 50174-2 and BS EN 50174-3.
Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).
Ensure that any cables not sitting on the top surface of a cable rack or tray are secured so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4210 CABLE INSTALLATION – PRE-FABRICATED WIRING SYSTEMS
Ensure that the manufacturer prepares drawings, detailing the installation and identifying each component of the pre-fabricated wiring system, and its location.
Ensure connectors are only installed in dry environments, and not within wet areas such as showers and bathrooms.
Ensure connections are located such that they are accessible after all works are completed, for maintenance and inspection and testing.
Ensure home run cables are fixed directly to the soffit. Where groups of 2 or more cables are run together these shall be run on cable baskets or trays.
Ensure extender cables are clipped to the soffit or structural elements, independent of ceiling supports.
Ensure pre-fabricated wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).
Ensure home run and extender cables are installed such that they are supported clear from the ceiling and run along the lines of the ceiling grid so that they do not restrict access to the ceiling void or other services.
Ensure all cables without mechanical protection suitable to protect against penetrate by screws, nails and similar, or without protection by and earthed metallic armour or sheath rated as protective conductor for the circuits enclosed, and installed within partitions are routed in accordance with permitted cable routes and, if installed at a depth of less than 50 mm, protected by a 30 mA RCD, in accordance with BS 7671 (IET Wiring Regulations).
Ensure un-used connectors are fitted with end caps.
Ensure all connectors in which protective conductor currents may exceed 10 mA have a label complying with BS EN ISO 7010, incorporating safety sign W012 (electricity warning triangle with lightning bolt) with the following words in black on a yellow background: "WARNING. HIGH PROTECTIVE CONDUCTOR CURRENTS. ISOLATE CIRCUIT BEFORE DISCONNECTING."

Y61 – Cables & Wiring

Cables are to be continuity and polarity tested at the works and each passed cable assembly is to be serial numbered with the recorded data detailed on the product. Once integrated into the works the pre-fabricated wiring shall be re-tested as part of the initial verification of the fixed installation in accordance with BS 7671 (IET Wiring Regulations).

4211 **CABLE SLEEVES:**
Pack sleeves with fire resistant material after cable installation in accordance with the designated fire rating of the area involved and to comply with Building Regulations.
Cables shall be cleats, cable ties or cable supports shall be installed within 750mm each side of cable sleeves and shall be suitable to withstand the mechanical loads expected following collapse of the supports on the fire side of the sleeve, to the extent that no strain is transferred to the seal.

4212 **MARSHALLING TERMINAL BOXES**
Standard - BS EN 60670-22 and relevant parts of BS EN 60947-7.
Provide steel enclosure to IP 31 (indoor) or IP 65 (outdoor) with lockable hinged lid, DIN rail mounted terminals, 25A minimum, labels and warning signs.
Arrange terminals in single or three phase, or function order groups with spacer plates between groups, end stops and clamps at each end of rail.
Number each terminal and fit each conductor with identification ferrules, cross-referenced to circuit charts and as installed drawings.

Y62 – Busbar Trunking

1010 **BUSBAR SYSTEMS STANDARDS:**
Supply and install busbar trunking systems in accordance with BS 159 (high-voltage busbars and busbar connections) , relevant parts of BS EN 61439 (low-voltage) and the requirements of BS 7671 Requirements for Electrical Installations (The IET Wiring Regulations).

Powertrack systems shall comply with relevant parts of BS EN 61534 and BS 7671. Refer to schedules or drawings for details.

1011 **BUSBAR LAYOUT:**
Set out busbars as indicated in diagrammatic form on the drawings. Provide all necessary offsets, bends, tapers, transformation pieces, expansion joints, anchor points etc. as required whether or not these are detailed.
Busbar systems for general power and lighting shall be of proprietary plug-in type.

2000 **PRODUCTS/MATERIALS**

2011 **BUSBAR SYSTEM**
Electrical Supply voltage between phases, frequency, current rating, classification, short circuit fault current and short time rating all as scheduled.
Power track, Bench, Dado and Underfloor trunking systems to comply with BS EN 61534-1

Use high conductivity copper busbars and connections unless otherwise specified. Full size neutral shall be used.

2021 **BUSBAR TRUNKING**
Enclosure to be extruded aluminium or steel or thermoplastic and comply with relevant parts of BS EN 50085.
Steel underfloor trunking to BS 4678-2.
Enclosure material and degree of protection as detailed in the schedule.

For steel enclosures, apply a high standard of finish to enclosures. For a paint finish apply a minimum of one coat rust inhibiting primer, one undercoat and two semi-gloss finish coats. Remove rust and degrease metal prior to application of selected finish. Zinc coated steel is acceptable as anti-rust treatment. Use rust-proofed (e.g. cadmium plated) screws, bolts, nuts and washers.
Finish and colour Manufacturer's standard, unless detailed otherwise in the Schedule.

Use trunking fittings of the same type and manufacture as the busbar trunking. Use manufacturers purpose made units/fittings at changes of direction. Use screw fixed covers for metal enclosures and snap on for thermoplastic.
Provide facilities for the correct termination of supply cable.

Provide external fixing brackets at not greater than 2m intervals. In accordance with manufacturers recommendations.

Provide clear marking of busbars and tap-off outlet sockets with phase colours to enable sequence identification throughout system.

2026 **WALL/DADO AND UNDERFLOOR TRUNKING WITH LV SOCKETS:**
Standards - BS EN 61534-21, BS EN 61534-1, BS EN 61534-22 as appropriate
Style – As scheduled or indicated on the drawings.
Fittings - Use fittings of same type and manufacturer as trunking with snap on covers.
Provide facilities for termination of supply.
Connection of LV sockets - Plug in.

2031 **END-FEED UNITS, CENTRE-FEED UNITS AND TAP-OFF UNITS:**
Standard – relevant parts of BS EN 61534 (Powertrack systems)
Provide end-feed units, centre-feed units and tap-off facilities along the busbar system, with current rating, number of poles and phases as indicated on the drawings.

Y62 – Busbar Trunking

Provide tap-off units with Fuses/MCCB's current rating, class and type as indicated on the drawings. Provide termination points for outgoing cables in every tap-off unit. Provide isolating switch with number of poles as indicated.
Follow the proprietary layout, as indicated on the drawings.

2041 PROTECTIVE CONDUCTORS:
Standard BS EN 61534-1
Where specified, provide separate protective conductor throughout busbar system length comprising copper tape, size shall be as on the schedule or drawings.
The protective conductor shall be installed internally or externally to busbar enclosure as indicated. Bond the protective conductor to the trunking enclosure using a method in accordance with BS 7430 at 1.2m maximum intervals or as otherwise indicated, using high tensile brass bolts and locking nuts.
Complete trunking system before installing the protective conductor. Ensure the continuity of protective circuits.

3000 WORKMANSHIP

3011 GENERAL:
Install busbar trunking in accordance with manufacturers' instructions and relevant standards. Check total length of busbar system required on site prior to manufacture commencing.
The manufacturer’s recommendations for minimum spacings between busbar surfaces and adjacent busbars or other surfaces shall be maintained throughout the busbar run, to avoid the need to de-rate to busbars.
Fit covers at end of each run or provide proprietary end boxes.

3021 BONDING:
Bond between adjacent lengths of busbar trunking with approved mechanical means to maintain conductivity. Tighten bolted connections between adjacent lengths of busbars to correct torque setting. Avoid damage to conductors.

3031 EXPANSION:
Anchor busbars rigidly in a minimum of one position and provide means of absorbing maximum expansion and contraction likely to occur in busbars under normal operating conditions. The locations of expansion joints and anchor points shall be determined by the manufacturer based on the geometry of the proposed busbar installation.

Busbars shall be spaced from other services and the fabric of the building to ensure that these do not act as unintentional anchor points, when the busbar expands.

Busbar supports shall be independent of any other service.

3041 LABELS:
Fix identification and warning labels throughout system length. On non-encapsulated conductors marked clearly with phase colours to enable sequence identification throughout system.

3050 FIRE BARRIERS:
Provide barriers of fire-resisting materials within the busbar trunking where vertical runs pass through floors and horizontal runs pass through fire break walls to prevent spread of fire (BS 7671 Section 527).

Y63 – Support Components – Cables

1000 GENERAL

1010 APPLICATION:
Cables referred to in this section are only those types that can be installed without further mechanical protection.

1012 LAYOUT AND SEGREGATION
Set out cable support systems as indicated in diagrammatic form on the drawings. Provide all necessary offsets, bends, tapers, transformation pieces etc. required whether or not these are detailed. The layout of the systems and the routing of cables shall ensure maximum circuit lengths and grouping shown on drawing and schedules are not exceeded.

2000 PRODUCTS/MATERIALS

2011 CABLE SUPPORTS:
Support all cables throughout their length using conduit, trunking and enclosures, cable tray, cable racking, special support systems, cleated or clipped fixing direct to building fabric, or aerial catenary suspension systems, as required.
Ensure tray, racking and special support systems are continuous and firmly fixed to building fabric. Allow space for indicated cables + 30% spare, unless otherwise indicated.
Ensure cable support system allows for spacing in accordance with BS 7671 for the design current of the cable.
Ensure cable support system is installed so that cables are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).
Cable support systems for fire rated cables shall afford the same resistance to fire as the specification for the cable to ensure continued operation of the circuit during a fire.

2012 FIXINGS FINISHES:
Ensure finish for all support components, fixings, hangers and accessories is galvanized or sherardized finish.

2021 CABLE SUPPORT SYSTEM: (NES 2020 and 2030)
Standard BS EN 61537
Material
Hot rolled steel galvanized after manufacture to BS EN ISO 1461; or bending and profiling quality hot dipped galvanized steel to BS EN 10143, and BS EN 10346.
Finish - Self colour galvanized.

Perforated tray.
Use return flanged type with manufacturer's standard perforations pattern, unless otherwise indicated.
The thickness of the tray shall be the Manufacturer's standard thickness for type.

Cable rack (ladder)
Proprietary system of channel sections with return lip and compatible jointing and fixing accessories.

Cable basket.
Cable baskets to have 50 mm square grid and side walls.
Light duty to be 25 mm sides, medium duty 50 mm sides and heavy duty 75mm sides.
For under floor basket tray three independent supports legs shall be provided along each standard section of basket, where legs are required. Support leg depth as indicated. Every section shall have at least one connection point screwed to the floor.
Accessories and fittings shall be as manufacturers’ standard items.
Include take-off plates for conduits, trunking etc.

Cable support system fittings
Use factory made fittings throughout of same material, type, pattern, finish and thickness as the cable support system, site modified fittings will only be acceptable on existing installations. Use reducers, inside angles, outside angles and drop outs as manufacturer's standard. Use flat bends, equal tees, unequal tees and crosses with gusseted corners. Join lengths of cable support system and fittings using

manufacturer's standard shouldered ends, fish plates, or couplers, with galvanised or zinc plated slotted domed head 'roofing' bolts, nuts, washers and shake proof washers.
Each fitting shall have a bonding braid attached across it to form the continuous bonding of the support system.
Tray/rack supports - use threaded rod or proprietary support channel.

Ensure cable support system is installed so that the cables are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).
Ensure that any cables not sitting on the top surface of the support system are secured so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

2022 **WIRE ROPE SUSPENSION SYSTEM:**
Where specified within the Scope of Works or Schedules for the support of cable trays or baskets, use proprietary Wire Rope Suspensions Systems which comply with BS EN 12385-1, BS EN 13411-3, BS EN 13411-4, DIN 3093, and BSRIA COP 22/2002. Wire Rope Suspensions to be suitable for the safe working load and comprise Stainless Steel grade 316 wire rope, Stainless steel grade 302 Spring fasters with fixings by loops, stud (permanently fixed to wire rope length) or toggle as appropriate. The installation shall comply with BSRIA COP 22/2002 and 'solid' stud type suspensions shall be provided at maximum spacing of 20m, with a minimum of one in any straight run.

2026 **CABLE CLIPS, TIES AND CLEATS**
Standard BS EN 61914 (cable cleats)

Bolted cleats shall be aluminium alloy, galvanised iron or moulded black polythene. Galvanised iron cleats shall be used to fix fire rated cables.
Proprietary cable ties shall be wrap round self-locking releasable pattern. Cable ties may be Nylon except where used to fix power or fire rated cables, where stainless steel ties shall be used. Stainless steel cable ties shall be suitable to withstand the forces exerted by power cables under short circuit conditions, including a safety factor of 3.
Fixings used for fire rated cables shall sustain the same fire conditions as that provided by the cable, without failure.
Cable clips shall be the Polypropylene surface type with pre-fixed hardened steel pin for general use except on mineral insulated cables. For mineral insulated cables use bright copper one hole 'P' clips or two-way saddles (for runs of multiple cables) for unsheathed mineral insulated cables, PVC covered for sheathed mineral insulated cables
Use cable ties to BS EN 62275.
Ensure all wiring system components and cable supports are selected and installed so that wiring systems are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

3000 **WORKMANSHIP**

3011 **CABLE SUPPORT INSTALLATION:**
Support from building fabric with minimum clearance behind of 20mm. Install fixings at regular intervals to prevent visible sagging when loaded, with maximum spacing 1.2m and 230mm from fittings.
Keep cutting of cable tray to a minimum. Cut along a line of unperforated metal. Ends of hangers to be cut flush with locking nuts or support brackets. Make good finish with zinc rich paint, primer and topcoat, or two pack epoxy paste, as appropriate to material and finish.
Fit holes cut in tray for passage of cables with grommets, bushes or other lining. Install all bolts, fixings and hangers with threaded portion away from cables.
Ensure all wiring containment systems are selected and installed so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

3022 **CABLE CLEATS, TIES, SADDLES AND CLIPS INSTALLATION:**
Ensure all cable supports are selected and installed so that wiring systems are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

Single core cables forming part of a three-phase circuit shall be installed in trefoil formation whether installed horizontally or vertically and supported using proprietary trefoil cleats certified for the peak fault

current that cable could be subjected. The cleats shall be spaced in accordance with the manufacturer's recommendations for the given fault level. Where necessary the neutral conductor shall be run adjacent to its set of phase conductors using quadrafoil cleats.
Single core cables forming part of a DC circuit or single phase and neutral non-life safety circuit when run horizontally on trays or ladders shall be installed 'flat touching' together with the associated earth cable. Each conductor shall be individually fixed using proprietary metallic cable ties to the cable tray or ladder at the spacings indicated in the table below. Marker ties shall be provided at 3000mm intervals which shall encompass all conductors of the circuit. Where the cables run vertically, they shall be cleated using metallic cable cleats at fixing centres noted in the table below
Non-life safety multi core cables laid horizontally on cable tray or ladder shall be secured by the use of proprietary metallic cable ties or 'P' clips, securing the cables of only one circuit. The ties shall be spaced in accordance with the table below. Additional ties shall also be provided within 100 mm of each bend. Where non-life safety cables run vertically they shall be cleated using metallic cable cleats with spacings in accordance the table below.
Life safety multi core cables laid horizontally on cable tray or ladder shall be secured by the use of proprietary stainless-steel cable ties or 'P' clips, securing the cables of only one circuit. The ties shall be spaced in accordance with the table below. Additional ties shall also be provided within 100 mm of each bend. Where Life Safety cables run vertically, they shall be cleated in accordance with the table below. Cleats utilised for life safety cabling shall be as recommended by the manufacture for that type of cable and shall be manufactured from either cast iron or stainless steel.

Where cables are on inverted tray, they shall be fixed with cable cleats spaced in accordance the table below or the manufactures recommendations should they be more onerous. Cleats for non-life safety cables shall be stainless steel/metallic type, and cleats for life safety circuits shall be as recommended by the manufacture for that type of cable and shall be manufactured from either cast iron or stainless steel.

Where cables are to be installed direct to the structure they are to be supported by cleats bolted to vertical and/or horizontal mild steel galvanised channel supports which in turn shall be bolted to the structural walls or soffit at the required fixing centres for the cable fixings noted in the table below or the manufactures recommendations should they be more onerous. Cleats for non-life safety cables shall be stainless steel/metallic type, and cleats for life safety circuits shall be as recommended by the manufacture for that type of cable and shall be manufactured from either cast iron or stainless steel.

Insulated cable ties, P Clips and cleats shall be manufactured from materials with low smoke zero halogen properties.

The maximum spacing between cable cleats and fixings for cables in accessible positions is defined in the table below.

Overall diameter of cable(1)	**Type of cable and plane of cable installation**					
	Non-armoured cables		Steel Wire Armoured cables including fire resisting armoured cable		Mineral insulated copper clad or aluminium sheathed cables	
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
<9mm	300	300	-	-	600	600
9-15mm	300	300	300	300	900	1200
15-20mm	300	300	300	300	1500	1800
20-40mm	300	300	300	600		
40-50mm	600	600	900	900		
50-60mm	600	900	900	900		
60-70mm	900	1200	900	1200		
>70mm	900	1200	1200	1200		

Notes:
1. For flat cables taken as the dimension of the major axis.
2. Fire resistant fixings should be used for fire resistant cables.
3. The spacing's shown above apply to multi-core cables.

Y63 – Support Components – Cables

4. The spacing of fixings on single core cables in AC installations must take account of the magnitude of forces generated under fault conditions.
5. The spacing's stated for horizontal runs may be applied to runs at an angle of more than 30º from the vertical. For runs at an angle of 30º or less from the vertical, the vertical spacing's are applicable.
6. For cables supported on horizontal tray use ties for each circuit. Use tie manufacturer's special tensioning tool where available. Crop off tie ends.
7. For sub-circuit wiring on continuous flat surfaces of wood, plaster, brick etc. use polypropylene surface fixing clips with pre-fixed hardened steel pin for PVC insulated and sheathed cables and sheathed or bright mineral insulated cables. Use round or flat or flat twin pattern as appropriate, manufactured specifically for cable being fixed. Use one hole 'P' clips or two-way saddles of bright copper for unsheathed mineral insulated cable. Use PVC covered for sheathed mineral insulated cables.
8. Space cleats, ties, saddles and clips as Appendix G of Guidance Note 1 `Selection & Erection' published by the IET.

Y71 – LV Switchgear & Distribution Boards

1011 STANDARD:
Comply with all relevant parts of BS EN 61439 for Low-voltage switchgear and controlgear assemblies. Assemblies shall be type tested (TTA) in accordance with BS EN 61439-1 and BS EN 61439-2

1012 TYPE TEST:
Provide verification of type test in accordance with BS EN 61439 For type tested assemblies, the short circuit strength of main busbars, busbar supports, connections to incoming and outgoing units in the configuration to be used, shall be verified. Certificates issued by The Association of Short-Circuit Testing Authorities (Inc) - ASTA - are preferred, but certificates from other testing authorities will be considered.

1013 ELECTRICAL CHARACTERISTICS:
Ensure that electrical characteristics of component parts of assemblies are as indicated and apply when components are mounted in enclosures. Allow appropriate de-rating factors for effect of enclosures, other components and interconnections. Ensure that all components supplied and installed are suitable for Voltage, Current, Fault Levels and Frequency as scheduled.

1020 ELECTRICITY SUPPLY:
Ensure all electrical equipment supplied and installed is suitable for power supply indicated to BS EN 60038 and relevant parts of BS EN 61558

1014 INFORMATION ON DRAWINGS
The following electrical characteristics are shown on the system or the distribution diagram drawings:-
- Type of earthing system
- Number and type of live conductors at the origin
- Normal Voltage
- Frequency
- Maximum prospective short-circuit current at the origin (Ip(max)).
- Minimum prospective short-circuit current at the origin (Ip(min)).
- Earth-fault loop impedance at the origin (Ze)
- Electricity supplier's protective device and its tripping time at current Ip
- Protective devices
  - Current rating
  - Type
  - Category of duty

2000 PRODUCTS/MATERIALS

2011 SWITCHBOARDS / CONTROL PANELS, LV SWITCHGEAR AND CONTROLGEAR ASSEMBLY:
Standard – Relevant parts of BS EN 61439 as scheduled.
External design- Cubicle or Multi-cubicle type assembly as indicated on Schedules or drawings.
Degree of protection BS EN 60529
- Indoors boards to be rated to IP31 unless otherwise indicated.
- External boards to be rated to IP65

Electrical characteristics
- Rated operational voltage 400V +10% / -11%

Service conditions
- Ambient air temperature and altitude as relevant parts of BS EN 61439.
- EMC-Environment A - Light Industrial/Commercial

Co-ordination in accordance with BS 7671 (IET Wiring Regulations)
- Ensure that the relevant fault current (short-circuit) rating of each switchgear and controlgear assembly is greater than or equal to the maximum prospective fault current at the point of connection to the system.
- Ensure that the relevant design current does not exceed the rated current of the system, or rated current of a circuit of the associated assembly, taking into account applicable diversity and loading factors.
- Ensure that any devices and components are integrated into the assembly in accordance with the relevant parts of BS EN 61439.

Provide facilities to allow future extension of switchboard at either end.

Y71 – LV Switchgear & Distribution Boards

2012 NEUTRAL POLES

Neutral poles on 4 pole circuit breakers or switches shall be rated in accordance with the most onerous conditions specified in BS 7671 and the relevant product standard.

2021 ASSEMBLY CONSTRUCTION:

Enclosure standard BS EN 62208
Material of enclosure - steel.
Supply doors with fastenings and provision for locking in closed position. Use covers which require special tools for removal. Large removable covers to be provided with lifting handles and location brackets. Provide enclosure with fixing holes. Where enclosure is mounted externally provide fixing lugs external to enclosure.

All busbars are to be fully rated for Current carrying capacity, Frequency, Fault Level and rated Voltage as detailed on the drawings and/or schedules. Neutral bars are to be fully rated and not ½ sized bars.

Internal Separation to BS EN 61439-1 and 61439-2 and as Schedules or Drawings
Assembly to provide protection against direct and indirect contact. Protection to be maintained after removal or withdrawal of removable or withdrawable parts.

Ensure that fixed panel or cubicle of withdrawable type units are fitted with label to identify circuit with wording identical to that on the withdrawable portion.

Terminals for external conductors
Accommodate cross-sectional area of cables scheduled.
Parallel cabling to be provided with an individual terminal for each cable.

Top hat rails dimensional type to BS EN 60715. Steel rails to be manufactured and finished in accordance with BS EN 60715 Appendix A.

Mark terminals as BS 7671 (IET Wiring Regulations).

Provide earth terminal, or for multi-cubicle enclosures a copper earth bar the full length of the enclosure, so that exposed conductive parts of the assembly can be connected to the protective conductor. Ensure earth connection can be made to the assembly without damage to the finish coating. Make provision for armouring and metal sheaths of all incoming and outgoing cables, including common and individual glanding plates, to be bonded to earthing terminal or bar.

Accessibility for inspection
Arrange for following operations to be performed when assembly is in service and under voltage.
Visual inspection of switching devices and other apparatus; settings and indicators of relays and releases; conductor connections and markings.
Adjusting and re-setting of relays, releases and electronic devices.
Replacement of fuselinks.
Replacement of indicating lamps.
Fault location by voltage and current measuring.
Accessibility for maintenance.
Provide space between functional unit or group and adjacent functional units or groups. Provide retainable fastening means for parts likely to be removed for maintenance.

Short-circuit protection and short-circuit withstand strength as Schedules or drawings. Co-ordinate short-circuit protective devices and short-circuit current arising from rotating machines as detailed in Work Section V20. For motor control centres this information as detailed in Work Section W61.

Input voltage variations for electronic equipment supply as BS EN 61439.
Supply frequency deviation as BS EN 61439
Mounting - as scheduled or detailed in scope of works.

2031 ENCLOSURES FINISH:

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Apply high standard finish to enclosure and supporting metalwork. Degrease metal and remove rust prior to applying finish.

Comply with paint manufacturer's recommendations regarding preparation, stoving times, temperatures, mixing of finishes, application and coat thickness.

Finish and colour as Manufacturer's standard unless otherwise stated in the schedules. When other than manufacturer's standard finish is specified samples for each paint system and for each colour shall be provided.

2041 TYPE TESTS:

Provide certificates of verification of
temperature rise limits.
dielectric properties.
short-circuit strength to relevant parts of BS EN 61439
continuity of protective circuit.
clearances and creepage distances.
mechanical operation.
degree of protection.

Temperature rise limits
Temperature rise test for test current greater than 3150 A to be agreed by the engineers.
Temperature rise when ambient temperature exceeds +40°C or is lower than +10°C to be agreed by the engineers.

Short circuit withstand strength
Value of neutral bar current for short-circuit test 60%.

2051 ROUTINE TESTS

Carry out the following Routine Tests at the works after the panels have been finished and before shipping to site:
Dielectric test
Insulation resistance test
Primary and/or secondary current injection
Phase rotation
Operation of protection devices, instruments and measuring devices
Operation of control and monitoring devices

The Engineers/design team/client shall be invited to witness these tests at a time convenient to them.

2052 TESTS ON SITE

Repeat routine tests on site.

2060 SITE BUILT ASSEMBLIES:

Ensure that components of site assemblies are part of a proprietary system and type tested as defined above. Install assemblies in accordance with manufacturer's drawings and instructions.

2070 SITE MODIFICATION:

Do not make site alterations unless authorised. Where site modifications to assemblies are authorised make in accordance with manufacturer's certified drawings and instructions. Ensure that modifications made comply with type test certificate obtained for the arrangement of components.

2081 BATTERY CHARGER AND BATTERY UNIT:

Function, Input Voltage and Frequency as Schedules or drawings.

DC Output Voltage drop at full load 2%
Operating temperature range -10°C to +45°C.
Charger type Thyristor or Transistor.
Battery type Nickel Cadmium (maintenance free).
Enclosure, sheet steel,IP31

Corrosion resistant epoxy paint or Manufacturer's standard.
Colour Manufacturer's standard.

Facilities
- MCB input protection.
- Float charge.
- Battery over-discharge protection
- Fuses for battery protection.
- MCB's for outgoing circuits as indicated.
- Automatic selection of boost charge.

Meters
- Battery voltage.
- Charge/discharge current (dual scale for float and boost).

Lamp indications
- Supply on.
- Supply fail (monitor input terminals).
- Float charge.
- Boost charge.
- No charge (when supply is on).
- Battery voltage low.

Battery voltage high.

- Earth fault on output.

Common Alarm (connected to operate a relay with shrouded 230V 3A AC or 0.5A DC. N/O-N/C volt free contacts, closed on any alarm, for remote indication circuit)
- Supply failed.
- No charge (when supply is on).
- Battery voltage low.
- Battery voltage high.
- Earth fault on output.

2091 AIR-CIRCUIT BREAKERS

Comply with BS EN 60947-2. Provide fixed or isolating (withdrawable) removable type circuit breakers with provision for safe maintenance. Ensure that uninterrupted current rating indicated applies when unit is enclosed and in operating environment at rated operational voltage and that Utilisation Category is B.

Withdrawable and plug-in circuit breakers shall be provided with an earthing device to permit earthing of either the busbar (main incoming devices only) or outgoing circuit, A minimum of 1No earthing device shall be provided for each frame size per switchboard.

Provide circuit-breaker with rated service short-circuit breaking capacity (Ics) and short-time withstand current (Icw) equal to or greater than that for the associated switchboard.

Provide operating mechanism, controls, accessories and protection as indicated on Schedules or drawings.

Provide a minimum of 3 (unless otherwise detailed or required) N/O-N/C volt free auxiliary contacts rated a minimum 10A 230V wired to external terminals within the outgoing cabling section.

Provide interlocks to prevent movement of the circuit-breaker within the housing when in `closed' or `service' position. Provide automatic shutters to cover all live contacts when circuit-breaker is isolated, withdrawn or removed from housing.

Provide facility to padlock circuit-breaker in isolated/withdrawn position, and to lock automatic shutters covering live contacts when breaker withdrawn from housing.

2092 CIRCUIT-BREAKERS-MOULDED CASE

Comply with BS EN 60947-2. Provide moulded case isolating (withdrawable) or fixed type circuit-breakers, as detailed, with provision for safe maintenance. Ensure that uninterrupted current rating indicated applies when unit is enclosed and in operating environment at rated operational voltage and that Utilisation Category is B.

Withdrawable and plug-in circuit breakers shall be provided with an earthing device to permit earthing of either the busbar (main incoming devices only) or outgoing circuit, A minimum of 1No earthing device shall be provided for each frame size per switchboard.

Provide circuit-breaker with rated service short-circuit breaking capacity (Ics) and short-time withstand current (Icw) equal to or greater than that for the associated switchboard.

Provide manual closing mechanism and protection by combination of adjustable magnetic/thermal compensating devices unless otherwise indicated.

Provide 2 (unless otherwise indicated or required) N/O - N/C volt free auxiliary contacts rated a minimum of 10A 230V AC wired to external terminals within outgoing cabling section.

Where withdrawable provide interlocks to prevent movement of circuit breaker within housing when in 'closed' or 'service' position. Provide automatic shutters to cover all live contacts when circuit breaker is isolated, withdrawn or removed from housing.

Provide facility to padlock circuit- breaker in isolated/withdrawn position, and to lock automatic shutters covering live contacts when removed from housing.

2101 AIR BREAK SWITCHES DISCONNECTORS AND FUSE COMBINATION UNITS:

Supply fuse combination units in accordance with BS 88 (BS EN 60269)
Comply with BS EN 60947-3 and BS EN 62626-1.
Supply air break switches with uninterrupted rated duty and Utilisation Category AC 23 B (infrequent operation) unless otherwise indicated.
Utilisation category AC-3 where BS EN 62626-1 applies.
Operational performance not less than requirements of BS EN 60947-3, Table 4.

Fit fuse switches with cartridge fuse links in accordance with BS EN 60269, BS 88. Fit removable neutral link in switches controlling circuits with neutral conductor. Fit solid links in isolating switches. Fit each switch with facility to padlock in OFF position.
Ensure that withdrawable chassis isolating type switches are provided with fully shrouded fixed contacts or insulated cover plates, to prevent accidental contact with live parts.
Ensure that switches have individual enclosures and earth terminal, meet the degree of protection for the switchboard and have operating mechanisms interlinked with access door.

The means of operating (handle, push button etc) switches provided as the means of emergency switching shall be coloured red and the device facia shall be coloured yellow.

2111 PROTECTION DEVICES AND RELAYS

Comply with BS EN 61810.
Provide protection devices and relays as specified in the Work Sections, on drawings or Schedules.
Locate such that operation may be observed and the devices reset or adjusted without access to the interior of the enclosure.

2112 AUTOMATIC TRANSFER SWITCH EQUIPMENT (ATSE)

ATSE - Electromechanical ATS'S

Unless indicated otherwise in the Schedules, Electromechanical ATS's shall be enclosed within separate enclosures to their associated lv switchboards.

Where the transfer switch is specified with a draw-out function, shutters shall be provided which automatically close to fully shroud the live terminals when the transfer switch is withdrawn.

For closed transition switches, a timer shall be provided to limit the maximum period that the two sources are connected in parallel (adjustable 0 to 60secs), on expiry of the timer, the source 2 transfer switching device shall open.

Manual bypass facilities provided for test and maintenance purposes shall be incorporated within the ATS enclosure. The bypass shall allow the load to be connected to either of the sources without interruption of the supply to the load and shall be interlocked to prevent paralleling of the two sources.

Volt free contacts shall be located in a segregated section of the ATS enclosure.

ATSE - Interlocked Circuit Breakers
Shall comprise of motorised, 'plug-in' pattern non-automatic circuit breakers (Reference Y71.2091 & Y71.2092) mechanically and electrically interlocked to prevent both circuit breakers being simultaneously closed.

The incoming supply section for each device shall be segregated from the other and it shall be possible to remove either circuit breaker for maintenance purposes without disruption of the supply to the load. No live parts shall be exposed by removal of a device and a minimum of IP31 degree of protection shall be maintained.

It shall be possible to perform the following on the circuit breakers from the front facia of the switchboard without opening or removing covers:

Manual opening or closing of each circuit breaker

Padlocking the circuit breaker in their OFF positions for maintenance.

Circuit breakers shall incorporate an opening coil so that they may be opened upon failure of either source.

Mains sensing equipment shall be located within a separate controls section of the lv switchboard / ATSE Assembly.

Mains sensing shall be carried out by phase failure relays fitted to each supply phase which shall operate upon the voltage between any phase and neutral falling below a pre-set threshold for a pre-set period. After the pre-set period has elapsed and a voltage is sensed on the standby circuit breaker, the primary circuit breaker shall open and the secondary circuit breaker shall close.

Restoration of the normal supply shall be detected by the voltage between all 3 phases and neutral being above the pre-set threshold for a pre-set period.

After the pre-set period has elapsed the primary circuit breaker shall open, the secondary circuit breaker shall close.

Volt free contacts shall be fitted wired to a 'field wiring' terminal rail located within the controls section of the enclosure.

2131 TRIP/CLOSE SWITCHES AND CONTROL SELECTOR SWITCHES:
Standards - BS EN 60947-3 and BS EN 60947-5-1 as relevant.
Provide a panel mounted heavy duty, spring return key operated trip/close switch on each circuit- breaker fitted with electrically operated closing mechanism.
Ensure contacts have a continuous rating or AC and DC currents of 10A minimum at between 30V to 250V and make and break duty rating for AC and DC currents of 30A at 250V for a minimum period of 3 secs.
Where remote trip/close control is required, supply a panel mounted selector switch to select circuit-breaker for local or remote operation. Ensure that selection of remote or local closing does not prevent circuit breaker tripping under fault conditions.

2132 CONTROL CIRCUITS:
Control circuit voltage shall preferably not exceed 110 Volts ac (55-0-55)

Where control circuits are taken outside the enclosure to remote equipment use 24 Volts ac.
For circuit-breaker shunt trip and protective circuits use 30 Volt dc, for integral protective devices 230 Volts ac, or as otherwise indicated.
Provide control circuit transformers to supply power at voltages to suit control components in accordance with relevant parts of BS EN 61558 complete with primary and secondary fuses.

2140 CURRENT TRANSFORMERS:
Comply with BS EN 61869-2. Provide separate current transformers for each protection device and instrumentation. Ensure current transformers provide appropriate accuracy and are compatible with protective device characteristics, performance and VA rating required for satisfactory operation of protection devices, instruments and meters indicated.
Ensure that current transformers are capable of withstanding maximum short time withstand current of value and duration indicated for assembly.
Provide test links in secondary connections of all current transformers to facilitate testing of instruments, meters and protection devices.

2151 INSTRUMENTS AND METERS:
Standards
Comply with BS 89 series, BS EN 60051-1 and BS EN 60051-5 for voltmeters, ammeters, watt meters, frequency indicators and power factor indicators.
For static electricity meters, comply with:
BS EN 62502-11 for general requirements, tests and test conditions
BS EN 62052-21 for Tariff and load control equipment
BS EN 62052-31 for product safety requirements and tests
BS EN 62053-61 for power consumption and voltage requirements
BS 7856, BS EN 50470-1, BS EN 50470-2, BS EN 62053-22 or BS EN 62053-21 for kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters
BS EN 62053-23 or BS EN 62053-24 for kVAhr meters
For electromechanical meters for active energy, comply with BS EN 62053-11, BS EN 50470-1, BS EN 50470-3 and BS 7856

Where a meter is to be used to measure the amount of electricity supplied for billing purposes, for applications up to 100kW/100kWh the meter shall be MID Approved. For applications above 100kW/100kWh meters shall be of an approved type for electricity, by OFGEM. In addition, meters for domestic use shall be certified.

Protect wiring to voltmeters by separate fuses. Protect potential coils of watt meters, frequency indicators, power factor indicators and kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters by separate fuses.
Supply instruments and meters suitable for flush mounting and type, size and accuracy as drawings or schedules.
Ensure that indicating scales for all instruments comply with BS 3693. Supply so that normal indication is 50% to 75% of full scale deflection.
Completely segregate all instruments in instrument compartments. Panel mount meters on front of instrument compartment.
Provide test link for energy meter testing within instrument compartment.
Provide time switches for load control to BS EN 62054-21

Standards for instruments and meters with interface for communications with controllers. (Refer to scope of works and / or schedules for project particular requirements.)
RS 232C.
BS EN 61968
BS EN 61850
Profibus BS EN 62769
Profinet BS EN 62769
Modbus.
Modbus over Ethernet.
"Wired" interfaces to BS EN 61131-2 (volt-free contacts, relay driven
Communications systems for meters, metering data, metering data exchange:

Pulsed output device to BS EN 62053-31
BS EN 62056
PD CLC/TS 50568-4 and PD CLC/TS 50568-8
BS EN 61968-9 - interfaces for meter reading and control
BS EN 50491-11 - simple external consumer display (smart metering)
Relevant parts of BS EN 13757

2160A ELECTRICAL RECORDING INSTRUMENTS:
Provide electrical recording instruments.
Standard - BS EN 61143.

2171 INDICATOR LIGHTS:
Supply lamps of same type throughout. Provide indicator lamps with lamp test facility. Supply interchangeable indicators for respective units.
For LED indicators, include a voltage suppressor on each LED.

Usage	Lamp Type
Switchboard	LED
Motor control centres	LED

Protect wiring to indicator lamp units by separate cartridge fuses.
Lens Colour in accordance with BS EN 60073.

2176 AUDIBLE ALARMS:
Provide audible alarm system as specified in the Work Section.

2177 PADLOCKS
Provide padlocks and cabinet as specified in Work Section.
Provide each padlock with two keys complete with disc and ring. Engrave disc and padlock with suitable legend.
Provide wall mounted steel cabinet with hinged door for storing padlocks and keys on hooks.

2178 SWITCHBOARD INSTRUMENT AND CONTROL WIRING:
All instrument and control wiring to be either single core insulated cable contained within plastic panel wireway or double insulated cabling installed in a harness.

Identify each end of each wire with a unique number using colour coded 'O' ring markers. Fit lugs at termination points.
All wiring is to be neatly arranged and securely fixed. Where appropriate protect by cartridge fuses complying to BS EN 60269-1, BS 88-1.

2179 MOTOR CONTROL CENTRE, STARTER AND CONTROL PANEL INTERNAL WIRING:
Segregate control wiring from power circuits.
Contain control wiring within plastic wireways or in a harness.
Identify each end of each wire with a unique number using colour coded 'O' ring markers. Fit lugs at termination points.
Take account of thermal effects of grouping when routing power wiring.
All wiring is to be neatly arranged and securely fixed. Where appropriate protect by cartridge fuses complying to BS EN 60269-1, BS 88-1.

2180 LOW VOLTAGE COILS RATING:
Ensure coils for switching relays, contactors and other applications are capable of withstanding inherent voltage drop within system without armature or switching apparatus dropping out of position.

2191 FRAMEWORK:
Construct framework for supporting electrical equipment from mild steel plate and strip, cold and hot rolled steel sections or slotted angles, in accordance with BS EN 10210 and BS 4345 respectively. Comply with BS EN 1011-2 for metal arc welding.
Finish
Frameworks mounted inside building shall have a galvanized finish in accordance with BS EN 10346 or BS EN 10143.

Frameworks mounted outside building shall be hot dip galvanized to BS EN ISO 1461 following fabrication.
Supply cadmium or zinc electroplated bolts, nuts, washers and screws.

2201 FUSES:
Supply cartridge fuse links including fuse carrier, bases and associated components that comply with BS EN 60269-1, BS 88-1, fusing factor category gG, unless otherwise indicated.
Use motor circuit fuses where indicated.

2211 DISTRIBUTION BOARDS:
Comply with BS EN 61439-1 and 61439-2 and BS EN 61439-3, as appropriate. Enclosure to be steel,with hinged lockable cover, internal separation Form 1,degree of protection IP31, unless otherwise indicated. Make fuseboards fully shrouded. Fit each distribution board with an isolating switch, size as shown on the drawings.

Install busbars in same position relative to their fuse carriers or miniature circuit- breakers (MCBs) for each pole. In TPN distribution boards supply neutral busbars with one outgoing terminal for each outgoing circuit.
Neutral to be rated as phase conductor.

Provide a multi-terminal earthing bar for circuit protective conductors for both insulated and metal-cased boards, with one terminal for each outgoing circuit. Connect directly to earthing terminal without dependence on exposed conductive parts of enclosure.
Identify each protective device by numbering. Identify each terminal on neutral busbar and earthing bar with its respective protective device.
Provide durable, printed circuit identification chart inside enclosure.

Enclosures finish
Apply high standard finish to enclosure and supporting metalwork. Degrease metal and remove rust prior to applying finish.
Comply with paint manufacturer's recommendations regarding preparation, stoving times, temperatures, mixing of finishes, application and coat thickness.

Finish and colour as Manufacturer's standard unless otherwise stated.
When other than manufacturers standard finish is specified, samples for each type of paint system and for each colour shall be provided.

Provide spare ways, 25% or as indicated. Where specific ratings are indicated incorporate fuses or MCBs, otherwise leave ways blank complete with blanking covers for future additions.

Co-ordination in accordance with BS 7671 (IET Wiring Regulations)
Ensure that the relevant fault current (short-circuit) rating of each switchgear and controlgear assembly is greater than or equal to the maximum prospective fault current at the point of connection to the system.
Ensure that the relevant design current does not exceed the rated current of the assembly, or rated current of a circuit of the associated assembly, taking into account applicable diversity and loading factors.
Ensure that any devices and components are integrated into the assembly in accordance with the relevant parts of BS EN 61439.
Ensure all devices and components are declared suitable according to the assembly manufacturer's instructions or literature.

2221 CONSUMER UNITS:
Comply with BS EN 61439-3. Supply consumer units with minimum degree of protection in accordance with BS EN 60529, IP31.

Where a consumer unit or similar switchgear is to be installed in a dwelling, ensure that it is constructed from, or installed in an enclosure that completely surrounds it that is constructed from, non-combustible material (metal), in accordance with BS 7671 (IET Wiring Regulations).

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Provide fuses or miniature circuit-breakers and means of isolation as indicated.

Enclosures finish
For steel enclosure apply high standard finish to enclosure and supporting metalwork. Degrease metal and remove rust prior to applying finish.

Comply with paint manufacturer's recommendations regarding preparation, stoving times, temperatures, mixing of finishes, application and coat thickness.
Finish and colour as Manufacturer's standard unless otherwise indicated.
When other than manufacturer's standard finish is specified samples for each type of paint system and for each colour shall be provided.

Co-ordination in accordance with BS 7671 (IET Wiring Regulations)
Ensure that the relevant fault current (short-circuit) rating of each switchgear and controlgear assembly is greater than or equal to the maximum prospective fault current at the point of connection to the system.
Ensure that the relevant design current does not exceed the rated current of the assembly, or rated current of a circuit of the associated assembly, taking into account applicable diversity and loading factors.
Ensure that any devices and components are integrated into the assembly in accordance with the relevant parts of BS EN 61439.

2231 MINIATURE CIRCUIT-BREAKERS:
Standard
BS EN 60898-1 or BS EN 60898-2 for protection of AC circuits.
BS EN 60898-2 or BS IEC 60898-3 for protection of DC circuits.
Supply miniature circuit-breakers with voltage and current ratings, type according to instantaneous tripping current, rated braking capacity and frequency as drawings, scope of works or schedules.
Arc fault detection
Miniature circuit-breakers fitted with integral arc fault detection to comply with BS EN 62606.
Ensure devices with integral arc fault detection are placed at the origin of the circuit to be protected.

2235A ARC FAULT DETECTION DEVICE
Supply arc fault detection devices in accordance with BS EN 62606.
Ensure arc fault detection devices are placed at the origin of the circuit to be protected.

2235B COMBINED ARC FAULT DETECTION DEVICE WITH OVERCURRENT PROTECTION
Supply combined arc fault detection with over current operation in accordance with BS EN 62606 and BS EN 60898-1.
Ensure arc fault detection devices are placed at the origin of the circuit to be protected.

2235C COMBINED ARC FAULT DETECTION DEVICE WITH RESIDUAL CURRENT PROTECTION:
Supply combined arc fault detection with residual current operation in accordance with BS EN 62606 and either BS EN 61008-1 or BS EN 62423 as appropriate.
Ensure arc fault detection devices are placed at the origin of the circuit to be protected.
Select the residual current detection Type (AC, A, B or F) in accordance with BS 7671 (IET Wiring Regulations).

2235D COMBINED ARC FAULT DETECTION DEVICE WITH OVERCURRENT AND RESIDUAL CURRENT PROTECTION:
Supply combined arc fault detection with residual current/overcurrent operation in accordance with BS EN 62606 and either BS EN 61009-1, or BS EN 60898-1 plus either BS EN 61008-1 or BS EN 62423.
Ensure arc fault detection devices are placed at the origin of the circuit to be protected.
Select the residual current detection Type (AC, A, B or F) in accordance with BS 7671 (IET Wiring Regulations).

2241 RESIDUAL CURRENT DEVICE:
Comply with BS EN 61008 or BS EN 62423. Supply residual current circuit breakers (RCCBs) with rated voltage, rated current, rated tripping current, rated tripping time and rated breaking capacity as indicated.

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DC component
Ensure DC component does not affect operation by selecting the residual current detection Type (AC, A, B or F) in accordance with BS 7671 (IET Wiring Regulations).
Rated Tripping Current
30mA unless otherwise indicated on the drawings.
Rated Tripping Time
30ms unless otherwise indicated on the drawings.
Fit with integral over current protection as detailed on drawings or schedules.
Refrigerators and deep freezers should not be connected to RCCB Protected Circuits unless written confirmation is obtained.

Supply combined residual current/over current operated circuit-breakers (RCBOs) to BS EN 61009

Where, as indicated on the drawings or schedules, RCDs are fitted with integral arc fault detection to BS EN 62606, ensure devices are placed at the origin of the circuit to be protected.

2242 RESIDUAL CURRENT MONITORS
Standard - BS EN 62020 IEC62020

2247 AUTOMATIC RECLOSING DEVICES FOR CIRCUIT BREAKERS AND RESIDUAL CURRENT OPERATED CIRCUIT BREAKERS WITH OR WITHOUT OVERCURRENT PROTECTION:
Where detailed in the scope of works or scheduled / indicated on the drawings, supply automatic reclosing devices (ARDs) for circuit breakers, residual current devices with overcurrent protection (RCBOs) and residual current circuit breakers (RCCBs) in accordance with BS EN 63024
Ensure automatic reclosing devices are only installed on devices protecting parts of the installation where access is restricted to instructed persons or skilled persons as defined in BS 7671 (IET Wiring Regulations).
Ensure a suitable warning notice is displayed near the points of access to parts of the installation controlled by automatic closing devices

2250 CABLE TERMINATIONS:
Ensure that switchgear and distribution boards are provided with facilities to terminate size, number and type of cable indicated. Where necessary use fabricated steel extension boxes for glanding large and multiple cables.
Provide non-ferrous metal glanding plates for single core cable terminations.

2251 TERMINAL BLOCKS FOR AUXILIARY WIRING:
Provide rail mounted moulded terminal blocks with fully shrouded connectors, segregation plates, and end clamps. Ensure insulating material is suitable for maximum operating temperature of conductors.
Provide connectors to clamp conductors between metal surfaces. Ensure clamping screws do not make direct contact with conductors. Ensure conductors maintain sufficient contact pressure to ensure negligible impedance. Make metal in contact with conductors 85% copper alloy and screws of metal electrolytically compatible with copper alloy.
Provide each terminal with marking tag fitted into moulded tag slots.
Provide test probe facilities and integral disconnecting device to facilitate testing on terminals for indication, instrumentation and metering.
Manufacture rails from steel, hot dipped galvanised after manufacture.

2252 COMPONENT MOUNTING:
Mount all components on removable back plates. Ensure no fixings protrude into busbar chamber.

2261 / 2271 STATIC CAPACITOR / AUTOMATICALLY CONTROLLED CAPACITOR BANKS:
Refer to schedules for details of when / where required.
Standards
BS EN 61921 and the following to suit the application.
BS EN 60143.
BS EN 60831.
BS EN 60871.
BS EN 60931.

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BS EN 60110-1
Voltage rating of capacitor - 400V, 3-phase, 50 Hz.
Mounting – as detailed in schedules or scope of works.
Capacitor unit
Provide assembly housed in sheet steel enclosure complete with main terminals, comprising individual low loss, power capacitor elements and fuses to BS EN 60143-3 or BS EN 60871-4.
Capacitor unit assembly
Incorporate thermal equalizers within assembly of elements.
Fill enclosure with inorganic, inert and non-flammable granules.
Fit discharge resistors.
Ensure all internal and external connections are adequately rated and fully insulated.
Automatic bank enclosure - Manufacturer's standard.

2281 HARMONIC FILTER:
Refer to schedules for details of when / where required.
Unit - Filter conditioning to meet G5/4.
Mounting - Floor mounting. Built-in type.
Cubicle - Incorporating IGBTs, capacitors, reactors, block contactors and control gear.
Cable termination chamber - Mount cable termination chamber on side of cubicle with access through removable plates.

2291 MEDIUM VOLTAGE IRON CORE FILTER REACTOR:
Refer to schedules for details of when / where required.
Provide 3-phase filter reactor in accordance with BS EN 60076 and relevant parts of BS EN 61558
Reactor
Copper foil windings insulated between layers, impregnated under vacuum and in over pressure conditions with polyester resin and dried in furnace temperature of 150°C.
Ensure iron core flux density is designed for indicated harmonic loading. Ensure that saturation does not occur at switch-in of filter network.
Provide insulation for continuous operation at ambient temperature up to 40°C, temperature class T40/E.
Electrical connections - to copper bars in accordance with DIN 46206.

2301 SWITCHGEAR AND CONTROL GEAR ACCESSORIES
Provide switchgear and controlgear accessories as indicated. Provide insulating mats along the operating length of each switchboard of minimum width 1,000mm. Provide all switchgear operating tools required for each switchboard. Provide 10% of the number of each size of fuses used as spare.

3000 WORKMANSHIP

3010 FIXING:
Fix all equipment independently of wiring system. Use cadmium or zinc electroplated bolts, nuts, washers and screws.

3021 MOUNTING HEIGHT:
Mount single items of equipment 1450mm above finished floor level to centre of equipment, unless otherwise indicated.

Arrange groups of equipment, other than floor mounted assemblies, so that all parts of equipment requiring access for operation or maintenance are at least 500mm and no more than 2000mm above finished floor level (max height of operating handles 1800mm), unless otherwise indicated.

3030 ACCESS:
Ensure that clearance in front of switchgear and controlgear is not less than 1m, or as indicated.

3031 ACCESS TO CONTROL COMPONENTS:
Arrange control components to ensure adequate access for operation and maintenance.

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3032 ANCILLARIES:
Install ancillaries in accordance with manufacturer's instructions.

3041 MARKING:
Number terminals, cables and component parts to correspond with manufacturers certified drawings.

3051 CABLE TERMINATIONS:
Terminate paper-insulated cable by means of switchboard manufacturer's standard compound filled cable boxes.
Terminate PVC,XLPE and MICC cables inside enclosure by securing cables to switchboard with glanding plates or glanding brackets; and outside enclosure with glanding plates or fabricated steel extension boxes.
Provide cable support systems within the switchboards between cable entry point and connection to respective devices. Where multicore cables are glanded at a distance from device connection points the inner cable sheath should be maintained and supported and fixed within the switchboard.

3061 INSTALLATION AND COMMISSIONING:
Install and commission switchgear and controlgear in accordance with the appropriate standard and the manufacturers' recommendations. Include CT Polarity check in commissioning tests.
Commissioning of all equipment to be carried out by relevantly qualified specialist personnel.

Y73 – Luminaires & Lamps

Incorporates clauses from V41 – Street/area/flood lighting & some stds in NES V21

1000 GENERAL
Lamps and related equipment to comply with EU Regulation 2015/1428 with regard to ecodesign requirements.

1010 STANDARDS:
Supply luminaires and lamps as indicated to standards as appropriate.

1011 BUILDING REGULATIONS
The contractor shall ensure that all luminaires comply with the Building Regulations (Part B2 section 6) with respect to their fire retardant properties, in the configuration indicated on the drawings.

1012 PARTICULAR REQUIREMENTS
Provide luminaires as indicated in the Schedules and/or drawings.

2000 PRODUCTS/MATERIALS

2011 LUMINAIRES:
Standards
Supply luminaires with photometric data in accordance with relevant parts of BS EN 13032.
Ensure luminaires of similar type have same photometric performance as published data within the tolerances defined by the standard.

Supply luminaires with performance in accordance with:
BS EN 62722-1 in general.
BS EN 62722-2-1 for LED luminaires.
BS EN 62922 for organic LED (OLED) panels.

Supply luminaires in accordance with relevant parts of BS EN 60598 and BS 4533 where still current as below: (Luminaires with type “n” protection to comply with BS EN 60079-15 and BS EN IEC 60079-7)

- Fixed general purpose luminaires to BS 4533 Section 102.1 (BS EN 60598-2-1).
- Recessed luminaires to BS EN 60598-2-2.
- Luminaires for road and street lighting to BS 5489-1 and BS EN 60598-2-3. Photoelectric controller to BS 5972
- Floodlights to BS EN 60598-2-5, N Protection to BS 4533 Section 102.51. Floodlight towers steel structures to BS EN 1993-3-1
- Luminaires with built-in transformers for filament lamps to BS EN 60598-2-6
- Ground recessed luminaires to BS EN 60598-2-13.
- Luminaires for swimming pools and similar applications to BS EN 60598-2-18.
- Air-handling luminaires to BS 4533 Section 102.19 (BS EN 60598-2-19).
- Luminaires for hospitals and health care buildings to BS EN 60598-2-25.
- Electrical supply track systems for luminaires to BS EN 60570.
- ELV lighting systems for filament lamps to BS EN 60598-2-23
- Luminaires with limited surface temperature to BS EN 60598-2-24
- LED modules for general lighting to BS EN 62031 and BS EN 62717
- Transilluminated traffic bollards to BS EN 12899-2
- Lighting strings / chains to BS EN 60598-2-20.
- Rope lights to BS EN 60598-2-21.
- Luminaires for stage lighting, television and film studios to BS EN IEC 60598-2-17
- Presentation of data for luminaires used for road lighting to be in accordance with BS EN 13032-5

General requirements and tests / classification BS EN 60598-1 as indicated.

Safety
Fit luminaire with cover glass to protect against ultra-violet emission and risk from explosion of lamps where scheduled.
Ensure ground recessed luminaires are selected and installed in accordance with the guidance provided in Table A.1 of BS EN 60598-2-1, with respect to their location and intended application.

Y73 – Luminaires & Lamps

Safety support for Components - Provide secondary support for translucent covers, diffusers and gear trays so they are prevented from falling when their primary fixing is released.

Electromagnetic Compatibility- Ensure luminaires comply with BS EN 61547 for EMC immunity.

Comply with relevant parts of BS EN 61995 for devices for the connection of luminaires.

2021 EMERGENCY LIGHTING LUMINAIRES:
Comply with BS EN 60598-2-22.
Comply with ICEL:1001. Ensure emergency lighting luminaires are marked with ICEL certification label.

2030 EXIT SIGNS:
Comply with 5499-4.

2041 HAZARDOUS AREA LUMINAIRES:
Standards as appropriate :
BS EN IEC 60079 series / BS EN 60079-0, BS EN 60079-1, BS EN 60079-5, BS EN 60079-6, BS EN 60079-11, BS EN 60079-14 BS EN 60079-15, BS EN 60079-25.

2050 SIGNS & HIGH VOLTAGE INSTALLATIONS:
Standard
Comply with BS 559 and BS EN 50107-1.
Neon transformers
Supply transformers for tubular discharge lamps with no-load output voltage exceeding 1000 V in accordance with BS EN 61050.
Secondary protection to BS EN 50107-2.

2055 OPTICAL FIBRE LUMINAIRES
Where indicated provide optical fibre luminaires.
Optical fibre connection to BS EN ISO 11149.

2057 LED LUMINAIRES:
Standards
Supply luminaires with photometric data in accordance with relevant parts of BS EN 13032
Supply luminaires in accordance with BS EN 60598
Supply luminaires with performance in accordance with BS EN 62722-1 and BS EN 62722-2-1
Classification to BS EN 60598-1
Safety support for components
Provide secondary support for translucent covers, diffusers and gear trays so they are prevented from falling when their primary fixing is released.
Photometric performance
Ensure luminaires of similar type have same photometric performance as published data within the tolerances defined by BS EN 13032-1
Electromagnetic compatibility
Ensure luminaires comply with BS EN 61547 for EMC immunity.

2061 LAMPHOLDERS - GENERALLY:
Standards
Ensure lampholders are suitable for use with corresponding lamp caps to - BS EN 60061-1.
Lamp holders - BS EN 60061-2. Enhanced safety type BS 7895.
Bayonet lampholders - BS EN 61184.
Lampholders for tubular fluorescent lamps and starter holders - BS EN 60400.
Edison screw lampholders - BS EN IEC 60238.
Lampholders of miscellaneous types for building-in (e.g. projection lamps, floodlighting lamps etc) - relevant parts of BS EN 60838

Interchangeability - Ensure lampholders in luminaires of similar type and rating are identical.
Earthing - Ensure metal lampholders incorporate an earthing terminal.
Material - When plastic is used in the lampholder it shall be heat resistant moulded plastic.

Y73 – Luminaires & Lamps

2080 LAMPHOLDERS - MOUNTING:
Securely mount lampholder in luminaire when it is sole support for lamp.
Cord grip - provide integral cord grip type when lampholders are suspended by cord.
Conduit Mounted - when mounted directly to conduit system use backplate lampholder for conduit box.

2090 CONTROL GEAR AND COMPONENTS
Comply with all parts of BS EN 61347 / BS EN IEC 61347
Compatibility
Ensure control gear and components are suitable for lamp type, wattage, starting characteristics, and luminaire environment.
Obtain from manufacturers written confirmation of compatibility.
Efficiency tested in accordance with the relevant parts of BS EN IEC 62442 to suit lamp type selected.
Lighting control interface for dimming (Analogue voltage dimming interface for electronic current sourcing control gear) to BS EN IEC 63128

2101 FLUORESCENT LAMP BALLASTS AND STARTERS:
Standard
Ballasts
BS EN 61347-2-8 and BS EN 60921 for fluorescent lamps.
BS EN 61347-2-3 & 2-7and BS EN 60929 for DC supplied electronic ballasts.
BS EN 61347-2-3 and BS EN 60929 for fluorescent lamps and high frequencies.
Supply thermal protectors for ballasts for tubular fluorescent lamps to BS EN 60730-2-3.
Starters
BS EN 61347-2-1 and BS EN 60927 for starters other than glow switch.
BS EN 60155 for glow switch starters.
Use low distortion type.

2110 DISCHARGE LAMP BALLASTS AND STARTERS:
Standard
Ballasts - BS EN 61347-2-9 and BS EN 60923.
Starters - BS EN 61347-2-1 and BS EN 60927.

2115 LED MODULE CONTROL GEAR:
Provide LED module control gear to BS EN 61347-2-13 and BS EN 62384.

2120 CAPACITORS:
Use capacitors in accordance with BS EN 61048 and BS EN 61049 in tubular fluorescent, high pressure mercury and low pressure sodium vapour discharge lamp circuits.

2130 SUPPLY TERMINALS:
Use screw terminals for supply cables and circuit protective conductors, sized to terminate up to three 2.5mm2 conductors. Provide separate terminal blocks for each incoming circuit, with marking to identify each circuit.

2141 FUSE:
Include a fuse holder and BS 1362 fuse in each incoming circuit phase connection for fluorescent and discharge luminaires.

2150 INTERFERENCE:
Comply with BS EN 55015 .

2160 REMOTE GEAR:
Locate control gear in separate lockable cabinet of sheet steel with same degree of protection and finish specified for luminaire. Comply with manufacturer's recommendations for cable type and maximum length between gear and lamp.

2180 FLUORESCENT LAMPS:
Standard
Internationally specified tubular fluorescent lamps to BS EN 60081.

Y73 – Luminaires & Lamps

UK tubular fluorescent lamps to BS 1853-2 not included in BS EN 60081, BS EN 60901, BS EN 61195 and BS EN 61199.
Single capped fluorescent lamps to BS EN 60901(performance) and BS EN 61199 (safety)
Double capped fluorescent lamps to BS EN 61195 (safety) and BS EN 60081 (performance).
Self-ballasted lamps to BS EN 60969 and BS EN 60968 for safety requirements.

2182 FLUORESCENT INDUCTION LAMPS:
Comply with BS EN 62532

2185 TUNGSTEN HALOGEN LAMPS
Comply with BS EN 60357, BS EN 60432-2.

2190 HIGH PRESSURE MERCURY VAPOUR LAMPS:
Comply with BS EN 60188 and BS EN 62035 for safety specifications

2192 METAL HALIDE LAMPS:
Comply with BS EN 61167 and BS EN 62035 for safety specifications

2200 HIGH PRESSURE SODIUM VAPOUR LAMPS:
Comply with BS EN 60662 and BS EN 62035 for safety specifications

2210 LOW PRESSURE SODIUM VAPOUR LAMPS:
Comply with BS EN 60192 and BS EN 62035 for safety specifications

2215 LED LAMPS / MODULES:
Standards
BS EN 50564 for measurement of low power consumption.
BS EN 62031 for measurement of low power consumption.
BS EN 62612 for performance requirements and BS EN 62560 for safety specifications - self-ballasted LED lamps, for supply voltages > 50 V.
BS EN 62838 for LEDsi lamps with supply voltage not exceeding AC 50 V or ripple-free DC 120 V.
BS EN 62868 and BS EN 62922 for Organic LED (OLED) panels.

LED modules control gear
BS EN 62717 for performance requirements
BS EN 62031 for safety requirements
BS EN IEC 62386-207 for digital addressable lighting interface (DALI) control gear.
BS EN 61347-2-13 and BS EN 62384 for control gear.

2221 TRANSFORMERS FOR LV LUMINAIRES
Standards; relevant parts of BS EN 55014, BS EN 61000, BS EN 61047. BS EN 61347-2-2, BS EN 61558 .
Provide electronic or wound type as specified. Provide secondary fuse or thermal cut-out with automatic reset.

2230 LAMP MANUFACTURER:
Ensure that lamps of each type are from same manufacturer.

2241 SUPPORT SYSTEM - CONDUIT/TRUNKING:
Use not less than 20mm conduit of same type as main conduit system. Trunking type and size as indicated on drawings.

2251 SUPPORT SYSTEM - ROD:
Use continuously threaded rods with matching washers and nuts, minimum 6mm diameter and a carrying capacity of not less than twice the weight of the complete luminaire. Material, Cadmium plated steel unless otherwise indicated.

2260 SUPPORT SYSTEM - CHAIN:
Use cadmium plated steel chain with load carrying capacity of not less than twice weight of complete luminaire.

Y73 – Luminaires & Lamps

2271 SUPPORT SYSTEM -FLEXIBLE CORD:
Use size and type as appropriate. Confirm temperature rating is suitable for operating temperature of luminaire or lampholder. Confirm that cord is adequate for mass to be supported.

2280 SUPPORT SYSTEM - WALL BRACKETS:
Provide wall brackets. Confirm wall brackets are suitable for supporting luminaire.

2290 SUPPORT SYSTEM - BALL AND SOCKET:
Provide ball and socket as top support, complete with cover fixed to circular conduit box.

2295 SUPPORT SYSTEM – WIRE ROPE
Standards BS EN 12385-1, BS EN 13411-3, BS EN 13411-4, and BSRIA COP 22/2002
Use proprietary Wire Rope Suspensions Systems comprising of stainless steel components.

2301 COLUMNS AND BOLLARDS:
Standards
BS EN 40-2, BS EN 40-5, BS EN 40-6, BS EN 40-7 and BS EN 12767
Material, finish, height and lamp as specified in Work Section or on drawings.
Applied loads-Supply columns designed for additional externally applied loads 3 times luminaire mass.
Cutout and fuses to BS 7654 -Provide cut-out fuses and cable termination within accessible, lockable services enclosure.
Earthing-Include earthing terminal fixed within service enclosure.
Column base plate-Manufacturers standard.

2305 LIGHTING COLUMN/BOLLARD SWITCHGEAR:
Comply with the following unless detailed otherwise in the schedules or scope of works.
Service compartment
Standards
BS EN 40-2 for general requirements of lighting columns
BS 7671
Accessible only by use of a key or tool
Rating to BS EN 60529 - IP44.
Switchgear and circuit protection
Enclosure
Standard BS EN 61439
IP Rating to BS EN 60529 - Drip-proof to a minimum of IP31.
Circuit protective devices/Isolators
Standard
BS EN 60898
BS EN 61008
BS EN 61009
BS EN 60269, BS 88
BS EN 60947
Means of isolation
Double-pole isolator switch with key-lockable lock off facility or Double-pole mcb or RCBO with key-lockable lock off facility.

3000 ACCESSORIES

3011 TRACK LIGHTING:
Where indicated provide track for fixing fittings in accordance with BS EN 60570.

3021 INTEGRAL PHOTO-CELLS:
Incorporate integral photo-cell on luminaire where indicated, or provide photo cell control as indicated.

3031 AIR HANDLING LUMINAIRES:

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Provide assembly of luminaire and exhaust air device or luminaire and supply air device to meet design requirements for illumination and air flow. Ensure assembly can be integrated into a false ceiling, flush mounted as indicated on the drawings
Fixing-Ensure the fixing is capable of carrying the weight of the whole assembly.
Provide air-flow/noise performance data and air flow / light output characteristics.

4000 WORKMANSHIP

4011 ORIENTATION:
Install luminaires in accordance with the drawings, and in horizontal plane unless otherwise indicated. Orientation of lamps to be consistent throughout installation.

4021 CLEANLINESS:
Ensure luminaires are clean and grease free on handover.
Use gloves to prevent contamination of optical components as recommended by the manufacturer.

4031 INSTALLATION OF RECESSED FITTINGS:
Install luminaires flush with finished ceiling level.
Install ground recessed luminaires taking into account the guidance given in Table A.1 of BS EN 60598-2-13.

4040 INSTALLATION OF SEMI-RECESSED FITTINGS:
Install luminaires as manufacturer's detail.

4050 INSTALLATION OF WALL MOUNTED FITTINGS:
Install luminaires at height indicated.

4061 MATERIAL OF SUPPORTING SURFACE:
Ensure classification of luminaires is appropriate. Do not mount luminaires on or adjacent to readily flammable surfaces.

4070 INSTALLATION IN POTENTIALLY EXPLOSIVE ATMOSPHERES:
Comply with BS EN 60079.

4080 LUMINAIRES IN AREAS WITH INFRA-RED CONTROL SYSTEM:
Install luminaires in areas with infra-red control systems or data bearers so as to cause minimum disturbance to the infra-red transmission system in accordance with BS 7693.

4101 INSTALLATION OF EXTRA LOW VOLTAGE TUNGSTEN HALOGEN LAMPS:
Use same wattage lamp on luminaires fed from common transformer. Supply each luminaire on common transformer by separate cable of same cross-sectional area and length.

4110 SUPPORT
Ensure support is adequate for weight of luminaires.
Provide the following minimum number of supports for each luminaire longer than 600mm.

Luminaire Width mm	Minimum number of supports
Up to and including 300	2
Over 300	4

4120 SUPPORT FROM CONDUIT:
Where luminaire is supported from conduit provide a conduit box forming an integral part of conduit system at each point of suspension. Ensure suspensions are vertical.
Where conduit enters luminaire use back-nuts and washers to secure luminaire body to conduit support. Provide tube with corrosion resistance equal to conduit system.
Do not support luminaires directly from conduit boxes made from non-metal or heat sensitive materials, where the temperature of the material may exceed 60°C or the mass suspended exceeds 3kg.

4130 SUPPORT FROM TRUNKING:

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Where luminaire is supported from trunking use proprietary clamps or brackets appropriate to the luminaire and trunking.
Do not support luminaires directly from trunking made from non-metal or heat sensitive materials, where the temperature of the material may exceed 60oC or the mass suspended exceeds 3kg.

4141 SUPPORT BY DIRECT FIXING:
Refer to fixing methods as manufacturer's recommendations.

4151 SUPPORT IN SUSPENDED CEILING:
Support luminaires directly from building fabric and independent of ceiling unless otherwise indicated.

4160 SUSPENSION:
Suspend luminaires at height indicated. Ensure suspensions hang vertically unless otherwise indicated.

4170 SUSPENSION BY ROD:
Use washers, nut and lock-nut at top and bottom of rod. Paint cut ends with calcium plumbate primer or zinc rich paint.

4180 SUSPENSION BY CHAIN:
Use hook cover for suspension from circular conduit box. For connection to luminaires use luminaire manufacturer's own chain hook, but if not available use hook with standard screw threaded body to be secured to luminaire body with nuts and washers. Where indicated use captive hooks.

4190 SUSPENSION BY FLEXIBLE CORD:
Suspend cord from ceiling rose.

4200 SUSPENSION BY BALL AND SOCKET:
Install cable through ball and socket connected to conduit box.

4205 WIRE ROPE SUSPENSION SYSTEM:
Only use where specified within the Scope of Works or Schedules.
Proprietary Wire Rope Suspensions Systems which comply with BS EN 12385-1, BS EN 13411-3, BS EN 13411-4, and BSRIA COP 22/2002. Wire Rope Suspensions to be suitable for the safe working load and comprise Stainless Steel grade 316 wire rope, Stainless steel grade 302 Spring fasters with fixings by loops, stud (permanently fixed to wire rope length) or toggle as appropriate. The installation shall comply with BSRIA COP 22/2002

4211 COLUMNS AND BOLLARDS
Location-Confirm location before excavation.
Bases- Install bases or supervise work by others.
Mounting-Mount column or bollard on base as recommended by manufacturer.
Ensure columns and bollards are vertical.
Earthing-Install circuit protective conductor to connect luminaire to earthing terminal in service compartment; size circuit protective conductor same as live conductors. Bond accessible metal parts of column or bollard to earthing terminal.

4220 CONNECTIONS TO LUMINAIRES
Cable Protection -Use appropriate size of grommet where cables enter through hole in luminaire body.
Earthing-Ensure that the earthing terminal of luminaire is connected to the conduit protective conductor of the supply circuit.
Loose Wiring-Clip or tie back with suitable proprietary devices loose wiring within luminaire, at 300mm intervals.

4231 CONNECTIONS TO LUMINAIRES - DIRECT TO CONDUIT:
Terminate circuit wiring in luminaire terminal block using loop-in system taking all conductors through same cable entry of luminaire , unless stated otherwise in work section V21.

4241 CONNECTIONS TO LUMINAIRES - DIRECT TO TRUNKING:

Y73 – Luminaires & Lamps

For lighting trunking terminate wiring in luminaire terminal block using loop-in system taking all conductors through the same cable entry of luminaire, unless stated otherwise in work section V21.

4250 CONNECTIONS TO LUMINAIRES - SUSPENDED FROM TRUNKING:
Where luminaires are suspended from trunking, secure plug and socket type ceiling rose to BS 546, adjacent to, or on side of, trunking. Terminate circuit wiring at socket. Take flexible cord from plug of ceiling rose to supply terminals of luminaire.

4261 CONNECTIONS TO LUMINAIRES - RECESSED FITTINGS:
Where luminaires are recessed in a suspended ceiling, terminate circuit wiring at plug and socket type ceiling rose to BS 546, located not more than 500mm from the access through the ceiling. Use flexible cord from plug of ceiling rose to supply terminals of luminaire.

4270 CONNECTIONS TO LUMINAIRES - CONDUIT SUSPENSION:
Terminate circuit wiring in terminal block within supporting conduit box. Use flexible cable from terminal block to luminaire, installed within tube.

4280 CONNECTIONS TO LUMINAIRES - ROD OR CHAIN SUSPENSION:
Terminate circuit wiring in terminal block within supporting conduit box. Use flexible cord from terminal block to luminaire and clip cable to one of the rods or chains, do not weave cable through links of the chain.

4290 CONNECTIONS TO LUMINAIRES - MICS CABLE:
Fix cable gland to luminaire and continue conductors to supply terminals of luminaire.

4301 LIGHTING SWITCHES ON DIFFERENT PHASES:
When lighting switches on different phases are in a common box, use phase barriers in accordance with BS 7671. Provide warning label.

Y74 – Accessories for Electrical Services

1000 GENERAL
Install all switches, controls, outlets and meters in accordance with BS 8300 Parts 1 and 2 and legislation appropriate to the building location.

1010 APPLICATION:
Supply fixed electrical wiring accessories for use with fixed and portable peripheral equipment using either power or signalling cables.

1020 SAMPLES:
Where indicated submit samples of proposed materials and equipment for approval before work is started. Label each sample with name, catalogue number and services in connection with item.

1021 ACCESSORIES SUPPLIER:
Unless otherwise indicated source all accessories from the same manufacturer.

2000 PRODUCTS/MATERIALS

2011 ACCESSORIES - COMMON REQUIREMENTS
Provide accessories as detailed in the Work Sections / schedules and shown on drawings.
General requirements for electrical accessories to BS 5733.
Boxes and enclosures for electrical accessories to BS EN 60670 series.
Area of installation – as detailed in particular specification.
Enclosure box to BS 4662 for recessed (flush) mounting, with performance and safety standards in accordance with BS EN 60670-1.
Enclosure box to BS 5733 for surface mounting
Unless scheduled otherwise, degree of protection to BSEN 60529
IP30 Interior
IP54 Exterior
Hazardous area classification to BS EN 60079-14 as scheduled.
Enclosure degree of mechanical protection IK code to BS EN 62262 as scheduled.
Switches for Home and Building Electronic Systems (HBES) to comply with BS EN 50428 or BS EN 60669-2-5.
Coverplates to be overlapping unless otherwise specified
Enclosure material and finish to match conduit system. Enclosures to be recessed unless otherwise specified.

2021 INTERIOR LIGHTING SWITCHES:
Standard
BS EN 60669-1
Enclosure box to BS 4662, BS 5733 or BS EN 60670-1 as appropriate
Switchtype
Switches shall incorporate rocker bars unless otherwise specified. For emergency lighting a secret key switch shall be used with rocker bars as other switches in that area. If dimmers and/or press switches are shown on drawings then they shall be of the same rocker bar pattern as the switches in that area.
Rating of all the switches to be 15A. Mounting to be on an adjustable steel grid. All switches shall have a snap action microgap mechanism. Pole configurations as indicated on the drawings.
Electronic control switches e.g. dimmer switches and time switches are to comply with relevant part of BS 60669,
Ancillaries
Earthing terminal integral within switch box.
Blank inserts in all spare ways.
Neon's, shrouds, red rocker bars and operating keys as specified.

2022 PULL CORD SWITCHES
Standard
BS EN 60669-1 and BS EN 61058-2-1.
Rating of all the switches to be 16A for lighting circuits and 40-45A for showers, fans etc as specified. Mounting shall be surface. All switches shall have a snap action microgap mechanism. Pole configurations for 40-45A switches shall be DP and for 16A as specified (ie 1 way, 2 way, SP or DP).

Y74 – Accessories for Electrical Services

Ancillaries
Earthing terminal integral within switch box.
Neon indicator lamp.
Integral patress for surface mounting.

2031 EXTERIOR LIGHTING SWITCHES:
Standard
BS EN 60669-1.
Enclosure box to BS 4662, BS 5733 or BS EN 60670-1 as appropriate.
Switch type shall be either rocker bar with sealed-in plastic membrane or rotary disc or lever operating through sealing gland. Rating of all switches shall be 15A. Action shall be two position, unless otherwise stated. Enclosure pattern shall be weatherproof and shall be surface, unless otherwise stated. Enclosure material shall be galvanized cast iron or impact resistant moulded plastic.
Ancillaries
Earthing terminal integral within switch box.
For neon etc shall be as indicated on the drawings.

2041 TIME SWITCHES:
Wire timer and switch circuits to separate terminals. Information regarding control and additional specification for time switches used for lighting is in work section V21, for all other uses see work section V20.
Standard BS EN 60730-2-7.
Time switch type shall be quartz stabilized motor with 30 hour spring reserve or quartz stabilized solid state with a minimum of 50 hour nickel cadmium battery backup unless otherwise specified.
Enclosure shall be dustproof sheet steel or impact resistant moulded plastic with viewing panel and arranged for conduit entry, unless otherwise indicated.

2051 LUMINAIRE CONNECTORS:
Rating shall be 5A.
Connector type
Load carrying captive cord grip type plug/socket and clip-on cover to BS 5733, BS 546 or BS 5733 Load Supporting BS 7001 (3 or 4 pin as appropriate).
Load carrying capacity to match connected luminaire.
Cover plate finish white moulded plastic.

2071 ISOLATING SWITCHES:
Provide isolating switches for fixed appliances, with utilization category and making capacity as indicated.
Standard - BS EN 60669-1
Enclosure box to BS 4662, BS 5733 or BS EN 60670-1 as appropriate.

Standard – BS EN 60947-3
Enclosure box - BS 4662, BS 5733 or BS EN 60670-1, BS EN 60947-3.
Isolation during repair and maintenance - BS EN 62626-1
Standards - BS EN 60669-1 and BS EN 60669-2 or relevant parts of BS EN 61058 or BS EN 60947-1 / BS EN 60947-3 and BS EN ISO 62626-1 to suit the application.
Mounting to be on an adjustable steel grid. Engrave front plate to indicate equipment served. Switch type toggle.
Ancillaries
Earthing terminal integral within switch box.
Neon indicator with red lens.
Cord outlet with cord grip.

2081 FUSED CONNECTION UNITS SWITCHED AND UNSWITCHED:
Standard - BS 1363-4.
Enclosure box to BS 4662, BS 5733 or BS EN 60670-1 as appropriate.
Engrave front plate to indicate equipment served.
Pole configuration to be DP switched or unswitched as shown on the drawings.
Ancillaries
Fuses to BS 1362 sized as indicated.

Cord outlet and cord grip, where scheduled.
Neon indicator where scheduled.

2091 SOCKET-OUTLETS:
Standards
13A socket-outlet to BS 1363-2 (2016 or later)
13 A plug tops to BS 1363-1.
Enclosure box to 4662, BS 5733 or BS EN 60670-1 as appropriate.
Home and Building Electronic systems to BS EN 60669-2-5.
Where RCD is incorporated the RCD to be in accordance with BS 7288.
Gangs - 2.

Socket outlets shall be single or twin and DP switched or unswitched as shown on drawings. The rating shall be 13A. Provide separate earth terminals for termination of cpc's suitable for high protective conductor currents, where scheduled or where circuits are identified.
Ancillaries
Plug tops, provide for 25% of outlets.
Where protected outlets specified extend outlets to have either a spring flap covering whole of outlet, or screw type weathering cap and chain.
Neon indicator where specified.

2091F SOCKET-OUTLETS - DOUBLE WITH INTEGRAL USB CHARGING, SWITCHED:
Standard
Socket-outlet to BS 1363-2 (2016 or later).
Enclosure box to BS 4662, BS 5733 or BS EN 60670-1 as appropriate.
HBES systems to BS EN 50428 or BS EN 60669-2-5.
USB charging in accordance with BS EN 62680-1-1
Switching - Switched.
Rating - 13 A.
Ancillaries - two USB charging socket-outlets
Gangs - 2.

2091H SOCKET-OUTLETS - INDUSTRIAL, UNSWITCHED:
Standard
Socket-outlet to BS EN 60309-2.
Enclosure box to BS 5733 or BS EN 60670-1 as appropriate
Voltage, poles, interlocking and BS EN 60529 ingress protection rating
Ensure socket-outlets have an ingress protection rating not less than IP44.
Ensure socket-outlets for use outdoors or in areas with sprays, water jets or excessive splashing have an ingress protection rating of not less than IP66

2091I SOCKET-OUTLETS - INDUSTRIAL, SWITCHED:
Standard
Socket-outlet to BS EN 60309-2, switched socket-outlet assembly BS EN 60309-4.
Enclosure box to BS EN 60309-4, BS 5733 or BS EN 60670-1 as appropriate.
Isolation provided for use during repair and maintenance in accordance with BS EN 62626-1
Voltage, poles and BS EN 60529 ingress protection rating
Ensure socket-outlets have an ingress protection rating not less than IP44.
Ensure socket-outlets for use outdoors or in areas with sprays, water jets or excessive splashing have an ingress protection rating of not less than IP66
Ancillaries and interlocking - as scheduled.

2095 DUAL USB CHARGING OUTLETS:
Standard
Electrical safety to BS EN 62368-1 or BS EN 60950-1.
Enclosure box to BS 4662, BS 5733 or BS EN 60670-1 as appropriate.
HBES systems to BS EN 50428 or BS EN 60669-2-5.
USB battery charging in accordance with BS EN 62680-1-1
Supply voltage: AC 230 V 50 Hz.

USB charging socket-outlets
Quantity - 2.
Output voltage and current to BS EN 62680-1
Ensure that the BS EN 60664-1 installation overvoltage category is suitable for the intended installation conditions at the point of connection to the fixed installation in accordance with BS 7671 (IET Wiring Regulations).

2101 COOKER CONTROL UNIT:
Standard - BS 4177. Enclosure box to BS 4662, BS 5733 or BS EN 60670-1 as appropriate.
With integral 13 A switched socket-outlet and pilot light.
Pole configuration to be DP switched. The rating shall be 45A.

2111 CORD OUTLETS:
Standard - BS 5733 and BS EN 61058-2-1.
Engrave front plate to indicate equipment served. Rating shall be 20A for all outlets except cooker and for cooker outlets 45A. Pole configuration to be DP & E.
Ancillaries
Cord grid. Cord Set to BS EN 60799.
Terminal block sized for cables.
For cooker 2x10mm^2, for all others 2x2.5mm^2

2121 CABLE AND APPLIANCE COUPLERS:
Standards
Industrial couplers, BS EN 60309-1, BS EN 60309-2.
Appliance couplers for household and similar general purposes BS EN 60320-2-2.
Material polycarbonate male and female type connectors.
Colour
25V, Violet.
50V, White.
110 - 130V, Yellow.
220 - 240V, Blue.
380 - 415V, Red.
500 - 750V, Black.
Degree of protection to BS EN 60529
Internal- IP 44.
External - IP 67
Ancillaries as indicated on drawings. RCD's in accordance with BS 7288.

2125 REMOTE CONTROL STATIONS
Standard - BS EN 60947-5-1
Actuator colours and marking to BS EN 60073.
Ensure rated thermal current, rated operational current and utilisation category of contacts are compatible with control circuit characteristics and circuit protection device.
Provide local isolation of equipment for safe maintenance, where necessary, to:
Relevant parts of BS EN 60947, BS EN 62626-1 as appropriate.

2131 TELEPHONE AND DATA OUTLET SOCKETS:
Standard - For jack socket to BS 6312-2.1 and BS 6312-2.2 or RJ 45,LJU.
Size shall be standard unless otherwise indicated. Circuit configurations as indicated on drawings. Connections shall be insulation displacement type unless otherwise indicated.
Enclosure box to BS 4662.

2151 D TYPE MULTIPIN CONNECTORS:
Circuit configurations as indicated on drawings. Connections shall be solder terminals. Size and circuit configuration (single or twin) shall be as indicated on drawings.

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2161 BNC SOCKETS:
Circuit configurations as indicated on drawings. Connections shall be crimp terminals. The impedance of the outlet shall be 75 ohm. The mounting shall be insulated unless otherwise indicated. Connections shall be insulation displacement type unless otherwise indicated.
Ancillaries shall be dust caps for sockets unless otherwise indicated.

2171 AERIAL SOCKETS:
Standards BS EN 50083 and BS EN 60728-11
Circuit configurations (single or twin UHF, VHF, TV, FM or DAB or satellite Intermediate frequency as indicated on drawings. Connections shall be insulation displacement type unless otherwise indicated
Ancillaries safety isolation to CAI recommendations for communal aerial systems.

2181 LOW VOLTAGE ISOLATING TRANSFORMER UNITS:
Standards
BS EN IEC 61558-1 for general safety requirements for transformers
BS EN 61558-2-4 for isolating transformers
BS EN 61558-2-6 for safety isolating transformers
BS EN 61558-2-15 (in medical locations).
The configuration shall be single phase, double wound. Rating - Input 230V/ Output power 1500VA, unless otherwise indicated on the drawings.

Type	Output Voltage	Description
V1	110V	For power tools in plantrooms with plug and socket to BS EN 60309-1
V2	24V	For portable lights in plantrooms
V3	110/24V dual	For power tools and portable lights in plantrooms

Ancillaries – Unless scheduled otherwise
Plug and socket for 110V, Plug and socket for 25V, DP switch primary supply, Centre tapped secondaries, secondary side fusing.

2191 SHAVER POINTS:
Provide shaver points, internally switched by plug insertion.
Standard – BS EN 61558-2-5.
Enclosure box to BS 4662, BS 5733 or BS EN 60670-1 as appropriate.
Components - Double wound single phase transformer 230/230V and 110V, with internal overload protection.
Outlet compatibility for:
UK shaver plugs to BS 4573
2-pin Europlug to BS EN 50075
US 2-pin plug to NEMA 1-15

2201 INDICATOR LAMPS:

Standard BS EN 62094-1.

Lamp – LED unless detailed otherwise in the scope of works or schedules.

Coding principles for indicators (lens colour) to BS EN 60073.

Lens retaining rings - Moulded plastic unless detailed otherwise elsewhere.

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3010 EARTHING:
Ensure metal framework of equipment is bonded to main earth point. Ensure that cable CPC's are connected to earth bar.
Provide earth CPC between earth lug on metal box and accessory casing except where accessory is encased in plastic.

3020 PROTECTION:
Ensure there is no physical or electrical damage to accessories when they are removed from their packaging and during installation.
Provide masking covers for surface mounted accessories to protect surface from paint.

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Where accessories are flush mounted install front plate after painting is finished.

3030 FIXING:
Align accessories horizontally and vertically, as indicated. Where accessories are grouped, mount horizontally in line and parallel to each other and equidistant.
Fix cover plates to boxes with brass fixing screws.

3041 MEASURING MOUNTING HEIGHTS:

Take measurement for position of electrical accessories to the centre line of equipment from either finished floor or worktop. Where specified height coincides with top of tiling, leave a clear gap of 50mm above tiling.

3051 STANDARD WALL-MOUNTED ACCESSORIES MOUNTING HEIGHTS:
Mounting heights shall be in accordance with Schedule Y74sch2, unless indicated otherwise.

For locations not listed provide common mounting heights for accessories of a similar type and function, considering the function of the accessory, its use in the workplace, facility or infrastructure, and any risks to health, safety and welfare.

Ensure mounting heights for sockets and accessories comply with the following standards as relevant to the use of the building:
Approved Document M Volume 1
Approved Document M Volume 2
BS 8300 Parts 1 and 2
IET Guidance Note 1: Selection and Erection

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1010 INSPECTION AND TEST PROCEDURE:
Comply with:
BS 7671 (IET Wiring Regulations) for requirements for initial and/or periodic verification of low voltage electrical installations in general.
Relevant parts of BS EN 61557 and IET Guidance Note 3: Inspection and Testing for methods and measuring equipment, monitoring and methods.
BS EN 60079-17 for appropriate safety precautions when undertaking inspection and testing in potentially explosive atmospheres.
Adopt progressive testing where necessary.

1020 SUPPLY CHARACTERISTICS:
Obtain information called for in BS 7671 about supply characteristics from Supplier, other than where to be measured as part of testing procedure.

1030 DESIGN INFORMATION:
Obtain all design assumptions, calculations and any other information to enable compliance with BS 7671 to be verified.

2010 INCORPORATED EQUIPMENT CHARACTERISTICS:
Obtain and use information from manufacturers of equipment provided.
Use information provided, for equipment supplied by others and incorporated into installation.

2021 PROSPECTIVE FAULT CURRENT:
Determine values of prospective fault current (I_{pf}) by measurement, unless other means are indicated as described in Appendix 14 of BS 7671. Determine I_{pf} at all necessary points within installation to confirm correct equipment selections.
Where necessary obtain from supply undertaker values of I_{pf} at the origin of the installation. Adjust subsequent measured values of I_{pf} accordingly. Where alternative supply arrangements are available select the arrangement giving rise to the highest I_{pf} value.

2030 INITIAL VERIFICATION:
Carry out detailed inspection to verify the requirements of BS 7671 Section 643 in the order given in Section 643.

2041 TEST EQUIPMENT AND CONSUMABLES:
Provide test equipment and consumables in accordance with relevant standards and manufacturers' instructions to complete tests satisfactorily, and to retest any failed installations following corrective measures.
Standards
Test equipment and accessories to relevant parts of BS EN 61557, relevant parts of BS EN 61010, and Health and Safety Executive Guidance Note GS38 Electrical test equipment for use of low voltage electrical systems.
Test equipment quality assurance requirements to BS EN ISO 10012.

2051 TESTING
Carry out in the same order as published the tests required by BS 7671 Section 643.

2061 CONTINUITY OF PROTECTIVE CONDUCTORS:
Confirm continuity. Use AC or DC source

2071 PROTECTION BY AUTOMATIC DISCONNECTION OF SUPPLY:
Using a test current of at between 20 A and 25 A, measure and record external earth fault loop impedance Z_e.

If alternative supply arrangements are available, determine the lowest and highest values of Z_e.
Verify the highest value of earth fault loop impedance Z_{db} for each distribution board.
If alternative supply arrangements are available, verify the earth fault loop impedance Z_{db} for each distribution board when using the supply arrangement with the highest impedance.
Measure the highest value of earth fault loop impedance Z_s for each circuit, and verify that each circuit meets the requirements of Chapter 41 of BS 7671, including the effectiveness of any supplementary

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protective equipotential bonding where necessary.
If alternative supply arrangements are available, verify each circuit's earth fault loop impedance Z_s when using supply arrangement with highest impedance.

Where residual current devices are used for automatic disconnection of supply, verify their operation using test equipment meeting BS EN 61557-6, taking into account the operating characteristic of the device in accordance with Table 3A in Appendix 3 to BS 7671.
For IT systems, verify compliance with Regulation 411.6 of BS 7671 using methods identified in Regulation 643.7.1 c).

2080 SETTINGS AND ADJUSTMENTS:
Confirm characteristics and settings of protective devices are within maximum and minimum specified tripping times.
Check correct operation of devices.
Confirm interlocks and sequences operate safely and as indicated.

2091 STANDBY GENERATORS:
Perform works tests on standby generators and provide test certificates.
Comply with BS 5000-3 and BS 5000-11 or BS EN 60034-3 as appropriate.
Carry out load test where specified within Work Sections.
Allow for attendance by the Engineer to witness works tests.
Carry out special tests where indicated in the Works Sections.

2101 HV AND LV SWITCHGEAR:
Perform works tests on HV and LV switchgear in accordance with BS EN 62271-200 and relevant parts of BS EN 61439 as appropriate, and provide test certificates.
Allow for attendance by the Engineer to witness works tests.
Carry out special tests where indicated in the Work Sections.

2111 HV POWER TRANSFORMERS:
Perform works tests on HV power transformers in accordance with BS EN 60076-3, BS EN 60076-4 and BS EN 60076-5 and provide test certificates.
Allow for attendance by the Engineer to witness works tests.
Carry out special tests where indicated in the Works Sections

2121 SPECIALIST INSTALLATIONS:
Carry out site testing and inspection and provide test certificates for specialist installations in accordance with:-
fire detection and alarm systems – relevant parts of BS 5839.
evacuation alert systems – BS 8629
lightning protection - BS EN 62305
fire protection for electronic equipment installations - BS 6266.
fire extinguishing installations and equipment on premises – relevant parts of BS 5306.
emergency lighting installations and equipment on premises - BS 5266-1, BS EN 50171, BS EN 50172 and BS EN 13032-1 as appropriate.

Fire Alarm, Voice Alarm and Evacuation Alert System Installations:

The voice alarm system shall be tested in accordance with BS 5839-8. In particular the following shall be performed;

- All communications and speaker circuit wiring shall be tested for insulation resistance, continuity, presence of earth loops and polarity prior to commencing commissioning.
- Load on each output circuit (subsequent to completion of audibility measurements and final setting of loud speaker tapings).

The Fire Alarm Trade Contractor shall carry out audibility measurements in all areas of the building to ensure that minimum audibility levels have been achieved in accordance with BS 5839 for fire alarm installations and BS EN 50849 and BS 5839- 8 for Voice Alarm Installations.

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The Evacuation Alert System Trade Contractor shall carry out audibility measurements in all flats to ensure that the minimum audibility levels have been achieved in accordance with BS 8629 Clause 10.2.

Audibility measurements shall be performed once areas are complete (including all finishes and furnishings where provided within the Contract) and plant operational under normal conditions. The Fire Alarm Trade Contractor shall allow to adjust loudspeaker tap settings to achieve a sound level within the 'preferred' range. Following adjustments to loudspeaker tapings, audibility measurements shall be repeated.

Results of final audibility measurements and 'as-installed' loudspeaker tap settings shall be recorded on Record Drawings.

For Voice Alarm Systems, subjective assessment of intelligibility may be acceptable during commissioning and for system demonstration prior to acceptance, if this is the preferred method of the Building Control / Fire Officer. In the event of a dispute, measurements shall be taken in accordance with BS EN 60268-16, any costs associated with these measurements shall be borne by the Electrical Trade Contractor.

Standby power supplies shall be subjected to a discharge test to demonstrate that they have sufficient capacity to maintain power to the system in its quiescent and alarm states, for the rated durations. Dummy loads shall be added to the system to simulate loads allowed for future capacity.

For radio liked systems, the following records relating to the radio data should be recorded where applicable:

1) the system coding (i.e. system address) which should, where possible, be unique to avoid the

possibility of interference;

2) the system's channel/frequency; and

3) details of the signal levels received at, or from, each evacuation alert device, including signal levels relating to all the radio devices and the background noise level, and confirmation that these signal levels are in compliance with the manufacturer's recommendations.

2131 CALIBRATION:
Provide current certificates of calibration for all instruments used during test procedures. Record particular instrument identity on record sheets.
Ensure that the method of calibration meets the quality assurance requirements of BS EN ISO 10012 and that all reference sources are traceable to United Kingdom Accreditation Services (UKAS) accredited standards.

2141 CERTIFICATION AND REPORTING:
Complete and hand over to the Client a Completion or Periodic Inspection Certificate to BS 7671 Section 644 and Appendix 6 or New Installation or Additions or Alterations to an Existing Installation as appropriate.
Append any risk assessments and other documentation required by BS 7671 to the certification.
Append inspection and test results to the certificates.

2151 INSTALLATION CERTIFICATES:
Provide installation certificates for electrical installations in accordance with BS 7671 (IET Regulations) Section 644 and Appendix 6.
Certificates shall be accompanied by a complete schedule of test result:
Record details of departures from BS 7671 (IET Wiring Regulations) on certificate.
Where appropriate provide copies of calculations justifying departure from BS 7671 (IET Wiring Regulations) and attach to certificates.
Append any risk assessments and other documentation required by BS 7671 to the certification.
Append inspection and test results to the certificates.

2161 RECORDS:

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Record all results and instrument readings on approved Record Sheets and hand over to the client two copies for each inspection and test, as soon as possible after such inspection and test.
Append results of testing to BS 7671 (IET Wiring Regulations) to the certification provided in accordance with Section 644.

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3011 EXTRANEOUS-CONDUCTIVE PARTS AND PROTECTIVE BONDING:
Test for protection against direct and indirect contact in accordance with BS 7671 (IET Wiring Regulations) dependant on the method of protection.
Verify that all extraneous-conductive-parts of the installation are adequately connected to the main earth terminal in accordance with BS 7671 (IET Wiring Regulations).
Verify that all extraneous-conductive-parts of a location are effectively connected by protective bonding. Unless protection against electric shock requires a lower value, verify that the impedance of main protective bonding does not exceed 0.1Ω
Where additional protection is provided by supplementary protective bonding, verify that the resistance is sufficiently low to provide the required additional protection requirements of Chapter 41 of BS 7671, between simultaneously-accessible extraneous-conductive-parts and/or exposed-conductive-parts.
Confirm the classification of conductive parts which are not verified as either exposed-conductive-parts or extraneous-conductive-parts of the location, as defined in BS 7671 (IET Wiring Regulations). Demonstrate that their impedance to the earthing terminal of the location is sufficiently high, in accordance with Section 13.5 of IET Guidance Note 5: Protection Against Electrical Shock, using appropriate values of human body resistance R_b and maximum current through the human body I_b for the installation conditions and external influence

3020 PHASE SEQUENCE:
Check and confirm correct polarity of all conductors in all circuits.

3031 HIGH VOLTAGE TESTS:
Carry out high voltage tests as indicated:
Comply with relevant parts of BS 923, BS EN 61180, BS EN 60060 and BS EN 61180 as appropriate.

3041 CABLES:
Test continuity and insulation of all cables and carry out HV tests on HV cables prior to handover.
Test continuity and insulation of buried cables immediately after back-filling.

3051 CONDUIT, TRUNKING AND DUCTING:
Test and confirm electrical continuity of metal containment systems before installing cables.

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2000 PRODUCTS/MATERIALS

2011 LABELS AND NOTICES:
Apply identification labels and notices in accordance with BS 7671 (IET Wiring Regulations), Section 514 to all electrical cables plant and equipment including components of mechanical systems. Fit labels and notices as shown on drawings or specified in the Work Sections.
BS 7671 Labels and Notices
- Identification of protective devices.
- Diagrams, charts or tables to comply with Clause 514.9, 560.7.9, 560.7.10 and 560.7.11 and as indicated.
- Warning notices, voltages in excess of 230 volts to earth.
- Isolation notices
- Periodic inspection and test notices.
- Residual current device quarterly notices.
- Earth electrode safety electrical connection label.
- Bonding conductor connector point to extraneous conductive parts label.
- Earth free local equipotential bonding areas warning notice.
- Electrical separation areas warning notice.
- Outdoor equipment socket outlet notice.
- Circuits with high protective conductor current (Regulation 543.7.1.205).
- Wiring complying with previous versions of Section 514 (Regulation 514-14-1)
- Operating instructions to comply with clause 560.7.12.
- Warning notice, non-standard wiring colours.
- Warning notices, alternative sources of supply

2021 MATERIALS:
Use materials for labels and notices with a predicted life equal to or greater than the design life of the electrical cables, plant, equipment or installation to which it refers.
Ensure durability of identification is to BS ISO 17398.
External- Engraved thermosetting plastic laminate.

Internal - Engraved thermosetting plastic laminate.

Labels shall be coloured in accordance with The Health and Safety (Safety Signs and Signals) Regulations 1996, and associated HSE guidance L64 generally as follows:

Application	Background Colour	Colour of Lettering / Symbols
Prohibition, danger alarm notices	RED	WHITE
Warning notices	YELLOW AMBER	BLACK
Identification or descriptive notices	WHITE	BLACK
Mandatory notices	BLUE	WHITE
Emergency escape / First Aid notices	GREEN	WHITE

2031 FIXING:
Fix labels and notices using materials compatible with label or notice and surface to which it is fixed using fixing screwed into tapped hole. Use adhesives only with written consent from the Engineer.

2041 ARRANGEMENT:
Obtain approval prior to manufacture, with regard to style, colour, lettering, size and position of all labels and notices. Provide sample showing style, colour, lettering and size, for approval.

2051 LETTERING AND SIZE OF LABELS AND NOTICES:
Ensure that all lettering and symbols comply with the requirements laid out in BS 7671 (IET Wiring Regulations), Section 514 and BS ISO 3864-1 for height of lettering where not otherwise indicated. Ensure labels and notices of adequate size for the lettering required, and allow a minimum margin around all lettering of one line space vertically and two letter spacing horizontally.
Font - Helvetica Medium unless otherwise indicated.

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2060 CONDUCTOR ARRANGEMENT:
Arrange circuit polarity so that phases read in phase rotation order followed by the neutral, if any, from top to bottom in horizontal conductor layouts and left to right in vertical conductor layouts. Ensure flat horizontal arrays have leading phase to the left and neutral to the right from left to right when viewed from supply point. Arrange phase or live pole of two wire apparatus at top or left hand and neutral and earth both at bottom or right hand side. In all cases, ensure conductor arrangements defined are when viewed from front face of all equipment and terminating facilities. Apply identification markers in accordance with BS 7671 (IET Wiring Regulations), section 514 to all conductor termination points.

2070 SAFETY SIGNS:
Label all electrical plant and equipment in accordance with relevant parts of BS ISO 3864 and provide safety signs complying with BS EN ISO 7010. Provide sign W012 where voltages above ELV exist.
Label all electrical plant and equipment with the labels specified in the appropriate British Standards for that plant or equipment.
Identify each substation and main switchroom
For any fire extinguishing system provide signs in accordance with BS EN ISO 7010
Give details of,
- Name of the Substation or switchroom.
- The presence of High and Low Voltages.
- Administrative instructions for access.
- Location and method of contacting controlling authority.
- Actions to be taken in an emergency.

Position safety signs in accordance with BS 5499-10.

2080 PLANT AND EQUIPMENT LABELS:
Fit labels on all items of plant, equipment, switches, etc., include the following information:-
- service controlled.
- circuit reference.
- voltage, type of supply and phase etc.
- circuit protection type and rating.

2085 GRAPHICAL SYMBOLS FOR USE ON EQUIPMENT IN ACCORDANCE WITH BS EN 80416:
Graphical symbols for use on equipment to be created and applied in accordance with BS EN 80416-1, BS EN 80416-2, BS EN 80416-3.

2090 MAINTENANCE NOTICES:
Fix notices giving warning of, and instructions on, any special maintenance procedures to plant and equipment.

2091 MOULDED CASE CIRCUIT-BREAKER - WARNING LABEL
Where moulded case circuit breakers are used in the construction of a switchboard or panel board the contractor shall provide a warning notice in minimum print. size of 5mm letters fixed in a prominent position clearly visible from the operating side of the switchboard or panel board to warn of possible danger as follows:-

WARNING LABEL
ALL MOULDED CASE CIRCUIT- BREAKERS WHICH TRIP FOR ANY REASON DURING OPERATIONAL USE MUST BE VISUALLY INSPECTED FOR ANY FORM OF DAMAGE PRIOR TO ANY ATTEMPT BEING MADE TO RESET THE DEVICE TO SERVICE CONDITION.

Reference to manufacturers recommendations and instructions for use and operation of MCCB devices must be identified in all operations and maintenance documentation.

2092 SUPPLIES TO FIRE FIGHTING AND LIFE SAFETY SYSTEMS
Every switched disconnector and protective device that can isolate the supply to fire fighting or life safety system plant, equipment or controls shall be labelled (using white characters on a red background) as follows:

Device — Label Text (XXX = system refer below)

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Protective device that only serves fire fighting or life safety plant or controls, but incorporates no switch.	"XXX"
Protective device or switched disconnector that only serves fire fighting or life safety plant or controls.	"XXX : DO NOT SWITCH OFF"

Additionally the following labels shall be provided depending on whether the device(s) is supplied from the live or dead side on the main isolating device:

Supply Arrangement	Label Text (XXX = system refer below)
Device supplied from the dead side of the main isolating device.	"WARNING: THIS SUPPLY REMAINS LIVE WHEN THE MAIN SWITCH IS TURNED OFF"
Main isolating device – Devices served from the live side	"WARNING: THE XXX SUPPLY(IES) REMAIN(S) LIVE WHEN THIS SWITCH IS TURNED OFF"
Main isolating device – Devices served from the dead side	"WARNING: THIS SWITCH ALSO CONTROLS THE SUPPLY(IES) TO THE XXX CIRCUIT(S)"

System	Label Text Replacing XXX
Generally or a combination of the below sytems	"FIRE FIGHTING / LIFT SAFETY SYSTEMS"
Emergency voice communication system (EVC)	"EMERGENCY VOICE COMMUNICATION SYSTEM"
Evacuation alert system	"EVACUATION ALERT SYSTEM"
Fire alarms or Fire and Voice Alarms	"FIRE ALARM SYSTEM"
Voice alarms	"VOICE ALARM SYSTEM"

2100 COLOUR CORRECTED LIGHT FITTINGS:
Fix a warning or identification disc to light fittings containing colour corrected fluorescent tubes or other colour corrected light sources to ensure that maintenance staff install the correct lamps.

2101 ELV LIGHTING TRACKS
Where ELV lighting tracks are intended to serve extra-low voltage luminaires without integral transformers a warning label shall be affixed either to the track or adjacent to the track. The label shall be engraved; 'WARNING: Transformer fed track. No more than n x 50 watt 12 volt fittings (or equivalent) to be connected to this track'. Where 'n' is the maximum quantity appropriate to the transformer rating.

2110 MOTORS AND STARTERS LABELS:
Fit identification labels to all motors, starters and starter panels. Ensure positive identification of respective motors and starters. Provide motors with non-corrodible labels attached adjacent to each bearing giving details of the lubricant to be used. Mark direction of normal rotation on motor casing. Provide labels to identify motor equipment fitted with surge suppressors and thermistors stating that insulation test voltages must not be applied to thermistors and thermistor control units. Ensure labelling is compatible with schematic and wiring diagrams, and complies with BS EN 60034-8. Labels fitted at manufacturers Works or, if indicated otherwise, labels fitted at site.

2121 ENGRAVED ACCESSORY PLATES:
Engrave switchplates, spur units, pushes and special plates for bedhead units, call systems, fire alarms, etc. as indicated. Use 6mm high letters with engraving coloured red, except where otherwise indicated.

2131 SWITCHGEAR:
Fit labels on switchgear as required by BS 7671 and relevant parts of BS EN 61439 to indicate duty of unit, its voltage, phase and current rating, protective device rating size of conductor involved, and all other necessary details. Use an agreed serial coding system, provide at the switch a key to the coding system, as required.
Any identification of a switchboard busbar or conductor shall comply with the requirements of BS 7671 Table 51, so far as these are applicable.

2141 DISTRIBUTION BOARDS:

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On each distribution board identify every outgoing way with a renewable circuit chart in a transparent plastic envelope permanently fitted inside distribution board cover. Clearly indicate in typed script, circuit identification number, cable size, fuse or circuit breaker rating and a description of item and area supplied by circuit.

Where final circuits are intended to serve circuits with high protective circuit currents, provide labels in accordance with BS 7671, Regulation 543.7.1.5.

Where alterations or additions are made to an installation that includes conductors identified using colours complying with versions of BS 7671 prior to Amendment No2:2004, a warning notice complying with Regulation 514.14.1 shall be affixed to each switchboard or distribution board which serves circuits wired using both the current and previous versions of BS 7671.

2161 SPECIAL PURPOSE EARTHING:
Fit labels to special purpose earthing conductors and connection points, describing their purposes and any instructions necessary for their operation and maintenance.
Earthing and bonding networks for buildings with telecommunications, information technology and control system installations in accordance with BS EN 50310 and BS 7671.
Telecommunications functional earths as BS 6701.

2171 INDICATOR LAMPS AND PUSH BUTTONS FOR POWER SYSTEMS:
Use indicator lamp and push button colours in accordance with BS EN 60073.

Indicator lamp	Red	-	danger or alarm.
	Yellow	-	caution.
	Green	-	safety.

Where not defined submit details of proposed colours for other lamps.

Push buttons	Red	-	emergency action.
	Red	-	stop or off.
	Yellow	-	intervention.
	Green	-	start or on.

Where not defined submit details of proposed colours for other lamps.

2180A CONDUIT AND TRUNKING COLOUR CODING:
In areas of mechanical plant or voids accommodating mechanical services, or where otherwise indicated, identify electrical conduits and ducts in accordance with BS 1710. Apply colour orange to BS 4800 by painting on service as a band over 150mm or applying an adhesive tape type wrap around services over a length of 150mm.
Place identification colours at bulkheads, wall penetrations and any other place where identification is necessary.
Provide colour coding where specified in Work Sections for special applications

2191 CABLE IDENTIFICATION:
Provide all cables, other than final sub-circuit wiring enclosed in conduits or trunking, with labels fixed at each end of cable, either side of wall and floor penetrations, at approximately 12m intervals on route or at convenient inspection points by means of non-releasable plastic straps unless otherwise stated.
Ensure labels show the following information:-
Reference number of cable.
Size and number of conductors.

2192 SCHEMATIC DIAGRAMS:
Provide a purpose made schematic diagram permanently fixed showing the connections of the equipment and plant.

Locations	-	At main switchgear, (fixed to structure).
Materials	-	Printed paper, transparent cover and framing, or printed paper, encapsulated.

2201 TERMINAL MARKING AND CONDUCTOR IDENTIFICATION:
Provide for switchgear and control gear elements whose terminals are marked in accordance with BS 5472 (EN 50005) and BS 6272 (EN 50042). Use a unique reference to identify each element in the

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switchgear or control gear. Mark on or adjacent to each element its reference. Identify each terminal for connection to external wiring or cabling using a reference system complying with BS EN 60445 based on the element reference and the appropriate element terminal reference and BS 7671, where applicable.

On terminals use lettered or numbered ferrules or sleeves to BS 3858 to mark each auxiliary conductor or control cable core with the identity of the terminal to which it is connected and the reference of plant or equipment to which it is connected and the identity of the terminal at the remote end. Ensure that main circuit conductors are identified in accordance with BS 7671 (IET Wiring Regulations) Section 514. Ensure that all identification of terminals and conductors is recorded and included on record drawings and in operation and maintenance documentation.

At each interface between conductors identified using colours or markings complying with versions of BS 7671 prior to Amendment No2:2004, identification ferrules shall be fitted to the existing conductors marked in accordance with BS 7671 Appendix 7 Table 7A or Table 7E, as appropriate.

2211 UNDERGROUND CABLE IDENTIFICATION:

Identify external underground cable routes by means of approved concrete markers along their length at distances not exceeding 35m and where a change of direction occurs on such routes. Provide cables markers with a brass plate or impress concrete to clearly indicate the reference number of the cable and operating voltage of cable.

Provide key to any reference system used at switchgear.
Mark direct buried cables with plastic tape yellow printed black as detailed below:-.

WIDTH	up to 600mm	600-1000mm	1000-1400mm	1400-1800mm
DEPTH up to 500mm	1 tape at 200mm below ground level in the centre of the trench	2 tapes at 200mm below ground level horizontally spaced 400mm apart	3 tapes at 200mm below ground level each tape horizontally spaced 400mm apart	4 tapes at 200mm below ground level each tape horizontally spaced 400mm apart
DEPTH 500-800mm	1 tape at 200mm and 1 tape at 500mm below ground level in the centre of the trench	2 tapes at 200mm and 2 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart	3 tapes at 200mm and 3 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart	4 tapes at 200mm and 4 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart

2221 CABLE CONDUCTOR COLOUR CODING:

Identify cable conductors in accordance with BS 7671 (IET Wiring Regulations) Regulation 514 and Appendix 7, note that a lighting sub-circuit switch wire is a phase conductor in a single phase circuit.
In alterations or additions to existing installations identify conductors and terminals as BS 7671 Appendix 7.
All single phase final sub-circuit phase wiring carried out-using single core cables shall be coloured brown. Where multi-core cables are used for switch wires, blue, black or grey conductors shall be coded Brown at terminations.

2231 CABLE JOINTING AND TERMINATION:

Connect all cables in the installation so that the correct sequence of phase rotation is maintained throughout. Where straight through joints are approved joint high voltage conductors as they lie, ensuring their complete length is phased out on completion. Ensure connections at terminations of HV cables are made in the correct phase rotation and ensure cable conductor termination marking if any, complies with this phase sequence. Where straight through joints are approved on low voltage cables, whether power cables, control or auxiliary cables, joint conductors strictly in accordance with their colour or numeric coding. Where such joints are approved on mineral insulated or other non-coded conducted cables, identify each core at the joint and make the joint core to core.

2241 CABLE SHEATH IDENTIFICATION - INTERNAL:

Use the following coloured cables sheaths and cable codes for various services as follows:

Service	Sheath Colour	Cable Code
Fire alarm / Evacuation Alert Systems	Red	FA
Clock circuits	Brown	CL

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Telecommunications	Grey	T
Data	As system suppliers requirements or as indicated	D
Control	Black	C
Radio frequency	Black	RF
Low voltage	Black	LV
Low voltage mineral insulated	Orange, unless otherwise indicated on the drawings	
Low voltage essential circuits	Blue	
Extra low voltage control	Brown	ELV
High voltage	Red	HV

2251 CABLE SHEATH IDENTIFICATION - EXTERNAL:

Identify cable sheaths for various services in accordance with NJU Guidelines on the Positioning and Colour Coding of Utilities' Apparatus, as follows,

HV - Red.
LV - Black.
Telecommunications and data - Grey.

2261 ADDITIONAL SAFETY SIGNS:

Comply with BS ISO 3864-1 for design principles for safety signs and safety markings.
Application

For main switch and electrical plant room access doors - BS EN ISO 7010 - P011 & P004 with supplementary sign "Authorised persons only".

For use with permit to work systems - BS EN ISO 7010 - P031. Printed on rigid plastic, with hanging loop, with supplementary wording "Do not operate. Work in progress".

For use at each emergency stop - BS EN ISO 7010 with supplementary sign "Emergency stop push-button".

Y90 – Fixing to Building Fabric

1010 PREPARATION:
Mark-out, set out and firmly fix all equipment, components and necessary brackets and supports.

1020 MANUFACTURER'S DRAWINGS:
Use manufacturer's drawings and templates for purposes of marking and setting out.

1030 FIXINGS:
Ensure structure and fixings are suitable for items to be fixed.

1040 LOADING DETAILS:
Provide loading details for all fixing types.

1050 BUILDING-IN BY OTHERS:
Provide all necessary assistance to enable any item of building-in type to be built in by others.

1060 SIZE OF FIXING:
Use largest size of bolt, screw or other fixing permitted by diameter of hole in item to be fixed.

1070 GREASING OF FIXINGS:
Ensure all bolts, screws or other fixings used are greased or lubricated in accordance with manufacturer's instructions.

2000 PRODUCTS/MATERIALS

2010 STANDARDS:
Ensure that fixings such as expanding anchors are tested for tensile loading and where appropriate resistance to loading in shear.

2020 PLUGS:
Use plugs of suitable size and length for fixings. Use plastic, fibrous or soft metal non-deteriorating plugs to suit application. Do not use wood plugs.

Ensure that when screw is in place, threaded length is in plug. Ensure plugs used for screw fixing are set-in to correct depth prior to final tightening.

2030 SCREWS:
Generally use sheradized steel wood screws for fixing to concrete, brickwork or blockwork.
In damp or exposed situations use greased brass wood screws.

2040 CAST-IN FIXINGS:
Where cast-in fixings are permitted, mark out and set fixings in accordance with manufacturer's instructions.

2050 SHOT FIRED FIXINGS:
Obtain approval prior to using shot fired type fixings.

2060 SELF ADHESIVE FIXINGS:
Obtain approval prior to using self-adhesive type fixings.

2070 PROPRIETARY CHANNEL INSERTS:
Provide proprietary channel inserts for casting in where indicated.

2081 NON-PENETRATIVE SUPPORT SYSTEMS FOR ROOF MOUNTED EQUIPMENT:
Obtain approval prior to using non-penetrative support systems for roof mounted equipment.
Ensure that the roof build-up is suitable for non-penetrative supports.
Install in accordance with the manufacturer's recommendations.

3000 WORKMANSHIP

Y90 – Fixing to Building Fabric

3010 DRILLING:
Drill holes squarely. Use drills of requisite size and depth, and appropriate to fabric. Do not flame-cut holes in metal work.

3020 PROPRIETARY FIXINGS:
Comply with manufacturer's instructions for all fixings.

3031 FIXING TO REINFORCED CONCRETE:
Take precautions to avoid fixing through reinforcement. Unless otherwise indicated do not fix to the bottom, or within 100mm of the bottom, on the sides of concrete beams.

3040 FIXING TO BRICKWORK:
Do not fix to unsound material or mortar between brickwork courses.

3050 FIXING TO TIMBER RAILS:
Fix equipment, brackets and supports by drilling hole through timber rail and fixing with bolt, back plate, washer and loose nut.

3061 FIXING TO HOLLOW STUD/TILE/BLOCK WALLS:
Fix equipment, brackets and supports where there is access at rear of wall, by drilling hole through wall and fixing with bolt, back-plate, washer and loose nut.
Fix equipment, brackets and supports where there is no access at rear of wall, drill hole and use, screw anchor type fixing, or gravity type toggle fixing or spring type toggle fixing.

3071 FIXING TO CONCRETE, BRICKWORK OR BLOCKWORK
Fix equipment, brackets and supports using wood screws in plugs or drill holes and fix using steel bolts of grouted bolt type or expanding bolt type fixing, as required.

3081 FIXING TO METALWORK:
Fix equipment, brackets and supports by drilling holes and fixing using either self-tapping screws or gravity type toggle fixing or spring type toggle fixing or set screws or bolts complete with washers, shakeproof washers and loose nuts as recommended by the manufacturer

3091 FIXING TO STRUCTURAL STEELWORK AND CONCRETE STRUCTURES:
Provide manufacturer's information on recommended fixing. Obtain approval for any fixing to structure steel work and concrete structures.
Generally use proprietary fixings to structural steelwork and concrete structures.
Obtain approval to cut holes in structural steelwork or concrete structures or weld to structural steelwork.

3101 NON-PENETRATIVE SUPPORT SYSTEM FOR ROOF MOUNTED EQUIPMENT / SERVICES
Where detailed in the scope of works or on the drawings or offered as an alternative to traditional mounting methods, a proprietary system shall be provided. Systems to comprise a free standing, galvanized steel frame, assembly and support bases to spread the load.
Support frames must not penetrate the roof waterproofing membrane or insulation, but shall facilitate easy access to the roof waterproofing for the purpose of future repair and renewal by others.
The system manufacturer shall submit loading calculations for approval by the structural engineer based on the limiting UDL deck loading, maximum point loads and maximum base pressures.
Ensure that future roof maintenance access to roof finish is provided under each support system

10000 NES VERSION Y90 TEXT Dec 19

Y91 – Offsite Painting & Anticorrosian Treatments

1010 GENERAL REQUIREMENTS:
Where particular methods of finish and painting are not specified, ensure following requirements are met.
Protect all metal work, plant, equipment, pipelines and fittings, ductlines, ancillaries, brackets and supports against corrosion and oxidization.
Provide ferrous metals, machined or otherwise with protective coatings at manufacturer's works.
Ensure all items requiring on-site decorative finishes are provided primed to suit base material and required finish.

1020 DAMAGED FINISHES:
Following delivery to site, storage on site and installation make good any damage to finishes, by cleaning, degreasing and re-furbishing.

2000 PRODUCTS/MATERIALS

2011 PAINT MATERIALS:
Use the following materials as appropriate:

PAINT / COATING	MATERIAL
Solvent borne priming paint to BS 7956	Bare woodwork
Red Oxide priming paint	Bare iron & steelwork
Zinc Chromate priming paint	Bare ferrous & non-ferrous metals
Calcium Plumbate priming paint to BS 3698	Galvanised steel or composite wood/metal components
Undercoating paints / Gloss finishing paint to BS 7664	For previously primed or painted surfaces before application of finishing coats Previously primed or painted/ undercoated surfaces
Epoxy resin paint	Specialist coatings calling for resistance to acids, alkalis, oils, solvents, abrasion, or high humidity, unless otherwise indicated
BS 4842, BS 6496	Paints for aluminium alloys
Powder coating to BS EN 13438	Previously galvanized or sherardised steel products, for architectural (internal and external application), fencing and construction purposes.
Aluminium paint to BS 388	Structural steelwork, storage vessels, heated metallic surfaces and similar applications calling for moisture and heat resistant properties, unless otherwise indicated
Cold galvanizing paint	Making good damage to previously galvanised surfaces and protection to galvanised materials modified during the installation process, unless otherwise indicated
Zinc-rich metallic to BS 4652	Bare iron and steelwork where electrical conductivity has to be ensured
Black tar-based paint to BS 1070	Moisture resistant protection to metal surfaces where decorating appearance is not important
Bitumen based coatings for cold application to BS 3416	Protection of iron and steel, typically steel pipelines and fittings for use in contact with potable water
Bitumen based coating for cold application to BS 6949	Not to be used in contact with potable water

2020 PAINT QUALITY:
Ensure paints used are of quality and type to suit application and that:-
primers have good adhesion, covering power, rust-inhibiting and grain filling properties.
gloss finishing paints are of machine finish grade having high adhesion and high resistance to solvents, mineral oils, cutting oils, detergents, chipping and impact damage.

2030 HEAT RESISTANT PAINT:

Y91 – Offsite Painting & Anticorrosian Treatments

Use heat resistant paints for applications to surfaces over 80°C.

3000 WORKMANSHIP

3010 GENERAL:
Ensure paints are applied in accordance with manufacturer's instructions and to BS 6150 as appropriate.

3020 WEATHER AND OTHER CONDITIONS:
Do not apply paints where weather, temperature, humidity or other conditions may have a damaging effect upon finish or paint.

3030 CLEANING:
Ensure metal surfaces are thoroughly cleaned, all mill and weld scale removed and finally degreased.
Clean steel surfaces to relevant parts of BS EN ISO 8503.
Prepare surfaces for painting in accordance with BS EN ISO 4618.

3040 APPLICATION OFF-SITE:
Wherever possible ensure paint finishes applied by component manufacturers are spray applied.

3050 APPLICATION:
Apply paint evenly and ensure finish shows no excessive brush marks, grinning, runs, sagging, ropiness or other application defects.

3060 COLD GALVANIZING:
Repair damage to galvanized components due to installation process, i.e. following cutting, drilling or welding, by applying 2 no. substantial coats of cold galvanizing paint.

3070 PROTECTION OF BRIGHT MACHINE PARTS:
Apply a protective coating to all bright machined parts before despatch from works.
Do not remove protective coatings unless required for installation, testing or commissioning purposes and in such cases reinstate upon completion.
Repair any damaged protective coating or bright machined part, or where necessary replace damaged component.
Use and apply metal coatings as required and in accordance with manufacturer's instructions.
Complete where possible all welding, drilling, bending and other work before metal coating.

3081 DRAINAGE PIPEWORK WHERE VISIBLE EXTERNALLY
Where rainwater or drainage pipework is visible externally or is in a quasi-external location such as car park areas paint the system with 2 coats of black bitumen paint.

Schedules

A30schM – Schedule of Mechanical Manufacturers

Equipment	Manufacturer
R10 Rainwater Pipework/Gutters	Contractors selection, unless stated otherwise on schedules
R11 Foul Drainage above Ground	Contractors selection unless stated otherwise on schedules or in scope or work.
S40 **S41 Petrol/Oil Storage & Distribution**	Blake Group JA Envirotanks (Joseph Ash) Midland Combustion [Midcom] – tanks & transfer pumping sets Premier Group (Premier Pump and Tank Company) Titan Envirnonmental (plastic tanks)
T31 Heat Emitters	Radiators Dimplex Bisque Commercial Contour Casings (LST radiators and guards) Hudevad Jaga MHS Radiators Myson Radiators (Part of Rettig group) Stelrad Radiators Quinn (Merroit) Zehnder Ltd. (inc. Runtal & Thermal Radiators)
T70 Local cooling units	Refer to U 60 or U 41
U60 Air conditioning	DX spits / VRV (T62) / Heat Pumps AEUK Aermec Airedale International Clivet Daikin Air Conditioning UK Ltd ICS Heat Pumps (sole agent for De'Longhi) Marstair (Divion of TEV Ltd) Mitsubishi Electric Mitsubishi Heavy Industries Samsung (manufacturer) (sold as Vent Axia units) Toshiba Walter Meier (Climate UK) (Hitachi)
W54 Liquid Detection Alarm	Andel PPL Aquillar (Master distributor for Tyco Tracetek) TTK UK Ltd. Jam (Aqualarm) Protech Systems
W60 Controls/Monitoring	TAC / Satchwell – (Owned by Schneider Electric) Trend Control Systems Ltd. (Only System Houses who are Trend TTC's or SI's will be will be considered acceptable) Honeywell Control Systems Johnsons Control Systems Sauter Automation Ltd. Siemens Building Technologies (Building Automation) Trane UK Ltd. (Building Management Systems) Cylon Controls
Y10 Pipes, Fittings & Accessories Listed here are manufacturers of specialist systems / equipment.	Specialist Pipework Systems Pegler Yorkshire push–fit and pressfit Geberit Mapress (press-fit system) Victaulic grooved system

A30schM – Schedule of Mechanical Manufacturers

Equipment	Manufacturer
General service pipework to be Contractors selection unless stated otherwise on schedules.	SAV UK Ltd. (plastic coated aluminium pipe for final run outs to terminals) TYCO Building Services Products (Grinell grooved system) Omegaflex (“TracPipe”) Corrugated Stainless Steel Tube for natural gas to BS EN 15266 Underground pre-insulated pipe systems Flexenergy heating and cooling products (PB) Flexalen Durotan Ltd.(PE-Xa / Steel) REHAU (PE-Xa) Watts Industries (Microflex PE-Xa) Vital Energi (Steel) Other Special Fittings Guyson International (Hansen quick release hose couplings) Aquaflow Regulators Ltd. (flow regulators / restrictors in hot and cold water systems)
Y10 Support Systems Contractors selection unless stated otherwise on schedules	Extensis Ltd. IHL (Industrial Hangers Ltd.) Walraven Roof Pro Unistrut
Y11 Valves / Strainers	General service and commissioning Pegler Yorkshire (Broen commissioning valves and PICV’s) Crane Frese Hattersley Herz valves Marflow Hydronic Systems Flowcon TA Hydronics (Tour & Andersson) Oventrop SAV UK Ltd. Manifold Commissioning Systems SAV Crane Hattersley Herz valves Marflow Hydronic Systems TA Hydronics (Tour & Andersson) Differential pressure, high limit, flow control, PICV, and other Crane Danfoss Randall Frese Flowcon Hattersley Herz valves Pegler Yorkshire Honeywell Control Products Marflow Hydronic Systems Oventrop Samson Controls Spirax Sarco SAV UK Ltd. TA Hydronics (Tour & Andersson)

A30schM – Schedule of Mechanical Manufacturers

Equipment	Manufacturer
	General Control valves + TRV’s Crane Frese Hattersley Herz valves Oventrop Pegler Yorkshire Broen Aquaflow Regulators Ltd. (flow restrictors) Safety / Pressure relief Bailey Birkett (Safety Systems UK Ltd.) Nabic Valves (Delta Fluid Products Ltd.) Spirax Sarco Specialist Valves Applied Energy Products Ltd (Redring thermostatic mixing etc) Caleffi (thermostatic mixing) Crane Donkin Gas Valves Ltd. Hattersley Herz valves (Thermostatic mixing, pressure regulating /reducing, return water temperature controller, preassembled manifold commissioning units) Honeywell ACS Control Products (Thermostatic mixing, pressure regulating /reducing, back flow prevention, thermal balancing / disinfection for HWS) Hopkinsons (Steam) Horne Engineering (thermostatic mixing) Kemper (Thermostatic mixing, pressure regulating /reducing, back flow prevention, thermal balancing) Reliance Water Controls (thermostatic mixing) Safi (Chemical / corrosion resistant) Landon Kingsway – (Gas/oil shut off) Alcon Solenoid Valves – (Gas/oil/water shut off) Watts Industries (thermostatic mixing, pressure regulating,backflow prevention)
Y11 Expansion Bellows and flexible connections	Boa Flexible Solutions Ltd Isolated Systems Ltd. J & P supplies Ltd. N Minikin & Sons Superflex (Interflex)
Y20 Pumps	Glandless In Line Armstrong Grundfoss Lowra (UK) Ltd. Smedegaard Pumps Ltd. Wilo (UK) Ltd. Centrifugal Armstrong DAB pumps Grundfoss Lowra (UK) Ltd.

A30schM – Schedule of Mechanical Manufacturers

Equipment	Manufacturer
	Wilo (UK) Ltd. KSB Submersible / Sump /Sewage ITT Flygt New Haden Pumps Lowra (UK) Pump Technical Services - Jung Pumpen Oil Transfer / Viscous Liquids Midland Combustion Varley Pumps Chemical George Fischer Sterling Fluid systems Ltd. Pressurisation Units Armstrong KGN Pillinger Mikrofill Smedegaard Pumps Ltd. Packaged Booster sets Allan Aqua Systems Aquatec Ltd. Pressmain Armstrong KGN Pillinger Grundfoss Lowra (UK) Ltd. Smedegaard Pumps Ltd. Wilo (UK) Ltd.
Y24 Trace Heating	Isopad Raychem Thermon (UK) Ltd.
Y41 Fans and Roof Units	Centrifugal Flakt Woods Helios Ventilation Systems Ltd UK Kiloheat Matthews and Yates Nuaire Axial Elta Fans Helios Ventilation Systems Ltd UK Nuaire Flakt Woods Twin Fan units, Duct mounted in line centrifugal & Mixed flow Elta Fans Helios Ventilation Systems Ltd UK Nuaire Vent Axia / Roof Units Group Xpelair (Part of Applied Energy Products Ltd) Plastic Central Fans (Colasit)

A30schM – Schedule of Mechanical Manufacturers

Equipment	Manufacturer
	Fumeair Parsons Plastics Wall/window/inline Helios Ventilation Systems Ltd UK Vent Axia Xpelair Car Park Extract Jet / impulse fans Colt International – jetstream or impulse fans Flakt Woods – jet fans Nuaire PSB Ventilation – impulse fans Other special fans Exhausto *(chimney fans and flue dilution systems)*
Y45 Attenuators/Acoustic Treatment	Allaway Acoustics Industrial Acoustics Co. Trox Brothers Ltd. Galloway Acoustics
Y46 Grilles/Diffusers/Louvres	Advanced Air Gilberts Ltd. Halton Products Motorised Air Products Krantz Koolair (UK) Ltd. Schako Trox (UK) Ltd. Waterloo Air Management
Y50 Thermal Insulation Contractors selection of installation specialist	Insulation Manufacturers Armacell UK GRM Distribution Ltd. Isover (Saint-Gobain) Kingspan Tarec Knauf NMC (UK) Ltd. Neville Thompson (Isogenopak cladding) Rockwool Saint-Gobain Isover Venture Tape Europe (Ventureclad self adhesive laminated foil film) Fire Protection Cladding systems Promat “Vicuclad” board cladding Rockwool “Fire Duct” Fire protection board cladding Saint Gobain Isover “U- Protect” slab and flexible wired mat
Y51 Testing and Commissioning	Contractor to select specialist who must be a member of The Commissioning Specialists Association (CSA)
Y52 Vibration Isolation Mountings	Industrial Acoustic Company Ltd. Chrisie and Grey Mason (UK) Ltd. Isolated Systems Ltd.
Y53 Control Components	Aercon (Power Utilities Ltd.) room - pressure controls Invensys Climate Control (Drayton) CMR Controls (room pressure controls)

A30schM – Schedule of Mechanical Manufacturers

Equipment	Manufacturer
	Danfoss Randall Ltd. Honeywell Control Systems Siemens Building Technologies West Energy Saving Technologies Ltd. (Innovative ventilation controls direct Acting by current sensing cookers & other electrical appliances, Thermistor sensor to dead leg of bath or shower). Oliver IGD Ltd. (Gas Detection and Gas Analysis Products) Murco (gas detection)

T31sch1 – Schedule of Radiators

Radiator Types
A - Steel Panel
B - Steel Tubular
C - Cast iron Column
D - Aluminium

1 - Welded Top
2 - Round Top
3 - Low Surface Temperature Type
4 - Special shape

a - Single panel type
b - Single panel convector type
c - Double panel type
d - Double panel convector type

X – Manufacturers/Contractors Selection.

Ref	Type	Output (W)	Mean water temp (°C)	Room air temp (°C)	Water flow rate (kg/s)	Height (mm)	Length (mm)	Colour/finish	Accessories/Special Requirements/Notes
ERA D-01	A4b	1000	Electric	14	N/A	430	620	White	Complete with adjustable thermostat.
ERA D-02	A4b	1000	Electric	14	N/A	430	620	White	Complete with adjustable thermostat.
ERA D-03	A4b	1000	Electric	14	N/A	430	620	White	Complete with adjustable thermostat.
ERA D-04	A4b	1000	Electric	14	N/A	430	620	White	Complete with adjustable thermostat.

Notes:

1	Finish: powder coat to an RAL colour as agreed with the architect.
2	Refer to specification section T20 for materials and workmanship clauses and standards

Indoor Units

Ref	Type	Outdoor unit ref	Room served	Room Cooling Load (kW)		Heating Load (kW)	Air Volume (l/s)		External Pressure Drop (Pa)	Room noise criteria NR	Refrigerant / Notes
				Sensible	Latent		Fresh air	total			
IDU-S6-007	Wall mounted	ODU-S6-007	S6-007-1	2.4	0	0	N/A	N/A	N/A	40	R32

Schedule of Outdoor units

Ref	Location	Noise Level	Power supply details	Cooling Minimum EER	Heating COP	Seasonal coefficient of performance SCOP (for building NCM)	Refrigerant, Compressor type and motor details
ODU-S6-007	S6-007-1	61 dBA	1~/50/220-240	4.23	N/A	N/A	R32

1. Units shall be supplied with three speed controller and return air sensor (as indicated on controls schedule) all fitted, wired and tested and compatible with building's control system. The controls specialist shall supply the appropriate controller to the fan coil unit manufacturer free issue.
2. Electrical supply to BS EN 60038
3. Loads are scheduled with fans running at medium speed.
4. Ensure manufacturer's ratings comply with relevant part of BS 4856.
5. Fabricate from galvanised mild steel sheets and stiffeners without sharp edges.
6. The units shall be rigid enough to ensure quiet operation.
7. Units shall incorporate fixing lugs.
8. Protect units from corrosion internally and externally.
9. Do not use self-tapping screws.
10. Provide drip tray under coil and under control valve where fitted, fabricated from noncorrosive material or protected against corrosion with external faces insulated to prevent condensation. The tray shall be degreased before applying anti-condensation insulation to the external surfaces. Tray to be laid to fall in the direction of the drain connection.
11. Ensure connection to drip tray is flush with the bottom of the tray.
12. Fix heating and cooling coils to prevent air leakage around coils. On air side control units "carry over" from heating coil to be no greater than 100W when the unit is in full cooling and the heating coil has the design heating water flow rate
13. Form heating and cooling coils from copper tube and aluminium fins.
14. Provide adequate access to remove components in one piece. Filter to be easily withdrawn from installed position.
15. Provide access to moving parts with airtight doors.

T70sch - Schedule of Local Cooling Units/ Heat Pump Units

16. Provide duct connections upstream and downstream.
17. Provide factory fitted acoustic and thermal lining to boxes with all edges sealed and finished to prevent material migration. Insulation to be Class O surface.
18. The motor frame shall be totally enclosed and fitted with maintenance free sealed for life bearings. Motors shall be insulated to BS EN 60085.
19. Fan and motor assembly shall be fitted with a continuously rated motor.
20. All fan and motor assemblies shall be statically balanced to prevent the transmission of vibration and the complete assembly shall be fitted with neoprene rubber mounts.
21. Provide a return air filter of nylon galvanised steel mesh (BS EN ISO 16890 coarse 50%).
22. The electrical contractor shall connect the flex (provided as part of the FCU, 2m long) into the fuse connector unit. The flex shall be adequately supported so as to not impose and strain on the cable terminals.
23. Install in accordance with the manufacturer's recommendations to give a neat appearance with supports out of view. Ensure equipment is firmly fixed and level.
24. Refrigerant pipework to be seamless copper tube to BS EN 12735 Parts 1 or 2 as applicable refrigerant quality copper, fully annealed and internally degreased and cleaned
25. Comply with EU Regulations 206/2012 or 2016/2281with regard to ecodesign requirements including information on disassembly, recycling and/or disposal.
26. Where applicable, comply with BS EN 14825 for testing and rating at part load conditions and calculation of seasonal performance

Function	Type	Rated Voltage (kV)	Rated Current (A)	Mechanical Endurance	Lightning Impulse withstand	Cable Connection	Installation	Protection Devices	Accessories	Notes
Ring Switch	Manual SW/ES	12kV	630A	SW: M2 ES: M0	75kVp	185mm2 Copper/ XLPE/SWA/ MDPE	Indoor, Freestanding TX Mounted	1	2, 3, 5, 10	Designation 6A & 6B
Circuit Breaker	SF6 CB	12kV	200A	M1, E2	75kVp	TX, Close Coupled	Indoor, Freestanding TX Mounted	2	1, 3, 4, 5, 7, 8, 9, 11, 12	Designation 6A & 6B

Protection Devices		Accessories					
1	EFPI (Earth Fault Passage Indication)	1	Operation Counter	5	Local Control	10	Circuit earthing
2	VIP400 Self powered IDMT OC/EF Relay to BS EN 60255.	2	Cable voltage present indication (VPIS)	6	Local/Remote Select	11	Busbar earthing
		3	Fault-Trip lamp	7	Intertrip Send	12	Gas pressure gauge (SF6)
		4	Trip Circuit Supervision	8	Intertrip Receive		
				9	Additional VF Contact --NO --NC		

Notes

1. 2No Transformer mounted ring main units with designation 6A and 6B to be provided as detailed on the schematic drawings
2. Ring main Unit Parameters:
   Configuration: Indoor Transformer mounted
   Non-Extensible
3. IAC: AF 21kA
4. The Contractor shall submit detailed specifications for approval prior to purchase of RMUs
5. Approved Manufacturers: Schneider Electric
6. Rated short time withstand current for earth switch (Ik): 3.15 kA for 1 seconds
7. Protection settings for all new relays shall be confirmed by the Contractor as part of the protection grading coordination study

Rating kVA	Prim Volts	Sec Volts	Taps	Manual / Auto	Vector Group	HV Connection	LV Connection	Type-Cast/Dry/ Oil/Syn	Cooling	Enclosure
2000	11000	433	± 2.5, 5%	M	Dy11n	Cable 3c 185mm2 CuXLPE	Busbar	Syn	KNAN	Sealed Tank

Parameter	LV	HV
Nominal voltage	400V	11kV
System highest voltage	1kV	12kV
Lightning impulse withstand voltage (peak)	4kV	75kV
System fault current	50kA	21kA
Open-terminal voltage	420V	
K factor	13%	

Fittings (Tick appropriate boxes)

Level indicator	✓	Jacking lugs	✓
Thermometer pocket	✓	Two stage Buchholz Relay	✓
Double Contact Liquid thermometer	✓	Two Stage Winding thermometer (on each phase)	✓
Air Vent		Silica Breather	✓
Air Relief Device	✓	Restricted E/F CT	
Insulated star point	✓	Test Disconnecting Links – None, HV, LV	HV
Plain skid base	✓	Enclosure interlocks	
Rating and connection plate	✓	Fire behaviour Class – F1 (Cast Resin Only)	N/A
Earthing Terminal	✓	Surge arrestors	

Additional notes:-

1. For standards refer to V11 - 300.021
2. Provide liquid cooled 3-phase HV/LV transformers to BS EN 60076 and BS EN 50464 as shown on the drawings
3. Transformers shall Midel fluid filled, hermetically sealed HV/LV transformer(s) for internal / external mounting
4. Prior to the testing and commissioning of the electrical installation the Contractor shall measure the secondary no-load volts on each transformer to determine if the taps require adjusting. Details of the measured voltages and tap settings shall be forwarded to the Engineers for comment.
5. The Contractor shall allow for the transformer specialist to attend site to readjust the taps on each transformer as agreed with the Engineers.
6. Insulation Class – Class A.
7. Transformer to be supplied with MIDEL 7131 transformer fluid.
8. Cooling: ONAN is oil-insulated ,natural circulation (oil), air cooled, natural circulation (air)
9. Maximum load and no-load losses for liquid-filled and cast iron resin transformers

- In accordance with EU Regulation 548/2014 Tier 2 (2021)

10. 2No Transformers to be provided, with designation 6A and 6B.
11. Transformers to be provided with close coupled RMU

Fan Ref	Service / location	Description / type	Max / Min Air Vol (m^3/s)	Static Resistance (Pa)	Limiting SFP [W/(l/s)]	Motor / drive details						Limiting in duct Sound Power Levels (dB re 10-12 W) at design air flow Octave band mid-frequency (Hz)							
						Motor efficiency /class	Rating (kW)	Full load (A)	Speed control method	Overall fan /motor /drive efficiency (%)	Motor Type max speed & phase	63	125	250	500	1k	2k	4k	8k
EF-S6-007	S6-001-1	Wall Mounted	0.03	65	0.5				VSD										

Notes:

1. Quoted fan duties are based on pressure losses external to the fan unit and on the following equipment air side pressure losses. Before ordering the fans, the contractor shall adjust the fan static pressures to suit pressure drops of actual components used in the systems and any changes to the ductwork layout, types / quantities of bends etc from that indicated on the tender drawings.

Equipment	Pressure loss (Pa)
Intake & discharge louvres	N/A
Grilles	N/A
Diffusers	N/A
LTHW heating coils less than 15kW	N/A
LTHW heating coils over 15 kW	N/A
CHW cooling coils less than 15kW s	N/A
CHW cooling coils over 15 kW	N/A
Panel filters	N/A
Bag filters	N/A
Shutter Fire dampers	N/A
Smoke dampers / combination fire / smoke control dampers	N/A
Control dampers	N/A
Attenuators	N/A

2. Quoted fan duties include the following commissioning allowances:-

	Low Pressure Systems
On Flow Rates	10 %

3. If the quoted fan sound power levels are exceeded by actual figures of fans selected, then the relevant attenuator insertion loss shall also be increased to maintain the permissible discharge and radiated noise levels.

4. 2 & 4 Pole TEFV, 3-phase, cage induction motors rated for 400 volts, 50 Hz, (outputs 0.75kW and above) shall be High Efficiency having a rated efficiency at full load equal to or greater than the IE3 limit (or IE2 limit if fitted with a VSD) as defined in BS EN 60034-30-1 unless noted otherwise.
5. Specific Fan Power (SFP) at 25% of design flow rate to be no greater than that achieved at 100% design flow rate
6. All fans with motors larger than 1.1kW shall have variable speed drives
7 Demarcation of responsibilities and location of VSD
8. Variable Speed Drive details / BMS interface
9. Refer to clause Y72.2191 for standard requirements for VSD's
10. Fan data required at commissioning:
    i. Air volume
    ii. Motor input power (which for an EC motor must be read from a meter which calculates the real power from the harmonics present)
    iii. SFP_v for EPC calculations in accordance with BS EN 16798-3

Acoustic Ref	Type	Size (mm)		Air volume (m^3/s)	Face Velocity m/s	Classification to BS EN 13030			Maximum pressure Drop (Pa)	Limiting Noise level (Sound power level dB(A))	Notes / Accessories
		Width or Length	Height			Water Penetration class	Coefficient of discharge class	Limiting core velocity (m/s)			
LV-LV-001-01	Weather Louvre	2000	1000			B		2.5			Provided by architect
LV-LV-001-02	Weather Louvre	7400	810			B		2.5			Provided by architect
LV-LV-002-01	Weather Louvre	2000	1000			B		2.5			Provided by architect
LV-S6-002-01	Weather Louvre	1000	1950			B		2.5			Provided by architect
LV-S6-002-02	Weather Louvre	1000	1950			B		2.5			Provided by architect
LV-S6-002-03	Weather Louvre	4500	1400			B		2.5			Provided by architect
LV-S6-003-01	Weather Louvre	3000	1300			B		2.5			Provided by architect
LV-S6-003-02	Weather Louvre	4500	1400			B		2.5			Provided by architect

Notes

1. Louvres to be weather resistant with wire mesh screen to prevent ingress leaves and birds (tested in accordance with BS EN 13030)
2. Finish Powder coated to be agreed with the architect
3. All aspects of the louvre construction and installation shall be in full compliance with Health Technical Memorandum 03-01.

Appendices

Appendix A – SBUHB Cyber Security Impact Assessment
Appendix B – SBUHB ICT Specification

End of Specification

CYBER SECURITY IMPACT ASSESSMENT

[Insert proposal/project/service name]

Author(s) name, title, company, department:

Date of submission

Document history

Revision history

Detail the document's full revision history below;

Date of submission	Version	Author	Revision Summary
	V0.1		First submission

Approval

This document requires approval from the following individuals;

Date approved	Version	Name	Title	Department
				Cyber Security

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Third Party Information

Project/Service Name	
Project/Service Manager	
System Owner **(Named or titled individual)**	
Service Unit / Department: **(if applicable)**	
Contact Email Address	
Your IT Service desk/Helpdesk details Telephone Number E-Mail Address Opening Hours Out of Hours details (If Applicable)	

Overview

Provide a plain text, high level technical description of the project/service and its implementation at Swansea Bay University Health Board:.

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Section 1 – Network Connectivity

This sections covers the network connectivity requirements and commitments if network access is a requirement. Please complete:

Req	Requirement Description	Response
A	Wired Ethernet Connection required	Yes/No
A1	Wired Port Technologies: Fixed speed 100Mb/s, half-duplex, POE or non-POE?	
B	Wi-Fi Connection Required:	Yes/No
B1	Wi-Fi Technology e.g. 802.11N/5GHz	
B2	Wi-Fi Security: WPA3-Enterprise (TLS/PEAP) etc	
C	Any VLAN / Segmentation requirement	
D	IPv4/IPv6, static or DHCP	
E	Firewall/NAT requirements:	
F	Any TCP/UDP ports opened	

Additional Notes

Section 2 – Patching and Supported Software

This sections covers minimum requirements and commitments to maintain and support any Operating Systems or Software that form part of the solution. Please Complete:

Req	Requirement Description	Response
A	List any Operating Systems and build/version that form part of the solution	
A1	Commitment to support/patch Operating System for lifetime of solution. Please describe how support and patching will be achieved.	
A2	End of Life/Support date of Operating System:	
A3	Commitment to patch within 14 days of update release:	
B	List any software that forms part of the solution.	
B1	Commitment to support/patch Software and how updates and support will be achieved.	
B2	Support Arrangements: Please provide details of the support arrangements for this device e.g. 24/7x365, 9-5 Mon-Fri etc.	
C	If the Operating System is Windows based, can it join the Health Board Active Directory domain?	
C1	Any Group Policy or Schema requirements when joining domain?	
D	Can your device be updated with windows updates i.e. WSUS or SCCM? If not, explain why and counter measures employed to ensure updates.	

Support/Patching: Describe the arrangements that are place for the patching, and ongoing maintenance / support of any Operating Systems or Software that form the solution

Section 3 – Anti Malware Software

This sections covers anti malware provision for any device that forms part of the solution. Please Complete:

Req	Requirement Description	Response
A	Can the Swansea Bay University HB managed Kaspersky End Point Protection software run on the devices that form the solution	Yes/No
A1	Can the Swansea Bay University HB managed End Point Protection safely run scheduled scans of the host device.	Yes/No
A2	Are any exceptions (USB etc) required to be made to the default End Point Protection?	
B	Is any additional or alternative Anti Malware software provided? If so please list.	
B1	Commitment to updates:	

Anti Malware: Describe any arrangements that are place to provide anti-malware protection for the system, and ensure that the protection remains up-to date.

Section 4 – Security of Data in Transit and at Rest

This section covers any requirement or commitment to the use of data security technologies on data at rest, or in transit. Please Complete:

Req	Requirement Description	Response
A	Do any web services form part of the solutions	Yes/No
A1	Does the web service use HTTP or HTTPS.	
A2	Are HTTPS certificates provided?	Yes/No
A3	How long will certificates be valid, and what commitment to maintain/renew certificates.	
B	Does data at rest, require any encryption technology	Yes/No
B1	List any encryption technology used or provided and commitment to support	
B2	Will the device configuration be backed up? If so can you explain how will this be done?	
C	Are backups of data provided or required as part of the solution	Yes/No
C1	What backup methods/software is proposed	

Data Security: Describe any data security requirements:

Section 5 – Vulnerability Assessment and Penetration Testing

This sections covers any requirements around reoccurring vulnerability assessment of any part of the solution. Please Complete:

Req	Requirement Description	Response
A	Do you perform any Vulnerability Assessment on any part of the solution:	Yes/No
A1	Please list frequency and method of assessment and remediation of results.	
B	Do you have any objection to Swansea Bay University HB undertaking reoccurring vulnerability assessment on any part of the solution:	Yes/No
B1	Please detail any objection and exceptions	

Vulnerability Assessment: Any additional notes/concerns:

Section 6 – Cyber Security Known Threats

This section covers any commitments around known risks to Cyber Security. Please Complete:

Req	Requirement Description	Response
A	Are any hard coded, default or known username/password part of the solution:	Yes/No
A1	Please list commitment to change any known or default username/passwords:	
A2	Will all passwords meet the Swansea Bay University HB password requirements:	Yes/No
A3	Are any account auto lockout features part of the solution:	
B	In the event of a cyber-attack can the system be isolated and/or disconnected from the network:	Yes/No
C	Please list any Cyber Security Certifications or Qualifications relevant to the solution:	

Cyber Security Known Threats: Any additional notes/concerns:

Section 7 – Welsh Health Circular Requirements

The Welsh Government have produced the Welsh Health Circular - Cyber security and information governance (WHC/2017/025) to direct health boards within NHS Wales on what they should require external organisations to hold in relation to security assurances for handling personal data.

#	Level of access to personal data (Note; 'The supplier' also refers to or any party within their supply chain)	Required security Requirements		
		Cyber Essentials	**Cyber Essentials Plus**	**Have or working towards ISO 27001 certification**
1	The supplier **does not store or process** personal data AND **will not be granted access** to systems on the NHS network which store or process personal data			
2	The supplier **does not store, process or have access** to personal data. The supplier require ad-hoc **infrequent access** to devices which are connected to the NHS Wales network, or the network itself, which would be achieved through attending sites and **connecting directly into the equipment**.	Yes		
3	The supplier **could have access to low amounts** of personal data which is **stored on the NHS network. No information will be stored by the supplier**. The supplier may also require ad-hoc **infrequent access** to devices which are connected to the NHS Wales network, or the network itself, which would be achieved through attending sites and **connecting directly into the equipment**. There shall be no means of accessing any systems connected to the NHS network, or any data held on NHS systems remotely.	Yes		
4	The supplier **have access to medium volumes of personal data on NHS systems/network** or **hold low-medium volume of data externally**. The supplier may also require **frequent access to devices** which are connected to the NHS Wales network, or the network itself, which is either achieved through attending site and **connecting directly, or via an authorised remote access** mechanism.		Yes	
5	The supplier **have access to bulk volumes of personal data on NHS systems/network** or **hold bulk volumes of data externally** or processing applies to contracts that are **essential to support key clinical capability.**		Yes	Yes

	The supplier may also require **frequent access** to devices which are connected to the NHS Wales network, or the network itself, which is either achieved through attending site and **connecting directly, or via an authorised remote access mechanism.**			

Indicated level of access to personal data as described above:

e.g Level 1

Section 8 – Code of Connection

Please complete this section if a Code of Connection exists, or is required. This is a requirement for any connection from the external internet to NHS Wales networks:

Code of Connection: Confirm that a valid code of connection exists for any 3rd parties requiring connection into the NHS Wales network as a result of this project. Describe also the method and extent of the connection that will be used.
Once completed, please provide the certificate number.

Section 9 – Cloud Provider Assessment

If cloud technology is used as any part of the system, please complete and attached the Cloud Questionnaire. If you do not have the Cloud Questionnaire please contact sbu.cyber@wales.nhs.uk for a copy.

Cyber Security Impact Assessment Score – INTERNAL USE

(To be completed by Cyber Security Team at SBUB)

Section	Identified Risk	Risk Assessment				Comments / Progress / Further Action / Final Outcome
		Risk Type	Likelihood	Impact	Score	
1						
2						
3						
4						
5						

6						
7						
8						
9						
TOTAL						

Appendix 1 - Risk Type (INTERNAL USE)

Confidentiality	Integrity	Availability
Maintaining the confidentiality of data ensures that only individuals who have an authorised and legitimate reason to access the data are able to do so. Examples of breaches of confidentiality include: • Potential to enable unauthorised access to information. • Inability to audit access to sensitive information. • Potential failure of the audit system.	Maintaining the integrity of data ensures that it remains correct and valid at all times. Examples of a breach of integrity include: • Unauthorised system access allowing data to be modified. • Interception of data in transit allowing it to be modified. • A lack of control over the permissions allocated to system users.	The continued availability of a system ensures that users are able to access the information they requires at all times. Examples of a breach of availability include: • A Denial of Service attack preventing access to a system. • Account lockout. • A network outage. • Crypto locker infection preventing access to data. • A malware infection of client access devices. • The loss of encryption keys

Appendix 2 - Risk Scoring Table (INTERNAL USE)

Likelihood score	1	2	3	4	5
Descriptor	**Rare**	**Unlikely**	**Possible**	**Likely**	**Almost certain**
Frequency How often might cyber incident occur	This will probably never happen/recur	Do not expect it to happen/recur but it is possible it may do so	Might happen or recur occasionally	Will probably happen/recur but it may not be a persisting issue	Will undoubtedly happen/recur,possibly frequently

Impact score (severity levels) and examples of descriptors	1	2	3	4	5
	Negligible	**Minor**	**Moderate**	**Major**	**Catastrophic**
Actual or potential impact on the Health Board Operation	No impact on Health Board	Limited impact to a device or service, with no impact on patient care.	Impact on a service / ward / department that impacts on patient care.	Impact that disrupts operations of multiple service / wards / departments, has adverse national publicity and impact patient care.	Impact that disrupts operations of multiple services, dilvery units and has significant adverse national / international publicity with impact on patient care.
Unavailability	<1 hour	1 – 24 hours	1 – 7 days	1 – 4 weeks	1+ month
Financial Impact	**No direct financial loss or financial loss up to 1k**	**Damage or direct financial loss up to £10,000**	**Direct financial loss/cost up to £100,000.**	**Risk of litigation with cost up to £1M.**	**Risk of litigation with cost over £1M**.

		Likelihood				
		1	2	3	4	5
		Rare	Unlikely	Possible	Likely	Almost certain
Impact Score	5 Catastrophic	5	10	15	20	25
	4 Major	4	8	12	16	20
	3 Moderate	3	6	9	12	15
	2 Minor	2	4	6	8	10
	1 Negligible	1	2	3	4	5

Status

1 - 3	Low risk
4 - 6	Moderate risk
8 - 12	High risk
15 - 25	Extreme risk

Cabling Infrastructure Design Specification for ICT

Final Version 2.1

Specification for the Design of Cabling Infrastructures in University Health Board Environments

Document Reference: CommScope 2

Issue	2.1
Date	07 October 2019
Author	Karl Tryner
Copyright	Ethicus Consultancy Ltd

Document Control

Revision Control

All documentation will be updated at the discretion of the SBU IT. Any changes to the documentation will require a new issue to be produced and re-circulated to all parties.

Changes deemed by the SBU IT as minor will be issued as addendum's to this tender document and will be reflected accordingly in the revision control section. Changes deemed by the SBU IT as major will be revised as a new issue of the tender document and will be reflected accordingly in the revision control section.

Issue	Date	Reason	Implemented by
1.0	03/07/19	Issued	K.Tryner
2.0	25/09/19	Changed from new buildings to ICT	K.Tryner
2.1	07/10/19	Logo on cover page updated to latest version	K.Tryner

Issue Control

On updating the issue of the tender document or generating an addendum to the tender document all documentation shall be issued to the following:

Issued To	Documentation Issue												
K.Tryner (Ethicus Consultancy Ltd)	1.0	2.0	2.1										
Jonathan Fellows (SBUHB)	1.0	2.0	2.1										

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1 Introduction

1.1 Overview

The aim of this document is to provide new buildings with a cabling infrastructure which has high reliability, is easy to maintain and can support the applications and services of today and the future.

The specification has been written to ensure that a cost-effective solution is provided without compromising any standards or safety issues, and that all single points of failure are designed out by means of route diversity and service duplication.

This document describes the specification for the design of the network infrastructure of both fibre and copper networks for both voice and data services into and out of single and multiple building(s), and all interconnections between buildings.

It is important to note that all telecom rooms are for the sole occupancy of SBU IT and their associated voice and data distribution equipment. It is not permissible for other parties to store or install equipment within these rooms. The SBU IT standard model is for no sharing and for sole occupancy however there are limited occasions where sharing is required for multiple service providers within a single building and in which case the shared model for frames will be used. All request for shared hub room spaces shall be made to SBU IT for consideration.

All aspects of this document shall be met together with all Appendices. Appendix D shall be completed and signed off before hand over for each MER and SER.

The product set has been standardised on CommScope. This product set has been selected for its high degree of reliability, quality and performance. By standardising on the CommScope product set a standard warranty for voice and data has been set for all buildings within the SBU IT. To this effect CommScope voice and data products specified within this document shall be selected.

All installation work shall be covered by a CommScope warranty. To ensure that this happens only approved CommScope Authorised Integrators can be used.

This document shall be used in conjunction with:

a) Ducting best practices
b) Bonding best practices
c) Fibre inspection and cleaning best practices
d) Fire stopping best practices
e) Power segregation best practices
f) Fire detection in telecom rooms best practice
g) Minipod with copex best practices
h) Fibre patch panel installation best practices
i) Patch panel installation best practices
j) Copper testing best practices
k) Singlemode fibre best practices
l) Cable pulling best practices
m) Standards

1.2 Specification of Criteria

Two levels of criteria are specified, mandatory and highly desirable. The mandatory requirements are described by the word “must” and “shall”; whilst highly desirable are described by the words “should”, “may” or “desirable”. Mandatory requirements shall be adhered to under all circumstances and may not be changed. Highly desirable requirements are the desired ways of design, implementation and documentation that may be changed depending on individual circumstances.

All parties shall adhere to this specification document. Any deviation from this document shall be on written approval by SBU IT.

2 Definition of Terms

2.1 Definition of Terms

2.1.1 Buildings

A roofed structure enclosed by walls on all sides containing telecommunications related equipment for the transmission and reception of data, voice, video etc, signals. It may also contains equipment related processing and storage of the signal content.

2.1.2 Backbone cable

A cable that connects any combination of carrier and network devices for the transmission of multiplexed signals.

2.1.3 Channel

ISO/IEC 11801: defines a channel as “The end to end transmission path connecting any two pieces of application specific equipment. Equipment and work area cords are included in the channel, but not the connecting hardware into the application specific equipment.”

2.1.4 Consolidation point

ISO/IEC 11801: defines a consolidation point as “A connection point in the horizontal cabling subsystem between a floor distributor and a telecommunication outlet.”

2.1.5 CP link

ISO/IEC 11801: defines a CP link as “The part of the permanent link between the floor distributor and the consolidation point, including the connecting hardware at each end.”

2.1.6 Cross connect

ISO/IEC 11801: defines a cross connect as “An apparatus enabling the termination of cable elements and their cross-connection, primarily by means of patch cords or jumpers.

2.1.7 Distribution Equipment Room (DER)

A room within a building or building that houses all the core network transmission and processing equipment as well as the campus backbone infrastructure

2.1.8 Entrance room

A room within the building that caters for the entry of cables into the building.

2.1.9 Pit

A box, joint box, manhole or cable chamber.

2.1.10 Pit cover

A covering lid used to seal a pit.

2.1.11 Main Equipment Room (MER)

A room within a building that houses network equipment, horizontal cabling, and building backbone cabling infrastructure.

2.1.12 Satellite Equipment Room (SER)

A room within the building that houses edge network equipment and horizontal cabling.

2.1.13 Solution

An end to end network of active and interconnecting passive devices that are required to transmit and process a stream(s) of client or application specific data.

2.1.14 Telecommunications

A branch of technology concerned with the transmission, emission and reception of signals, that is, information of any nature by cable, radio, optical or other electromagnetic systems. Telecommunications covers all forms of information whether voice, video, data etc.

2.1.15 Telecoms room

Generic term used to describe telecommunications equipment rooms and spaces, including but not limited to entrance rooms, DERs, MERs, SERs, etc

2.2 Abbreviations

AC	Air Conditioning
AP	Access Point
BD	Building Distributor
BICSI	Building Industry Consulting Service International
BMS	Building Management System
BS	British Standard
BT	British Telecom
CCTV	Closed Circuit Television
CD	Campus Distributor
CP	Consolidation Point
DDA	Disability Discrimination Act
DECT	Digital Enhanced Cordless Telecommunications
DER	Distribution Equipment Room
EPO	Emergency Power Off
EVC	Emergency Voice Communications
F/FTP	Screened Shielded Twisted Pair
FD	Floor Distributor
GSM	Global System for Mobile Communications
HDPE	High-density Polyethylene
HVAC	Heating Ventilation Air Conditioning
IP	Internet Protocol
ISO/IEC	International Standards Organisation
LC	Lucent Connector
LJU	Line Jack Unit
LSZH / LSOH	Low Smoke Zero Halogen
MER	Main Equipment Room
OTDR	Optical Time-Domain Reflectometer
PSU	Power Supply Unit
PWS	Public Work Station
RCDD	Registered Communications Distribution Designer
RTU	Remote Terminal Unit
SER	Satellite Equipment Room
SMS	Short Message Service
STS	Static Transfer Switch
TO	Telecommunications Outlet
UPS	Uninterruptible Power Supply
UTP	Unshielded Twisted Pair
VOIP	Voice over IP

3 Cabling Systems

3.1 Overview

The topology of the cabling systems shall be set out and clearly defined in terms of design and product set.

3.2 Cabling System Structure

The cabling system shall be considered as a series of clearly defined subsystems, interconnected via active equipment that may perform media translation. The fundamental topology of the system derives from the nationally and internationally recognised standards for Generic IT Cabling Systems. A block diagram of a diverse cabling system showing the various subsystems in relation to a building layout is shown below.

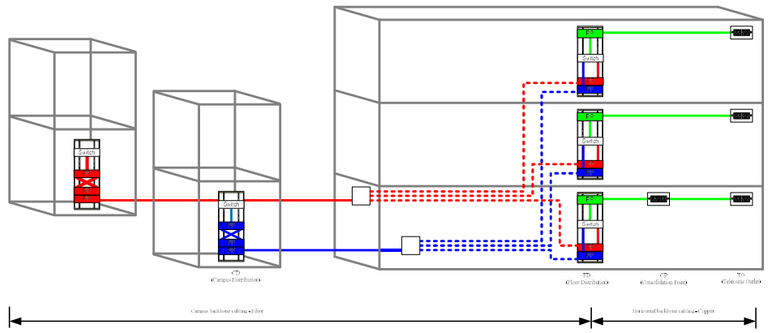


Figure 1 Building System Design with redundancy

There are two hierarchical cabling systems for any one end to end solution. The basic elements are as follows:

- Campus Backbone (Red – A leg and Blue – B leg)
- Horizontal Cabling (Green)

3.2.1 Campus backbone cabling subsystem

The campus backbone is the cabling subsystem that provides data and/or telecommunication services between buildings.

The following connections are provided by the campus backbone system:

- Connects Campus Distributors (CDs) on the same campus with fibre cabling infrastructure
- Connects between CDs located at remote sites via a service provider network
- Connects from CD to Floor Distributor (FD) with fibre cabling infrastructure

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Further details of the campus backbone cabling sub system are available in section 6 of this document.

3.2.2 Horizontal cabling subsystem

The horizontal cabling is the cabling subsystem that provides data and/or telecommunication services from the Floor Distributor (FD) to the user Telecommunication Outlets (TOs).

The following connections are provided by the horizontal cabling system:

- Connects FD to TO with copper or fibre cabling infrastructure

Further details of the horizontal cabling subsystem are available in section 5 of this document.

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4 Telecommunications Room

4.1 Overview

This section details the design criteria for all types of telecom room and their association with each other.

Telecom rooms are an integral part of a building's infrastructure. During building design, specific consideration shall be given telecom room:

- Position
- Space
- Layout
- Lighting
- Ventilation
- Power
- Security
- Routing
- False floor
- Ceiling void
- Cable management

4.2 Position

4.2.1 General

The telecoms rooms shall be located such that the maximum distance for horizontal and backbone cabling in the building are not exceeded.

4.2.1.1 DER to DER Design for New Buildings

A data room that provides fibre connectivity to other buildings within the campus is known as a Distribution Equipment Room (DER). A DER will house the CD and may in some instances also house a BD and FD. However, the primary function of the DER is to provide core switching to other buildings SERs. A DER may in some circumstances accommodate carrier trunks although this is not necessarily always the case. All DERs shall be meshed.

The DERs shall:

- Be separated across the campus to maximise the efficiency of feeding individual buildings
- Where there are 2 DERs both DERs shall be meshed together with a resilient fibre backbone – A leg and B leg
- Where there are more than 2 DERs all DERs shall be meshed together with a fibre backbone – A leg only
- Each DER feed shall be capable of servicing the load of the other DER in the event of a backbone fibre failure
- DER campus backbones shall not share the same building entry
- DER campus backbone shall not share the same route

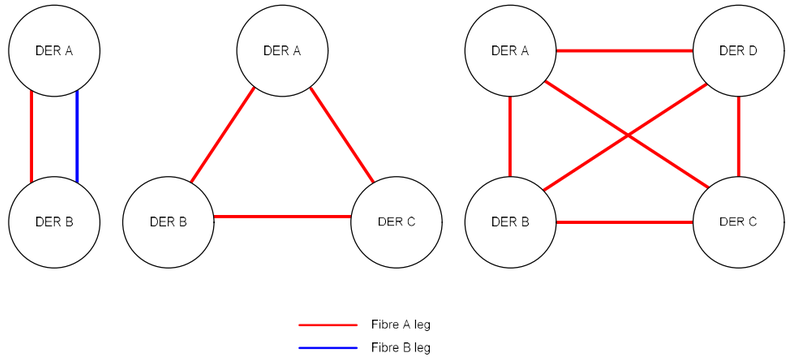


Figure 2 DER to DER fibre backbone mesh design

4.2.1.2 Multiple SER Design for New Buildings

Multiple SER design is the standard model of cabling architecture for SBU IT. All new buildings will be provided on this model. This model has no distribution layer switch in each building i.e. each building only contains SERs with home runs across the campus to DERs. Any relaxation of this model will need explicit permission in writing from SBU IT.

The SERs shall:

- Be separated as far as possible from each other whilst maintaining the 90m rule to the TOs
- Have a dual DER feed into each SER – A leg and B leg
- Each DER feed shall be capable of servicing the load of the other DER in the event of a trunk failure
- DER trunks shall not share the same building entry
- DER trunks shall not share the same route
- All TO channel lengths shall maintain the 90m rule

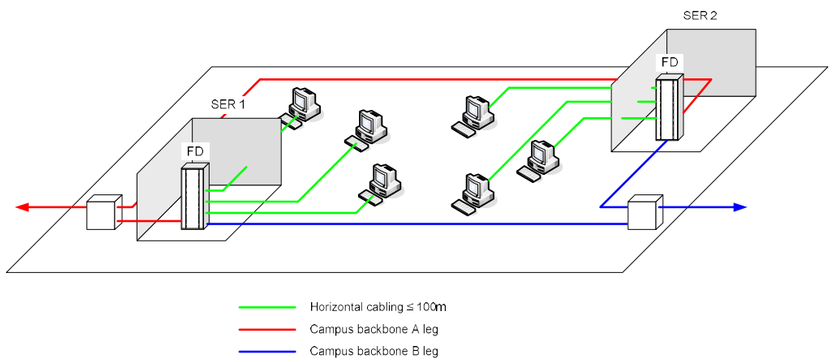


Figure 3 Multiple SER Design

4.2.1.3 Multiple Floor Data Room Design for New Buildings

Where the building contains multiple floors then a minimum of 1 SER shall be provided for every floor. The below diagram shows a typical scenario.

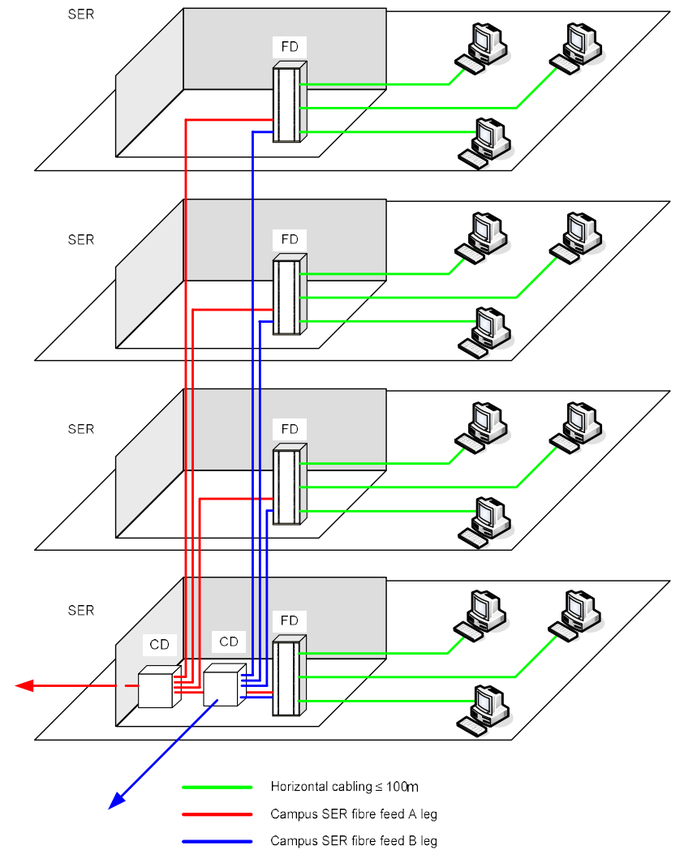


Figure 4 Multiple Floor Data Room Design

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4.2.2 Siting Telecom Rooms

The rules for siting telecom rooms are:

- Avoid areas that may limit any future expansion e.g. adjacent to areas containing heavy plant, lifts or other such equipment.
- In areas where flooding is a potential threat all telecom rooms shall be sited one floor above the maximum flood level. Flooding can be defined as land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood.
- In multi-storey buildings that can be serviced by a single SER it should be located central to the building.
- Where security is a concern the telecom room, where possible, shall not be sited against external walls. Basement floors are desirable followed by floors above the ground floor.
- Shall be located away from high-level sources of EMI.
- Shall be sited with its own access from a major thoroughfare– not acceptable to gain access via smaller rooms i.e. classroom, lecture theatre, private office, etc.
- Shall not be sited within a plant room, or off an office, laboratory or other occupied space.
- Should be positioned adjacent to main ICT risers on each floor
- No wet services or liquid to run through or above telecom rooms.
- Mechanical and electrical services not intended for use within the Telecom shall not run through the telecom room i.e. electrical cables, gas pipes, steam pipes
- HVAC ducting shall not use the telecom room as a route, it shall only terminate within the room
- Shall not be located adjacent to or below wet rooms i.e. bathroom, kitchen laboratory areas etc.
- Mechanical risers shall not be located near telecom rooms.

4.3 Size of Telecom Room

4.3.1 General

The SERs shall be designed to accommodate all the known and planned requirements for the equipment it shall house. SERs serving horizontal cabling to a building shall be designed to accommodate all floor areas that are to be used as office areas, or could accommodate office areas.

Calculation of floor space is dependent on the purpose of the telecom room. All calculations shall be based on an interconnect channel design with access layer switches only.

Interconnect with Switches – A design where the telecom room only houses switches and patch panels. The switches patch directly into the distribution patch panel.

The telecom room sizes shall be as follows:

- SERs – 2 cabinets

All telecom rooms shall have:

- ≥1000mm between the wall/equipment/services and each front and rear of each row of cabinets – if equipment or services protrude from a wall the ≥1000mm shall be taken from the furthest protrusion –see figure 14 for example showing a UPS
- ≥1200mm to one end of cabinet row and any other equipment/cabinets/ramps
- ≥500mm to the other end of cabinet row and any other equipment/cabinets/ramps

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- Headroom ≥3500mm
- Raised floor ≥300mm from floor slab to underside of false floor
- Floor loading ≥8kn/m^2
- Room shall be rectangular shaped
- Door to align as near as possible to wall facing the front of the cabinets for single row of cabinets

4.4 Telecom Room Layout

Where an SER is classified as a shared space 800x1200 cabinets with swipe access door locks shall be used. Where an SER is classified as sole occupancy for IBU IT open frames shall be used.

The following are examples of requirements.

4.4.1 Typical SER Layout for Cabinets

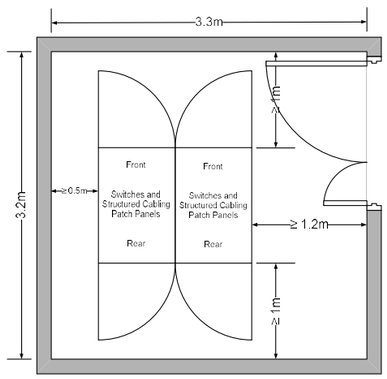


Figure 5 Typical room layout for SERs with cabinets

4.4.2 Typical SER Layout for Cabinets with a Protrusion

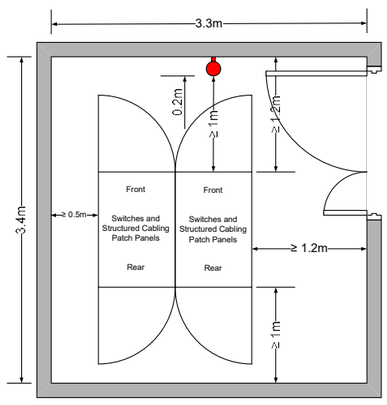


Figure 6 Telecom room layout for SER with cabinets with a 200mm protrusion

4.4.3 Typical SER Layout for Frames

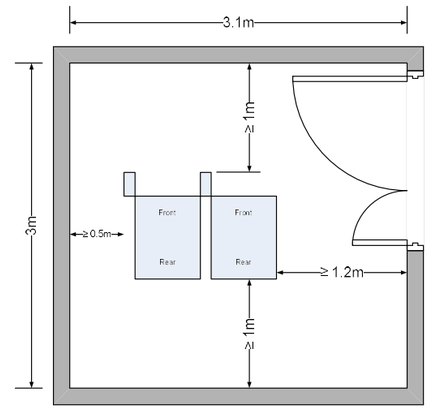


Figure 7 Typical room layout for SERs with frames

4.5 Door Entry

The door entry shall be:

- Double door entry with no centre pillar
- Main door to be ≥900mm in width
- Secondary door to be ≥ 450mm in width
- Both doors to open inwards
- The secondary door (narrowest) to have top and bottom draw bolts into the door frame and slab respectively
- The main door to have a suitable security lock fitted with a SALTO door entry
- Touch fob to be wall mounted
- 2 off Cat 6 single outlet for door entry system
- Override for fail safe mode – doors open
- Power from generator backup – essential circuit
- To be ≥ 1350mm width (total opening for both doors)
- The doors shall be a solid construction with no glass panels
- Doors shall be ≥90 minute fire rated
- Fitted with the following signs to the main door entry side
  - Telecom room number
  - No unauthorised access
  - Laser warning
  - CCTV warning
  - Electricity warning

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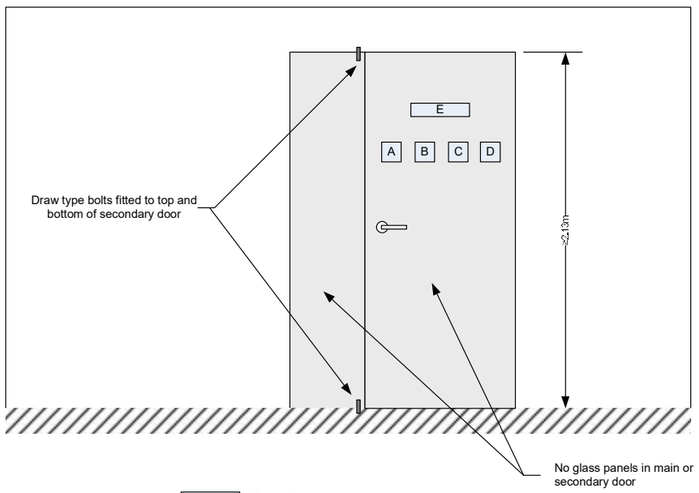


Figure 8 Telecom room door entry details

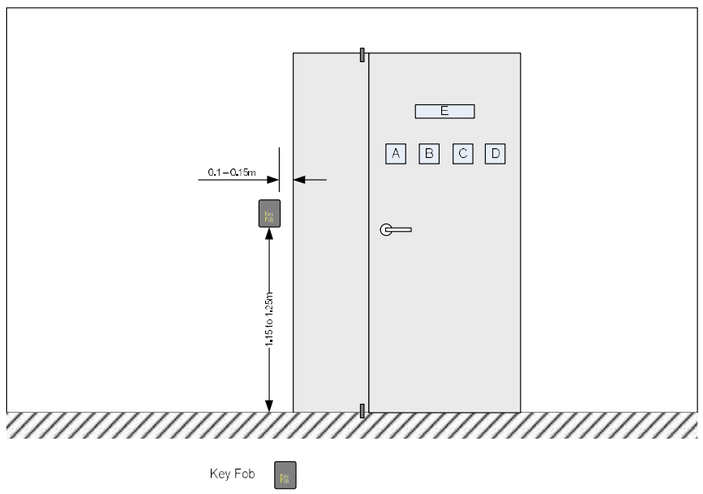


Figure 9 Telecom room key fob details

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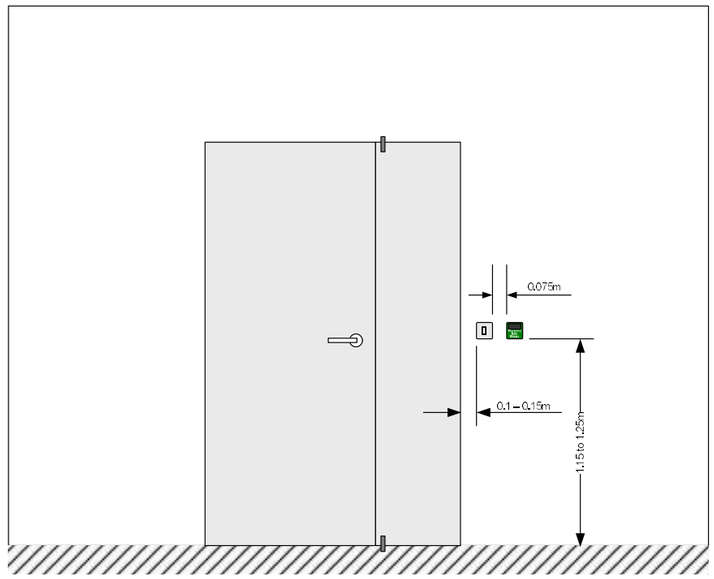


Figure 10 Telecom room door exit details

4.6 Cabinet Elevations

The layouts follow the telecom room layouts but detail how the copper and fibre patch panels and switches are laid out.

The general requirements for all cabinets are:

- Top position for fibre campus backbone
- Next position for 1U fibre horizontal cable manager
- 24 port cat 6a patch panel
- 1U 48 port network witch
- 24 port cat 6a patch panel
- Continue to repeat below sequence
- 24 port cat 6a patch panel
- 1U 48 port network witch
- 24 port cat 6a patch panel

4.6.1 SER Cabinet Layout

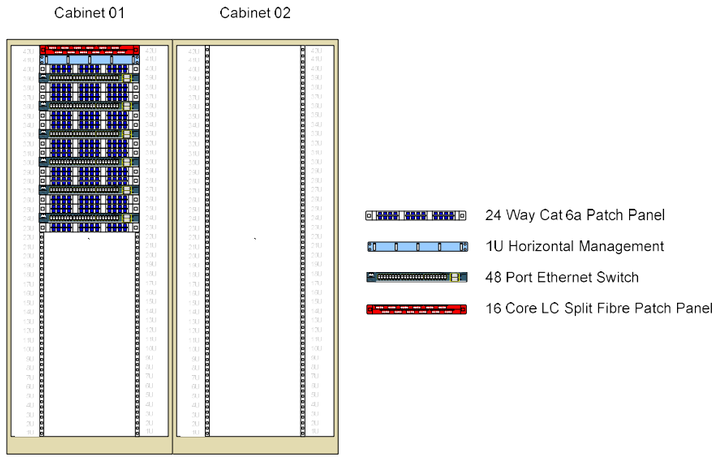


Figure 11 SER cabinet layout

4.7 Lighting

All SERs shall have no suspended ceiling installed. Where there is a refresh and the SER has a suspended ceiling installed the ceiling shall be removed as part of the refurbishment works.

Lighting shall be measured 1m above the finished floor in the centre of the hot and cold aisles. The luminance shall be a minimum of 500lx in the horizontal and 200lx in the vertical plane. Diffusers shall be used to ensure an even spread of light throughout the length and width of the aisles. Spot lighting shall not be used to illuminate the aisles.

The light fixtures shall be Philips SmartForm LED panel (BPS460 LED 48/840 PSD W22L124 MLO-PC or BPS460 LED 24/840 PSD W22L124 MLO-PC) or equivalent. The layouts of the SmartForm panels shall be as detailed below.

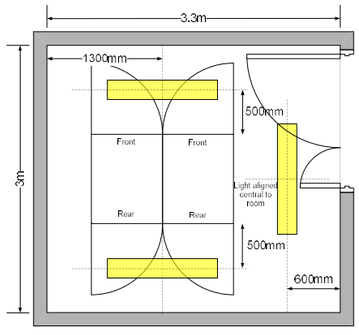


Figure 12 Lighting layout for SERs

4.8 Cooling

The telecom room shall be provided with free cooling ventilation and supplemented with air conditioning. Consideration shall be taken for future power requirements of new equipment. A suitable margin above the flood-wiring scenario shall be taken into account. To allow a safety margin of cooling it shall be designed to accommodate the requirements of flood wiring with all ports active.

4.8.1 Telecom Room Requirements

Each Telecom room shall have:

- DX Unit
  - N for SERs
  - Each DX unit shall be capable of supplying a ≥5kW of cooling
  - 23^0C to 25^0C for SERs
  - DX unit to be mounted ≥2m from the final floor level
- The cooling system shall be tested and commissioned prior to the installation of active equipment. The active equipment covers, but is not limited to, UPS, network switches etc.
- The cooling system shall be available of a 24 hour 365 day basis
- The telecoms room shall be protected against contaminants and pollutants

Contaminant	1 Concentration
Chlorine	0.01 ppm
Dust	100 µg/m^3/24 h
Hydrocarbons	4 µg/m^3/24 h
Hydrogen Sulphide	0.05 ppm
Nitrogen Oxides	0.1 ppm
Sulphur Dioxide	0.3 ppm

Table 1 - Contaminants List

4.8.3 DX Cooling SER Layouts

All AC units shall point forwards towards the front of the cabinets.

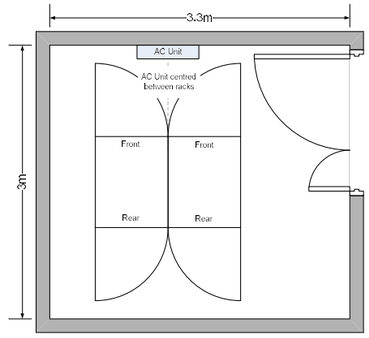


Figure 13 DX layout for SERs

4.9 Power

Each SER shall have:

- A local distribution board
  - Sufficient breakers for
    - PDUs
    - HVAC unit
    - Commando sockets
    - 13A twin sockets
    - Lighting
    - 4 spare breaker positions
- Two commando sockets for each cabinet/rack housing active equipment
  - 240v 16A rating
  - All commando sockets within a single cabinet/frame shall be on the same phase
  - Commando plug termination
  - For high level containment the commando sockets shall be directly above the cabinet/rack – one aligned to the rear left hand side and one to the rear right hand side of the cabinet/rack
  - Diverse route to distribution board within the SER
  - Left hand commando socket (looking at the front of the cabinet/frame) to be fed from the essential (generator backup) mains
  - Right hand commando socket (looking at the front of the cabinet/frame) to be fed from the none essential mains
  - Essential commando socket to be labelled as 'Essential'
  - None essential commando socket to be labelled as 'None Essential'
  - Each commando to have its own circuit breaker MCB type C
- UPS shall plug into the essential mains commando
- Two PDUs for each SER cabinet housing active equipment
  - 240v 16A rating
  - 12 way C16
  - Un-switched
  - Un-managed
  - One PDU to be mounted at the rear right and one to the rear left (looking from the front of the cabinet/frame)
  - Rear right PDU to be wiring into the UPS
  - Rear left PDU to be connected into the none essential commando socket
- A minimum of 2 off double 13A switched sockets fed from the local distribution board
- All cabinets/frames shall be separately earth bonded using a minimum of 6mm earthing cable back to a grounding bar located within the Telecom room. Bonding shall be in accordance with BS 7671.

4.10 UPS

All new buildings shall be provided with a UPS system located in each SER. The full specification for the UPS shall be sought from SBU IT. It is the responsibility of the Main Contractor to correctly size the UPS for operational capacity and battery autonomy based on the loads given in this specification.

This UPS shall be located in the SER and feed distribution boards in each SER within the building.

The UPS shall be fitted with an appropriate communications card.

Loads shall be balanced across the UPS phases. Each rack shall be fed with single phase power.

The UPS within each SER shall be commissioned, integrated and fully operational prior to the SER hand over.

An external manual bypass facility will be provided to allow the UPS to be taken completely out of circuit to allow maintenance or replacement operations tom the UPS without affecting availability of the loads it protects.

4.10.1 N Redundancy

Where a building requires an N redundant UPS system it is important that the UPS loading be carefully considered. A centralised UPS solution will be supplied. All network equipment essential for the operation or security of the network shall be connected to the UPS system. Consultation and approval shall be sought from the SBU Estates electrical design engineering team.

The specification for an N redundant UPS system is:

- 20 minute backup
- Training for a maximum of 6 people on site
- Manufacturer 4 hour fault response service contract will be provided for a five year period
- Ethernet alarm connection
- External maintenance bypass interface
- Emergency Power Off (EPO) – A STS anti-tamper enclosure shall be fitted
- Batteries shall be sealed type – replacement batteries shall also be sealed type. It is not acceptable to fit vented batteries

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4.11 Internal Cable Tray

4.11.1 Telecom Room High Level Containment

The high level cable management requirements for SER shall be:

- All cables within SERs shall enter the cabinets at high level
- All high level cables shall be installed on 600 x 50/60mm suspended cable basket
- Each cabinet shall be fed by a two off 300 x 50/60mm suspended basket
- High level cable basket to be suspended at a height of ⩾200mm above the highest cabinet/rack
- High level cable basket to be suspended at a height of ⩾200mm below all points of the ceiling slab
- The high level cable basket shall be aligned so that the waterfall enters the cabinet through the cabinet entry grommet
- All data containment shall be installed as the lowest service containment as it is accessed on a higher frequency than any other service
- SERs shall not be fitted with suspended ceilings
- All cables leaving the cable basket for entry into a cabinet shall be supported with aluminium or powder coated steel waterfalls
- The basket shall be suspended on Unistrut bars held in place by A2 stainless steel M10 threaded rods
- The threaded rods shall be at ≤1000mm centres
- The threaded rods shall be secured to the ceiling slab and shall support the weight of the maximum number of cables plus a safety margin of 100%
- The length of the Unistrut bars shall, as a minimum, be the width of the cable basket plus 100mm. It is not acceptable for the threaded bars to be installed within the cable basket
- The Unistrut bar shall be fully de-burred with end caps installed as required
- The cable basket shall extend from the room entry to within 120mm to the finish of the last cabinet
- The cable basket shall be labelled at ≤1800mm centres with a Traffolyte engraved label of dimensions ≥150 (length) x 50 (height) x 1.6mm (depth). The label shall be cable tied on at both ends of the label. The label shall be yellow with black lettering. The text shall read ‘IT Data Cabling ONLY’

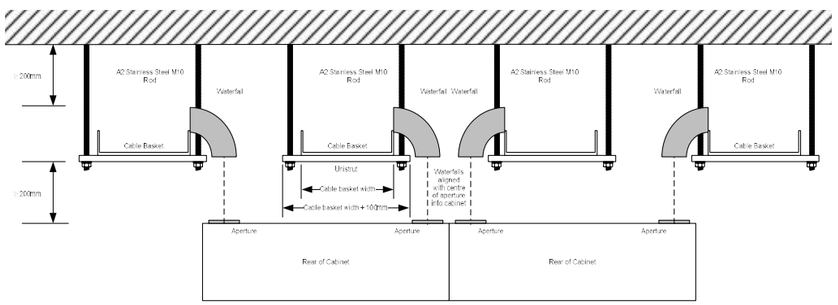


Figure 14 Example of waterfall Dropouts

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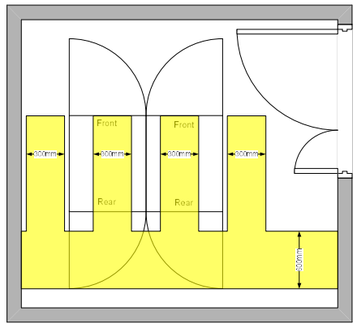


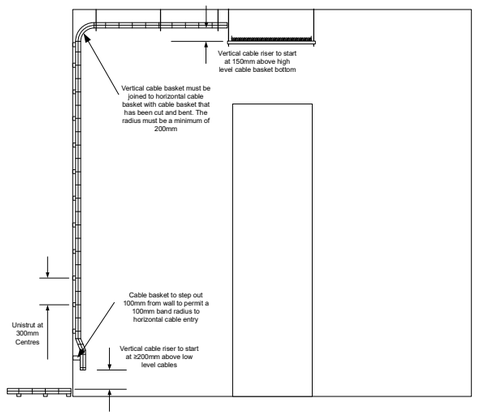
Figure 15 Typical example of high level containment routes

4.11.1 Telecom Room Low to High Level Containment

The low level to high level cable management requirements for SER shall be:

- Cables entering the SER at low level shall be directed to high level before entering the cabinets
- A riser shall be created using 600 x 50/60mm wall mounted cable basket
- The basket shall be wall mounted on Unistrut bars using all metallic fixings, plastic rawl plugs are not permitted
- The length of the Unistrut bars shall, as a minimum, be the width of the cable basket plus
- The vertical Unistrut bars hall be at ≤300mm centres
- The bottom of the riser shall start ≤200mm above the cables entering at low level
- The bottom of the riser shall step out 100mm before its end
- A slow radius bend of ≥200mm shall be created to join the vertical riser to the high level suspended basket
- The horizontal section shall join onto the high level containment at 150mm above the high level basket bottom
- The horizontal section shall be supported ≤50mm from the start of the 200mm bend radius
- The horizontal section shall be supported at the point it joins the high level containment
- The basket shall be suspended on Unistrut bars held in place by A2 stainless steel M10 threaded rods
- The threaded rods shall be at ≤1000mm centres
- The threaded rods shall be secured to the ceiling slab and shall support the weight of the maximum number of cables plus a safety margin of 100%
- The length of the Unistrut bars shall, as a minimum, be the width of the cable basket plus 100mm. It is not acceptable for the threaded bars to be installed within the cable basket
- The Unistrut bar shall be fully de-burred with end caps installed as required
- The cable basket shall extend from the room entry to within 120mm to the finish of the last cabinet
- The cable basket shall be labelled at ≤1800mm centres with a Traffolyte engraved label of dimensions ≥150 (length) x 50 (height) x 1.6mm (depth). The label shall be cable tied on at both ends of the label. The label shall be yellow with black lettering. The text shall read ‘IT Data Cabling ONLY’
- Cables shall be strapped to the underside of the vertical section of cable basket with metallic straps

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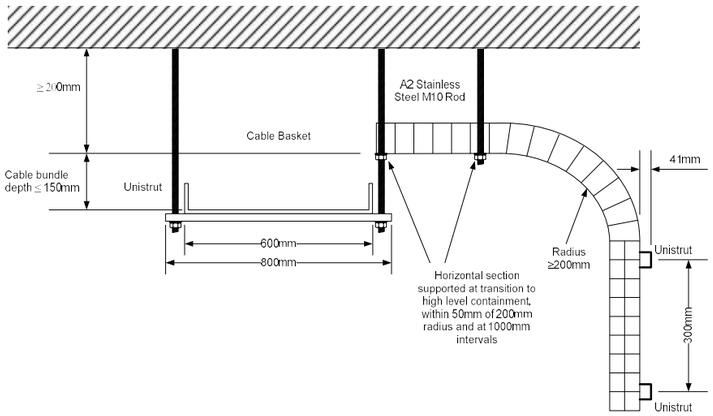


Figure 16 Low level to high level containment detail

4.12 Acoustic Performance

All walls, doors, ceilings and floors shall have an acoustic performance of not less than R_w, R_w+C_{tr} of 60/50.

All walls shall be sealed and filled prior to handover.

4.13 Cable Penetration

Where cables penetrate a telecom room the following shall apply:

- An aperture shall be cut into the telecom room that is sized to allow the complete penetration of the data cable containment
- The data cable containment shall pass through the penetration with no break/joint

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- Data cables shall be installed to the left of the cable basket
- All cable entry points shall be fire stopped to the required rating
- All fire stops shall be in accordance with BS 9999: latest revision.
- Fire stopping shall be installed by a LPCB or FIRAS accredited contractor
- Submit evidence that the Manufacturers products and systems are Third Party accredited by LPCB or FM (Factory Mutual)
- Two automatic fire stopping products
    - Shall allow the installation of cables without breaking the fire stop
    - Shall be installed within the fire stop to the right of the installed data cabling
    - Each device shall allow a minimum capacity of 800mm^2
    - Products shall be approved by estates or the PFI partner

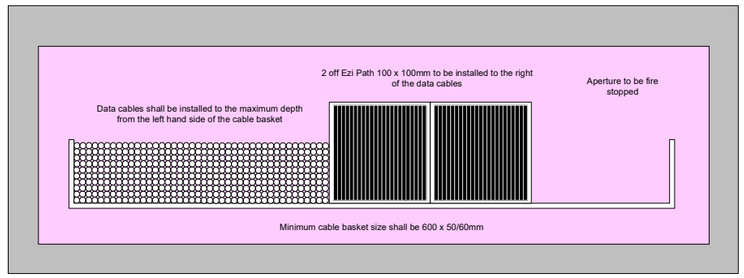


Figure 17 Cable penetration

4.14 Fire Detection

Each telecom room shall have a smoke and heat alarm fitted in a central ceiling location. This alarm shall be the same type and manufacture of the building fire detection system. The alarm shall be linked into the building fire detection system.

4.15 Pre Commissioning Patch Panel Protection

Immediately after a patch panel has been installed and terminated the front of the RJ45 ports shall be protected against dust ingress. It is acceptable to use a suitable none marking tape that leaves no adhesive once removed. If the tape has to be removed for testing purposes it shall be renewed immediately after testing completion with new tape.

4.16 Telecom Room Cleaning

The Main Contractor shall clean all MER and SERs on a weekly basis. Cleaning shall cover the removal of all waste material and the vacuum cleaning of the floor and the inside of cabinets. It is not acceptable to brush the floors clean.

The cleaning shall be done from start of contract until hand over.

4.17 Frames

Within the SERs cabinets are required to house the termination of the copper distribution cabling, inter building/campus fibre optic cable and active I.T. hardware.

All cabinets shall be equipped as follows:

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- 47U high where the SER has enough vertical height to accommodate. The cabinet shall not exceed 47U.
- 42U high where the SER cannot accommodate a 47U cabinet
- U markers to be installed on both front and rear verticals, starting with U01 at the bottom
- 800 x 1200mm unless otherwise specified
- Swipe door access for the front and rear
- Cage nuts to be installed at every 1U position
- 19" adjustable rack mountings front and rear – **IMPORTANT** front mounting angles to be set back by 150mm to provide clearance for patch leads
- Vertical cable management hoops/rings are to be installed at a rate of one per 6U
- Panels fitted to the floor of the cabinet to fully seal it
- Latching & lockable front and rear with lockable metal side panels
- Front door to be single opening steel mesh vented ≥ 76%
- Rear door to be single opening steel mesh vented ≥ 76%
- All metallic panels and detachable parts to be bonded
- All cabinets to be bayed
- Two off 300mm baskets to be installed within the cabinet. The baskets shall run from the cabinet floor to the top panel. One basket to be mounted to each side at the rear of the cabinet
- Cabinets to be bonded to the earth system to the IEEE 17th Edition

All open frames shall be equipped as follows:

Qty	Part Number	Description 1	Units
1	MM20CMR3-W	MM20 cable mgmt ring,1.75X3",14 PCS, white	Each
2	MM20VMS704-W	MM20, vertical cable mgmt cage W/ door 4”	Each
2	MM20730-W	MM20, rack, 30" channel,7’ black	Each
3	60400533	Screws, patch panel mounting, #12-24 X 0.625, 50PCS, black	Pack
2	OR-GBV72KIT	Vertical ground bar kit, 5/8 x 72""	Each
2	OR-60400010	Grounding kit	Each
16	OR-GL2014	Two hole ground lug	Each

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5 Horizontal Distribution

5.1 Overview

The horizontal distribution extends from the FD within the telecoms rooms. It is critical that the horizontal distribution design gives consideration to:

- Data communications media choice
- Layouts
- Routing
- False floor
- Ceiling void
- Cable management

5.2 Channel Design Rules

The distances quoted in Table 2 are from the source equipment (i.e. switch) to the terminal equipment (i.e. PC). Allowances shall therefore be made for vertical drops/rises as well as the horizontal runs.

Technology	**Distance for application (m)**			
	1000 Base T	10G Base T	1000 Base LX	10G Base LX
Cat 6	100	37	N/A	N/A
Cat 6a	100	100	N/A	N/A
OS2 Fibre	N/A	N/A	2000	10000

Table 2 - Maximum distances



Figure 18 Maximum channel design

The total length of the horizontal cable (solid conductor) shall not exceed 90m and the total length of the patch cordage (stranded cable) shall not exceed 10m. The total combined end-to-end length shall not exceed 100m and shall contain no more than 4 connectors.

5.3 Media Selection

BS 6701:2016+A1:2017 deals with telecommunications cabling and has been revised to accommodate the CPR requirements. Section 5.1.3.1 calls for a minimum classification for telecommunications cables of EuroClass Cca.

The category and type of copper cable to be installed shall be:

- For a new building – Cat 6a F/FTP Cca
- External to the building fabric – Cat 6a U/UTP
- All WiFi outlets, regardless of building type shall be Cat 6a F/FTP Cca

The grade of copper cabling shall be cat 6a. Any deviation from this document shall be on written approval by SBU IT.

5.4 Patch Cord Colours and Category

Patch cord colours shall be selected to match the service to be provided. The colours and services are:

Data – Blue

VoIP – Blue

BMS – Pink

All patch leads shall be category 5e U/UTP or above.

5.5 Velcro Straps

It is IMPORTANT to note that all horizontal cables and patch cords shall be secured to containment, patch panels, jacks, Minipods, bundled together etc with Velcro straps. It is not acceptable to use cable ties on any cable type.

5.6 Use Case Outlet Quantities

Each use case will demand different requirements from a structured cabling infrastructure. The main use cases and associated technologies have been defined below as the minimum requirements for outlet concentrations.

Use Case	Number of channels per outlet
SBU IT	Data and Traditional Voice
Swansea Bay User	1 per user
None Swansea Bay User	2 per user
Printers	1 per local
Laboratory	To be defined on a project by project basis
BMS Trend Controller	To be defined on a project by project basis
Automatic Metering	To be defined on a project by project basis
RTU Power Control	To be defined on a project by project basis
Emergency Lighting	To be defined on a project by project basis
Fire Alarm	To be defined on a project by project basis
Door Access	To be defined on a project by project basis
IP CCTV	1 per unit
Wireless AP	1 per unit – Note 5
Intruder Alarm Panel	To be defined on a project by project basis
Lift Controller	2 per unit
Lift Telephony	1 per lift
Barrier	To be defined on a project by project basis

Table - Outlet Densities per use case

5.7 Outlet Presentation

5.7.1 Floor Boxes

The following use cases may use the floor box design:

- General office
- PWS
- Learning space

Each floor box outlet shall consist of:

- 1 to 8 qty jacks in a 24 port Cat 6a shielded patch panel mounted in the telecom room frame/cabinet
- 1 qty printed label – patch panel
- 1 to 8 qty Cat 6a Cca F/FTP cable runs – length to be determined by Contractor
- 1 qty floor box with 1 or 2 off double gang back boxes reserved for telecoms - **shall have ≥ 50mm of clearance between the underside of the floor box lid and the top side of the data cables faceplate**
- 1 to 8 qty Cat 6a shielded jacks
- 1 to 8 qty straight adapter
- 1 or 3 qty blank adapter
- 1 to 8 qty engraved outlet labels and 1 qty floor box label
- 1 qty gland for floor box
- 32mm copex for cables up to floor box – length to be determined by Contractor **– the maximum number of cables per 32mm copex shall be 4 off**
- 1 qty Copex anchor – to attach the Copex to the cable basket
- Velcro type ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)
- 2 to 18 off cable label for each Cat 6a cable run – approved type of cable label at the floor box and the patch panel

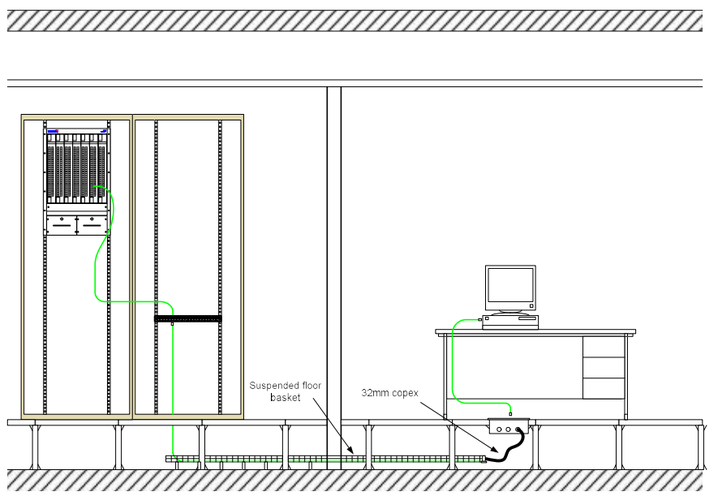


Figure 19 Floor box

Under Floor Minipod

The following use cases may use the under floor box design:

- General office
- PWS
- Learning space

Each Minipod outlet shall consist of:

- 1 to 6 qty jacks in a 24 port Cat 6a shielded patch panel mounted in the telecom room frame/cabinet
- 1 qty printed label – patch panel
- 1 to 6 qty Cat 6a Cca F/FTP cable runs – length to be determined by Contractor
- 1 qty 3 or 6 way Minipod
- 1 to 6 qty Cat 6a shielded jacks
- 1 to 6 qty angled adapter
- 1 or 5 qty blank adapter
- 1 to 6 qty engraved outlet labels and 1 qty Minipod label
- 1 qty gland for Minipod
- 3m of 32mm copex for cables up to Minipod
- 1 qty Copex anchor – to attach the Copex to the cable basket
- Velcro type ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)
- Cable label for each Cat 6a cable run – approved type of cable label at the Minipod and the patch panel

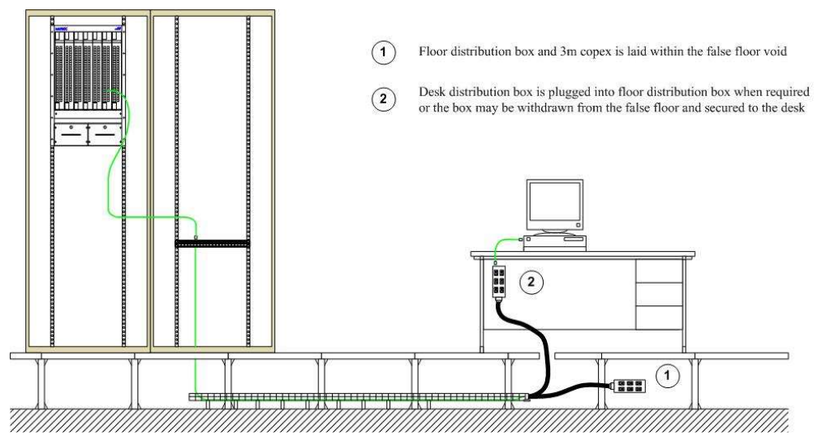


Figure 20 Under floor Minipod

5.7.2 Power pole

The following use cases may use the power pole design:

- General office
- PWS

Each Outlet shall consist of:

- 1 to 4 qty jacks in a 24 port Cat 6a shielded patch panel mounted in the telecom room frame/cabinet
- 1 qty printed label – patch panel
- 1 to 4 qty Cat 6a Cca F/FTP cable runs – length to be determined by Contractor
- 1 to 4 qty Cat 6a shielded jacks
- 1 qty single or double gang cat 6 faceplate
- 1 to 4 qty angled adapter
- 1 to 2 qty blank adapter
- 1 qty single or double back box
- 1 to 4 qty outlet label
- 1 or 2 qty gland for outlet
- Velcro type ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)
- Cable label for each Cat 6a cable run – approved type of cable label at the CP and the TO

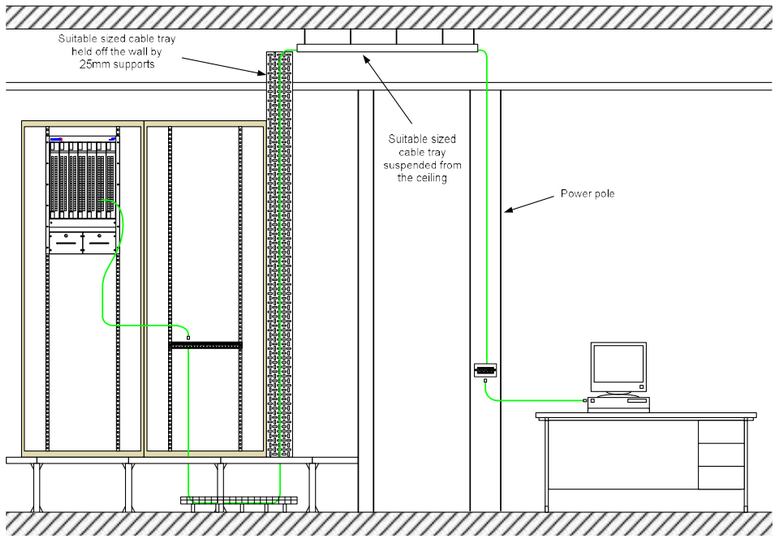


Figure 21 Power pole with consolidation point

5.7.3 Dado trunking

The following use cases may use the dado trunking design:

- General office
- Halls of residence
- PWS
- Learning space

Each dado trunking outlet shall consist of:

- 1 to 4 qty jacks in a 24 port Cat 6a shielded patch panel mounted in the telecom room frame/cabinet
- 1 qty printed label – patch panel
- 1 to 4 qty Cat 6a Cca F/FTP cable runs – length to be determined by Contractor
- 1 to 4 qty Cat 6a shielded jacks
- 1 qty single or double gang cat 6 faceplate
- 1 to 4 qty angled adapter
- 1 or 2 qty blank adapter
- 1 qty single or double gang back box
- 1 to 4 qty outlet label
- 1 or 2 qty gland for outlet
- Velcro type ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)
- Cable label for each Cat 6a cable run – approved type of cable label at the TO and the patch panel

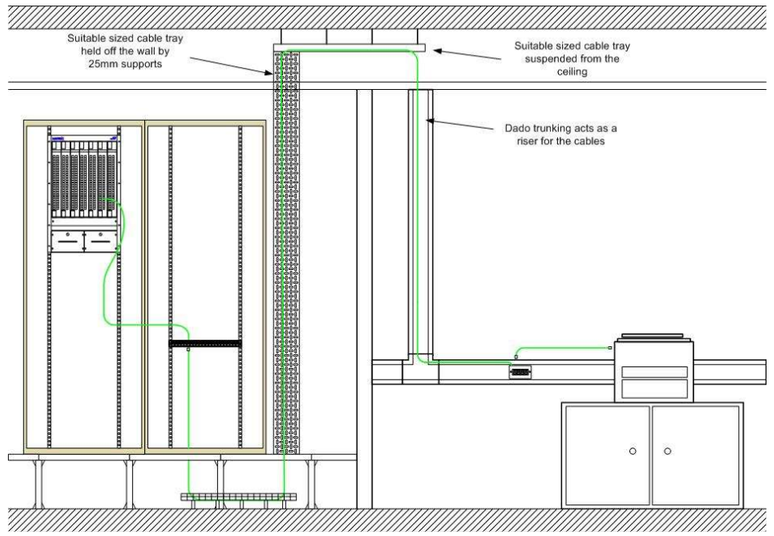


Figure 22 Dado trunking outlets

5.7.4 Stud walls

The following use cases may use the stud wall design:

- General office
- Halls of residence
- BMS Trend Controller
- Automatic Metering
- Emergency lighting
- Door access
- IP CCTV
- PWS
- RTU power
- DECT phone repeater
- Fire alarm
- Intruder alarm
- Learning Space

Each stud wall outlet shall consist of:

- 1 to 4 qty jacks in a 24 port Cat 6a shielded patch panel mounted in the telecom room frame/cabinet
- 1 qty printed label – patch panel
- 1 to 4 qty Cat 6a Cca F/FTP cable runs – length to be determined by Contractor
- 1 to 4 qty Cat 6a shielded jacks
- 1 qty single or double gang cat 6 faceplate
- 1 to 4 qty angled adapter
- 1 or 3 qty blank adapter
- 1 qty single or double gang back box
- 1 to 4 qty outlet label
- 1 qty 25mm flexible conduit – length to be determined by Contractor
- 2 qty 25mm glands
- Velcro type ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)
- Cable label for each Cat 6a cable run – approved type of cable label at the TO and the patch panel

It is important to note that RTU power, fire alarm and intruder alarm outlets shall be lockable. If the RJ45 interface to the equipment is accessible to multiple parties a lockable Cat 6a patch lead shall be used. The patch lead shall be lockable at one end only as the other end plugs into the lockable outlet.

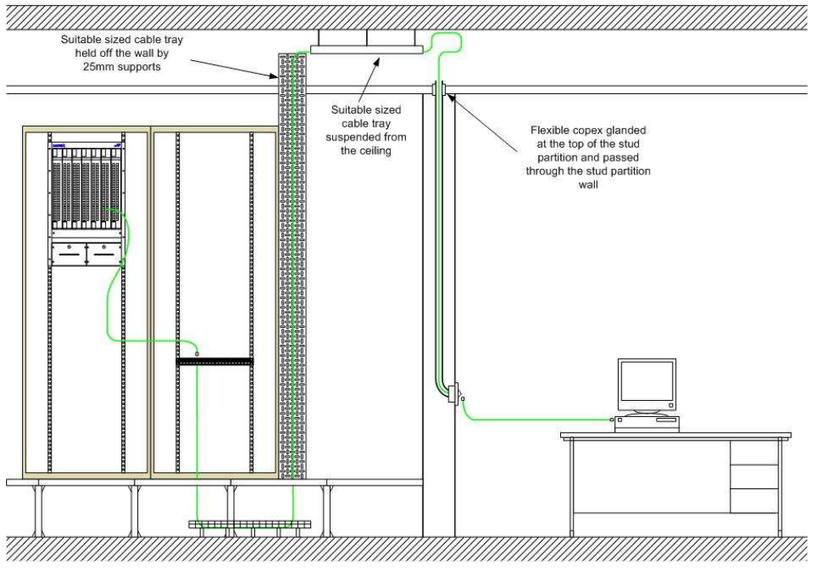


Figure 23 Stud partition outlets

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5.7.5 Dry Riser

The following use cases may use the dry riser design:

- RTU power
- Door access

Each dry riser outlet shall consist of:

- 1 qty jack in a 24 port Cat 6a shielded patch panel mounted in the telecom room frame/cabinet
- 1 qty printed label – patch panel
- 1 qty Cat 6a Cca F/FTP cable runs – length to be determined by Contractor
- 1 qty Cat 6a shielded jack
- 1 qty single gang cat 6 faceplate
- 1 qty angled adapter
- 1 blank adapter
- 1 qty single gang back box
- 1 qty outlet label
- 1 qty gland for outlet
- Velcro type ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)
- Cable label for each Cat 6a cable run – approved type of cable label at the TO and the patch panel

The outlet shall be within 1m of the control unit and within 150mm of the containment.

If the RJ45 interface to the equipment is accessible to multiple parties a lockable Cat 6a patch lead shall be used. The patch lead shall be lockable at one end only as the other end plugs into the lockable outlet.

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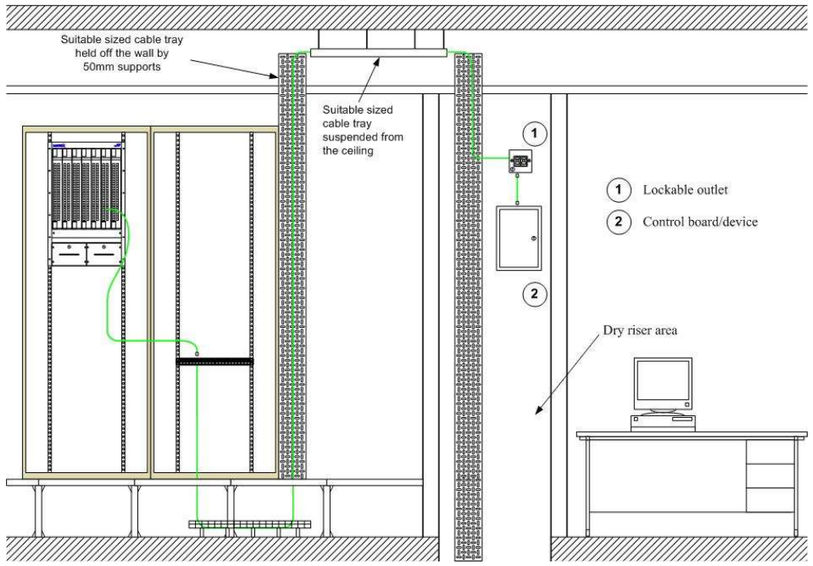


Figure 24 Dry Riser Outlets

5.7.6 Suspended Ceiling

The following use cases may use the suspended ceiling design:

- IP CCTV
- Wireless AP
- General high level
- DECT phone repeater

Each outlet shall consist of:

- 2 qty jacks in a 24 port Cat 6a shielded patch panel mounted in the telecom room frame/cabinet
- 1 qty printed label – patch panel
- 2 qty Cat 6a Cca F/FTP cable runs – length to be determined by Contractor
- 2 qty Cat 6a shielded jacks
- 1 qty 5m loop of cable from the containment run. The two cables for the AP shall be strapped together with Velcro straps every 300mm
- 1 qty single gang Cat 6a faceplate
- 2 qty straight adapter
- 1 qty single gang back box
- 2 qty outlet label
- 1 qty gland for outlet
- White plastic cable tie to be fitted to the AP security tag
- Velcro type ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)
- Cable label for each Cat 6a cable run – approved type of cable label at the CP and the patch panel

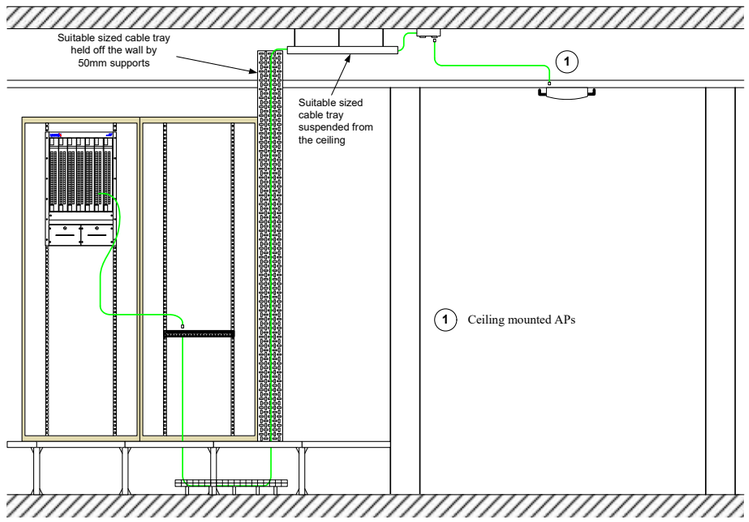


Figure 25 Suspended ceiling outlets

5.7.7 Ceiling Mounted – No Suspended Ceiling

The following use cases may use the ceiling mounted design:

- IP CCTV
- Wireless AP
- DECT phone repeater

Each outlet shall consist of:

- 1 qty mounting bracket. The bracket shall be long enough to suspend the AP below all M&E services
- 1 qty 24 port cat 6a shielded patch panel mounted in the data room frame/cabinet
- 1 qty printed label – patch panel
- 1 qty cat 6a Cca F/FTP cable runs – length to be determined by Contractor
- 1 qty cat 6a shielded jacks
- 1 qty single gang lockable faceplate
- 1 qty straight adapter
- 1 qty blank adapter
- 1 qty single gang back box
- 1 qty outlet label
- 1 qty gland for outlet
- Velcro type ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)
- Cable label for each cat 6a cable run – approved type of cable label at the TO and the patch panel

The outlet shall be within 100mm of the AP mounting bracket.

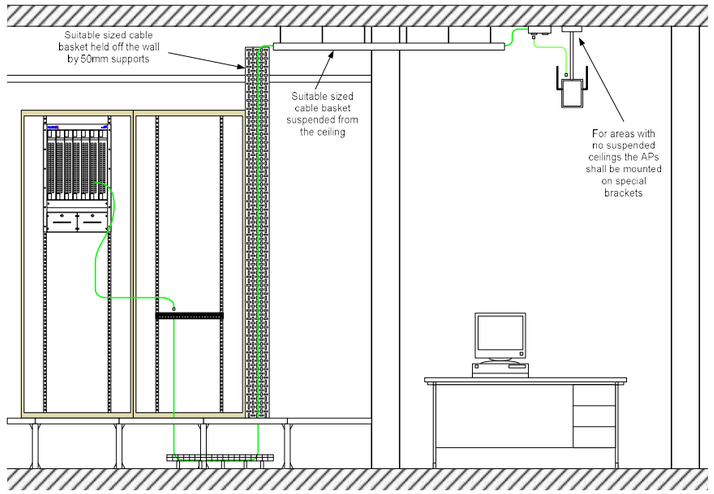


Figure 26 Ceiling mounted with no suspended ceiling outlets

5.7.9 Surface Mounted

The following use cases may use the surface mounted design:

- Halls of Residence
- BMS Trend Controller
- Automatic Metering
- RTU power
- Emergency lighting
- Door access
- IP CCTV
- Wireless AP
- DECT phone repeater
- Fire alarm
- Lift controller
- Lift telephony
- Door access

Each surface mounted outlet shall consist of:

- 1 to 4 qty jacks in a 24 port Cat 6a shielded patch panel mounted in the telecom room frame/cabinet
- 1 qty printed label – patch panel
- 1 to 4 qty Cat 6a Cca F/FTP cable runs – length to be determined by Contractor
- 1 to 4 qty Cat 6a shielded jacks
- 1 qty single or double gang lockable Cat 6a faceplate
- 1 to 4 qty angled adapter
- 1 to 2 qty blank adapter
- 1 qty single or double gang back box
- 2 to 4 qty outlet label
- 1 qty gland for outlet

- Velcro type ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)
- Cable label for each Cat 6a cable run – approved type of cable label at the TO and the patch panel

As the outlets are exposed to multiple parties a lockable Cat 6a patch lead shall be used. The patch lead shall be lockable at one end only as the other end plugs into the lockable outlet.

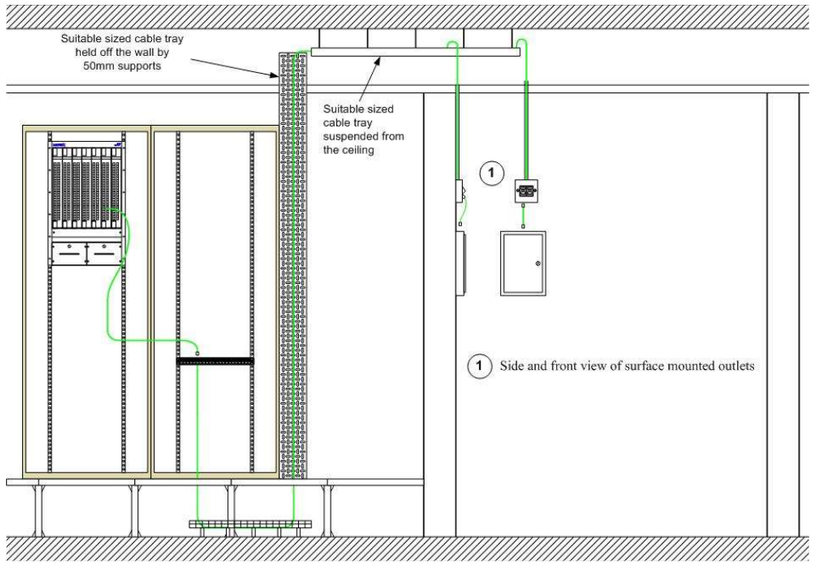


Figure 27 Surface mounted outlets

5.7.10 Temporary Outlets

The following use cases may use the temporary outlet design:

- Temporary General Office

For temporary desk locations the preferred option is to use Consolidation Points (CP) in the ceiling which drop down to trunking or mini trunking outlets. Each CP shall be sized according to the requirements of the temporary desks and may consist of single, double, quad outlets as well as 3, 4 or 6 port minipods.

The cable from the Consolidation Point (CP) to the TO shall be of a solid conductor construction i.e. horizontal cable and not patch cordage.

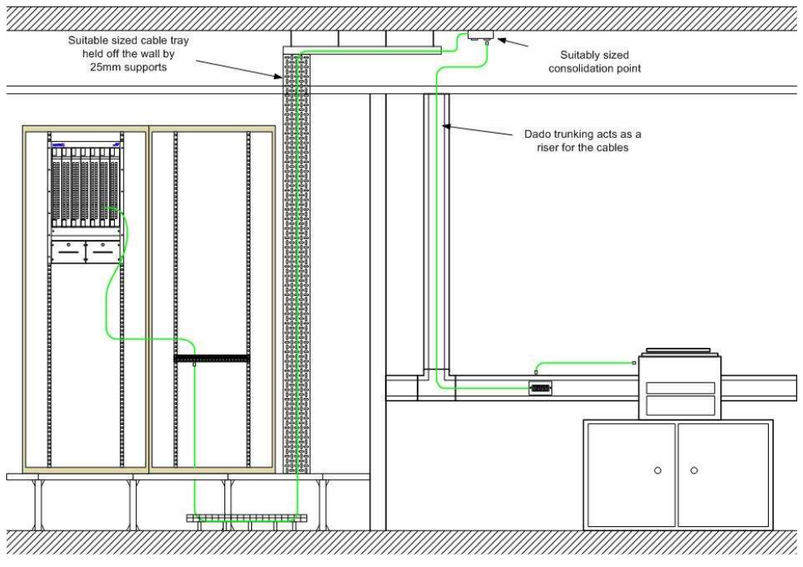


Figure 28 Temporary outlet with consolidation point

5.7.11 External

The following use cases may use the external design:

- Wireless point to point

Each external outlet shall consist of:

- 1 qty jack in a 24 port cat 6 UTP patch panel mounted in the telecom room frame/cabinet
- 1 qty printed label – patch panel
- 1 qty cat 6 external rated UTP cable runs – length to be determined by Contractor
- 1 qty cat 6 UTP jack
- 1 qty external IP 67/65 rated wall box
- 1 qty straight adapter
- 1 qty blank adapter
- 1 qty outlet label
- 1 qty gland for outlet
- Velcro type ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)
- Cable label for each cat 6 cable run – approved type of cable label at the TO and the patch panel

All external copper cable runs shall be protected with a lightning surge protection device rated at 1G Base Tx. The device shall be located within 2 metres of the building entrance and be suitably bonded to earth.

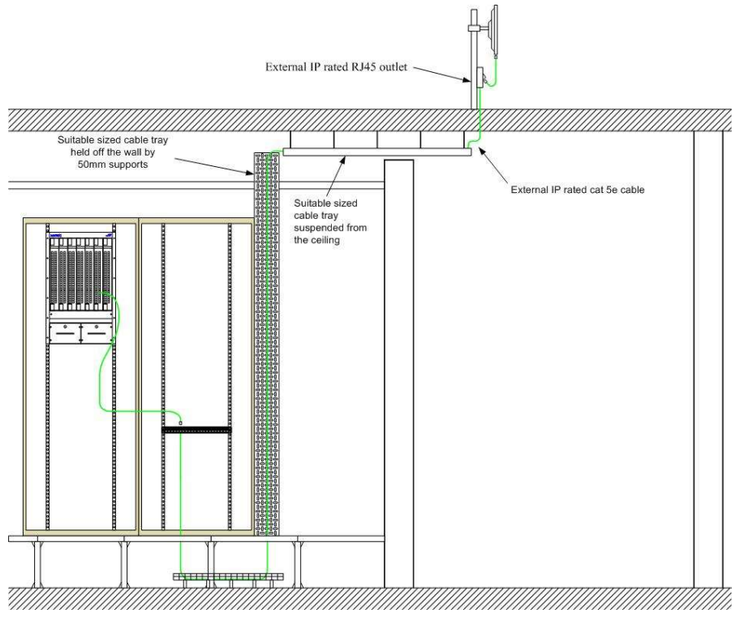


Figure 29 External mounted outlets

5.7.12 External APs

The following use cases may use the external design:

- Wireless APs

Each external outlet shall consist of:

- 1 to 4 qty jacks in a 24 port Cat 6a shielded patch panel mounted in the telecom room frame/cabinet
- 1 qty printed label – patch panel
- 1 to 4 qty Cat 6a Cca F/FTP cable runs – length to be determined by Contractor
- 1 to 4 qty Cat 6a shielded jacks
- 1 qty single or double gang Cat 6a faceplate
- 1 to 4 qty angled adapter
- 1 to 2 qty blank adapter
- 1 qty single or double gang back box
- 2 to 4 qty outlet label
- 1 qty gland for outlet
- Velcro type ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)
- Cable label for each Cat 6a cable run – approved type of cable label at the TO and the patch panel

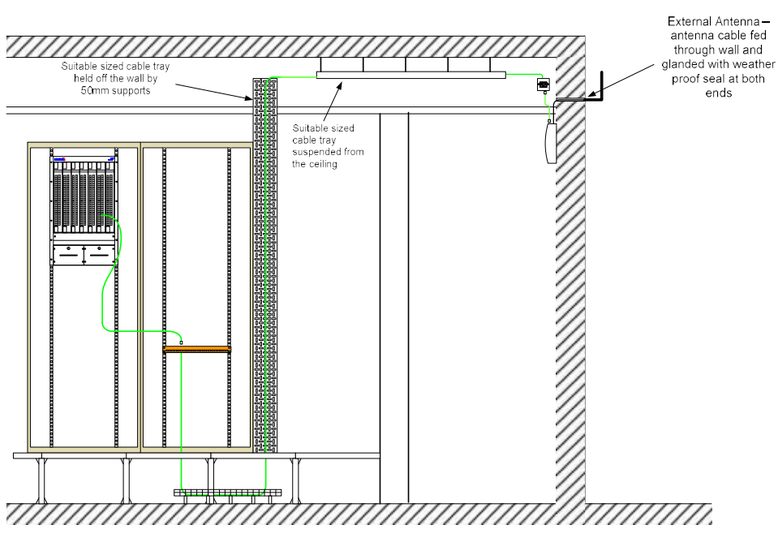


Figure 30 External mounted wireless APs

5.7.13 Remote external APs with Powered Fibre Cable

The following use cases may use the external design:

- Wireless APs that are remote from buildings or buildings with no telecom rooms.
- IP CCTV cameras that are remote from buildings or buildings with no telecom rooms

Each external outlet shall consist of:

- 1 or 2 qty duplex LC OS2 connector in a 48 core OS2 LC patch panel mounted in the telecom room frame/cabinet
- 2 or 4 qty OS2 LC pigtails
- 1 qty printed label – patch panel
- 1 qty CommScope 12 awg 2 or 4 core OS2 hybrid powered fibre cable run – length to be determined by Contractor
- 1 qty 1 or 2 port CommScope PoE extender
- 1 qty printed label – PoE extender
- 1 qty duplex patch cord cut in half – this is to be spliced onto the powered fibre cable at the CommScope PoE extender for connection into the SFP
- 1 qty SPF 1G port single mode transceiver module
- 1 qty port in a 19” rack mounted -48V dc power supply – CommScope Power Express Class 2 with alarm module
- 1 to 4 qty Power Express distribution module – max 8 devices
- 1 to 3 qty Power Express blank slot panel
- 1 qty port in a 19” rack mounted -rectifier – CommScope SPS rectifier distribution shelf
- 1 qty rectifier controller display
- 1 to 3 qty SPS power rectifier module – 1600W per module
- 0 to 2 qty rectifier blank slot panel
- 2 qty 2 or 4 AWG bus bar power conductors plus lugs at each end – to connect the Power Express Class 2 shelf with the SPS power rectifier distribution shelf
- Velcro type ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)
- Cable label for each powered fibre cable run – approved type of cable label at the TO and the patch panel

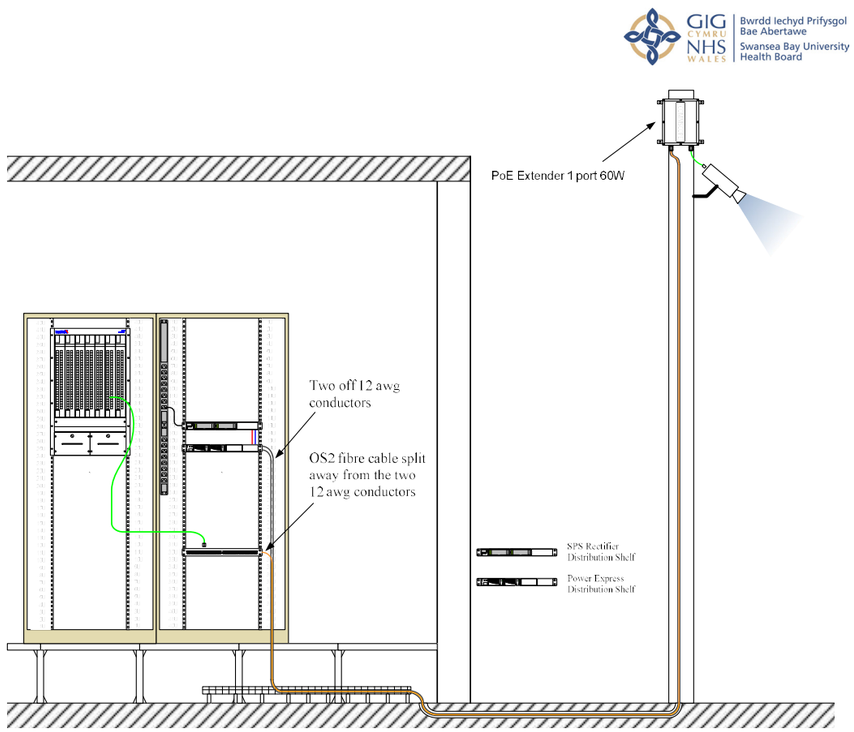


Figure 31 Powered fibre cable

5.7.14 Barrier Systems for Vehicles

Barrier systems will require some form of data/voice communication but due to the uncertain nature of these requirements barrier systems shall be specified on a case by case basis. The Contractor shall seek approval in writing from SBU IT for the specification of the barrier system, communications and position.

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6 Backbone Distribution

6.1 Overview

The backbone distribution is a collapsed backbone design i.e. the cores within the DERs connect direct to the edge switches in the SERs. There is no distribution layer switches in this model.

It is critical that the backbone distribution is designed correctly and consideration given to:

- Data communications media choice
- Layouts
- Routing
- False floor
- Ceiling void
- Cable management

6.2 Media Choice

6.2.1 OS2 / Blown Fibre

All new Campus Backbone fibre links shall be blown fibre OS2, regardless of whether the building has traditional fibre that is not being refreshed.

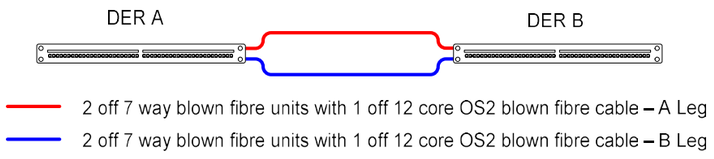
For new buildings or buildings that will be refurbished/refreshed, then the Building Backbone fibre cable shall be blown fibre OS2.

For existing buildings that have traditional fibre already installed and where there is an additional requirement for new Building Backbone links, then the fibre cable shall be blown fibre OS2.

All fibre cores shall be terminated on LC UPC duplex pigtails by fusion splicing. It is not acceptable to use mechanical splicing techniques.

6.3 Two DER Fibre Backbone Design

Both DERs shall be resilient meshed together. Between each DER there shall be:



- 4 off 7 tube external blown fibre unit to the building entry
- 8 off gas seal units – two at each DER building entry
- 4 off 7 tube Eca blown fibre tubes from the building entry to each DER
- 2 off 12 core OS2 fibre backbone cables – A and B leg
- 4 off 12 core OS2 LC patch panels – two in each DER
- 24 off OS2 LC pigtails – 12 in each DER
- 4 off patch panel labels – one in each DER
- 12 off port labels – 6 in each DER

- XX off labels for the blown fibre tubing at each manhole, building entry, riser floor and at each patch panel entry point
- 2 off labels for the blown fibre cable – one at each end
- Velcro type cable ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)
- Each DER trunk shall not share the same building entry
- Each DER trunk shall not share the same external ducting route
- Each DER trunk shall not share the same internal containment route

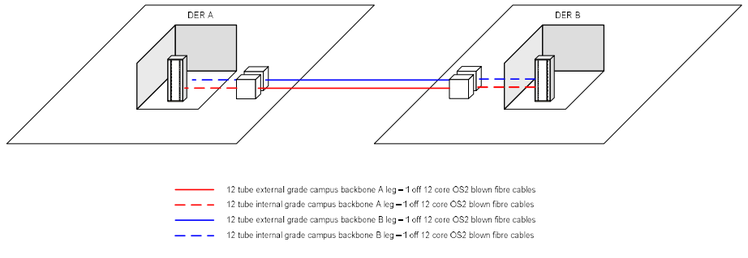
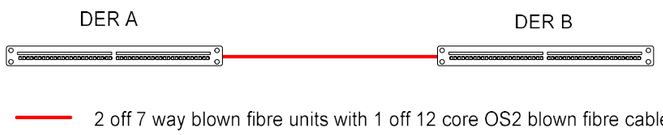


Figure 32 Two DER to DER blown fibre

6.4 Three or More DER Fibre Backbone Design

All DERs shall be meshed together. Between each DER there shall be:



- Two off 7 tube external blown fibre unit to the building entry
- Four off gas seal units – two at each DER building entry
- Two off 7 tube Eca blown fibre tubes from each building entry to each DER
- A 12 core OS2 fibre backbone cable
- Two off 12 core OS2 LC patch panels – one in each DER
- 24 off OS2 LC pigtails – 12 in each DER
- 2 off patch panel labels – one in each DER
- 12 off port labels – 6 in each DER
- XX off labels for the blown fibre tubing at each manhole, building entry, riser floor and at each patch panel entry point
- 2 off labels for the blown fibre cable – one at each end
- Velcro type cable ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)
- Each DER trunk shall not share the same building entry
- Each DER trunk shall not share the same external ducting route
- Each DER trunk shall not share the same internal containment route

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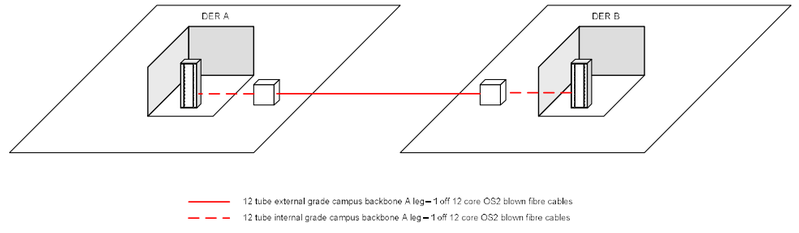
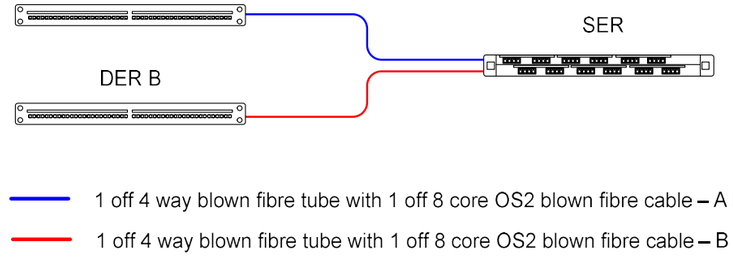


Figure 33 Three or more DER to DER blown fibre

6.5 DER to SER Fibre Design

Dual entrance fibre designs shall be achieved for all new buildings and any refurbishments of existing buildings.

Each SER shall have:



- A blown fibre ring to feed the building. The size and number of tube and tube units to be specified by SBU IT
- Two off resilient 8 core OS2 fibre DER trunks – fibre trunks shall not share the same DER
- Two off resilient 4-way external blown fibre tube unit from the main blown fibre ducting to the building entry gas seal unit – to each SER. It is acceptable to use a large tube unit into the building entry and splitting it into separate 4 way tube units
- Two off resilient gas seal units at the building entry – A leg and B leg
- A 4-way LSOH blown fibre tube unit from each gas seal unit to each SER – one off for the A leg and one off for the B leg
- Each DER trunk shall not share the same building entry
- Each DER trunk shall not share the same external ducting route
- Each DER trunk shall not share the same internal containment route
- Two off resilient plastic fibre patch panel with 8 off LC connectors – one at the A leg DER and one at the B leg DER
- One off resilient split fibre patch panel with 16 off LC connectors – at each SER, the A leg shall be in the top draw and the B leg in the bottom draw

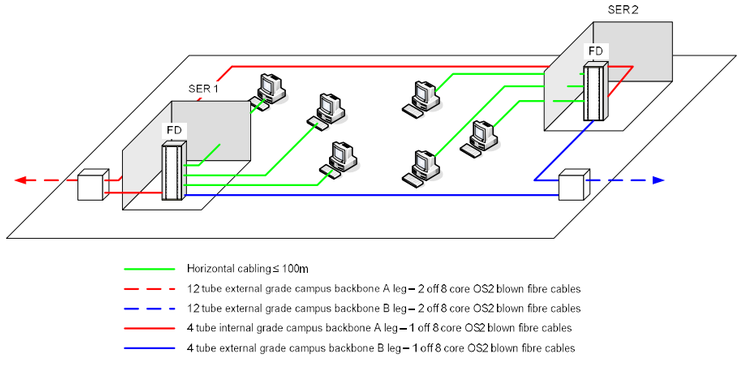


Figure 34 SER blown fibre

6.6 Fibre Polarity

All installed fibre cables, installed between two patch panels, shall have each pair flipped. All fibre patch cords shall be flipped.

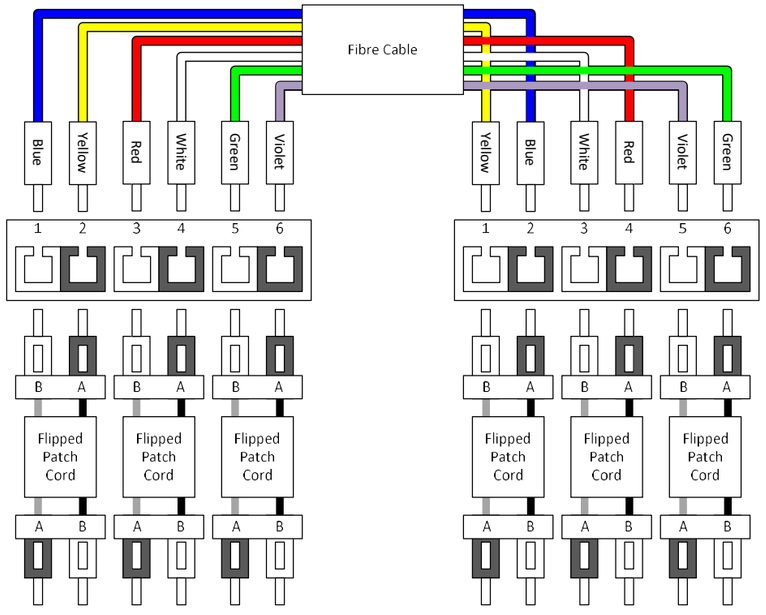


Figure 35 Fibre polarity

7 Emergency Voice Communication (EVC)

7.1 Overview

All general telephones shall be VoIP based and as such do not form part of this section. The only tradition based voice switch telephones shall be public emergency phones, DDA (disability discrimination act) refuge call points, critical alarms and lift phones.

All voice grade cables must be FireTuf ® grade cables capable of fire resistant to BS5839 26.2E > 2hrs @ 9500C, BS6387 > 3hrs @ 9500C and BS EN 50200 > 3hrs @ 9500C. These cables are available in 1, 2 and 4 pair configurations. Where more than 4 pairs are required then multiple cables must be used. The minimum requirement for a single telephone point is 2 pairs.

The voice distribution covers campus and building distribution. Within these two defined structures are two solutions, each with their own topology. The two solutions are public emergency/DDA telephony/critical alarm and lift telephony.

The campus voice distribution for a new build extends from the main telecommunications room to the nearest campus exchange.

The building voice distribution extends from the building distribution frame within the main telecom room to the FD(s).

It is critical that the voice block wiring is designed correctly and consideration given to:

- Layouts
- Routing
- External ducting

7.2 User Type Outlet Quantities

Each user type will demand different requirements from a voice block wiring infrastructure. The main user types and associated technologies have been defined below as the minimum requirements for outlet concentrations.

User Type	LJU Outlets	Direct Terminated
Disabled Toilet	1 per room (4 pairs)	1 per room (4 pair)
Public Emergency/DDA Phone	1 per position (4 pairs)	
Lift Telephony	1 per lift (4 pairs)	

Table 3 User type outlet quantities

7.3 Voice Design

For the public emergency and DDA building distribution block wiring each phone shall be fed from the designated MERs voice distribution frame with a single 4 pair FireTuf cat 5e cable.

The voice cables shall be terminated onto a 237A disconnect module on the distribution frame and onto an LJU phone socket in close proximity to the phone.

For the critical alarm distribution block wiring each alarm shall be fed from the designated MERs voice distribution frame with a single 4 pair FireTuf cat 5e cable. The voice cables shall be terminated onto a 237A disconnect module on the distribution frame and directly into the critical alarm. This solution does not require a TO connector i.e. direct terminated.

For the lift building distribution block wiring each phone shall be fed from the designated MERs voice distribution frame with a single or multiple 4 pair FireTuf cat 5e cable(s). The voice cables shall be terminated onto a 237A disconnect module on the distribution frame and onto a suitably sized 201D distribution point within 2m of the lift control equipment.

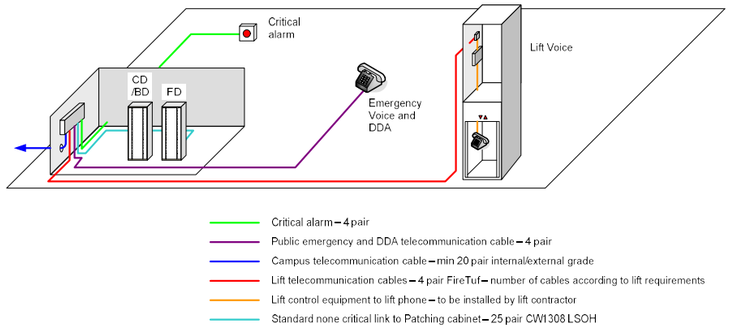


Figure 36 Voice block wiring design

7.4 Disabled Toilet, Public Emergency/DDA and Lift Control Room Phone

Each phone distribution extends from the voice patch panel within the MER/SER to the TO.

Each link shall consist of:

- 1 qty 237A 10 pair disconnect module
- 1 qty 51A hinged label holder
- 1 qty printed label – 51A label holder
- 1 qty LJU
- 1 qty single or double gang back box
- 1 qty faceplate to DDA regulations and recommendations
- 1 qty outlet label
- 1 qty gland for outlet
- 1 qty 4 pair cat 5e SF/UTP FireTuf ®cable – length to be determined by vendor
- Velcro type cable ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)
- 2 qty cable label for each FireTuf ® cable run – approved type of cable label at the patch panel and TO.

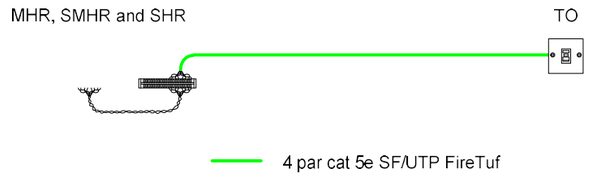


Figure 37 EVC phone

7.5 Critical Alarm

Each critical alarm extends from the voice patch panel within the MER/SER to the critical alarm.

Each link shall consist of:

- 1 qty 237A 10 pair disconnect module
- 1 qty 51A hinged label holder
- 1 qty printed label – 51A label holder
- 1 qty 4 pair cat 5e SF/UTP FireTuf ®cable – length to be determined by vendor
- Velcro type cable ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)
- 2 qty cable label for each FireTuf ® cable run – approved type of cable label at the patch panel and TO.

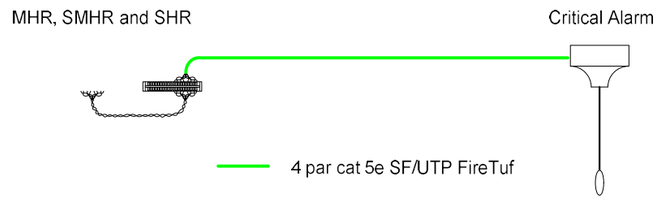


Figure 38 Critical alarm

7.6 Lift Telephony

Each lift phone extends from the voice patch panel within the MER/SER to the lift control room voice distribution box.

Each link shall consist of:

- 1 qty KRONE disconnect box suitably sized for 4 pairs per lift
- XX qty 237A 10 pair disconnect module – 4 pairs per lift
- XX qty 51A hinged label holder – to match the number of 237A modules required
- XX qty printed label – 51A label holder – to match the number of 237A modules required
- 1 qty printed label – distribution box

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- XX qty 4 pair cat 5e SF/UTP FireTuf ®cable – length to be determined by vendor
- Velcro type cable ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)
- 2 qty cable label for each FireTuf ® cable run – approved type of cable label at the patch panel and TO.

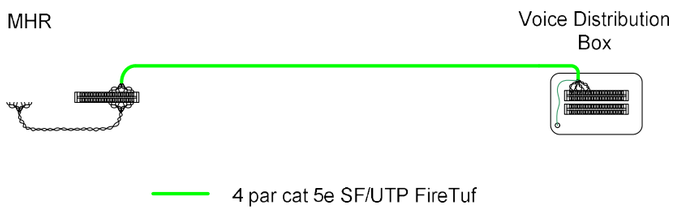


Figure 39 Lift telephony

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8 Voice

8.1 Overview

There shall be an overlay of traditional digital telephony to support the VoIP based telephony.

8.2 Voice Design

The voice design shall be:

- The voice gateway shall be presented onto a 24 port amphenol to RJ45 patch panel with amphenol 25 pair cables
- A 24 port cat 5e UTP patch panel shall provide the distribution panel for the CW1308 break out cable
- A XX telecom cable to each building – length to be determined by the vendor and pair size to be determined by SBU IT
- The telecom cable shall be terminated into the MER on a:
  - XX pair KRONE distribution box – size to meet the requirements of the incoming telecom cable
  - XX qty 237A 10 pair disconnect modules - number to meet the requirements of the incoming telecom cable
  - XX qty 51A hinged label holders – one for each 237 module
  - XX qty printed labels – one for each 237 module
  - 1 qty printed label – distribution box
- Main telecom distribution cable(s) to emanate from the incoming distribution box and to pass through the required areas within the hospital
- At strategic locations the main telecom distribution cables shall be terminated onto main distribution boxes:
  - XX pair KRONE distribution box – size to meet the requirements of the incoming telecom cable
  - XX qty 237A 10 pair disconnect modules - number to meet the requirements of the distribution telecom cable
  - XX qty 51A hinged label holders – one for each 237 module
  - XX qty printed labels – one for each 237 module
  - 1 qty printed label – distribution box
- From each distribution box the main telecom distribution cable shall continue to services other main distribution boxes
- From a main distribution box a secondary telecom cable may be installed to feed secondary distribution boxes
  - XX pair KRONE distribution box – size to meet the requirements of the incoming telecom cable
  - XX qty 237A 10 pair disconnect modules - number to meet the requirements of the distribution telecom cable
  - XX qty 51A hinged label holders – one for each 237 module
  - XX qty printed labels – one for each 237 module
  - 1 qty printed label – distribution box
- A 4 pair category 5e Cca cable shall be installed from the main or secondary distribution box to the voice outlet – length to be determined by the vendor
- A single LJU voice outlet (to include jack, faceplate and backbox) shall be installed at the user location
- XX off labels for the break out cable at each manhole, building entry, riser floor, patch panel entry point and distribution box entry point
- Velcro type cable ties – suitable quantity for installation (every 300mm within the communications room and every 600mm outside of the communications room. Additional Velcro type ties shall be used as necessary)

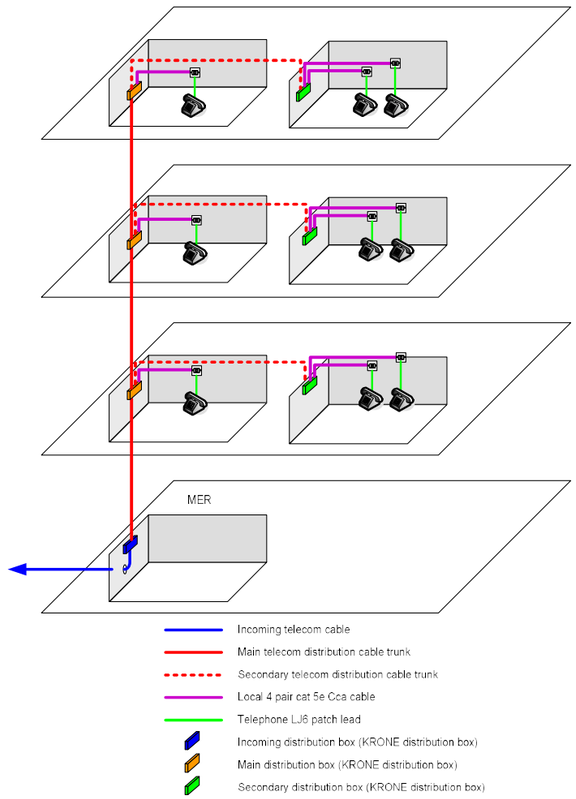


Figure 40 Voice block wiring design

9 Audit

9.1 General

ABU IT reserves the right to request an audit from a CommScope representative on the structured cabling element of the project. The CommScope representative shall be given access to all areas where structured cabling products have been installed or are to be installed.

The installer shall provide, at the request of the CommScope representative, sufficient resources to assist in the removal of ceiling tiles, access equipment for high level access, lifting floor tiles, lifting man hole covers etc.

Any areas of concern that may impact on the warranty, at the time of inspection or during the 25 year warranty period, shall be resolved at the cost of the installer. Any areas of concern that do not impact the warranty, now or during the 25 year warranty period, but are deemed to not fulfil the requirements of this specification or industry good practices, shall be resolved at the cost of the installer.

10 Roles and Responsibilities

10.1 General

The design of the cabling system will include input from the Building Designer, Main Building Contractor, Electrical Contractor, Specialist Data Contractor, Estates and Facilities Project Leader and SBU IT. Close liaison between all parties is required to deliver building design and services suitable for installation of structured cabling to EN 50173 & EN 50174.

It is anticipated that the Main Contractor shall appoint a competent Data Contractor. Corporate membership by the Data Contractor of BICSI and individual qualification to BICSI RCDD standard should be considered favourably alongside other accreditations the Main Contractor may require.

Key points to take into account during the design phase include

- Number of points required
- Cable pathways
- Building and Floor distributors (hub rooms) specification
- Power and cooling
- Component choice
- Installation scheduling
- Quality control

10.2 Responsibilities

The responsibilities for the installation of the cabling system, supply and installation of the data network components to a commissioned solution in compliance with all SBU IT specifications are as follows:

10.2.1 Building Designer

- Provide Building Distributors and Floor Distributors (hub rooms) to the specification provided by SBU IT (below).
- Provide details of locations and quantities of hub rooms and data outlets along with detailed drawing to SBU IT. Accurate drawings are to be issued prior to start of cabling system installation showing individual outlet positions with single/double/quad outlets being clearly marked. As a guide, in single occupancy offices there should be a minimum of three data points installed within 1.5m of the anticipated primary desk location.
- 1. Building/floor distributors (hub rooms)
  Ensure that there are adequate hub rooms to service the building and that no office outlet is more than 90 metres cable distance from a hub room.
  Design each hub room to accept at least one 800mm x 800mm equipment racks. The space required for a room containing two racks is approx 2800mm x 2000mm to allow an engineer to gain safe access to the front, rear and side of rack, and the doors to open fully.
  As an estimate, the amount of space required within a rack for active equipment shall be equal to the amount of space taken by passive components.

10.2.2 Main Contractor

- Provide services to support equipment racks in each hub room. To include power, cooling (air conditioning), lighting, fire detection and containment for cabling.
- Provide cable pathways sufficient to accommodate structured cabling system (including allowance for any future expansion).
- Ensure earthing and bonding compliance to BS EN 50310.
- Provide two diverse duct routes into the building, linking into the existing SBU IT duct system so as to provide diverse routing of cables to the Data Network core.
- Provide all MAC address information for all installed network-enabled equipment.
- Design cabling system.
- Supply and install equipment racks.
- Install and test of cabling system.
- Install and test of fibre optic links between hub rooms.
- Supply and installation of all sundry rack accessories stated elsewhere in this document, including cable management arms.
- No IP addresses shall be allocated until this information has been provided to the SBU IT.
- Design of data network at a physical and logical level in compliance with issued UOS specifications, approval required by SBU IT
- Supply of all data networking hardware
- Supply and patch all copper circuits to active data network switches
- Supply and clean fibre patch leads prior to installation
- Design of the wireless data service in compliance with UOS issued wireless specifications seeking approval from SBU IT.
- Supply of all wireless access points
- Patch all mains cords of network hardware
- Installation of all data networking switches
- Pre stage for configuration all data network hardware and wireless access points
- Supply and patch of all fibre patch cords
- Supply and install all cat 6a 0.5m patch cords for APs
- Completion of all fibre patching and labelling
- Completion of all copper patching and labelling
- Install and test fibre optic links to the SBU IT data network (external to the new/refurbished building).
- Carry out wireless map off plan
- Labelling of all installed circuits Physical installation of wireless access points
- Compliance of wireless works with SBU IT specification for WIFI provision
- Complete post installation wireless heat map survey
- Caplum audit for installed circuits
- Services in hub rooms
  - Provide power from a dedicated single outlet (not a fused spur) to each power distribution block. The socket shall be secured is such a way that the plug top cannot be casually removed or switched off (e.g. located in a secure enclosure or mounted out of normal reach).
  - Provide air conditioning (cooling) to counteract the heat produced by the equipment in the rack: for reasons of access and ensuring that condensate cannot enter the equipment rack, the air conditioning shall **not** be located above the rack.
  - Provide lighting for safe working in the equipment rack. If the room has no windows then an emergency light fitting is to be provided.
  - Provide fire detection associated with the building system for remote fire monitoring.
  - Provide containment within each hub room to accommodate the structured and fibre optic cabling.
  - Provide earth terminal point for connection of equipment rack to building earth system.
- Cable Pathways
  - Provide a comprehensive distribution network of cable pathways radiating from each data equipment room to conduct individual service cables to their rooms. **The distribution shall be accessible throughout its length to facilitate installation of additional circuits and to enable fault investigation.** Within the rooms provide trunking with separate lids for mains and structured cabling.
  - Provide cable pathway from the building distributor (hub room) to the cable entry point of the new building.
  - All pathways shall maintain adequate separation from sources of electrical interference. Extensive guidance on pathway design is provided in the standards.
- Equipment Racks
  - Provide and install all racks.
- Structured Cabling
  - Provide, install and terminate all structured cables (including cables for Access control, BMS and any other services that are expected to run on the SBU IT data network). These cables start at the destination office where they are terminated in an RJ45 faceplate. At the rack all cables are to be terminated on RJ45 patch panels. Cables to be tested with tester that is certified for testing the installed cabling and the results supplied to SBU IT. Circuits are to be labelled at both ends in accordance with SBU IT standard.
- Building Distribution (BD) Fibre Optic
  - The Data Contractor shall install, terminate and test all BD fibre optic cables.
- Campus Distribution (CD) Fibre Optic
  - The Data Contractor shall install, terminate and test all CD fibre optic cables.
  - Supply and patch and label all copper and fibre installed circuits.
  - Design, supply, installation and commissioning of a building wide Emergency Voice Communication system in compliance with UOS issued specifications.

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- **All works in strict compliance with the SBU IT IT and cabling specifications issued.**

10.2.3 Estates & Facilities

- Ensure information regarding:
  - Access Control
  - BMS
  - CCTV
  - Emergency lighting

  and any other device that needs a connection to the data network is passed to the project leader and SBU IT.
- Support of Access control and BMS is not provided until after building handover, due to the fact that SBU IT need to install the active equipment that connects to the SBU IT data network. If Access control and BMS are required before building handover, the following items need to be completed.
  - The building distributor (hub room) needs to be in a completed state with all structured cabling and fibre links external to the building installed and tested. This shall include the data cables to the Access and BMS controllers.
  - SBU IT staff shall be able to get access to the hub room to install power on the active equipment and link it to the SBU IT data network.
  - Once the active equipment has been installed and switched on there shall be no interruptions to the mains power supply feeding the rack.
  - SBU IT will notify the type and number of lock to be fitted to doors
  - The hub room shall be in a clean sterile state with all works completed.
- To determine the number and location of DDA refuge call phones throughout the building.
- To determine the number and location of public emergency and lift phones throughout the building.

10.2.4 SBU IT

- SBU IT will issue all IT specifications.
  - SBU IT will approve the design, the cable and components for the structured cabling system that has been proposed.
  - SBU IT will review and comment on the high and low level designs issued by the main contractor and approve if compliant with the issued SBU IT specifications.
- Design of Data and VOIP Installation
  - SBU IT will design the Data and VOIP installations at the service level for the new building. All proposed outlets will be fully activated.

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11 Documentation

11.1 As Built Documentation

Three sets of hand over documentation shall be submitted 2 weeks after practical completion has been granted by the SBU IT. The documents shall be in hardcopy and electronic format and include:

11.1.1 Documentation from data contractor

- Prior to construction:
  - Design submission
- As constructed drawings of the internal and external installations:
  - Cabinet layouts to include all fibre and copper patch panels along with labelling of patch panels and ports
  - Building floor plans in a new layer of AutoCAD to show all TO positions with port numbers, containment routes and sizes, telecom rooms, cabinet locations, building entry points, internal Building backbone routes between MER and SER etc
  - Site plans in AutoCAD to show external Campus backbone cable routes between DERs, and spurs to MERs etc
- Data formatted ready for load into IBU IT software system (a template can be provided) showing relationship and connectivity of:
  - Cables, Pits, Buildings, BEPs, DAs
  - TDUs, Gas Seals
  - Racks, Panels, U positions
  - Tubes, Fibre bundles, Panels, ports
  - Labels applied to all components
- Fibre Optic test results – OTDR and power meter at both wavelengths
- Copper test results – CSV format for all installed permanent links
- CommScope manufacturers system warranty
- Inventory of components used including tubes, fibre, joints, labelling and terminations
- Health and Safety file
- Patching records for all fibre and copper patch leads
  - Service type, PoE, 10 Base T etc
  - Outlet number
  - Distribution and terminal atch panel number
  - Distribution and terminal patch panel port number
  - Switch and port number
  - Room number
  - Room location
- Spare capacity statement (including stubs or other elements put in place for later expansion)
- Thresholds
  - % Use of fibre bundles.
  - % Use of tubes
  - % Use of internal tray capacity
  - % Use of external duct capacity / BEP

11.1.2 Documentation from fibre Contractor

- Fibre Optic inspection results
- Warranty

11.1.3 Documentation from civil or buildings contractor

- Duct construction design
- Site duct routes marked onto Estates AutoCAD planson a new layer
- Building Entry Point construction

11.2 Electronic Recording

SBU IT requires that all fibre and copper infrastructure installed as part of a structured cabling system as specified in this document is recorded in the SBU IT management toolset. This includes:

- Campus Backbone cabling subsystem
- Building Backbone cabling subsystem
- Horizontal Cabling subsystem
- Other system components as are necessary to properly populate the management toolset

12 Component Specification

12.1 General

The specification for the major elements comprising the structured cabling solution shall be defined below. Products shall be fully compliant to all requested standards for all parameters.

12.2 Copper Cables

All copper cables contained within the scope of the structured cabling shall be constructed of 4 pair Category 6, and be compliant to component specification to ISO/IEC 11801:2002, EN 50173:2002 and TIA/EIA 568-B.2-1. Please reference the tender documentation for the category performance.

The product sets shall be as follows:

12.2.1 CommScope– Cat 6a Cca

CopperTen Category 6a 4PR

F/FTP Horizontal Cable

The CommScope F/FTP 4PR cable is designed for applications up to 500 MHz and its connection properties exceed Category 6a specifications ISO/IEC 11801 and EN50173-1



Description	Sheath	Colour	Part No.
F/FTP 4pr Cat 6a (500m)	Cca	White	884035958/16

12.2.2 Telecom cables

1600 Cca Telecoms Cable and Cat 5e 4pair Cca telecom cable

Comtec standard telecoms grade cable is used for low speed voice and data transmission. It comes in 1 to 100 pairs and is over sheathed to provide a Cca cable.



Description	Sheath	Colour	Part No.
Cat 5e Cca 305m	Cca	White	Comtec 820814
CW1600 10pr	Cca	White	Comtec 810101
CW1600 20pr	Cca	White	Comtec 795605

CW1600 30pr	Cca	White	Comtec 814943
CW1600 50pr	Cca	White	Comtec 810102
CW1600 100pr	Cca	White	Comtec 814945

12.3 Copper Jacks and Patch Panels

12.3.1 CommScope– Cat 6a

CAT 6A SLX Shielded SL Jack 180 Deg

Category 6A performance jack. Adapters and faceplates to be purchased separately.



Description	Pack Qty	Colour	Part No.
Cat 6A jack shielded	1	Silver	2153449-2

12.3.2 CommScope– Cat 6 adapters and faceplates

Adapters

Range of adapters to suit different faceplates. Purchase jacks and faceplates separately.



Description	Pack Qty	Colour	Part No.
Single shuttered angled 25x50mm module	1	White	6540/1/802/00

Note – Photo shows a straight LJ6C adapter but all adapters shall be 25x50 with a 45^0 presentation.

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Faceplates

Euro style faceplate 25x50mm faceplate.

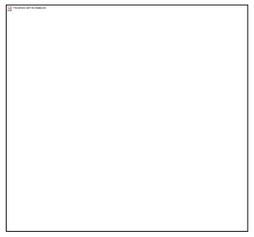


Description	Pack Qty	Colour	Part No.
Cat 6 Faceplate Double 50mm	1	White	1711399-1

12.3.1 CommScope– Cat 6 for the patch panels

CAT 6A SLX Shielded SL Jack 180 Deg

Category 6A performance jack. Adapters and faceplates to be purchased separately.



Description	Pack Qty	Colour	Part No.
Cat 6A jack shielded	1	Silver	2153449-2

Shielded CAT 6/6A Patch Panel

High density19" 1U Category 6/6A straight performance shielded patch panel. Supplied without jacks. Integral cable management and labelling field.



Description	Pack Qty	Colour	Part No.
24 port unloaded quick fit patch panel	1	Black	760237046
Saddle and Velcro strap kit	1	Silver	760229179

12.4 Copper Patchcords

All copper patchcords contained within the scope of the structured cabling shall be constructed of 4 pair Category 6 or 6a and be compliant to component specification to ISO/IEC 11801:2002, EN 50173:2002 and TIA/EIA 568-B.2-1. The patch cords shall be booted.

The product sets shall be as follows:

12.4.1 CommScope– Cat 6 and 6a

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UTP Cat 6 and 6a Patchcords

Range of Category 6 and 6a patchcords available in various cable types, and lengths.



Cat 6a patch cord 0.5m S/FTP LSOH	NPC6ASZDB-WT050M
Cat 6a patch cord 1m S/FTP LSOH	NPC6ASZDB-WT001M
Cat 6a patch cord 2m S/FTP LSOH	NPC6ASZDB-WT002M
Cat 6a patch cord 3m S/FTP LSOH	NPC6ASZDB-WT003M
Cat 6a patch cord 5m S/FTP LSOH	NPC6ASZDB-WT005M

Colour coding for cat 6a – XX = 15 White, 16 Blue, 17 Grey, 18 Yellow, 19 Red, 20 Green – other colours available on request but with minimum order quantities

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12.5 Fibre Cables and Tubes

All fibre cables contained within the scope of the structured cabling shall be constructed of 50/125µm (multimode) and 8/125µm (singlemode) and be compliant to component specification to ISO/IEC 11801:2002, EN 50173:2002 and TIA/EIA 568-B.2-1.

Fibre cables, for the purposes of this tender, shall be defined by cable type and whether internal or external to a building. Where a cable run is internal to a building tight buffered cable shall be used. This allows vertical runs between floors to be installed without the specialised strain relief required by loose tube.

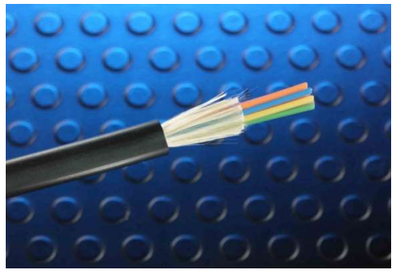
The product sets shall be as follows:

12.5.1 CommScope– Tight Buffered: recommended for internal applications

Tight Buffered Fibre Cable

4, 8, 12, 16 or 24 fibre multimode and singlemode distribution cable. Tight buffered, internal/external grade.

NB – For the purposes of this tender this cable shall be used **INTERNAL** to buildings.



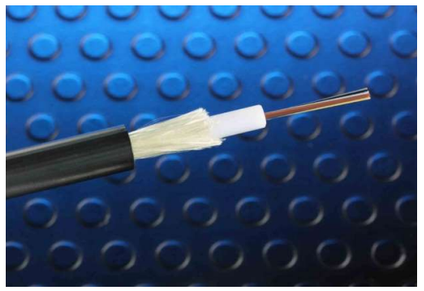
Description	4 Fibre	8 Fibre	12 Fibre
9/125µm	N/A	7023/3/228/08	N/A
Description	16 Fibre	24 Fibre	48 Fibre
9/125µm	N/A	N/A	N/A

12.5.2 CommScope– Loose Tube: recommended for external applications

Loose Tube Fibre Cable

4, 8, 12, 16 or 24 fibre multimode and singlemode distribution cable. Loose tube, internal/external grade.

NB – For the purposes of this tender this cable shall be used **EXTERNAL** to buildings.



Description	4 Fibre	8 Fibre	12 Fibre
9/125µm	N/A	N/A	N/A
Description	16 Fibre	24 Fibre	48 Fibre
9/125µm	N/A	N/A	7023/3/224/48

12.6 Fibre Cables

All fibre cables contained within the scope of the structured cabling shall be constructed of 9/125µm OS2 (single mode) or 50/125µm OM4 (multimode) and be compliant to component specification to ISO/IEC 11801:2002.

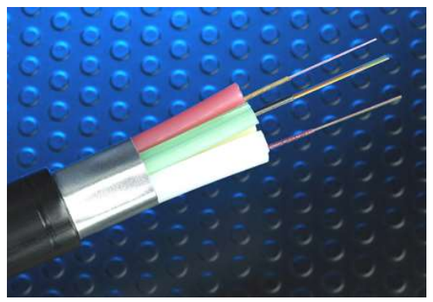
Fibre cables, for the purposes of this tender, shall be defined by cable type and whether internal or external to a building.

The product set shall be as follows:

12.6.1 CommScope– Blown Fibre

Blown Fibre OS2 4, 8 and 12 Core

4, 8 and 12 core OS2 grade 9/125 multimode blown fibre cable. Typical blowing distances of 1000m.

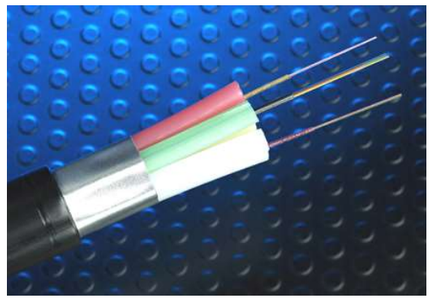


5	8 core OS2 blown fibre cable	2000m		
6	12 core OS2 blown fibre cable	2000m		

12.6.2 CommScope– Blown Fibre Tube

Blown Fibre Tubing

1, 2, 4, 7, and 19 way Blown Fibre Tubing. Available in LSOH, PVC, direct install (ducting) and direct buried.



Direct Install 4 way blown fibre tube	2000m	Black	
Direct Install 4 way blown fibre tube	1000m	Black	
Direct Install 4 way blown fibre tube	500m	Black	
Direct Install 7 way blown fibre tube	2000m	Black	
Direct Install 7 way blown fibre tube	1000m	Black	
Direct Install 4 way blown fibre tube	500m	Black	
LSOH 2 way blown fibre tube	500m	Grey	
LSOH 4 way blown fibre tube	500m	Grey	
LSOH 7 way blown fibre tube	500m	Grey	

12.7 Accessories

The product set shall be as follows:

12.7.1 CommScope – Blown Fibre accessories

Blown Fibre Accessories

A range of blown fibre tubing connectors and caps for internal and external use.



Description	Pack Qty	Part No.
Tube connector 5-5mm	10	7032/1/400/76
End cap 5mm	10	7032/1/400/72
Gas seal connector 5-5mm	10	
Tube sealing cap 5mm	10	7032/1/223/00
Reducer connector 8-5mm	10	7032/1/400/75

Customer Lead In Unit

Enables external cable to pass through the building fabric from an outside wall. Comprises of two separate units, an external and internal, connected by a length of conduit.



Description	Pack Qty	Part No.
Customer Lead In Unit	1	7032/1/400/85

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Gas Seal Unit

Seals external blown fibre tubing and acts as a demarcation between internal and external tubing. Positioned internal to the building at the tubing entry point.



Description	Pack Qty	Part No.
Gas Seal Unit	1	7032/1/400/86

Internal Distribution Unit

Used for the distribution and jointing of blown fibre tubing internal to a building.



Description	Pack Qty	Part No.
Internal distribution unit	1	7032/1/401/50

The cable sheath shall be constructed of LSOH material. The construction shall be tight buffered or loose tube and of internal/external grade. Cables running external shall use the existing ducting system, which cannot be guaranteed to be water of gas tight. It is required that the cable be specified for total immersion in water for lengthy periods of time and still meet the warranty period requested.

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12.8 Fibre Jacks

All fibre jacks contained within the scope of the structured cabling shall be constructed of 50/125µm (multimode) and 9/125µm (singlemode) and be compliant to component specification to ISO/IEC 11801:2002, EN 50173:2002 and TIA/EIA 568-B.2-1. The jack should be LC duplex construction with pigtail ferrules; direct termination is not an option for this tender. The quality of pigtail polishing shall be UPC for singlemode.

The product sets shall be as follows:

Split Metal Patch Panel 1U Metal patch panel with 2 off horizontal draws loaded with adapters	
Description	**Part No.**
LC singlemode	7033 1 015-01

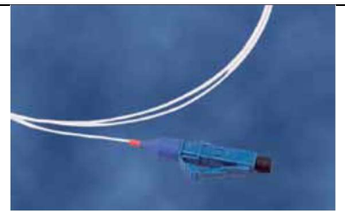
12.9 Fibre Patchcords and Pigtails

The product sets shall be as follows:

LC to LC OM3	 10
Description	**Part No.**
1m LC to LC patch cord OM3	6536969-1
2m LC to LC patch cord OM3	6536969-2
3m LC to LC patch cord OM3	6536969-3

LC to LC OS2	 17
Description	**Part No.**
1m LC to LC patch cord OS2	6536501-1
2m LC to LC patch cord OS2	6536501-2
3m LC to LC patch cord OS2	6536501-3

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Pigtails	24 
Description	**Part No.**
1m LC OS2 pigtail semi-tight	6536880-1
1m LC OM3 pigtail semi-tight	6536966-1

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12.10 Voice Boxes

All telecommunication box connections shall be manufactured by CommScope.

The product sets shall be as follows:

Connection Box 200 Series

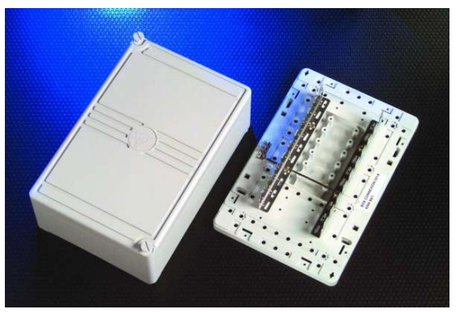
Plastic modular box, designed to accommodate 30, 50 and 70 pairs. Suitable for use with protection magazine and ComProtect over voltage protection.



Description	Qty	Dimensions	Part No.
29 220 Box for 3 LSA-PLUS® 10 pair modules	1	170(H)x120(W)x80(D)	6429/1/073/01
250/5 Box for 5 LSA-PLUS® 10 pair modules	1	210(H)x160(W)x90(D)	6525/1/022/00
250/7 Box for 7 LSA-PLUS® 10 pair modules	1	210(H)x160(W)x90(D)	6525/1/024/00

Connection Box 300 Series

Plastic modular box, designed to accommodate 100 and 250 pairs. Suitable for use with protection magazine and ComProtect over voltage protection.



Description	Qty	Dimensions	Part No.
301A Box for 10 LSA-PLUS® 10 pair modules	1	320(H)x210(W)x120(D)	6530/1/017/00
300 Box for 25 LSA-PLUS® 10 pair modules	1	640(H)x210(W)x120(D)	6428/1/290/00

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Connection Box 500 Series

Plastic modular box, designed to accommodate 340, 680, 1020 and 1360 pairs. Suitable for use with protection magazine and ComProtect over voltage protection.



Description	Qty	Dimensions	Part No.
510 Box for 34 LSA-PLUS® 10 pair modules	1	1000(H)x300(W)x130(D)	6532/2/009/00
520 Box for 68 LSA-PLUS® 10 pair modules	1	1000(H)x500(W)x130(D)	6532/2/010/00
530 Box for 102 LSA-PLUS® 10 pair modules	1	1000(H)x750(W)x130(D)	6532/2/011/00
540 Box for 136 LSA-PLUS® 10 pair modules	1	1000(H)x1000(W)x135(D)	6532/2/008/00

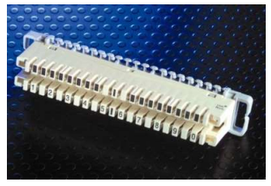
12.11 Voice 237 Modules

All telecommunication 237 modules shall be manufactured by CommScope.

The product sets shall be as follows:

Disconnection Module

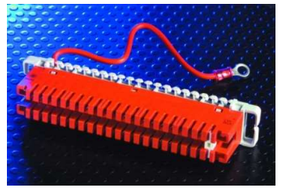
10 pair LSA-PLUS® modules which contain two piece contacts normally closed. Has advantage of individual pair disconnection and four wire test access.



Description	Pack Qty	Colour	Part No.
10 pair disconnection contacts	10	Cream	6089/1/810/00
10 pair disconnection contacts	10	Green	6089/1/811/00
10 pair disconnection contacts	10	Blue	6089/1/812/00

Earth Module

LSA-PLUS® modules with a one piece contact and earthing rail accommodating up to 2 identical wires per slot.



Description	Pack Qty	Colour	Part No.
76 way, earth lead and terminal ring	10	Red	6089/1/840/00
20 way, earth lead and terminal ring	10	Green	6089/1/841/00

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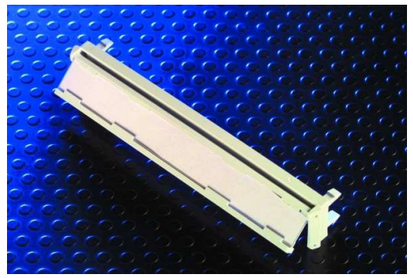
12.12 Voice 10 Pair Label Holders and Labels

All telecommunication label holders shall be manufactured by CommScope.

The product sets shall be as follows:

LSA-PLUS® Label Holder

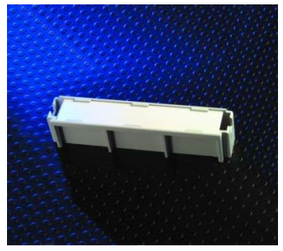
Label holders for mounting on 10 pair LSA-PLUS® modules. No need to remove when using test plugs or inserting jumper wires. Labels can be ordered separately.



Description	Pack Qty	Colour	Part No.
Double sided hinged label holder	10	Grey	6092/1/810/00
Double sided hinged label holder	10	Green	6092/1/811/00
Double sided hinged label holder	10	Blue	6092/1/812/00

Backmount Label Holder

Label holders for mounting directly onto backmount frames. Used to identify blocks of LSA-PLUS® modules fed by specific cables and or buildings, floor areas, etc.



Description	Pack Qty	Colour	Part No.
Label holder complete with label, fits on one position on backmount frame	10	Grey	6092/1/820/00

Vertical Label Holder

Label holders for mounting directly onto backmount frames. Used to identify a vertical backmount. Shall be positioned at the top or bottom of the frame.



Description	Pack Qty	Colour	Part No.
Label holder complete with label, fits on one position on backmount frame	100	Grey	6092/1/830/00

12.13 Lightning Protection

All telecommunication lightning protectors shall be manufactured by CommScope.

The product sets shall be as follows:

Pole Arrester

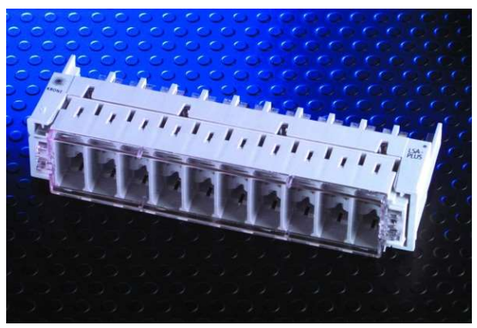
3 pole over voltage arresters.



Description	Pack Qty	Part No.
200V-5A/5KA with failsafe 21A.	100	6535/1/010/00

Protector Magazine

For 3 pole over voltage arresters, plugs into LSA-PLUS disconnection and connection modules.



Description	Pack Qty	Part No.
10 pair, fitted with clear cover magazine.	10	6535/1/010/00

12.14 Converters

All telecommunication converters shall be manufactured by CommScope.

The product sets shall be as follows:

Outlet Converters

Converters enable telecommunications equipment fitted with standard BT phone plugs to be connected to RJ45 based structured cabling systems.



Description	Pack Qty	Part No.
Standard 258A PABX master	10	6536/1/601/16
Standard 258A secondary	10	6536/1/601/18

Flying Lead Outlet Converters

Converters enable telecommunications equipment fitted with standard BT phone plugs to be connected to RJ45 based structured cabling systems.



Description	Pack Qty	Part No.
Flying lead 258A PABX master	10	6536/1/601/10
Flying lead 258A secondary	10	6536/1/601/12

12.15 Frames/Cabinets

Frames are required unless shared occupation applies.

All frames shall be Ortronics Mighty Mo 20

The product set will be as follows:





NBS Specifications - IBI

MHP2-IBI-XX-XX-SP-A-800-025 Rev: P0

Morriston Environmental Modernisation - Phase 2

E40 - Designed joints in in situ concrete RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/16	First issue.	P0

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

E40 Designed joints in in situ concrete.....1

E40
Designed joints in in situ concrete

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Phase 2

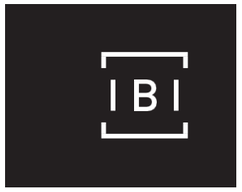
E40
DESIGNED JOINTS IN IN SITU CONCRETE

TO BE READ WITH PRELIMINARIES/GENERAL CONDITIONS.

320 HYDROPHILIC WATERSTOPS TYPE A

1. Manufacturer: Newton Waterproofing Systems
   - Contact details
     - Address: Newton House
       17-20 Sovereign Way
       Tonbridge
       Kent
       TN9 1RH
     - Telephone: +44 (0)1732 360095
     - Web: www.newtonwaterproofing.co.uk
     - Email: info@newtonwaterproofing.co.uk
   - Product reference: Newton 315 Polymer Waterbar
2. Cross Section:
3. Density / Specific gravity: 1.26.
4. CoilLength: 10 and 20 m.
5. Shelf life: 24 months.
6. Hardness: Shore A.
7. Melting point: 110.
8. Application temperature: 5–40°C.
9. Service temperature: -30°C to +60°C.
10. Minimum required concrete cover: 80 and 50 mm.
11. VOC content: None.
12. Initial delay of swelling: 7 days.
13. Full swell achieved: 28 days.
14. Increase in mass (Neutral water - 7 pH): 900%.
15. Increase in mass (High alkaline water - 12.5pH): 350%.
16. Increase in mass (Aggressive water - DIN 4030): 330%.
17. Max swelling pressure (confined within joint): 2.8 N/mm².
18. Water resistance (tested): 5.0 bar.
19. Working water resistance (safety factor of 2.5): 2.0 bar.
20. Reaction to fire classification: B2 Euroclass.





CONTACT US

London, Manchester, Brighton, Cardiff,
Birmingham, Newark, Glasgow, Dublin

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MHP2-IBI-XX-XX-SP-A-800-030 Rev: P1

Morriston Environmental Modernisation - Phase 2

F10 - Brick/ block walling RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/16	Issued for RIBA Stage 4.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

F10 Brick/ block walling UNCHANGED 1

F10
BRICK/ BLOCK WALLING UNCHANGED

TYPES OF WALLING

110 CLAY FACING BRICKWORK

1. Description: Facing brickwork; for use above and below ground
2. Bricks: To BS EN 771-1.
   - Manufacturer: Wienerberger,
     Wienerberger House,
     Cheadle Royal Business Park,
     Brooks Drive,
     Cheadle,
     Cheshire, SK8 3SA
     T: 0161 491 8200
     - Product reference: Nevada Buff
   - Recycled content: None permitted
   - Special shapes: None
3. Mortar: As section Z21.
   - Standard: To BS EN 998-2
   - Mix: 1:1:6 cement:lime:sand 4 N/mm² (class M4) - premixed
   - Additional requirements: Colour: Y99 Marigold
4. Bond: Half lap stretcher
5. Joints: Bucket handle
6. Features: As indicated on design drawing

355 CONCRETE COMMON BLOCKWORK

1. Description: For internal leaf of external wall and internal partitions
2. Blocks: To BS EN 771-3.
   - Manufacturer: Contractor's choice
     - Product reference: Submit proposals
   - Configuration: Group 1
   - Compressive strength
     - Mean value: 7.3 N/mm²
     - Characteristic value: 7.3 N/mm²
     - Category: II
   - Freeze/ thaw resistance: Suitable for exposed external use below dpc
   - Thermal properties: Thermal conductivity: 1.17 W/mK
   - Recycled content: None permitted
   - Work sizes (length x width x height): 440 x 100 x 65 (for coursing)
     440 x 140 x 65 (for coursing)
     440 x 100 x 215
     440 x 140 x 215
     - Tolerance category: D1
   - Special shapes: Coursing blocks
3. Mortar: As section Z21.
   - Standard: To BS EN 998-2
   - Mix: 1:5 masonry cement:sand 4 N/mm² (class M4)

4. Bond: Half lap stretcher

TESTING

410 COMPRESSIVE STRENGTH OF MORTAR FOR EACH WALLING TYPE

1. Testing authority: A UKAS Accredited laboratory
2. Test method: To BS EN 1015-11.
3. Preliminary tests procedure: As follows:
   - Specimens
     - Number of specimens: 6.
     - Type: 40 x 40 x 160 mm prism.
     - Preparation: At least six weeks before walling commences.
   - Specimen testing: Half of specimens at 7 days. Remainder at 28 days.
     - Retarded mixes: Extend curing periods to include retardation period.
   - Response to result: If mean compressive strength at 28 days is not within the range given below repeat tests with more suitable sand or next higher …….
4. Site tests procedure: As follows.
   - Number of specimens: Six per 150m² of walling or per storey whichever the more frequent.
   - Specimen types: As preliminary test, but prepared during construction.
   - Specimen testing: Half of specimens at 7 days. Remainder at 28 days.
     - Retarded mixes: Extend curing periods to include retardation period.
5. Required test mean compressive strength at 28 days (N/mm²): To be within the following range:
   - Walling type: As noted in clauses 110 and 355
6. Results: Submit.

415 FRESH MORTAR CEMENT CONTENT

1. Test method: BREMORTEST in accordance with Building Research Establishment Information Paper 8/89
2. Test specimens: Test mortar for the following wall types: F10/ 110 & 355 .
3. Results: Submit.

WORKMANSHIP GENERALLY

430 CONDITIONING OF CLAY BRICKS AND BLOCKS

1. Bricks and blocks delivered warm from manufacturing process: Do not use until cold.
2. Absorbent bricks in warm weather: Wet to reduce suction. Do not soak.

440 CONDITIONING OF CONCRETE BRICKS/ BLOCKS

1. Autoclaved concrete bricks/ blocks delivered warm from manufacturing process: Do not use.
2. Age of nonautoclaved concrete bricks/ blocks: Do not use until at least four weeks old.
3. Avoidance of suction in concrete bricks/ blocks: Do not wet.
   - Use of water retaining mortar admixture: Submit details.

460 MORTAR DESIGNATIONS

1. Mix proportions: For a specified designation select a mix from the following:
   - Designation (i) (BS EN 998-2 M12 equivalent)
     - 1:0-¼:3 (Portland cement:lime:sand with or without air entraining additive).

- 1:3 (Portland cement:sand and air entraining additive).

- Designation (ii) (BS EN 998-2 class M6 equivalent)
  - 1:½:4-5 (Portland cement:lime:sand with or without air entraining additive).
  - 1:3 (masonry cement:sand containing Portland cement and lime in approximate ratio 1:1, and an air entraining additive).
  - 1:2½-3½ (masonry cement:sand containing Portland cement and inorganic materials other than lime and air entraining additive).
  - 1:3-4 (Portland cement:sand and air entraining additive).
- Designation (iii) (BS EN 998-2 class M4 equivalent)
  - 1:1:5-6 (Portland cement:lime:sand with or without air entraining additive).
  - 1:3½-4 (masonry cement:sand containing Portland cement and lime in approximate ratio 1:1, and an air entraining additive).
  - 1:4-5 (masonry cement:sand containing Portland cement and inorganic materials other than lime and air entraining additive).
  - 1:5-6 (Portland cement:sand and air entraining additive).
- Designation (iv) (BS EN 998-2 class M2 equivalent)
  - 1:2:8-9 (Portland cement:lime:sand with or without air entraining additive).
  - 1:4½ (masonry cement:sand containing Portland cement and lime in approximate ratio 1:1, and an air entraining additive).
  - 1:5½-6½ (masonry cement:sand containing Portland cement and inorganic materials other than lime and air entraining additive).
  - 1:7-8 (Portland cement:sand and air entraining additive).

2. Batching: Mix proportions by volume.
3. Mortar type: Continuous throughout any one type of masonry work.

500 LAYING GENERALLY

1. Mortar joints: Fill vertical joints. Lay bricks, solid and cellular blocks on a full bed.
2. Clay block joints
   - Thin layer mortar: Lay blocks on a full bed.
   - Interlocking perpends: Butted.
3. Bond where not specified: Half lap stretcher.
4. Vertical joints in brick and concrete block facework: Even widths. Plumb at every fifth cross joint.

520 ACCURACY

1. Courses: Level and true to line.
2. Faces, angles and features: Plumb.
3. Permissible deviations
   - Position in plan of any point in
4. relation to the specified building
5. reference line and/ or point at
6. the same level ± 10 mm.
   - Straightness in any 5 m length ± 5 mm.
   - Verticality up to 3 m height ± 10 mm.
   - Verticality up to 7 m height ± 14 mm.
   - Overall thickness of walls ± 10 mm.
   - Level of bed joints up to 5 m

7. (brick masonry) ± 11 mm.
   - Level of bed joints up to 5 m
8. (block masonry) ± 13 mm.

535 HEIGHT OF LIFTS IN WALLING USING CEMENT GAUGED OR HYDRAULIC LIME MORTAR

1. Quoins and advance work: Rack back.
2. Lift height (maximum): 1.2 m above any other part of work at any time.
3. Daily lift height (maximum): 1.5 m for any one leaf.

545 LEVELLING OF SEPARATE LEAVES

1. Locations for equal levelling of cavity wall leaves: As follows:
   - Every course containing vertical twist type ties or other rigid ties.
   - Every third tie course for double triangle/ butterfly ties.
   - Courses in which lintels are to be bedded.

560 COURSING BRICKWORK

1. Gauge: Four brick courses including bed joints to 300 mm.

580 LAYING FROGGED BRICKS

1. Single frogged bricks: Frog uppermost.
2. Double frogged bricks: Larger frog uppermost.
3. Frog cavity: Fill with mortar.

585 LAYING CELLULAR BRICKS

1. Orientation: Cavities downward.

595 LINTELS

1. Bearing: Ensure full length masonry units occur immediately under lintel ends.

615 BRICKWORK TO RECEIVE ASPHALT DPC

1. Substrate: Mortar bed finished flush, smooth and level.

635 JOINTING

1. Profile: Consistent in appearance.

645 ACCESSIBLE JOINTS NOT EXPOSED TO VIEW

1. Jointing: Struck flush as work proceeds.

665 POINTING

1. Description: TO WALLING TYPE F10/110
2. Joint preparation: Remove debris. Dampen surface.
3. Profile: Bucket handle

666 POINTING

1. Description: TO WALLING TYPE F10/355
2. Joint preparation: Remove debris. Dampen surface.
3. Profile: Bucket handle Flush

671 FIRE STOPPING

1. Avoidance of fire and smoke penetration: Fit tightly between cavity barriers and masonry. Leave no gaps.

690 ADVERSE WEATHER

1. General: Do not use frozen materials or lay on frozen surfaces.
2. Air temperature requirements: Do not lay bricks/ blocks:
   - In cement gauged mortars when at or below 3°C and falling or unless it is at least 1°C and rising.
   - In hydraulic lime:sand mortars when at or below 5°C and falling or below 3°C and rising, or as manufacturer's/ supplier's recommendations.
   - In thin layer mortars when outside the limits set by the mortar manufacturer.
3. Temperature of walling during curing: Above freezing until hardened.
4. Newly erected walling: Protect at all times from:
   - Rain and snow.
   - Drying out too rapidly in hot conditions and in drying winds.

ADDITIONAL REQUIREMENTS FOR FACEWORK

710 THE TERM FACEWORK

1. Definition: Applicable in this specification to brick/ block walling finished fair.
   - Painted facework: The only requirement to be waived is that relating to colour.

730 BRICK/ CONCRETE BLOCK SAMPLES

1. General: Before placing orders with suppliers submit for approval of appearance labelled samples of the following: F10/110 .
2. Selection of samples: Representative of the range in variation of appearance.

740 FINISHED MASONRY WORK REFERENCE PANELS

1. General: Before proceeding to construct the following walling types, construct panels as specified. Give notice when panels are dry.
2. Selection of masonry units: Reasonably representative of the average quality of the whole order to be delivered
3. Panel types
   - Walling type: F10/110
     - o Location: Within site compound, to suit contractor's preferred location
     - o Size: 1.5 x 1.5 m

750 COLOUR CONSISTENCY OF MASONRY UNITS

1. Colour range: Submit proposals of methods taken to ensure that units are of consistent and even appearance within deliveries.
2. Conformity: Check each delivery for consistency of appearance with previous deliveries and with approved reference panels; do not use if variation is excessive.
3. Finished work: Free from patches, horizontal stripes and racking back marks.

760 APPEARANCE

1. Brick/ block selection: Do not use units with damaged faces or arrises.
2. Cut masonry units: Where cut faces or edges are exposed cut with table masonry saw.
3. Quality control: Lay masonry units to match relevant reference panels.
   - Setting out: To produce satisfactory junctions and joints with built-in features and components.
   - Coursing: Evenly spaced using gauge rods.
4. Lifts: Complete in one operation.

F10
Brick/ block walling

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5. Methods of protecting facework: Submit proposals.

780 GROUND LEVEL

1. Commencement of facework: Not less than 150 mm below finished level of adjoining ground or external works level.

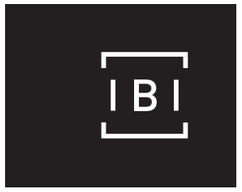
790 PUTLOG SCAFFOLDING

1. Use: Not permitted in facework.

830 CLEANLINESS

1. Facework: Keep clean.
2. Mortar on facework: Allow to dry before removing with stiff bristled brush.
3. Removal of marks and stains: Rubbing not permitted.





CONTACT US

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MHP2-IBI-XX-XX-SP-A-800-035 Rev: P1

Morriston Environmental Modernisation - Phase 2

F30 - Accessories/ sundry items for brick/ block walling RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/16	Clauses 155, 183 and 251 added. RIBA Stage 4 issue.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

F30 Accessories/ sundry items for brick/ block/ stone walling REVISED 1

F30
ACCESSORIES/ SUNDRY ITEMS FOR BRICK/ BLOCK/ STONE WALLING

REVISED

CAVITIES

110 CONCRETE FILL TO BASE OF CAVITY

1. Concrete generally: To BS EN 206 and BS 8500-2.
2. Concrete type: Designated GEN1
   - Workability: High.
3. Extent: Maintain 75 mm between top of fill and external ground level and a minimum of 225 mm between top of fill and ground level dpc.
4. Placement: Compact to eliminate voids.

120 CLEANLINESS

1. Cavity base and faces, ties, insulation and exposed dpcs: Free from mortar and debris.

130 PERPEND JOINT WEEP HOLES

1. Form: Open perpend joint.
2. Locations: Through outer leaf immediately above base of cavity, at cavity trays, stepped dpcs and external openings. 75 mm above top of cavity fill at base of cavity.
3. Provision: At not greater than 1000 mm centres and not less than two over each opening.

131 BED JOINT WEEP HOLES

1. Form: Open 10 mm diameter hole.
2. Locations: Through outer leaf immediately above base of cavity at cavity trays, stepped dpcs and external openings. 75 mm above top of cavity fill at base of cavity.
3. Provision: At not greater than 1000 mm centres and not less than two over each opening.

133 PERPEND JOINT PLASTICS WEEP HOLES

1. Manufacturer: Cavity Trays Ltd
   - Contact details
     - Address: Administration Centre
       Lufton Trading Estate
       Yeovil
       Somerset
       BA22 8HU
     - Telephone: +44 (0)1935 474769
     - Web: www.cavitytrays.com
     - Email: enquiries@cavitytrays.co.uk
   - Product reference: Type W Cavitray Weepvent
2. Colour: Clear.
3. Execution: Installing perpend joint plastics weep holes.
4. Duct extension: Not required.
5. Render front cover: Not required.
6. Free airflow: 320 mm².
7. Locations: Through outer leaf immediately above base of cavity, at cavity trays, stepped dpcs and external openings. 75 mm above top of cavity fill at base of cavity.
8. Provision: At not greater than 1000 mm centres and not less than two over each opening.

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Accessories/ sundry items for brick/ block/ stone walling

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155 PARTIAL FILL CAVITY INSULATION [BELOW DPC LEVEL] ADDED

1. Manufacturer: Kingspan Insulation
   - Contact details
     - Address: Kingspan Insulation Ltd
       Pembridge
       Leominster
       Herefordshire
       HR6 9LA
     - Telephone: +44 (0)1544 388601
     - Web: www.kingspaninsulation.co.uk
     - Email: info@kingspaninsulation.co.uk
   - Product reference: Kingspan Kooltherm K106 Cavity Board
2. Third party product certification: British Board of Agrément (BBA) Certification.
3. Fire performance: To BS EN 13501-1, class E.
4. Thermal conductivity (maximum): 0.018 W/m·K.
5. Cross section: Uniform thickness.
6. Thickness: 50mm
7. Face size (length x width): 1200 x 450 mm.
8. Compressive strength (minimum) at 10% compression: 100 kPa.
9. Edges: Square.
10. Facing: Outer facing - watertight, vapour-open polypropylene fleece; Inner facing - low emissivity composite foil.
11. Global warming potential: Less than 5.
12. Ozone depletion potential: Zero.
13. Core: Rigid thermoset fibre-free phenolic insulant core.
14. Additional requirements: Wall to be fully waterproofed prior to bonding insulation against wall. Insulation to receive a minimum 1200 gauge damp proof membrane over, fully lapped, taped and sealed prior to construction of new external face brickwork.

156 PARTIAL FILL CAVITY INSULATION

1. Manufacturer: ROCKWOOL Ltd
   - Contact details
     - Address: ROCKWOOL Ltd
       14th Floor, Chiswick Tower
       389 Chiswick High Road
       London
       W4 4AJ
     - Telephone: +44 (0)1656 862621
     - Web: www.rockwool.co.uk
     - Email: info@rockwool.com
   - Product reference: ROCKWOOL HP Partial Fill Cavity Slabs
2. Standard: BS EN 13162, ISO 14001, EN 13501-1
3. Thickness: 50 mm
4. Thermal conductivity (maximum): 0.034 W/mK
5. Fire performance: Non-combustible (Class A1 to BS EN 13501-1)
6. Water vapour resistance: Negligible
7. Reaction to fire class: A1

8. Additional requirements: None
9. Placement: Secure against face of inner leaf.
   - Residual cavity: Clear and unobstructed.
10. Joints between boards, at closures and penetrations: No gaps and free from mortar and debris.

181 CAVITY CLOSERS

1. Manufacturer: Dacatie Building Solutions, product brand of Quantum Profile Systems Ltd
   - Contact details
     - Address: Quantum Profile Systems Ltd
       Salmon Fields
       Royton
       Oldham
       Lancashire
       OL2 6JG
     - Telephone: +44 (0)161 627 4222
     - Web: www.dacatie.co.uk
     - Email: sales@dacatie.co.uk
   - Product reference: Dacatie 1 Hour Fire Rated XFR2000 Fire Cavity Barrier for Window and Door Reveals
2. Type: XFR2000 Cavity Closer 110
3. Accessories: To include integral dpc .
   To include integral fixing cramp.
   To include integral insulation

182 CAVITY CLOSERS

1. Manufacturer: ROCKWOOL Ltd
   - Contact details
     - Address: ROCKWOOL Ltd
       14th Floor, Chiswick Tower
       389 Chiswick High Road
       London
       W4 4AJ
     - Telephone: +44 (0)1656 862621
     - Web: www.rockwool.co.uk
     - Email: info@rockwool.com
   - Product reference: ROCKWOOL TCB Cavity Barrier
2. Fire performance: Euroclass A1 non-combustible. Fire resistance
3. Thickness: 110 mm

183 CAVITY CLOSERS ADDED

1. Manufacturer: ROCKWOOL Ltd
   - Contact details
     - Address: ROCKWOOL Ltd
       14th Floor, Chiswick Tower
       389 Chiswick High Road
       London
       W4 4AJ
     - Telephone: +44 (0)1656 862621
     - Web: https://www.rockwool.com/uk/

     - Email: info@rockwool.com
   - Product reference: ROCKWOOL® SP 60 FireStop Slab®
2. Fire performance: Up to one hour to BS 476-20 and BS EN 1366-4; Euroclass A1 non-combustible.
3. Length x width: 1000 x 650 mm.
4. Thickness: 75 mm.
5. Attachment:

REINFORCING/ FIXING ACCESSORIES

216 CAVITY WALL TIES USED WITH PARTIAL FILL INSULATION

1. Manufacturer: Leviat
   - Contact details
     - Address: President Way
       President Park,
       Sheffield
       South Yorkshire
       S4 7UR
     - Telephone: +44 (0) 114 275 5224
     - Web: www.leviat.com
     - Email: info.uk@leviat.com
   - Product reference: Ancon Teplo-BF Wall Tie
2. Tie type: Teplo-BF2.
3. Length: 225 mm.
4. Material/ finish: Basalt fibres set in a resin matrix
5. Tie mounted insulation retaining clips: Ancon Teplo clip

225 FIXING TIES IN MASONRY CAVITY WALLS

1. Embedment in mortar beds (minimum): 50 mm.
2. Placement: Sloping slightly downwards towards outer leaf, without bending. Drip centred in the cavity and pointing downwards.
3. Spacing: Staggered in alternate courses.
   - Horizontal centres: 900 mm
   - Vertical centres: 450 mm
4. Provision of additional ties: Within 225 mm of reveals of unbonded openings and at the vertical reveals of unsupported masonry.
   - Spacing: At not more than 300 mm centres vertically

241 WALL STARTERS/ CONNECTORS TYPE A

1. Manufacturer: Leviat
   - Contact details
     - Address: President Way
       President Park,
       Sheffield
       South Yorkshire
       S4 7UR
     - Telephone: +44 (0) 114 275 5224
     - Web: www.leviat.com
     - Email: info.uk@leviat.com

- Product reference: Ancon 36/8 Wall Extension System

2. Material: Stainless steel grade 1.4301 (304).
3. Tie type: Channel and ties.
4. Sizes
   - Channel length: 2400 mm long channel section.
5. Accessories: Complete with ten ties (SP36 or PP36 ties complete with debonding sleeve), plugs and screws. A debonding sleeve can be supplied.
6. Wall extension kit: Required.

251 WALL HEAD RESTRAINT SLIP TIES TYPE A ADDED

1. Manufacturer: Leviat
   - Contact details
     - Address: President Way
       President Park,
       Sheffield
       South Yorkshire
       S4 7UR
     - Telephone: +44 (0) 114 275 5224
     - Web: www.leviat.com
     - Email: info.uk@leviat.com
   - Product reference: IHR-V Head Restraint
2. Material: Austenitic stainless steel.
3. Length:

255 WIND POSTS

1. Standard: To BS EN 1090-1
2. Manufacturer: Submit proposals
   - Product reference: Submit proposals
3. Material: Steel to European Standards indicated in BS EN 1090-2
4. Sizes: Refer to Structural Engineer's requirements and details
5. Fixings (complete with washers and shims): Resistance to water crossing cavity: Resistant

283 SLIP TIES

1. Manufacturer: Leviat
   - Contact details
     - Address: President Way
       President Park,
       Sheffield
       South Yorkshire
       S4 7UR
     - Telephone: +44 (0) 114 275 5224
     - Web: www.leviat.com
     - Email: info.uk@leviat.com
   - Product reference: Ancon Movement/ Lateral Restraint Slip Ties
2. Material: Austenitic stainless steel.
3. Length: 125 mm.
4. Type: Ancon PPS wall tie.

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FLEXIBLE DAMP PROOF COURSES/ CAVITY TRAYS

331 DAMP PROOF COURSES

1. Manufacturer: Visqueen
   - Contact details
     - Address: Visqueen
       Heanor Gate Industrial Estate
       Heanor
       Derbyshire
       DE75 7RG
     - Telephone: +44 (0) 333 202 6800
     - Web: www.visqueen.com
   - Product reference: Visqueen Zedex CPT High Performance DPC
2. Material: Co-polymer thermoplastic.
3. Third party certification: British Board of Agrément certified, 94/3059 / CE Mark EN 14909.
4. Colour: Black.
5. Accessories: DPC jointing tape.
   Detailing strip.
6. Length: 20 000 mm.
7. Mass: 750 g/m².
8. Joint strength: 220 N.
9. TensileStrength: 14 Mpa.
10. Elongation: 500%.
11. Reaction to fire: F Class.
12. Tensile strength MD: 17 Mpa.
13. Resistance to static loading - 20kg load: <20 kg.
14. Application temperature: In accordance with manufacturers specification and recommendations

346 SITE FORMED FLEXIBLE SHEET CAVITY TRAYS – PLASTICS

1. Manufacturer: Delta Membrane Systems Ltd
   - Contact details
     - Address: Delta House
       Merlin Way
       North Weald
       Epping
       Essex
       CM16 6HR
     - Telephone: +44 (0)1992 523523
     - Web: www.deltamembranes.com
     - Email: info@deltamembranes.com
   - Product reference: Delta® High Performance DPC
2. Thickness: 1.25 mm
3. Roll width: To suit installation requirements
4. Colour: Black

381 JUNCTION CLOAKS/ STOP ENDS FOR PREFORMED DPCS/ CAVITY TRAYS

1. Manufacturer: Delta Membrane Systems Ltd
   - Contact details

- Address: Delta House
  Merlin Way
  North Weald
  Epping
  Essex
  CM16 6HR
- Telephone: +44 (0)1992 523523
- Web: www.deltamembranes.com
- Email: info@deltamembranes.com

2. Profile: Stop end.
   Top hat
3. Product reference: Delta High Performance Preformed Units

INSTALLATION OF DPCS/ CAVITY TRAYS

415 INSTALLATION OF HORIZONTAL DPCS

1. Placement: In continuous lengths on full even bed of fresh mortar, with 100 mm laps at joints and full laps at angles.
2. Width: At least full width of leaf unless otherwise specified. Edges of dpc not covered with mortar or projecting into cavity.
3. Overlying construction: Immediately cover with full even bed of mortar to receive next masonry course.
4. Overall finished joint thickness: As close to normal as practicable.

425 INSTALLATION OF GROUND LEVEL DPCS

1. Joint with damp proof membrane: Continuous and effectively sealed.

435 INSTALLATION OF STEPPED DPCS IN EXTERNAL WALLS

1. External walls on sloping ground: Install dpcs not less than 150 mm above adjoining finished ground level.

445 INSTALLATION OF SILL DPCS

1. Form and placement: In one piece and turned up at back when sill is in contact with inner leaf.

475 INSTALLATION OF SITE FORMED CAVITY TRAYS

1. Requirements to prevent downward ingress of water
   - Profiles: To match those shown on drawings. Firmly secured.
   - Joint treatment: Use continuous length wherever possible, otherwise lap at least 100 mm and seal to produce a free draining and watertight installation.
   - Horizontal cavity trays: Support using cavity closer.
   - Sloping cavity trays: Prevent sagging.
   - Cleanliness: Free from debris and mortar droppings.

485 INSTALLATION OF CAVITY TRAYS OVER OPENINGS AND OTHER CAVITY BRIDGINGS

1. Length: To extend not less than 150 mm beyond ends of lintels/ bridgings.

495 INSTALLATION OF GAS RESISTANT DPCS/ CAVITY TRAYS

1. Joint treatment: Use continuous length wherever possible, otherwise lap at least 150 mm and seal to form a gas and watertight installation.
2. Joint with damp proof membrane: Overlap dpc/ cavity tray not less than 150 mm.

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525 DPC/ CAVITY TRAY LEADING EDGE IN FACEWORK – SET BACK

1. Treatment at face of masonry: Set back 5 mm from face of wall with recessed mortar joint to expose edge at the following locations: At window and door heads .

535 DPC/ CAVITY TRAY LEADING EDGE IN FACEWORK - PROJECTING

1. Treatment at face of masonry: Projecting 5 mm from face of wall at the following locations: At ground level .

560 INSTALLATION OF VERTICAL DPCS

1. Form: In one piece wherever possible.
   - Joints: Upper part overlapping lower not less than 100 mm.

570 INSTALLATION OF JAMB DPCS AT OPENINGS

1. Joint with cavity tray/ lintel at head: Full underlap.
2. Joint with sill/ horizontal dpc at base: Full overlap.
3. Projection into cavity: Not less than 25 mm.
4. Relationship with frame: In full contact.

580 INSTALLATION OF JAMB DPCS TO BUILT-IN TIMBER FRAMES

1. Fixing: Securely fastened to back of frame.
   - Fasteners: Galvanized clout nails or staples.

JOINTS

610 MOVEMENT JOINTS WITH SEALANT

1. Description: TO EXTERNAL FACING BRICKWORK AND INTERNAL FACING BLOCKWORK
2. Joint preparation and sealant application: As section Z22.
3. Filler: Closed cell polyethylene foam
   - Thickness: To match design width of joint.
   - Manufacturer: Submit proposals
     - Product reference: Submit proposals (fire resistant)
   - Placement: Build in as work proceeds with no projections into cavities and to correct depth to receive sealant system.
4. Sealant
   - Designation: ISO 11600-F-20LM
   - Manufacturer: Submit proposals
     - Product reference: Submit proposals (fire resistant)
   - Colour: To match adjoining brickwork or blockwork

630 UNEXPOSED CONTRACTION JOINTS

1. Formation: Close butt as work proceeds.

650 POINTING IN FLASHINGS

1. Joint preparation: Free of debris and lightly wetted.
2. Pointing mortar: As for adjacent walling.
3. Placement: Fill joint and finish flush.

660 PINNING UP TO SOFFITS

1. Top joint of loadbearing walls: Fill and consolidate with mortar.

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670 HEAD OF NON-LOADBEARING WALLS

1. Restraints: 75 x 100 mm channel of galvanized steel sheet to BS EN 10346 fixed to metal deck with self-tapping screws at 600 mm centres
   - Fixing: Secure to soffit.
2. Joint filler: Required to provide fire resistance (e.g. Siderise TW)
   - Placement: Full, no gaps.

PROPRIETARY SILLS/ LINTELS/ COPINGS/ DRESSINGS

735 PRECAST CONCRETE LINTELS

1. Standard: To BS EN 845-2.
2. Manufacturer: Naylor Concrete Products Ltd.,
   Whaley Road, Barugh Green
   Barnsley, South Yorkshire
   S75 1HT.
   T: 01226 320810
   E: technical@naylor.co.uk
   - Product reference: Naylor Ultra-Fire Lintels
3. Types: Single
4. Sizes: As schedule
5. Additional requirements: As schedule
6. Placement: Bed on mortar used for adjacent work.
   - Bearing length (minimum): 150 mm

756 PREFABRICATED STEEL LINTELS

1. Manufacturer: Keystone Lintels Ltd
   - Contact details
     - Address: Ballyreagh Industrial Estate
       Sandholes Road
       Cookstown
       County Tyrone
       BT80 9DG
     - Telephone: +44 (0)28 8676 2184
     - Web: www.keystonelintels.co.uk
     - Email: info@keystonelintels.co.uk
   - Product reference: HT/S- 100
2. Length: As schedule

MISCELLANEOUS ITEMS

850 WALL PLATES

1. Placement: On full bed of mortar to correct horizontal level.

DELETED CLAUSES

241 Wall starters/ connectors DELETED

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NBS Specifications - IBI

MHP2-IBI-XX-XX-SP-A-800-059 Rev: P2

Morriston Environmental Modernisation - Phase 2

H31 - Metal profiled/ flat sheet cladding/ covering RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/17	RIBA Stage 4 issue. Clause 120 title revised. Clause 121 added.	P2

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

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H31
METAL PROFILED/ FLAT SHEET SELF-SUPPORTING CLADDING/ ROOF COVERING REVISED

TYPES OF CLADDING/ COVERING SYSTEM

120 METAL - ROOF SYSTEM REVISED

1. Description: Metal roof system - typically
2. Support structure: Galvanised cold rolled purlins to Structural Engineer's information and specification
   - Bearing width (minimum): 60mm
   - Pitch: Refer to elevation drawings (minimum 2.5° designed pitch)
3. Cladding/ covering system type: Standing seam
4. External sheets
   - Standards generally: To BS EN 14782
   - Material: Aluminium 3105 to BS EN 485-2 and BS EN 1396: 2015
   - Manufacturer: Euroclad Group Ltd,
     Wentloog Corporate Park,
     Wentloog Road,
     Cardiff, CF3 2ER.
     Tel: +44 (0)2922 010101.
     Fax: +44 (0)2922 010122.
   - Product reference: EC 75-400 Euroseam®
   - Overall system depth:: 215mm (0.35 W/m²K U value)
   - Composition: Manufacturer standard
   - Thickness (nominal): 0.9 mm
   - Profile: Standing seam, profile height (minimum) 75mm, pitch/ seam centres 400 mm
   - Finish side 1 (outer):
     - Coating/ treatment: Mill finish stucco embossed
     - Coating thickness: Manufacturer's standard
     - Colour: Natural
   - Finish side 2 (inner): N/A
5. Additional requirements:
6. Accessories: Aluminium verge clips.
   Aluminium verge channel.
   Aluminium verge closer.
   Aluminium drip angle.
   Aluminium sliding ridge clips (if required).
   Additional accessories as required to complete the installation
7. Primary cladding/ covering sheet fasteners: Sheet overlap mechanically seamed over head of halter using Euroclad ECZIP-MST with aluminium rivets or stainless steel M10 nut & bolt fixed through the profile at the fixed point position as detailed on drawings ESN131, ESN132, ESN133, ESN181
8. Spacers: Euroseam ECZIP-SS110 Stainless Steel Halter (A110 Halter at fixed point positions and verges only) fitted at recommended nominal centres to Quattro spacer system with 100mm brackets fitted typically at 1.2m centres
   - Fasteners: **Halter to Spacer**: standard method: Stainless Steel self tapping screws 2 number per halter min 6.0mm/max 7mm dia x min 25mm long.
     Spacer to purlin: Standard method: Stainless steel self driller Hex head min 5.5mm dia x min 25mm long with washer 2 x per bracket diagonally opposite (4 x per bracket for

bracket heights =/> 260mm). NB: where fixings are required to drill through more than a total of 3mm steel, consult with Elite Sales for details.
Rail to bracket fix: Stainless steel self driller Hex head 5.5mm dia x min. 25mm long and washer. 1 number through rail into bracket at beginning and end of each run of Rail

9. Breather membrane: Not required in the Elite system
10. Thermal insulation: As clause 271
11. Air and vapour control layer: As clause 261
12. Acoustic insulation: N/A
13. Lining sheet: As clause 241
14. Fire performance: As clause 204 and 208
    - Roof covering:
    - Cavity fire barriers: No requirement
15. Insurance and warranties: 25 year system guarantee
16. Safety
    - Walkability: Roof and Lining sheets to be walkable in accordance with BS 5427
    - Fragility: To ACR(M)001, Class B
17. Additional requirements: None

121 METAL - WALL SYSTEM ADDED

1. Description: Metal wall system (to discrete areas above louvre openings, up to roof soffit). Refer to details for locations
2. Support structure: Galvanised cold rolled SFS to Structural Engineer's information and specification
    - Bearing width (minimum): 60mm
    - Pitch: Vertical
3. Cladding/ covering system type: Coated metal profiled wall panel
4. External sheets
    - Standards generally: To BS EN 14782
    - Material: Colorcoat Prisma® by Tata Steel high performance pre-finished steel. Substrate to be Galvalloy® metallic coating based on a zinc (95%): aluminium (5%) eutectic alloy manufactured to BS EN 10346: 2009 S220GD
    - Manufacturer: Euroclad Group Ltd,
      Wentloog Corporate Park,
      Wentloog Road,
      Cardiff, CF3 2ER.
      Tel: +44 (0)2922 010101.
      Fax: +44 (0)2922 010122.
    - Product reference: Euroclad Opus 25_200 (Elite 58)
    - Overall system depth:: 105mm (0.53 W/m²K U value)
    - Composition: Manufacturer standard
    - Thickness (nominal): 0.9 mm
    - Profile: 200mm panel profile, with 3mm joint gap.
    - Finish side 1 (outer):
        - o Coating/ treatment: Colorcoat Prisma®.
        - o Coating thickness: Manufacturer's standard
        - o Colour: RAL colour to be confirmed, to match louvres.
    - Finish side 2 (inner): N/A

H31
Metal profiled/ flat sheet self-supporting cladding/ roof covering

132740 - Morriston Environmental Modernisation - Phase 2

        - o Coating/ treatment: High Performance Polyester Standard Backing Coat
        - o Coating thickness: Manufacturer's standard
        - o Colour: Light Grey
5. Additional requirements:
6. Accessories: All flashings and accessories required to complete the installation.
7. Primary cladding/ covering sheet fasteners: Stainless steel Opus Plank fixings into Quattro bar
    - Fastener profile location: Underlap
8. Spacers: Quattro spacer system with 80mm brackets fitted to sheeting rails typically at 1.5m centres. Quattro rails typically at 1.167m centres along wall.
   NB: use of an additional Quattro rail may be required to allow tolerance at abutting sheet ends
    - Fasteners: Fixing to Cold Rolled sheeting rails from 1.5 - 2.2mm thick:
      Spacer to sheeting rails: Standard method: Stainless steel self driller Hex head min 5.5mm dia x min 25mm long with washer 2 x per bracket diagonally opposite (4 x per bracket for bracket heights =/> 260mm). NB: where fixings are required to drill through more than a total of 3mm steel, consult with Elite Sales for details.
      At base of each piece of Quattro rail: Stitch Quattro rail to bracket. Stainless steel self driller Hex head 5.5mm dia x min. 25mm long and washer 1 number through each rail into bracket
9. Breather membrane: Not required in the Elite system
10. Thermal insulation: As clause 271
11. Air and vapour control layer: As clause 261
12. Acoustic insulation: N/A
13. Lining sheet: As clause 241
14. Fire performance: As clause 204 and 208
    - Cavity fire barriers: No requirement
15. Insurance and warranties: 25 year system guarantee

GENERAL REQUIREMENTS

172 THERMAL PERFORMANCE/ BRIDGING

1. Requirement: Complete the thermal design of the cladding/ covering system to avoid excessive thermal bridging
    - Standard: MCRMA Technical Paper No 14

DESIGN/ PERFORMANCE REQUIREMENTS

185 PERFORMANCE COMPLIANCE

1. Verification: Before commencing fabrication, submit evidence based on laboratory testing or computer modelling
    - Verifying authority: Thermal, sheet/spacer structural and acoustic performance: Euroclad Group Ltd.
      Refer also to British Board of Agrement Certificate Number 04/4151

187 DEFLECTION OF METAL CLADDING/ ROOF COVERING

1. Roof covering: Maximum permitted deflection under distributed loads as a multiple of span and due to:
    - Permanent load: L/500
    - Permanent and imposed loads (or undrifted snow load): L/200
    - Permanent and wind loads: L/90

198 WATER PENETRATION

1. Requirement: Under site exposure conditions, moisture must not penetrate onto internal surfaces, or into cavities not designed to be wetted

200 AVOIDANCE OF INTERSTITIAL CONDENSATION

1. Requirement: See British Board of Agrement Certificate Number 04/4151.

   "*Under the normal climatic conditions experienced in the UK, interstitial condensation is unlikely to be a significant problem unless the building is classed under internal humidity class 5 or the building or areas of the building have special internal design conditions*".

   In such cases consult with Euroclad technical department

202 AVOIDANCE OF SURFACE CONDENSATION

1. Requirement: Determine surface condensation risk of cladding/ covering system using the method described in BS EN ISO 13788. If necessary, revise thermal insulation to provide satisfactory temperature factor (fmin). Ensure that damage and nuisance from surface condensation does not occur

203 FIRE PERFORMANCE OF EXTERNAL WALL CLADDING

1. Reaction to fire
   - External surfaces:

204 FIRE PERFORMANCE OF ROOF SHEETING

1. External fire exposure: To BS EN 13501-5, Class Broof(t4)

208 FIRE PERFORMANCE OF INSULATION

1. Reaction to fire: To BS EN 13501-1, Class A1

FIXING CLADDING/ ROOF COVERING

219 FASTENERS

1. Unspecified fasteners: Recommended for the purpose by the cladding/ covering manufacturer

221 FITTINGS AND ACCESSORIES

1. Unspecified fittings and accessories: Recommended for the purpose by the cladding/ covering manufacturer

223 PREVENTION OF ELECTROLYTIC ACTION

1. Isolating tape: Type recommended by cladding/ covering manufacturer
   - Location: To contact surfaces of supports and sheets of dissimilar metals

234 GUTTERS

1. Description: FOR SUBSTATION 6 AND LV ENCLOSURE ROOFS
2. Manufacturer: As clause 120
   - Product reference: Euroclad gutter flashing
3. Sizes: Manufacturers standard, to suit required rainwater roof drainage capacity.
4. Material: Manufacturers standard
   - Gauge/ Thickness: Manufacturers standard
   - External finish: To match outer roof sheet
5. Jointing method: As recommended by manufacturer

H31
Metal profiled/ flat sheet self-supporting cladding/ roof covering

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6. Fixing method: Manufacturers standard
7. Accessories: Rainwater outlets and downpipes as required to complete the installation, refer also to NBS section R10.
   1 No. weir overflows to each gutter installation

241 LINING

1. Manufacturer: As clause 120
   - Product reference: EC 32-200-1000 Liner MW5_2L
2. Finish/ Colour: Colorcoat Lining Enamel. Substrate must be Galvatite hot-dip zinc coated steel to BS EN 10346: 2009 S220GD+Z.
   Metal thickness to be a nominal 0.7mm.
   Colour: Bright White
3. Primary sheet fasteners: Fixing arrangement tested to non-fragile Class B rating in accordance with ACR(M)001:2005 at all purlin centres up to 2.1M, on straight sheet, curved sheet and at hips
4. Intermediate supports:: Stainless steel 5.5mm dia x min 25mm long self driller Hex head with min 15mm dia washer every other corrugation
5. End laps size (minimum): 60mm
6. End and side lap sealing: Stainless steel 5.5mm dia x min 25mm long self driller Hex head with min 15mm dia washer every corrugation. Fix so that there is a minimum edge distance of 30mm from the fixings to the sheet edge.
   NB: where fixings are required to drill through more than a total of 3mm steel, consult with Elite Sales for details.

   Also refer to Euroclad drawing number FR3.

   Sealing: Continuous run of 4mm diameter Class A mastic. Positioned above fixing positions – see clause 554.
   Side lap sealing: 50mm x 1mm Liner Sealing Tape positioned centrally along the sidelap joint

261 AIR AND VAPOUR CONTROL MEMBRANE

1. Requirements: *For building humidity class 1 (to BS EN 13788):*
   Sealed lining as clause 241

271 MINERAL WOOL THERMAL INSULATION

1. Standard: To BS EN 13162
2. Manufacturer: As clause 120
   - Product reference: Glass Fibre Quilt insulation (thermal transmittance value Lambda 90/90 0.040 W/mK**)**
3. Thickness (minimum): 160mm compressed to **139mm** to give a 'U' value of 0.34 W/m²K where purlins are at average 1.5M centres (3 Dimensionally Modelled on software fully compatible with BS EN ISO 10211-1/10211-2. The calculations have been carried out in accordance with BR433 March 2006 and EN ISO 6946)
4. Recycled content: None permitted
5. Installation: Continuous and lightly compressed between outer and lining sheets. Secure to prevent future movement or dislodgement

300 PROFILE FILLERS GENERALLY

1. Material: Metallocene catalysed polyolefins (MP)
2. Manufacturer: As clause 120
   - Product references: Large and Small Flute Fillers to suit Euroclad profiles. External profile large fillers profile tops removed to assist ventilation

3. Colour: Black
4. Thickness: Euroseam Ridge Filler 30mm, others 25 mm
5. Fixing method: Euroseam ridge fillers secured inside ridge closures, Euroseam eaves fillers secure under sheet between drip angle and sheet. Liner fillers trapped between liner sheet and internal flashings
    - Requirement: To close cavities/ regulate air paths within the external envelope. Tight fit with no unintended gaps. If not using separate VCL, seal internal liner fillers with strip 12 x1 Class A mastic to both liner and closures to assist air tightness

410 FIXING SHEETS GENERALLY

1. Cut edges: Clean true lines
2. Penetrations: Openings to minimum size necessary
    - Edge reinforcement: Refer to Euroclad technical for requirements
3. Sheet orientation: Exposed joints of side laps away from prevailing wind unless shown otherwise on drawings
4. Sheet ends, laps and raking cut edges: Fully supported and with fixings at top of lap
5. Fasteners: Drill holes. Position at regular intervals in straight lines, centred on support bearings
    - Position of fasteners in oversized drilled holes: Central
    - Fasteners torque: Sufficient to correctly compress washers
6. Debris: Remove dust and other foreign matter before finally fixing sheets
7. Completion: Check fixings and sealants to ensure that they are watertight, and that fixing and sheets are secure with no buckling or distortion
8. Cut edges: Paint to match face finish

460 ACCOMMODATION OF THERMAL MOVEMENT

1. Sheet type/ location: All roof installations
2. Method: Sliding fixings and fixed points

480 FLASHINGS/ TRIMS GENERALLY

1. Lap joint treatment
    - Vertical and sloping flashings/ trims: Butt joints as Clause 482
    - Horizontal flashings/ trims: Butt joints as Clause 482, sealed and where possible arranged with laps away from prevailing wind
2. Method of fixing: To structure in conjunction with adjacent sheeting. Otherwise to sheeting
    - Fasteners: Manufacturers standard

482 BUTT-JOINTED FLASHINGS/ TRIMS

1. Manufacturer:: As clause 120
2. Material:: 2 or 3mm Aluminium Plain Mill or Polyester Powder coated to Interpon D standard generally for verge flashings fascias etc.
   0.9mm aluminium to match roof finish for appropriate details only ie ridge cappings and small scale flashings as per MCRMA Technical Paper Number 11
3. Finish:: Mill finish to match outer roof sheet
4. Butt straps: 150 mm wide and made from sheet of same material and finish
5. Butt joints: Seal

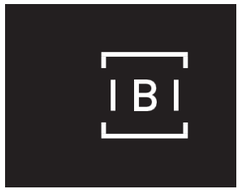
540 ABUTMENTS

1. Junctions with flashings: Weathertight and neatly dressed down

554 WATER VAPOUR SEALING AT LAPS AND PENETRATIONS IN METAL LININGS – SEALANT TAPE

1. Sealant tape: As clause 241
    - Position: On Liner laps as clause 241. At penetrations and abutments ensure an effective seal
2. Seal quality: Effective, continuous and not over-compressed





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Morriston Environmental Modernisation - Phase 2

J40 - Flexible sheet tanking/ damp proofing RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/17	RIBA Stage 4 issue. Clause 291 revised.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

J40 Flexible sheet waterproofing/ damp proofing REVISED **1**

J40
FLEXIBLE SHEET WATERPROOFING/ DAMP PROOFING REVISED

TO BE READ WITH PRELIMINARIES/ GENERAL CONDITIONS. - NOT USED

TYPES OF TANKING/ DAMP PROOFING

291 HIGH DENSITY POLYETHYLENE/ POLYPROPYLENE STUDDED CAVITY DRAIN MEMBRANE REVISED

1. Substrate: Existing concrete retaining wall
   - Preparation: In accordance with manufacturers recommendations
2. Manufacturer: Newton Waterproofing Systems
   - Contact details
     - Address: Newton House
       17-20 Sovereign Way
       Tonbridge
       Kent
       TN9 1RH
     - Telephone: +44 (0)1732 360095
     - Web: www.newtonwaterproofing.co.uk
     - Email: info@newtonwaterproofing.co.uk
   - Product reference: Newton 508 (Newton 508 (M1))
3. Material
   - Studded layer: High-density polyethylene (HDPE).
   - Filter layer: High-density polyethylene (HDPE).
4. Third-party certification: BBA certificate 94/3010, Product sheet 1.
5. Stud height: 8.0 mm.
6. Sheet thickness: 0.7 mm.
7. Weight (minimum): 500 g/m².
8. Colour: White.
9. Integral plaster key: M3 Rot-proof polythene mesh heat welded during the manufacturing process.
10. Recycled content: 100%.
11. Material: HDPE
12. Fire performance: B2 (DIN 4102). To BS EN 13501-1): Euroclass.
13. Vicat softening temperature: 126°C.
14. Service temperature: -40 to +80°C.
15. Compressive strength - Permanent: 170 kPa.
16. ThermalConductivity: 0.461 W/m·K.
17. Water vapour resistance – Sd value: >604 m.
18. Water vapour resistance – µ value: >1 208 000 µ.
19. Water vapour diffusion resistance: >3020 MNs/g.
20. Resistance to fire - Euroclass: Not tested - F.
21. Chemical resistance – Excellent: 100%.
22. Oxidation resistance – Excellent: 100%.
23. Radon gas resistance - Membrane: 3.1 x 10^-12 m²/s.
24. Radon gas resistance - Joints*: 2.7 x 10^-12 m²/s.

25. Resistance to liquid hydrocarbons: Passed.
26. Methane permeability: 1.42 x 10^-8 m²/s.
27. Carbon dioxide transmission rate: 63.1 mL/(m².d.atm).
28. Methane transmission rate: 63.1 mL/(m².d.atm).
29. Fixing: In accordance with manufacturer's recommendations
    - Fasteners: In accordance with manufacturer's recommendations
      - Fixing centres: In accordance with manufacturer's recommendations
30. Joints: The membrane should preferably be used with the flanged edge positioned in front of and overlapping the previously-installed membrane width by the width of the 70 mm flange. Joints with the flanged edge are sealed using Newton Waterseal Tape.
    Stud-into-stud joints (where the studs both overlap and fully interlock) can be sealed with Newton Waterseal Tape, in accordance with manufacturers specification
31. Drainage components: Newton Basedrain cavity drainage channels, with corner pieces as applicable
32. Accessories: Newton Basedrain adaptor and 63mm pipe to external drainage.
    Newton Inspection Port (D26) complete with ducting and Basedrain Inspection Port 90 degree bend (D27).
    Incoming services through the existing retaining wall to be sealed using Newton Pipe Collars in conjunction with Newton 107F and Newton 106 FlexProof membranes, all installed in strict accordance with the manufacturers recommendations and specification.

WORKMANSHIP

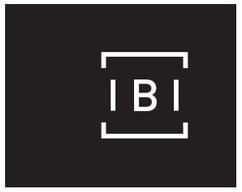
310 WORKMANSHIP GENERALLY

1. Condition of substrate
   - Clean and even textured, free from voids and sharp protrusions.
   - Moisture content: Compatible with damp proofing/ tanking.
2. Air and surface temperature: Do not apply sheets if below minimum recommended by membrane manufacturer.
3. Condition of membrane at completion
   - Neat, smooth and fully supported, dressed well into abutments and around intrusions.
   - Completely impervious and continuous.
   - Undamaged. Prevent puncturing during following work.
4. Permanent overlying construction: Cover membrane as soon as possible.

320 INSPECTION

1. Give notice: Before covering any part of membrane with overlying construction.





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Morriston Environmental Modernisation - Phase 2

K10 - Gypsum board dry linings/ partitions/ ceilings RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/16	RIBA Stage 4 issue. Clause 400 omitted. Clauses 156, 220, 401 and 545 added.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

K10 Gypsum board dry linings/ partitions/ ceilings REVISED 1

K10
GYPSUM BOARD DRY LININGS/ PARTITIONS/ CEILINGS REVISED

TYPES OF DRY LINING

155 WALL LINING SYSTEM (METAL STUDS) LV BUILDING ADDED

1. Description: Independent wall lining system to LV Switchroom
2. Manufacturer: British Gypsum,
   East Leake,
   Loughborough,
   Leicestershire LE12 6HX
   W: www.british-gypsum.com.
   T: 0115 945 6123.
   E: bgtechnical.enquiries@bpb.com.
   British Gypsum contact: Graham Lloyd (T: 07786 337414 / E: graham.lloyd@bpb.com).
   - Product reference: B216001D *(hybrid version - insulation omitted)*
3. Studs
   - Type: Gypframe 70 I 70 at 600mm centres and Gypframe 70 S 50 at abutments, openings
     and junctions
   - Centres: 600 mm
4. Cavity between wall and studs: 10mm minimum (between studs and front face of drained cavity system membrane)
5. Unbraced height (maximum): 3900mm (based on limiting deflection of L/240 at 200 Pa)
6. Head condition: Timber head plate (screw fixed to internal face of external cavity wall blockwork)
   - Deflection allowance: 15 mm maximum
7. Fire separation
   - Cavity fire barriers: Not required
8. Insulation: Not required
   - Recycled content: Not applicable
   - Thickness: Not applicable
9. Vapour control layer: Not required
10. Resilient layer: Not required
11. Linings: One layer of 15mm Gyproc Moisture resistant Board (as clause 403), sheet width 1200mm. Fixing as clause 590.
    Screws: 25mm British Gypsum Jack-Point Screws to I studs and 25mm British Gypsum Drywall Screws elsewhere
12. Access units: Access required to cavity drain channel, refer also to NBS J40/291
13. Finishing: Seamless jointing
    - Primer/ Sealer: As recommended by board manufacturer for vapour control
    - Accessories: Metal beads/ stops (stainless steel or plastic only) recommended by board manufacturer
14. Other requirements: None

156 WALL LINING SYSTEM (METAL STUDS) TO TOP OF STEEL FRAMING WITHIN SUBSTATION 6 BUILDING. REVISED

1. Description: To top of steel framing within Substation 6 building.

2. Manufacturer: British Gypsum,
   East Leake,
   Loughborough,
   Leicestershire LE12 6HX
   W: www.british-gypsum.com.
   T: 0115 945 6123.
   E: bgtechnical.enquiries@bpb.com.
   British Gypsum contact: Graham Lloyd (T: 07786 337414 / E: graham.lloyd@bpb.com).
   - Product reference: B216001D
3. Studs
   - Type: Gypframe 70 I 70 at 600mm centres
   - Centres: 600 mm
4. Cavity between wall and studs: Not required - construct wall lining flush against the rear face of partial fill cavity insulation
5. Unbraced height (maximum): Approximately 300mm
6. Head condition: Underside of roof liner sheet
   - Deflection allowance: 15 mm maximum
7. Fire separation
   - Cavity fire barriers: Not required
8. Insulation: As per clause P10/190
9. Vapour control layer: Not required
10. Resilient layer: Not required
11. Linings: One layer of 15mm Gyproc Moisture resistant Board (as clause 403), sheet width 1200mm. Fixing as clause 590.
    Screws: 25mm British Gypsum Jack-Point Screws to I studs and 25mm British Gypsum Drywall Screws elsewhere
12. Finishing: Seamless jointing
    - Primer/ Sealer: As recommended by board manufacturer for vapour control
    - Accessories: Metal beads/ stops (stainless steel or plastic only) recommended by board manufacturer
13. Other requirements: None

220 PROPRIETARY SUSPENDED CEILING SYSTEM ADDED

1. Standard: To BS EN 13964.
2. Evidence of compliance: All ceilings kits to be CE marked. Submit Declaration of Performance (DoP).
3. Manufacturer: Siniat Ltd,
   Marsh Lane,
   Easton-in-Gordano,
   Bristol BS20 0NF.
   T +44 (0)1275 377789
   F +44 (0)1275 377456
   W: www.siniat.co.uk
   - Product reference: GTEC metal furring suspended ceiling system RCC 016
4. Fire performance
   - Reaction to fire: Not required
   - Fire resistance of complete wall lining assembly: Not required
   - Cavity fire barriers: As per P10/410 Flexible cavity barriers
5. Lining board: Single skin of GTEC 12.5 mm Standard Board

- Finishing: All as per the current Siniat Ltd drywall manual recommendations. GTEC taping and jointing system using appropriate GTEC jointing materials and GTEC paper joint tapes.
- Accessories: Metal beads/ stops recommended by lining board manufacturer

6. Suspension system
   - Grid centres: Primary grid centres 1200mm (GTEC MFPC44); Secondary grid centres 400mm (GTEC MFCC50).
   - Hangers: MFC2330 GTEC metal angle hangers.
     - Length: To give ceiling soffit height above finished floor level as indicated on the reflected ceiling plan layout (refer to IBI 332 series drawings).
     - Centres: 1200 mm
7. Insulation: Insulation to void: glass mineral wool. (option for enhanced sound insulation). Density: 10kg/m³
   - Thickness: 100 mm
8. Access units: Required
9. Integrated services fittings: Hangers and housings for linear luminaires
10. Electrical continuity and earth bonding: As existing provision
11. Accessories/ Other requirements: Apply 6mm continuous beads of GTEC Intumescent Acoustic Sealant around the perimeter of the framing or to the outer layers of board, ensuring that all air-paths are sealed.

GENERAL/ PREPARATION

305 COMPLIANCE WITH PERFORMANCE REQUIREMENTS

1. Testing/ Assessment: Submit UKAS accredited laboratory reports for the following: Maximum air pressure and corresponding deflection limits: Partition types K10/155.
2. Materials, components and details: As used in testing/ assessment reports. If discrepancies arise, give notice.

335 ADDITIONAL SUPPORTS

1. Framing: Accurately position and securely fix to give full support to:
   - Partition heads running parallel with, but offset from main structural supports.
   - Fixtures, fittings and service outlets. Mark framing positions clearly and accurately on linings.
   - Board edges and lining perimeters, as recommended by board manufacturer to suit type and performance of lining.

375 NEW WET LAID BASES

1. Dpcs: Install under full width of partitions/ freestanding wall linings.
   - Material: Bituminous sheet or plastics.

COMPONENTS

401 GYPSUM PLASTERBOARD ADDED

1. Type: To BS EN 520, type A
2. Core density (minimum): 650 kg/m³.
3. Reaction to fire: Manufacturer's standard
4. Water vapour resistance factor: Manufacturer's standard
5. Thermal conductivity: Manufacturer's standard
6. Other BS EN 520 characteristics: None

K10
Gypsum board dry linings/ partitions/ ceilings

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7. Recycled content: Submit proposals
8. Exposed surface and edge profiles: Suitable to receive specified finish. Clean and undamaged

403 GYPSUM PLASTERBOARD (MOISTURE-RESISTANT)

1. Type: To BS EN 520, type H1
2. Core: Moisture-resistant.
   - Density (minimum): 710 kg/m³.
3. Paper facings: Moisture-resistant.
4. Reaction to fire: Manufacturer's standard Class A2-s1, d0 or better
5. Water vapour resistance factor: Manufacturer's standard
6. Thermal conductivity: Manufacturer's standard
7. Other BS EN 520 characteristics: None
8. Recycled content: Submit proposals
9. Exposed surface and edge profiles: Suitable to receive specified finish

INSTALLATION

435 DRY LININGS GENERALLY

1. General: Use fixing, jointing, sealing and finishing materials, components and installation methods recommended by board manufacturer.
2. Cutting gypsum boards: Neatly and accurately without damaging core or tearing paper facing.
   - Cut edges: Minimize and position at internal angles wherever possible. Mask with bound edges of adjacent boards at external corners.
3. Fixings boards: Securely and firmly to suitably prepared and accurately levelled backgrounds.
4. Finishing: Neatly to give flush, smooth, flat surfaces free from bowing and abrupt changes of level.

455 METAL FRAMING FOR PARTITIONS/ WALL LININGS

1. Setting out: Accurately aligned and plumb.
   - Frame/ Stud positions: Equal centres to suit specified linings, maintaining sequence across openings.
   - Additional studs: To support vertical edges of boards.
2. Fixing centres at perimeters (maximum): 600 mm.
3. Openings: Form accurately.
   - Doorsets: Use sleeved or boxed metal studs and/ or suitable timber framing to achieve strength grade requirements for framing assembly and adequately support weight of door.
   - Services penetrations: Allow for associated fire-stopping.

510 SEALING GAPS AND AIR PATHS

1. Location of sealant: To perimeter abutments and around openings.
   - Pressurized shafts and ducts: At board-to-board and board-to-metal frame junctions.
2. Application: To clean, dry and dust free surfaces as a continuous bead with no gaps.
   - Gaps greater than 6 mm between floor and underside of gypsum board: After sealing, fill with jointing compound.

545 CAVITY FIRE BARRIERS WITHIN SUSPENDED CEILINGS ADDED

1. Type: Mineral wool-reinforced mattress with foil face to two sides; thickness to suit required fire resistance, see below.

2. Fire resistance: As existing provision / requirements
3. Ceiling void subdivision: Fix barriers not more than 20 m apart in any direction.
4. Fixing at perimeters and joints: Secure, stable and continuous with no gaps, to provide a complete barrier to smoke and flame.
5. Service penetrations: Cut and pack to maintain barrier integrity. Sleeve flexible materials. Adequately support services passing through barrier.
6. Ceiling systems for fire protection: Do not impair fire-resisting performance of ceiling system.

560 JOINTS BETWEEN BOARDS

1. Tapered edged gypsum boards
   - Bound edges: Lightly butted.
   - Cut/ unbound edges: 3 mm gap.
2. Square edged plasterboards: 3 mm gap.
3. Square edged gypsum fibre boards: 5 mm gap.

565 VERTICAL JOINTS

1. Joints: Centre on studs.
   - Partitions: Stagger joints on opposite sides of studs.
   - Two layer boarding: Stagger joints between layers.

570 HORIZONTAL JOINTS

1. Surfaces exposed to view: Horizontal joints not permitted. Seek instructions where height of partition/ lining exceeds maximum available length of board.
2. Two layer boarding: Stagger joints between layers by at least 600 mm.
3. Edges of boards: Support using additional framing.
   - Two layer boarding: Support edges of outer layer.

590 FIXING GYPSUM BOARD TO METAL FRAMING/ FURRINGS

1. Partitions/ Wall linings: Fix securely and firmly at the following centres (maximum):
   - Single layer boarding: To all framing at 300 mm centres. Reduce to 200 mm centres at external angles.
   - Multi-layer boarding: Face layer at 300 mm centres, and previous layers around perimeters at 300 mm centres.
2. Ceilings: 230 mm. Reduce to 150 mm at board ends and at lining perimeters.
3. Position of screws from edges of boards (minimum): 10mm from bound edges / 13mm from cut edges.
   - Screw heads: Set in a depression. Do not break paper or gypsum core.

595 DEFLECTION HEADS

1. Fixing boards: Do not fix to head channels.

610 FIXING GYPSUM BOARD TO TIMBER

1. Fixing to timber: Securely at the following centres (maximum):
   - Nails: 150 mm.
   - Screws to partitions/ wall linings: 300 mm. Reduce to 200 mm at external angles.
   - Screws to ceilings: 230 mm.
2. Position of nails/ screws from edges of boards (minimum)
   - Bound edges: 10 mm.
   - Cut/ unbound edges: 13 mm.

3. Position of nails/ screws from edges of timber supports (minimum): 6 mm.

FINISHING

670 SEAMLESS JOINTING TO GYPSUM BOARDS

1. Cut edges of boards: Lightly sand to remove paper burrs.
2. Filling and taping: Fill joints, gaps and internal angles with jointing compound and cover with continuous lengths of paper tape, fully bedded.
3. Protection of edges/ corners: Reinforce external angles, stop ends, etc. with specified edge/ angle bead.
4. Finishing: Apply jointing compound. Feather out each application beyond previous application to give a flush, smooth, seamless surface.
5. Nail/ screw depressions: Fill with jointing compound to give a flush surface.
6. Minor imperfections: Remove by light sanding.

692 RIGID BEADS/STOPS

1. Internal: To BS EN 13658-2.
2. External: To BS EN 13658-2.

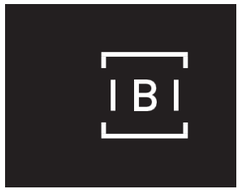
695 INSTALLING BEADS/ STOPS

1. Cutting: Neatly using mitres at return angles.
2. Fixing: Securely using longest possible lengths, plumb, square and true to line and level, ensuring full contact of wings with substrate.
3. Finishing: After joint compounds/ plasters have been applied, remove surplus material while still wet from surfaces of beads exposed to view.

DELETED CLAUSES

400 Gypsum boards generally DELETED





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Morriston Environmental Modernisation - Phase 2

K11 - Rigid sheet flooring/ sheathing/ decking/ sarking/ linings/ casings RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/16	RIBA Stage 4 issue. First issue.	P0

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

K11 Rigid sheet flooring/ sheathing/ decking/ sarking/ linings/ casings 1

K11
RIGID SHEET FLOORING/ SHEATHING/ DECKING/ SARKING/ LININGS/ CASINGS

TYPES OF FLOORING/ SHEATHING/ DECKING/ SARKING/ LINING/ CASINGS

110 WOOD-BASED SHEETS GENERALLY

1. Standard: To BS EN 13986.
    - Evidence of compliance: All sheets to be CE marked. Submit Declaration of Performance (DoP).

815 PLYWOOD

1. Description: WPB plywood to door and window reveals internally
2. Substrate: Concrete blockwork as per section F10
3. Plywood: Plywood to BS EN 636.
    - Manufacturer/ Supplier: Contractor's choice
        - o Product reference: WPB plywood
    - Thickness: 18mm
    - Edges: Square
4. Joint treatment: Bonded with PVA adhesive to BS EN 204, Class D3

WORKMANSHIP

910 INSTALLATION GENERALLY

1. Timing: Building to be weathertight before fixing boards internally.
2. Moisture content of timber supports (maximum): 18%.
3. Joints between boards: Accurately aligned, of constant width and parallel to perimeter edges.
4. Methods of fixing, and fasteners: As section Z20 where not specified otherwise.

940 BOARD MOISTURE CONTENT AND CONDITIONING

1. Moisture content of boards at time of fixing: Appropriate to end use.
2. Conditioning regime: Submit proposals.

950 MOISTURE CONTENT TESTING

1. Test regime and equipment: Submit proposals.
2. Test results: Submit record of tests and results.

960 FIXING GENERALLY

1. Boards/ sheets: Fixed securely to each support without distortion and true to line and level.
2. Fasteners: Evenly spaced in straight lines and, unless otherwise recommended by board manufacturer, in pairs across joints.
    - Distance from edge of board/ sheet: Sufficient to prevent damage.
3. Surplus adhesive: Removed as the work proceeds.

975 METAL WALL FRAMING

1. Setting out: Framing accurately aligned, vertical and securely fixed to surrounding structure at maximum 600 mm centres. All board edges supported.

976 MINERAL WOOL INSULATION TO METAL FRAMING

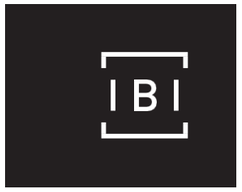
1. Installation: Neat and secure with butted joints and no gaps. Where insulation is not self-supporting, fixed at head of frame using clips or other suitable proprietary fixings.

K11
Rigid sheet flooring/ sheathing/ decking/ sarking/ linings/ casings

132740 - Morriston Environmental Modernisation - Phase 2

NBS Specifications - IBI





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MHP2-IBI-XX-XX-SP-A-800-097 Rev: P0

Morriston Environmental Modernisation - Phase 2

K40 - Demountable suspended ceilings RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/16	RIBA Stage 4 issue. First issue.	P0

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

K40 Demountable suspended ceilings 1

K40
DEMOUNTABLE SUSPENDED CEILINGS

TYPES OF CEILING SYSTEM

115 UNIT/ MODULAR SUSPENDED CEILING SYSTEM

1. Description: To HSDU areas; refer to IBI 332 series drawings.
2. Standard: To BS EN 13964.
3. Evidence of compliance: All ceilings kits to be CE marked. Submit Declaration of Performance (DoP).
4. Ceiling system manufacturer: Rockfon,
   Rockwool Limited,
   14th Floor,
   Chiswick Tower,
   389 Chiswick High Road,
   London, W4 4AL.
   Tel: 020 8222 7457.
   W: www.rockfon.co.uk.
   E: info@rockfon.co.uk.
   - Product reference: Rockfon® Medicare® Plus
5. Ceiling
   - Infill units: Rockfon® Medicare® Plus; fine fissured mineral fibre tiles with square edge profile; 20mm thick.
   - Ceiling module: 600 x 600 mm
   - Soffit height above finished floor level: Refer to reflected ceiling plans - IBI series 332 information
6. Grid
   - Form: Interlocking
   - Exposure: Exposed
7. Access: Infill units fully demountable
8. Suspension system: As clause 250
9. Perimeter trim: As clause 260
10. Accessories: None
11. Integrated services fittings: None
12. Other requirements: Cavity barrier as clause K10/545.

GENERAL/ PERFORMANCE - NOT USED

COMPONENTS

245 STANDARDS

1. Steel panels: To BS EN 10346.
2. Aluminium sheet, strip and plate: To BS EN 485-1 and -2.
3. Aluminium bars, tubes and sections: To relevant parts of BS EN 515, BS EN 573, BS EN 755 and BS EN 12020.

250 SUSPENSION SYSTEM

1. Description: Suspension system for clause 115.
2. Manufacturer: As clause 115.
   - Product reference: Rockfon System T24 A/E; Rocklink 24 suspension system

3. Extent of system: Include all hangers, fixings, main runners, cross members, primary channels, perimeter trims, splines, noggings, clips, bracing, bridging, etc. necessary to complete the ceiling system and achieve specified performance.
4. Top fixings: Compatible with structural soffit type and in accordance with manufacturers recommendations
5. Hangers: Wire or threaded rod suspension hangers as applicable for the structural soffit, ceiling height and installation type
6. Grid type: Exposed
   - Finish: Powder coated
   - Colour: White, as standard

260 PERIMETER TRIMS

1. Description: perimiter trims for ceiling system as clause 115.
2. Type: 32 x 19 mm steel angle trim, colour and finish to match exposed grid
3. Manufacturer: As clause 115.
   - Product reference: L19x32, colour Matt White 11
4. Fixings
   - Fasteners: In accordance with manufacturers recommendations and specification
   - Fixing centres (maximum): 450 mm

EXECUTION

305 SETTING OUT

1. General: Completed ceiling should present, over the whole of its surface exposed to the room below, a continuous and even surface, jointed (where applicable) at regular intervals.
2. Infill and access units, integrated services: Fitted correctly and aligned.
3. Edge/ perimeter infill units size (minimum): Half standard width or length.
4. Corner infill units size (minimum): Half standard width and length.
5. Grid: Position to suit infill unit sizes. Allow for permitted deviations from nominal sizes of infill unit.
6. Infill joints and exposed suspension members: Straight, aligned and parallel to walls, unless specified otherwise.
7. Suitability of construction: Give notice where building elements and features to which the ceiling systems relate are not square, straight or level.

310 BRACING

1. General: Secure, with additional bracing and stiffening to give a stable ceiling system resistant to design loads and pressures.

315 PROTECTION

1. Loading: Do not apply loads for which the suspension system is not designed.
2. Ceiling materials: When necessary, remove and replace correctly using special tools and clean gloves, etc. as appropriate.

320 TOP FIXING

1. Building structure: Verify suitability.
2. Structural soffit:
   - Suitability to receive specified fixings: Evaluate and confirm.
3. Fixing generally: In accordance with BS EN 13964.
4. Fixing to

- Concrete: Drill and insert suitable expanding anchors.
- Aerated concrete: Fix through from the top of concrete units and provide a system of primary support channels.
- Structural steel: Drill, or use suitable proprietary clips/ adaptors.
- Metal roof decking: Fix to sides of liner tray corrugations.
- Timber: Fix to side of joists at least 50 mm from bottom edge. If ceiling system is intended for fire protection, fix into top third of joists.
- Hollow structural members: Submit fixing proposals.

325 INSTALLING HANGERS

1. Wire hangers: Straighten and tension before use.
2. Installation: Install vertical or near vertical, without bends or kinks. Do not allow hangers to press against fittings, services, or insulation covering ducts/ pipes.
3. Obstructions: Where obstructions prevent vertical installation, either brace diagonal hangers against lateral movement, or hang ceiling system on an appropriate rigid sub-grid bridging across obstructions and supported to prevent lateral movement.
4. Extra hangers: Provide as necessary to carry additional loads.
5. Fixing
   - Wire hangers: Tie securely at top with tight bends to loops to prevent vertical movement.
   - Angle/ strap hangers: Do not use rivets for top fixing.
6. Spacings:

335 PERIMETER TRIMS

1. Jointing: Neat and accurate, without lipping or twisting.
   - External and internal corners: Mitre joints generally. Overlap joints at internal corners are …….
   - Intermediate butt joints: Minimize. Use longest available lengths of trim. Align adjacent lengths.
2. Fixing: Fix firmly to perimeter wall, edge battens or other building structure.
   - Fasteners:
   - Fixing centres:

340 EXPOSED GRIDS

1. Grid fixings:
2. Main runners: Install level. Do not kink or bend hangers.
   - Spliced joints: Stagger.
   - Wire hangers passing through main runners: Use sharp bends and tightly wrapped loops.
   - Angle/ strap hangers: Do not use rivets for bottom fixing.
   - Angular displacement of long axis of one runner in relation to next runner in line with it: Not visually apparent.
3. Cross members supported by main runners or other cross members: Install perpendicular to intersecting runners.
4. Cross tees: Flat and coplanar with flanges of main runners after panel insertion.
   - Cross tees over 600 mm long, cut and resting on perimeter trim: Provide an additional hanger.
5. Holding down clips: Locate to manufacturer's recommendations.
   - Fire-protecting/ resisting ceiling systems: Use clip type featured in the fire test/ assessment.

355 INSTALLING INFILL UNITS

1. General
   - Perimeter infill units: Trimmed, as necessary, to fully fill space between last grid member and perimeter trim. Prevent subsequent movement.
   - Deeply textured infill units: Minimize variations in apparent texture and colour. In particular, avoid patchiness.
2. Concealed grids: Install infill units uniformly, straight and aligned. Avoid dimension creep.
   - Infill units around recessed luminaires and similar openings: Prevent movement and displacement.

385 UPSTANDS AND BULKHEADS

1. Vertical ceiling systems: Support and brace to provide alignment and stability.
2. High upstands: Provide support at base of upstand.

390 OPENINGS IN CEILING MATERIALS

1. General: Neat and accurate. To suit sizes and edge details of fittings. Do not distort ceiling system.

395 INTEGRATED SERVICES

1. General: Position services accurately, support adequately. Align and level in relation to the ceiling and suspension system. Do not diminish performance of ceiling system.
2. Small fittings: Support with rigid backing boards or other suitable means. Do not damage or distort the ceiling.
   - Surface spread of flame rating of additional supporting material: Not less than ceiling material.
3. Services outlets
   - Supported by ceiling system: Provide additional hangers.
   - Independently supported: Provide flanges to support ceiling system.

401 CEILING-MOUNTED LUMINAIRES

1. Support:
   - Independently supported luminaires: Suspension adjusted to line and level of ceiling.
   - Ceiling supported luminaires: Modifications and/ or extra support required: …….
2. Surface mounted luminaires: Units installed so that in event of a fire the designed grid expansion provision is not affected.
3. Modular fluorescent recessed luminaires: Compatible with ceiling module. Extension boxes must not foul ceiling system.
4. Recessed rows of luminaires: Provide flanges for support of grid and infill units, unless mounted above grid flanges. Retain in position with lateral restraint.
5. Fire-protecting/ resisting ceiling systems: Luminaires must not diminish protection integrity of ceiling system.
6. Access: Provide access for maintenance of luminaires.

406 TRUNKING

1. Recessed trunking: Provide flanges for support of grid and infill units, unless mounted above grid flanges. Retain in position with lateral restraint.

411 MECHANICAL SERVICES

1. Fan coil units
   - Inlet/ Outlet grilles: Trim ceiling grid and infill units to suit.

- Space beneath: Sufficient for ceiling system components.
- Suspension and connections: Permit accurate setting out and levelling of fan coil units.

2. Air grilles and diffusers
   - Setting out: Accurate and level.
   - Linear air diffusers: Retain in place with lateral restraint. Provide flanges for support of grid and infill units.
   - Grille/ Diffuser ceiling joints: Provide smudge rings and edge seals.
3. Smoke detectors and PA speakers
   - Ceiling infill units: Scribe and trim to suit.
   - Independent suspension:
   - Flexible connections: Required.
4. Sprinkler heads: Carefully set out and level.

COMPLETION

505 TOOLS

1. Access tools: At Completion, supply one set of the following: Any tools or accessories required to maintain the system .

520 USER INSTRUCTIONS

1. Contents: Include the following:
   - Correct methods for removing and replacing infill units and other components.
   - Cleaning methods and materials.
   - Recommendations for redecoration.
   - Ceiling systems intended for fire protection: Limitations placed on subsequent alterations and maintenance procedures, to ensure that their fire performance is not impaired.
   - Maximum number, position and value of point loads that can be applied to ceiling system after installation.

530 SPARES

1. General: At practical completion, supply the following: 3 No. packs of tiles for ceiling system K40/115.

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Morriston Environmental Modernisation - Phase 2

L10 - Windows/ Rooflights/ Screens/ Louvres RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/16	RIBA Stage 4 issue.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

L10 Windows/ rooflights/ screens/ louvres UNCHANGED 1

L10
Windows/ rooflights/ screens/ louvres

132740 - Morriston Environmental Modernisation - Phase 2

L10
WINDOWS/ ROOFLIGHTS/ SCREENS/ LOUVRES UNCHANGED

GENERAL

110 EVIDENCE OF PERFORMANCE

1. Certification: Provide independently certified evidence that all incorporated components comply with specified performance requirements.

120 PRECONSTRUCTION SURVEY

1. Procedure: Before starting work on designated items take site dimensions, record on shop drawings and use to ensure accurate fabrication.
2. Designated items: All louvre elements listed within this section
3. Primary support structure: Carry out survey sufficient to verify that required accuracy and security of erection can be achieved.
4. Timing: Before fabrication.

140 CONTROL SAMPLES

1. Procedure
   - Finalize component details.
   - Fabricate one of each of the following designated items as part of the quantity required for the project.
   - Obtain approval of appearance and quality before proceeding with manufacturer of the remaining quantity.
2. Designated items:

PRODUCTS

650 METAL LOUVRES

1. Manufacturer: Gilberts (Blackpool) Ltd.,
   Clifton Rd,
   Blackpool,
   Lancashire FY4 4QT.
   T: 01253 766911.
   E: info@gilbertsblackpool.com.
   W: www.gilbertsblackpool.com
   - Product reference: WH-75 High Performance Louvre;
     Ref. WHF-75 Flanged Frame (FF) Louvre
2. Material: Aluminium flanged frame with extruded aluminium blades. Bespoke sizes as indicated on louvre schedules
   - Finish as delivered: All aluminium components to be factory cut to size and supplied in a standard RAL/BS Polyester Powder Coat finish and suitable for a coastal environment, with minimum thickness of 40 microns which subject to documented cleaning regime in accordance with paint manufacturer's stipulations, the RAL/BS paint finish to aluminium components will be guaranteed for 25 years from the date of installation.
     Colour: TBC
3. Fire performance: Not applicable
4. Number of louvre banks: One; high performance louvre blade
5. Louvre blade pitch and angle: Pitch: 75 mm
6. Blanking panels: Not required
7. Accessories/ Other requirements: Stainless steel bird and insect mesh
8. Fixing: Manufacturer's standard

EXECUTION

710 PROTECTION OF COMPONENTS

1. General: Do not deliver to site components that cannot be installed immediately or placed in clean, dry floored and covered storage.
2. Stored components: Stack vertical or near vertical on level bearers, separated with spacers to prevent damage by and to projecting ironmongery, beads, etc.

750 BUILDING IN

1. General: Not permitted unless indicated on drawings.
   - Brace and protect components to prevent distortion and damage during construction of adjacent structure.

770 DAMP-PROOF COURSES IN PREPARED OPENINGS

1. Location: Ensure correct positioning in relation to window frames. Do not displace during fixing operations.

810 SEALANT JOINTS

1. Sealant
   - Manufacturer: Submit proposals
     - o Product reference: Submit proposals
   - Colour: To match either louvre element OR substrate
   - Application: As section Z22 to prepared joints. Finish triangular fillets to a flat or slightly convex profile.

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Morriston Environmental Modernisation - Phase 2

L20 - Doors/ shutters/ hatches RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/16	RIBA Stage 4 issue.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

L20 Doors/ shutters/ hatches UNCHANGED 1

L20
Doors/ shutters/ hatches

132740 - Morriston Environmental Modernisation - Phase 2

L20
DOORS/ SHUTTERS/ HATCHES UNCHANGED

GENERAL

110 EVIDENCE OF PERFORMANCE

1. Certification: Provide independently certified evidence that all incorporated components comply with specified performance requirements.

150 SITE DIMENSIONS

1. Procedure: Before starting work on designated items take site dimensions, record on shop drawings and use to ensure accurate fabrication.
2. Designated items: All doorsets listed within this specification

PRODUCTS

480 DOORSETS

1. Description: Stainless steel doorsets
2. Manufacturer: Teckentrup UK Limited
   Units 2-4 Opus 9 Industrial Estate
   Woburn Road,
   Winwick Quay
   Warrington. WA2 8UE.
   T: 01925 924050.
   W: https://www.teckentrup.co.uk/
   E: enquiries@teckentrup.co.uk
   - Product reference: Stainless steel doorset (for external use)
3. Door leaf:
   - Finish as delivered: Polyester powdercoated stainless steel (powder coating system to be suitable for a marine environment, with accompanying guarantees)
4. Frame and architraves:
   - Finish as delivered: To match door leaf
5. Glazing/ Infill details: Clear single glazing where noted on door schedule and elevation typology drawing
   - Manifestation: Not required
   - Beading: External
6. Ironmongery: As ironmongery schedule
7. Perimeter seals: EPDM weatherseal
8. Thermal performance (U-value maximum): Manufacturer's standard
9. Other requirements: Fully louvred inset panels where indicated on the elevation typology drawing and door schedule.
   Louvre powder coatings to match door leaf finish
10. Fixing: Built in with cramps

EXECUTION

710 PROTECTION OF COMPONENTS

1. General: Do not deliver to site components that cannot be installed immediately or placed in clean, dry, floored and covered storage.
2. Stored components: Stacked on level bearers, separated with spacers to prevent damage by and to projecting ironmongery, beads, etc.

730 PRIMING/ SEALING

1. Wood surfaces inaccessible after installation: Primed or sealed as specified before fixing components.

750 FIXING DOORSETS

1. Timing: After associated rooms have been made weathertight and the work of wet trades is finished and dried out.

760 BUILDING IN

1. General: Not permitted unless indicated on drawings.

780 DAMP PROOF COURSES IN PREPARED OPENINGS

1. Location: Correctly positioned in relation to door frames. Do not displace during fixing operations.

800 FIXING OF LOOSE THRESHOLDS

1. Spacing of fixings: Maximum 150 mm from each end and at 600 mm maximum centres.

820 SEALANT JOINTS

1. Sealant
    - Manufacturer: Submit proposals
        - o Product reference: Submit proposals
    - Colour: To match door frame OR substrate
    - Application: As section Z22 to prepared joints. Triangular fillets finished to a flat or slightly convex profile.

830 FIXING IRONMONGERY GENERALLY

1. Fasteners: Supplied by ironmongery manufacturer.
    - Finish/ Corrosion resistance: To match ironmongery.
2. Holes for components: No larger than required for satisfactory fit/ operation.
3. Adjacent surfaces: Undamaged.
4. Moving parts: Adjusted, lubricated and functioning correctly at completion.

850 LOCATION OF HINGES

1. Primary hinges: Where not specified otherwise, positioned with centre lines 250 mm from top and bottom of door leaf.
2. Third hinge: Where specified, positioned on centre line of door leaf .
3. Hinges for fire resisting doors: Positioned in accordance with door leaf manufacturer's recommendations.

860 INSTALLATION OF EMERGENCY EXIT DEVICES

1. Standard: Unless specified otherwise, install panic bolts/ latches in accordance with BS EN 1125.

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Morriston Environmental Modernisation - Phase 2

M60 - Painting/ clear finishing RIBA STAGE 4 ISSUE

132740

Revisions

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2021/11/16	RIBA Stage 4 issue.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
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Contents

M60 Painting/clear finishing UNCHANGED 1

M60
Painting/clear finishing

132740 - Morriston Environmental Modernisation - Phase 2

M60
PAINTING/CLEAR FINISHING UNCHANGED

COATING SYSTEMS

150 EGGSHELL/ SATIN PAINT

1. Description: TO INTERNAL WALLS TYPICALLY
2. Manufacturer: Dulux Trade (brand of AkzoNobel),
   Wexham,
   Slough,
   Berkshire, SL2 5DS.
   T: 0333 222 7021
   W: www.duluxtrade.co.uk
   - Product reference: Dulux Trade Diamond Eggshell
3. Surfaces: Preprimed and sealed
   - Preparation: Ensure surfaces are clean and dry
4. Initial coats: Surfaces to be mist coated with:
   Dulux Trade Drywall Primer Sealer for drywall areas, and
   Dulux Trade All Purpose primer for masonry areas
   - Number of coats: 1 (mist)
5. Undercoats: Not required
   - Number of coats: Not applicable
6. Finishing coats: Dulux Trade Diamond Eggshell
   - Number of coats: 2

180 FLOOR COATING

1. Description: TO GROUND FLOOR SLABS
2. Manufacturer: Watco UK Limited,
   Eastgate Court,
   195-205 High Street,
   Guildford,
   Surrey, GU1 3AW.
   Tel: 01483 418 418
   W: www.watco.co.uk
   E-mail: sales@watco.co.uk
   - Product reference: Watco Safety Coat
3. Surfaces: Power floated concrete / in-situ screed floor
   - Preparation: As per manufacturer's instructions
4. Initial coats: Watco Powerfloat Primer (if advised by the manufacturer)
   - Number of coats: 1
5. Finishing coats: Watco Safety Coat
   - Number of coats: 2
   - Slip resistance value - water wet (minimum): PTV to BS 7976 of 55

GENERALLY

215 HANDLING AND STORAGE

1. Coating materials: Deliver in sealed containers, labelled clearly with brand name, type of material and manufacturer's batch number.
2. Materials from more than one batch: Store separately. Allocate to distinct parts or areas of the work.

220 COMPATIBILITY

1. Coating materials selected by contractor
   - Recommended by their manufacturers for the particular surface and conditions of exposure.
   - Compatible with each other.
   - Compatible with and not inhibiting performance of preservative/fire-retardant pretreatments.

280 PROTECTION

1. 'Wet paint' signs and barriers: Provide where necessary to protect other operatives and general public, and to prevent damage to freshly applied coatings.

300 CONTROL SAMPLES

1. Sample areas of finished work: Carry out, including preparation, as follows:
2. Types of coating Location
3. M60/ 150. 180.
4. Approval of appearance: Obtain before commencement of general coating work.

320 INSPECTION BY COATING MANUFACTURERS

1. General: Permit manufacturers to inspect work in progress and take samples of their materials from site if requested.

PREPARATION

400 PREPARATION GENERALLY

1. Standard: In accordance with BS 6150.
2. Refer to any pre-existing CDM Health and Safety File.
3. Refer to CDM Construction Phase Plan where applicable.
4. Suspected existing hazardous materials: Prepare risk assessments and method statements covering operations, disposal of waste, containment and reoccupation, and obtain approval before commencing work.
5. Preparation materials: Types recommended by their manufacturers and the coating manufacturer for the situation and surfaces being prepared.
6. Substrates: Sufficiently dry in depth to suit coating.
7. Efflorescence salts: Remove.
8. Dirt, grease and oil: Remove. Give notice if contamination of surfaces/ substrates has occurred.
9. Surface irregularities: Remove.
10. Joints, cracks, holes and other depressions: Fill flush with surface, to provide smooth finish.
11. Dust, particles and residues from preparation: Remove and dispose of safely.
12. Water based stoppers and fillers
    - Apply before priming unless recommended otherwise by manufacturer.
    - If applied after priming: Patch prime.
13. Oil based stoppers and fillers: Apply after priming.
14. Doors, opening windows and other moving parts
    - Ease, if necessary, before coating.
    - Prime resulting bare areas.

M60
Painting/clear finishing

132740 - Morriston Environmental Modernisation - Phase 2

420 FIXTURES AND FITTINGS

1. Removal: Before commencing work remove: Coverplates, grilles, wall clocks, and other surface mounted fixtures.
2. Replacement: Refurbish as necessary, refit when coating is dry.

425 IRONMONGERY

1. Removal: Before commencing work: Remove ironmongery from surfaces to be coated.
2. Hinges: Do not remove
3. Replacement: Refurbishment as necessary; refit when coating is dry.

500 PREPRIMED STEEL

1. Areas of defective primer, corrosion and loose scale: Take back to bare metal. Reprime as soon as possible.

560 UNCOATED CONCRETE

1. Release agents: Remove.

570 UNCOATED MASONRY/ RENDERING

1. Loose and flaking material: remove.

590 UNCOATED PLASTERBOARD

1. Depressions around fixings: Fill with stoppers/ fillers

622 ORGANIC GROWTHS

1. Dead and loose growths and infected coatings: Scrape off and remove from site.
2. Treatment biocide: Apply appropriate solution to growth areas and surrounding surfaces.
3. Residual effect biocide: Apply appropriate solution to inhibit re-establishment of growths.

645 SEALING OF INTERNAL MOVEMENT JOINTS

1. General: To junctions of walls and ceilings with architraves, skirtings and other trims.
2. Sealant: Waterborne acrylic.
   - Manufacturer: Submit proposals
     - o Product reference: Submit proposals
   - Preparation and application: As section Z22.

APPLICATION

711 COATING GENERALLY

1. Application standard: In accordance with BS 6150, clause 9.
2. Conditions: Maintain suitable temperature, humidity and air quality during application and drying.
3. Surfaces: Clean and dry at time of application.
4. Thinning and intermixing of coatings: Not permitted unless recommended by manufacturer.
5. Overpainting: Do not paint over intumescent strips or silicone mastics.
6. Priming coats
   - Thickness: To suit surface porosity.
   - Application: As soon as possible on same day as preparation is completed.
7. Finish
   - Even, smooth and of uniform colour.
   - Free from brush marks, sags, runs and other defects.

- Cut in neatly.

8. Doors, opening windows and other moving parts: Ease before coating and between coats.

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Morriston Environmental Modernisation - Phase 2

M61 - Intumescent coatings for fire protection of steelwork RIBA STAGE 4 ISSUE

132740

Revisions

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2021/11/16	RIBA Stage 4 issue. Clause 202 revised.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

M61 Intumescent coatings for fire protection of steelwork REVISED 1

M61
Intumescent coatings for fire protection of steelwork

132740 - Morriston Environmental Modernisation - Phase 2

M61
INTUMESCENT COATINGS FOR FIRE PROTECTION OF STEELWORK REVISED

PROTECTIVE COATING SYSTEMS

110 ON-SITE COATING TO PRIMED STEEL

1. Description: Internally
2. Use/ location: To exposed steelwork supporting walls / roof
3. Fire performance: As clause 202
4. Preparation and priming: By steelwork contractor, as section G10.
5. Primer coat:: The compatibility / suitability of any off-site applied primer coat is to be reviewed by Kier Construction / approved intumescent coatings installer.
   Where deemed to be satisfactory no primer coat is required. Where not satisfactory, a Nullifire PM018 primer coat (refer to primer coat section of clause 116) should be applied
6. Intumescent coating system
   - Manufacturer: Nullifire,
     Tremco Illbruck Limited,
     Coupland Rd,
     Hindley Green,
     Wigan, WN2 4HT.
     T: 01942 251400.
     W: www.tremco-illbruck.com
     - Product reference: SC902 system
   - Intumescent coat
     - Type: SC902; two part, low VOC, one coat, high build system. Off-white colour when cured
     - Application:: Spray applied at close proximity (approx. 600mm from the surface). Coat / coverage to provide a minimim 3.538mm wft / 3.077mm dft
     - Finish: Non-visible areas: basic
   - Top sealer coat
     - Type: TS134; high-gloss, high-solid polyurethane top seal
     - Application:: Airless spray applied in 2 No. coats recommended. Brush and roller application may require multiple coats to achieve the necessary dft's.
       2 No. coats, with 115µm wft / 75µm dft to each - minimum 150µm overall
     - Colour: White
7. Bolt head/ nut protection: As main steelwork

PERFORMANCE AND GENERAL REQUIREMENTS

202 FIRE PERFORMANCE REVISED

1. Reaction to fire: To BS EN 13501-1, A2- s1, d0
2. Fire resistance to BS EN 13501-2: To BS EN 13501-2, REI 120

204 EXPOSURE AND DURABILITY

1. Environmental exposure: C3
2. Durability classification: Y

205 VALIDATION OF MATERIALS

1. Project-specific evaluation of intumescent coating materials
   - Standard: In accordance with BS EN 16623, clause 4.

- Test results: Submit on request.

210 WORKING PROCEDURES

1. Standard: In accordance with BS EN 16623.
2. Give notice: Before commencing surface preparation and coating application.
3. Quality control: Record project specific procedures for surface preparation and coating application.

215 WORKING CONDITIONS

1. General: Maintain manufacturer's recommended temperature, humidity and air quality conditions during application and drying.
2. Surface condition: Clean and dry at time of application.

220 APPLICATOR'S PERSONNEL

1. Operatives: Trained/ experienced in anticorrosive and intumescent coatings.
2. Evidence of training/ experience: Submit on request.

250 SPRAYED COATING APPLICATION ON SITE

1. Standard: In accordance with BS EN 16623.
2. Spray drift: Minimize.
3. Uncoated areas of steel:
4. Masking: Protect designated adjacent surfaces.
   - Designated surfaces: Fair-faced blockwork

270 INSPECTION

1. Permit intumescent manufacturer to
   - Inspect work in progress.
   - Inspect quality control records.
   - Take dry film thickness and other measurements.
   - Take samples of products.
2. Intumescent manufacturer's inspection reports: Submit without delay.

PREPARATION OF SURFACES - NOT USED

APPLICATION OF CASTINGS - NOT USED

APPLICATION OF COATINGS

410 INTUMESCENT COATING DRY FILM THICKNESS (DFT)

1. Applicable coatings:
2. Required dft: Determine for every steel member to give specified period of fire resistance. Use intumescent coating manufacturer's current published loading tables.
   - Special sections and partial fire exposure conditions: Obtain required dft in writing from manufacturer.
3. Schedule and drawings: Submit at least two weeks before starting work.
   - Schedule content: Member sizes, weights/ thicknesses, loading conditions, etc. showing, for each variant, the exposed perimeter/ sectional area (Hp/A) ratio and required dft.
   - Drawing content: Steelwork drawings marked in colour to show required dft for each member.

M61
Intumescent coatings for fire protection of steelwork

132740 - Morriston Environmental Modernisation - Phase 2

420 MEASUREMENT OF INTUMESCENT DFT

1. Primer dft: Determine average dft (for deduction from total dft after application of intumescent).
2. Intumescent dft: Determine at:
   - 500 mm centres along each coated plane of universal sections (8 planes), and rectangular hollow sections (4 planes).
   - 125 mm centres along coated circular hollow sections, spread evenly around circumference.
3. Acceptance standard
   - Average intumescent dft: Not less than required dft (exclusive of primer and top sealer).
   - Local intumescent dft: Not less than 80% of required dft. Areas greater than 100 mm equivalent diameter with a dft of less than 80% of required dft must be brought up to thickness.

440 BASIC FINISH

1. Definition: Reasonably smooth and even. Orange peel, other texture, minor runs and similar minor defects are acceptable.

450 NORMAL DECORATIVE FINISH

1. Definition: Good standard of cosmetic finish generally, when viewed from a distance of 5 m or more. Minor orange peel or other texture is acceptable.

460 HIGH DECORATIVE FINISH

1. Definition: High standard of evenness, smoothness and gloss when viewed from a minimum distance of 2 m.

490 TOP SEALER COAT

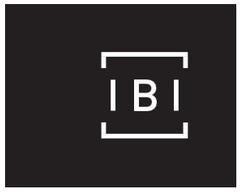
1. Application: To achieve dft recommended by manufacturer and to give an even, solid, opaque appearance, free from runs, sags and other visual defects.

COMPLETION

530 RECORDS OF INTUMESCENT APPLICATION

1. On completion of intumescent work, submit
   - Accurate surface preparation, coating and intumescent application records.
   - Fire resistance certificates.
   - Intumescent manufacturer's recommendations for maintenance and overcoating.





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Morriston Environmental Modernisation - Phase 2

N15 - Fire and safety signage systems RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/16	RIBA Stage 4 issue.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

N15 Internal fire and safety signage systems UNCHANGED 1

N15
INTERNAL FIRE AND SAFETY SIGNAGE SYSTEMS UNCHANGED

GENERAL

110 FIRE AND SAFETY SIGNAGE SYSTEMS

1. Description: FOR ESCAPE ROUTE
2. System manufacturer: Submit proposals
   - System reference: Submit proposals
3. Locations and layout: Submit proposals
   - Language: Welsh and English.
4. Material: Submit proposals
   - Other properties: Fixing holes. Photoluminescent

111 FIRE AND SAFETY SIGNAGE SYSTEMS

1. Description: FOR FIRE EQUIPMENT
2. System manufacturer: Submit proposals
   - System reference: Submit proposals
3. Locations and layout: Submit proposals
   - Language: Welsh and English.
4. Material: Submit proposals
   - Other properties: Fixing holes. Photoluminescent

112 FIRE AND SAFETY SIGNAGE SYSTEMS

1. Description: FOR PROHIBITION/ DANGER/ WARNING
2. System manufacturer: Submit proposals
   - System reference: Submit proposals
3. Locations and layout: Submit proposals
   - Language: Welsh and English.
4. Material: Submit proposals
   - Other properties: Fixing holes. Photoluminescent

SYSTEM PERFORMANCE

205 DESIGN OF INTERNAL SIGNAGE SYSTEMS

1. Description: Typically
2. Design: Complete detailed design and submit before commencing work.
3. Content: Signs including facing information, components, inserts, accessories and fixings necessary to complete the system.
4. Proposals: Submit drawings, schedules, technical information, calculations and manufacturer's literature before commencing work.

210 GENERAL REQUIREMENTS

1. Signage and way guiding system design: Typically
   - For fire escape and evacuation signage: In accordance with: BS 5499-4 or BS ISO 16069.

N15
Internal fire and safety signage systems

132740 - Morriston Environmental Modernisation - Phase 2

   - For way guiding systems: In accordance with BS ISO 16069.
   - For safety signs other than escape route signage: In accordance with: BS 5499-10.
2. Comply with the requirements of: Fire Strategy Report

220 SIGN DESIGN AND FORMAT

1. Description: Typically
2. Format: In accordance with BS EN ISO 7010.
   In accordance with NHS 'Wayfinding' or 'Wayfinding' Scotland
3. Geometric shapes, colours and layout: In accordance with BS ISO 3864-1.
4. Design principles for graphical symbols: In accordance with BS ISO 3864-3.
5. Colorimetric and photometric properties of safety sign materials: In accordance with BS ISO 3864-4.
6. Water safety: In accordance with BS ISO 20712-1.

260 PHOTOLUMINESCENT PROPERTIES

1. Description: FOR ESCAPE ROUTE SIGNAGE & FOR FIRE EQUIPMENT SIGNS
2. Luminance delay classification to BS ISO 17398: B

270 FIRE REACTION

1. Description: Typically
2. Non flammable surface
   - Standard: To Building Regulations Approved Document B

280 DESIGN LIFE

1. Description: Typically
2. Duration: 10 years
   - Subject to reasonable wear and tear.
3. Condition of use: Subject to regular maintenance.

290 SIGNAGE SAMPLES

1. Sign type: Fire escape
   - Action: Submit labelled samples.
   - Conformity: Retain samples on site for the duration of the contract or until instructed to remove.
   - Delivered products: To conform with labelled samples.

PRODUCTS - NOT USED

EXECUTION

610 FIXING SIGNS GENERALLY

1. Installation: Secure, plumb and level.
2. Fasteners and adhesives: As section Z20.
3. Strength of fasteners: Sufficient to support live and dead loads.
4. Fixings showing on surface of sign: Must not detract from the message being displayed.

COMPLETION

910 DOCUMENTATION

1. Submit

- Manufacturer's maintenance instructions.
- Guarantees, warranties, test certificates, record schedules and logbooks.

920 SPARES

1. Supply as follows
   - Type: For each sign type
   - Quantity: One set

930 SPECIALIST TOOLS

1. Supply as follows: Any specialist tools required to maintain or service the sign installations; 1 No. set to be supplied

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Morriston Environmental Modernisation - Phase 2

P10 - Sundry insulation/ proofing work RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/16	RIBA Stage 4 issue. Clause 190 added.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

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Sundry insulation/ proofing work

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P10
SUNDRY INSULATION/ PROOFING WORK REVISED

TYPES OF INSULATION

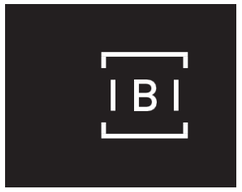
190 INSULATION FITTED BETWEEN STUDS TYPE A ADDED

1. Manufacturer: ROCKWOOL Ltd
   - Contact details
     - o Address: ROCKWOOL Ltd
       14th Floor, Chiswick Tower
       389 Chiswick High Road
       London
       W4 4AJ
     - o Telephone: +44 (0)1656 862621
     - o Web: https://www.rockwool.com/uk/
     - o Email: info@rockwool.com
   - Product reference: ROCKWOOL® FLEXI®
2. General requirements: Insulation products generally.
3. Standard: To BS EN 13162.
4. Thickness: 70mm
5. Thermal conductivity (maximum): 0.035–0.038 W/mK.
6. Fire performance: To BS EN 13501-1, Euroclass A1 non-combustible.
7. Acoustical Performance: Achieves Part E.
8. Water vapour resistance: Negligible.
9. Length: 1200 mm.

411 FLEXIBLE CAVITY BARRIERS

1. Manufacturer: ROCKWOOL Ltd
   - Contact details
     - o Address: ROCKWOOL Ltd
       14th Floor, Chiswick Tower
       389 Chiswick High Road
       London
       W4 4AJ
     - o Telephone: +44 (0)1656 862621
     - o Web: www.rockwool.co.uk
     - o Email: info@rockwool.com
   - Product reference: ROCKWOOL Fire Barrier Slab
2. Thickness: 100 mm
3. Fire performance: Euroclass Fire Rating A1/ Independently tested to BS 476-22 by accredited laboratories
4. Accessories: Fire barrier support angles 3 x 34 x 75 mm
   ROCKWOOL LUL Intumescent Sealant





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MHP2-IBI-XX-XX-SP-A-800-153 Rev: P1

Morriston Environmental Modernisation - Phase 2

P20 - Unframed isolated trims/ skirtings/ sundry items RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/16	RIBA Stage 4 issue.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

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P20 Unframed isolated trims/ skirtings/ sundry items UNCHANGED 1

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P20
UNFRAMED ISOLATED TRIMS/ SKIRTINGS/ SUNDRY ITEMS UNCHANGED

TO BE READ WITH PRELIMINARIES/ GENERAL CONDITIONS

150 METAL

1. Description: Door and louvre openings surrounds (internally)
2. Material: Stainless steel to BS EN 10088-2, grade 1.4301 (304)
   - Thickness: Refer to detail drawings - door and louvre openings
3. Finish: Polyester powder coating (marine environment); colour white (to match walls)
4. Fixing: Heavy-duty adhesive by ???
5. Metalwork: As section Z11.
6. Other requirements:: 10mm calcium silicate backing board (e.g. Promat Promatect®-H) applied to door / louvre openings prior to installation of surround profile (refer to detail drawings - door and louvre openings)

EXECUTION

510 INSTALLATION GENERALLY

1. Joinery workmanship: As section Z10.
2. Metal workmanship: As section Z11.
3. Methods of fixing and fasteners: As section Z20 where not specified.
4. Straight runs: To be in one piece, or in long lengths with as few joints as possible.
5. Running joints: Location and method of forming to be agreed where not detailed.
6. Joints at angles: Mitre, unless shown otherwise
7. Position and level: To be agreed where not detailed.

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MHP2-IBI-XX-XX-SP-A-800-154 Rev: P0

Morriston Environmental Modernisation - Phase 2

P21 - Door/ window ironmongery RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/17	RIBA Stage 4 issue. First issue.	P0

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

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P21
Door/ window ironmongery

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Phase 2

P21
DOOR/ WINDOW IRONMONGERY

PRE-TENDER

10 QUANTITIES AND LOCATIONS

1. Quantities and locations of ironmongery are as in schedule MHP2-IBI-XX-XX-SH-A-322002 .
2. Fixing: As sections L10 and L20.

20 HARDWARE MANUFACTURER - REFERENCE 1:

1. Manufacturer:
   Allgood plc, 63-83 Brearley Street, Birmingham, B19 3NT.
   T: 0121 3594415.
   E: info@allgood.co.uk.
   W: www.algood.co.uk

21 HARDWARE MANUFACTURER - REFERENCE 2:

1. Manufacturer:
   SD Hardware Ltd., Unit 7 Forge Lane. Enterprise Park, Saltash, Cornwall, PL12 6LX
   Tel: 01752 651330
   Email: sales@sdhardware.co.uk.
   W: https://www.sdhardware.co.uk/

GENERAL

141 SAMPLE BOARDS

1. General: Before placing orders with suppliers submit a sample board, containing labelled samples of ironmongery and showing methods of fixing.

170 IRONMONGERY FOR FIRE DOORS

1. Relevant products: Ironmongery fixed to, or morticed into, the component parts of a fire resisting door assembly.
2. Compliance: Ironmongery included in successful tests to BS 476-22 or BS EN 1634-1 on door assemblies similar to those proposed.
   - Certification: Submit CERTIFIRE certificates
3. Melting point of components (except decorative non-functional parts): 800°C minimum.

180 STRENGTH CLASS OR CATEGORY OF DUTY FOR DOOR IRONMONGERY

1. Requirement: To BS EN 1192, Class 4.
2. General: Durability of ironmongery components to be compatible with stated category of duty of each door leaf.
   - Exclusions: Ironmongery with specific duty or 'category of use' defined elsewhere.
   - Documentation: Before placing orders with suppliers submit documentation showing product compliance with stated category of duty.

DOOR HANGING DEVICES

310 SINGLE AXIS DOOR HINGES

1. Description: Typically
2. Standard: To BS EN 1935.
   - Hinges to doors on escape routes and fire/ smoke control doors: CE marked.
3. Manufacturer: As door manufacturer, refer to L10.
   - Product reference: Manufacturers standard.

4. Type: Double ball bearing butt
5. Size: Manufacturers standard.
6. Material/ finish: Manufacturers standard, suitable for exterior environment.
7. Hinge grade: 12
8. Other requirements: Security dog bolt

WINDOW HANGING DEVICES - NOT USED

DOOR OPERATING DEVICES

410 OVERHEAD DOOR CLOSERS

1. Description: Link arm overhead door closer (max. leaf size 1400mm wide)
2. Standard: To BS EN 1154.
   - Door closing devices to fire/ smoke control doors: CE marked.
3. Manufacturer: Geze UK Ltd.
   - Product reference: TS 4000 EN 1-6 with hold-open arm
4. Type: Face fixed
5. Power size: Adjustable 1-6
6. Other functions: Back check
   Mechanical hold open
7. Casing finish: Stainless steel
8. Operational adjustment
   - Variable power: Matched to size, weight and location of doors.
   - Latched doors: Override latches and/ or door seals when fitted.
   - Unlatched doors: Hold shut under normal working conditions.
   - Closing against smoke seals of fire doors: Positive. No gaps.
   - Fitting location:: Closer mounted to internal side of outward opening doors; closer body fitted to transom, arm fixed to door.

DOOR SECURING DEVICES

516 DOOR LOCKS

1. Description: DEADLOCK CASE, EURO PROFILE
2. Standard: To BS EN 12209.
3. Manufacturer: As clause 20
   - Product reference: 72 Series - 7286.80
4. Type: Euro profile cylinder mortice deadlock
5. Backset: 80mm
6. Material/ finish: Stainless steel
7. Keying: Suited, as schedule

521 DOOR LOCKS

1. Description: EURO PROFILE CYLINDER WITH THUMBTURN
2. Standard: To BS EN 12209.
3. Manufacturer: As clause 20
   - Product reference: 7429A (width variant to suit door leaf width, refer to door schedule).
4. Type: Euro profile cylinder with thumbturn
5. Backset: N/A

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Door/ window ironmongery

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6. Material/ finish: Stainless steel
7. Keying: Suited, as schedule

532 SPECIAL FUNCTION DOOR LOCKS

1. Description: Electro-magnetic lock
2. Manufacturer: Specialized Security products,
   Units 18-23
   Park Farm Industrial Estate
   Ermine Street
   Buntingford
   Hertfordshire, SG9 9AZ.
   T: 01763 274223
   E: sales@specialized-security.co.uk
   W: https://www.specialized-security.co.uk/
   - Product reference: EXT800
3. Type: Midi monitored stainless steel weatherproof maglock 12 / 24V dc
4. Backset: N/A
5. Material/ finish: Stainless steel
6. Keying: N/A
7. Additional requirements / accessories:: Magnetic lock to fail open / safe (i.e. door openable in the event of a fire alarm).
   Where required to suit installation, provide EM500ZLW Z&L brackets to facilitate locking operation.

577 PANIC EXIT DEVICES

1. Description: Push pad bolt
2. Standard: To BS EN 1125.
   - Panic exit devices for locked doors on escape routes: CE marked.
3. Manufacturer: ASSA ABLOY Limited trading as “Exidor”,
   Progress Drive,
   Cannock,
   Staffordshire, WS11 0JE.
   T: 01543 578661.
   E: sales@exidor.co.uk.
   W: https://www.exidor.co.uk/
   - Product reference: 293 A/SD
4. Type: Push pad bolt, with adjustable shoots (to suit steel doors)
5. Material/ finish: Satin stainless steel
6. Additional requirements: None

582 DOOR BOLTS

1. Description: FLUSH BOLTS TO SLAVE LEAVES
2. Standard: To BS EN 12051.
3. Manufacturer: As clause 20
   - Product reference: 48800
4. Type: Lever action flushbolt with square ends
5. Size: 203 x 19mm (bolt diameter 11mm)
6. Material/ finish: Satin stainless steel
7. Additional requirements: Allgood ref. 7051 (easy clean socket) to be used at floor location

WINDOW SECURING DEVICES - NOT USED

DOOR FURNITURE

641 PULL HANDLES

1. Description: FACE FIX; D SHAPE, 600mm c/c
2. Standard: To BS 8424.
3. Manufacturer: As clause 21
   - Product reference: SOXST600 (SOX Straight Guardsman S/S Pull handle; 600mm)
4. Shape: Straight bar with stand-off spacers
5. Diameter: 32mm
6. Distance between centres: 600 mm
7. Material/ finish: Polished stainless steel, grade 1.4301 (304)
8. Mounting: Face fix (with single sided invisible fixings, SOX-IN-FIX)
9. Additional requirements: None

642 PULL HANDLES

1. Description: BACK TO BACK FIXINGS; D SHAPE, 600mm c/c
2. Standard: To BS 8424.
3. Manufacturer: As clause 21
   - Product reference: SOXST600 (SOX Straight Guardsman S/S Pull handle; 600mm)
4. Shape: Straight bar with stand-off spacers
5. Diameter: 32mm
6. Distance between centres: 600 mm
7. Material/ finish: Polished stainless steel, grade 1.4301 (304)
8. Mounting: Back to Back fix (with Back to Back fixing kit, SOX-BB-FIX)
9. Additional requirements: None

670 PUSH PLATES

1. Description: TYPICALLY
2. Manufacturer: As clause 20
   - Product reference: Modric 6801K
3. Size: 700 x 100 x 1.5mm
4. Material/ finish: Satin stainless steel, grade 1.4401 (316)
5. Mounting: Face fix, with stainless steel Torx screws.
6. Additional requirements: None

690 KICK PLATES

1. Description: TYPICALLY
2. Manufacturer: As clause 20
   - Product reference: Modric 6854
3. Size: Height 200mm, width to suit door leaf minus 10mm, 1.5mm thick
4. Material/ finish: Satin stainless steel, grade 1.4401 (316)
5. Mounting: Face fix, with stainless steel Torx screws.
6. Additional requirements: None

710 ESCUTCHEONS

1. Description: EURO PROFILE

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Door/ window ironmongery

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2. Manufacturer: As clause 20
   - Product reference: Modric 796
3. Material/ finish: Satin stainless steel, grade 1.4401 (316)
4. Keyhole type: Euro profile cylinder
5. Usage: As schedule

720 DOOR STOPS

1. Manufacturer: As clause 20
   - Product reference: Modric 2301
2. Type: Floor mounted rubber buffer on stainless steel shoe for concrete fixing
3. Usage: As schedule

820 DOOR MOUNTED SIGNAGE

1. Description: Fire signage - Fire door keep shut
2. Manufacturer: Lock-Tech Architectural Hardware,
   57-60 Oxford Street,
   Swansea, SA1 3JD.
   T: 01792 720206.
   E: stuart.howe@lock-tech.co.uk.
   W: www.lock-teck.co.uk
   - Product reference: SDFX
3. Type: Welsh / English fire door sign (Welsh first), 75mm diameter, surface fixed with screws
4. Signage text:: Drws tân cadwch ar gau / Fire door keep shut
5. Material/ finish: Satin stainless steel, grade 1.4401 (316)

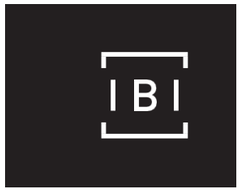
821 DOOR MOUNTED SIGNAGE

1. Description: Fire signage - Fire door keep locked
2. Manufacturer: Lock-Tech Architectural Hardware,
   57-60 Oxford Street,
   Swansea, SA1 3JD.
   T: 01792 720206.
   E: stuart.howe@lock-tech.co.uk.
   W: www.lock-teck.co.uk
   - Product reference: SDFW
3. Type: Welsh / English fire door sign (Welsh first), 75mm diameter, surface fixed with screws
4. Signage text:: Drws tân cadwch ar glo / Fire door keep locked
5. Material/ finish: Satin stainless steel, grade 1.4401 (316)

WINDOW FURNITURE - NOT USED

NBS Specifications - IBI





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MHP2-IBI-XX-XX-SP-A-800-174 Rev: P1

Morriston Environmental Modernisation - Phase 2

Q40 - Fencing RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/16	RIBA Stage 4 issue. Clause 210 added.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

Q40 Fencing REVISED 1

Q40
FENCING REVISED

FENCING SYSTEMS

210 WOODEN POST AND RAIL FENCING ADDED

1. Manufacturer: Jacksons Fencing,
   Stowting Common
   Ashford
   Kent, TN25 6BN.
   T: 01233 750393
   E: sales@jacksons-fencing.co.uk
   W: https://www.jacksons-fencing.co.uk/
   - Product reference: Standard Post & Rail Fencing (Nailed)
2. Standard: To BS 1722-7, type SPR 11/3.
3. Height: 1100 mm
4. Wood: Manufacturers standard
   - Treatment: Jakcure® pressure treated.
   - Finish: Manufacturers standard
5. Maximum centres of posts: 1.8 m
6. Method of setting posts: Driven to a minimum depth of 700 mm
7. Accessories: Single leaf field gate; lockable
8. Conformity: Submit manufacturer's and installer's certificates, to BS 1722-7.

350 STEEL PALISADE FENCING

1. Manufacturer: Steelway Fensecure,
   Queensgate Works,
   Bilston Road,
   Wolverhampton,
   West Midlands,
   WV2 2NJ
   T: 01902 490919
   W: www.steelway.co.uk
   E: sales@fensecure.co.uk
   - Product reference: Steel palisade fencing
2. Standard: To BS 1722-12, type SP30.
3. Height: 3000 mm
4. Pales: Corrugated 'D'
5. Pale tops: Triple pointed and splayed
   - Finish: Polyester powder-coated, as section Z31
     - o Colour: To be confirmed
6. Fixings: Submit proposals
7. Centres of posts (maximum): 2.75 m
8. Method of setting posts
   - Holes: 450 x 450 mm square or 600 mm diameter
   - Embedded length: 625mm
   - Completely filled to ground level with concrete.

Q40
Fencing

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9. Alternate method of post fixing:: Where applicable, it may be possible to fix the support posts to the generator compound concrete slab / base. This option is to be investigated with the fencing manufacturer / sub-contractor. Security, anti-tamper fixings to be used at all times.
10. Bottom of fencing: Maximum ground clearance 50 mm, additional rail fixed to pales 100 mm from bottom with two intermediate supports.
11. Accessories: Single leaf pedestrian gates as indicated on plans; lockable with emergency egress facility
12. Conformity: Submit manufacturer's and installer's certificates, to BS 1722-12.

GATES, POSTS AND STILES - NOT USED

ACCESSORIES - NOT USED

EXECUTION

710 INSTALLATION GENERALLY

1. Set out and erect
   - Alignment: Straight lines or smoothly flowing curves.
   - Tops of posts: Following profile of the ground.
   - Setting posts: Rigid, plumb and to specified depth, or greater where necessary to ensure adequate support.
   - Fixings: All components securely fixed.

715 COMPETENCE

1. Operatives: Contractors must employ competent operatives.
2. Qualifications: Submit certification of training.
   - NHSS Sector Scheme 2A sub categories: (d)
   - NHSS Sector Scheme 2C sub categories: (a)

720 SETTING POSTS IN CONCRETE

1. Standard: To BS 8500-2.
2. Mix: Designated concrete not less than GEN1 or Standard prescribed concrete not less than ST2.
3. Alternative mix for small quantities: 50 kg Portland cement to 150 kg fine aggregate to 250 kg 20 mm nominal maximum size coarse aggregate, medium workability.
4. Admixtures: Do not use.
5. Holes: Excavate neatly and with vertical sides.
6. Filling: Position post/ strut and fill hole with concrete to not less than the specified depth, well rammed as filling proceeds and consolidated.
7. Backfilling of holes not completely filled with concrete: Excavated material, well rammed and consolidated.

730 EXPOSED CONCRETE FOUNDATIONS

1. Filling: Compact until air bubbles cease to appear on the upper surface.
2. Finishing: Weathered to shed water and trowelled smooth.

780 MAKING GOOD GALVANIZED SURFACES

1. Treatment of minor damage (including on fasteners and fittings): Low melting point zinc alloy repair rods or powders made for this purpose, or at least two coats of zinc-rich paint to BS 4652.
2. Thickness: Apply sufficient material to provide a zinc coating at least equal in thickness to the original layer.

790 SITE PAINTING

1. Timing: Prepare surfaces and apply finishes as soon as possible after fixing.

COMPLETION

910 CLEANING

1. General: Leave the works in a clean, tidy condition.
2. Surfaces: Clean immediately before handover.

920 FIXINGS

1. All components: Tighten.
   - Timing: Before handover.

930 GATES

1. Hinges, latches and closers: Adjust to provide smooth operation. Lubricate where necessary.
   - Timing: Before handover.

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Morriston Environmental Modernisation - Phase 2

Q41 - barriers/ guardrails RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/16	RIBA Stage 4 issue. Clause 190 added.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

Q41 Barriers/ guardrails REVISED 1

Q41
Barriers/ guardrails

132740 - Morriston Environmental Modernisation - Phase 2

Q41
BARRIERS/ GUARDRAILS REVISED

TYPES OF BARRIERS/ GUARDRAILS

135 PROPRIETARY PROTECTIVE BARRIERS

1. Description: Vehicle barrier (to Service Yard)
2. Standard: To BS 6180.
3. Manufacturer: Hill & Smith
   Springvale Business & Industrial Park
   Bilston
   Wolverhampton, WV14 0QL
   T: 01902 499400
   W: www.armco.uk.com
   E: sales@hill-smith.co.uk
   - Product reference: C35 Slotted angle beams
4. Height above datum: 750mm (to top)
5. Material/ Protection: Steel, galvanized to BS EN ISO 1461 after fabrication
6. Surface finish: None
7. Colour/ Texture: Self finished
   - Minimum film thickness: Not applicable
8. Fixings/ Foundations: A2 grade stainless steel fixing screws fixed to support posts
9. Other requirements: Surface mounted RSJ posts (ORC001-747) suitably anchored into existing ground, at centres to suit manufacturers recommendations.
   Type D end terminations (ORC023) at pedestrian access locations.

190 VEHICLE ACCESS POINT BARRIERS ADDED

1. Manufacturer: Newgate (Newark) Limited
   Brunel Drive
   Newark, Nottinghamshire
   NG24 2DE
   Tel: 01636 700172
   E: sales@newgate.uk.com
   W: https://www.newgate.uk.com
   - Product reference: Heavy duty manual swing arm barrier (pair)
2. Boom
   - Span: 2 x 4650mm span (CL to post centres)
   - Type: Horizontal swing gate
   - Operation: Manual
   - Control system: None
   - Colour: As supplied
3. Fixings/ Foundations: Expanding anchors grouted into concrete foundation
4. Other requirements: Gates lockable (for padlock) when closed.
   Closing post with lockable latch receiver (pair required to 'hold' gates when open).

PERFORMANCE/ INSPECTION/ TESTING

305 PRODUCTION INSPECTION OF POSTS

1. General: At place of fabrication, at rate of 15 per order selected randomly.
   - Weld defect levels: As stipulated in Highways England 'Manual of contract documents for highway works' Volume 1 'Specification for highway works' Series 400.

320 TESTING VEHICLE FENCE POST FOUNDATIONS

1. Test post foundations: Install after completion of finished ground.
   - Locations: Every tenth post
2. Loading tests: Provide testing equipment and carry out tests in accordance with BS 7669-3 annex B.
   - Results: Submit one week prior to fence erection.
   - Completion: Remove test posts and foundations and make good finished ground.

330 VERIFICATION OF ANCHORAGES

1. Description: FOR VEHICLE SAFETY PARAPETS - METAL
2. Certification: Four weeks prior to installation, submit certificates from a United Kingdom Accreditation Service (UKAS) independent laboratory, stating that for tests in accordance with BS 5080-1, anchorages are capable of resisting the design loading.
3. Tolerance: Certification must include the maximum tolerance of hole size and evidence that load can be supported when anchor is installed in holes having these tolerances.

340 SITE TESTING ANCHORAGES IN DRILLED HOLES

1. Description: FOR VEHICLE SAFETY PARAPETS - METAL
2. Test parapet posts: Install on site.
3. Loading tests: To BS 5080-1.
   - Frequency of testing: One fixing at every fifth post
4. Anchorage loadings: Incrementally in tension to 10% above the nominal tensile load determined in accordance with design loading.
   - Load holding periods
     - Incremental loads: Not less than 30 seconds.
     - Test loads: Not less than 5 minutes.
   - Readings: Take after applying load and at the end of the time intervals stated.
   - Movement: Total not to exceed 1 mm during test.
     - Any evidence of slip during loading shall constitute failure.
5. Test results: Submit prior to full parapet installation.

INSTALLATION

405 COMPETENCE

1. Operatives: Contractors must employ competent operatives.
2. Qualifications: Submit certification of training.
   - UKAS Sector Scheme 2A sub-categories: Not applicable
   - UKAS Sector Scheme 2C sub-categories: (b)

420 ALIGNMENT

1. Erection: Fences/ barriers to present a flowing alignment. Tops of posts to follow ground profile.
2. Tolerance: ±30 mm of prescribed alignment and, within any 10 m length, ±15 mm from the straight or required radius.

430 ERECTION GENERALLY

1. Protection: Coat all internal and external surfaces of aluminium and steel posts below and up to 150 mm above ground level, with two coats of bituminous paint to BS 6949 type 2, unless other applied surface finish is specified.
2. Prevention of electrolytic corrosion: Isolate dissimilar metals.

3. Steel components: Do not drill, cut or weld after galvanizing.

490 DAMAGE REPAIR TO GALVANIZED SURFACES

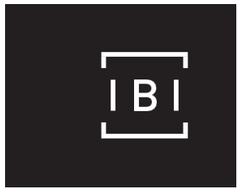
1. Areas of repair: Minor damage, including fixings and fittings.
   - Total area of repair not to exceed 0.5% of total surface area.
   - Each area not to exceed 1000 mm².
2. Renovation: Use low melting point zinc alloy repair rods or powders or at least two coats of zinc-rich paint to BS 4652.

COMPLETION

900 DOCUMENTATION

1. Contents
   - General product information.
   - Installation information.
   - Inspection and maintenance reports.
2. Number of copies: 2 No.
3. Submission: Two weeks prior to date when principal contractor expects work to be practically complete





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Morriston Environmental Modernisation - Phase 2

R10 - Rainwater drainage systems RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/16	RIBA Stage 4 issue. Clauses 311 and 370 revised.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

R10 Rainwater drainage systems REVISED 1

R10
RAINWATER DRAINAGE SYSTEMS REVISED

GENERAL

110 GRAVITY RAINWATER DRAINAGE SYSTEM

1. Gutters: As clause 311
2. Pipework: As clause 370
3. Accessories: As listed in clauses 311 and 370

SYSTEM PERFORMANCE

210 DESIGN

1. Design: Complete the design of the rainwater drainage system.
2. Standard
   - To BS EN 12056-3, clauses 3–7, Annex A and National Annexes.
   - To BS EN 12056-5, clauses 3, 4, 6 and 11.
3. Proposals: Submit drawings, technical information, calculations and manufacturers' literature.

221 COLLECTION AND DISTRIBUTION OF RAINWATER

1. General: Complete, and without leakage or noise nuisance.

230 DESIGN PARAMETERS - GENERAL

1. Roof and gutter construction and finish: Mill finish aluminium
2. Design rate of rainfall: As BS EN 12056-3, National Annex NB.2.
   - Category: 1
3. Design life of building: 50 years
4. Available capacity of existing below ground drainage (maximum): Refer to civil engineer's information

PRODUCTS

311 ALUMINIUM GUTTERS REVISED

1. Standard: Agrément certified
2. Manufacturer: Euroclad Group Ltd,
   Wentloog Corporate Park,
   Wentloog Road,
   Cardiff, CF3 2ER.
   Tel: +44 (0)2922 010101.
   Fax: +44 (0)2922 010122.
   - Product reference: Euroclad Euroline gutter system
3. Profile: Raked box (200 x 150)
4. Type/ Thickness: Extruded aluminium, 2.0mm minimum thickness
5. Nominal size: 150 mm
6. Finish: Mill finish aluminium (to match roof, clause)
7. Colour: Natural
8. Brackets: Not required; direct back fix to fascia board
   - Fixings: Stainless steel screws
     - o Size: 50 x 5 mm

R10
Rainwater drainage systems
132740 - Morriston Environmental Modernisation - Phase 2

9. Accessories: Jointing clips.
   Leaf guards.
   Stop ends (200x150).
   Outlet sections (100x75; for 100x75 rectangular downpipes, as clause 370).
   Weir overflow to 1 No. stop end.

360 SEALANT FOR GUTTERS

1. Type: To manufacturers standard specification (for clause 311)

370 ALUMINIUM PIPEWORK REVISED

1. Standard: Agrément certified
2. Manufacturer: Euroclad Group Ltd,
   Wentloog Corporate Park,
   Wentloog Road,
   Cardiff, CF3 2ER.
   Tel: +44 (0)2922 010101.
   Fax: +44 (0)2922 010122.
   - Product reference: Euroclad downpipe system
3. Type/ Thickness : Mill finish aluminium (2.5mm thick)
4. Section: Rectangular
5. Nominal size: 100 x 75mm
6. Finish Mill finish aluminium.
7. Colour: Natural
8. Brackets: Extruded aluminium pipe clips coated as pipes
   - Fixings: Stainless steel screws
     - o Size: 50 x 5 mm
9. Accessories: Rainwater shoes (100x75).
   Access fittings (100x75), mounted immediately above ground level shoe fitting.

CUSTOM MADE PRODUCTS - NOT USED

EXECUTION

600 PREPARATION

1. Work to be completed before commencing work specified in this section
   - Below ground drainage. Alternatively, make temporary arrangements for dispersal of rainwater without damage or disfigurement of the building fabric and surroundings.
   - Painting of surfaces which will be concealed or inaccessible.

605 INSTALLATION GENERALLY

1. Electrolytic corrosion: Avoid contact between dissimilar metals where corrosion may occur.
2. Plastics and galvanized steel pipes: Do not bend.
3. Allowance for thermal and building movement: Provide and maintain clearance as fixing and jointing proceeds.
4. Protection
   - Fit purpose made temporary caps to prevent ingress of debris.
   - Fit access covers, cleaning eyes and blanking plates as the work proceeds.

610 FIXING AND JOINTING GUTTERS

1. Joints: Watertight
2. Brackets: Securely fixed.

- Fixings: Screwed into fascia board
  - o Fixing centres: To manufacturers standard requirements
- Additional brackets: Where necessary to maintain support and stability, provide at joints in gutters and near angles and outlets.

3. Roofing underlay: Not applicable (roofing top sheet)

615 SETTING OUT EAVES GUTTERS - TO FALLS

1. Setting out: To true line and even gradient to prevent ponding or backfall. Position high points of gutters as close as practical to the roof and low points not more than 50 mm below the roof.
2. Outlets: Align with connections to below ground drainage.

616 SETTING OUT EAVES GUTTERS - LEVEL

1. Setting out: Level and as close as practical to the roof.
2. Outlets: Aligned with connections to below ground drainage.

635 FIXING PIPEWORK

1. Pipework: Fix securely, plumb and/ or true to line.
2. Branches and low gradient sections: Fix with uniform and adequate falls to drain efficiently.
3. Externally socketed pipes and fittings: Fix with sockets facing upstream.
4. Additional supports: Provide as necessary to support junctions and changes in direction.
5. Vertical pipes
   - Provide a loadbearing support at least at every storey level.
   - Tighten fixings as work proceeds so that every storey is self supporting.
   - Wedge joints in unsealed metal pipes to prevent rattling.
6. Wall and floor penetrations: Isolate pipework from structure.
   - Pipe sleeves: As section P31.
   - Masking plates: Fix at penetrations if visible in the finished work.
7. Expansion joint pipe sockets: Fix rigidly to buildings. Elsewhere, provide brackets and fixings that allow pipes to slide.

650 JOINTING PIPEWORK AND GUTTERS

1. General: Joint with materials and fittings that will make effective and durable connections.
2. Jointing differing pipework and gutter systems: Use adaptors intended for the purpose.
3. Cut ends of pipes and gutters: Clean and square. Remove burrs and swarf. Chamfer pipe ends before inserting into ring seal sockets.
4. Jointing or mating surfaces: Clean and, where necessary, lubricate immediately before assembly.
5. Junctions: Form with fittings intended for the purpose.
6. Jointing material: Strike off flush. Do not allow it to project into bore of pipes and fittings.
7. Surplus flux, solvent jointing materials and cement: Remove.

675 CUTTING COATED PIPEWORK AND GUTTERS

1. Cutting: Recoat bare metal.

700 ACCESS FOR TESTING AND MAINTENANCE

1. General: Install pipework and gutters with adequate clearance to permit testing, cleaning and maintenance, including painting where necessary.
2. Access fittings and rodding eyes: Position so that they are not obstructed.

COMPLETION

900 TESTING GENERALLY

1. Dates for testing: Give notice.
   - Period of notice (minimum): 7 days
2. Preparation
   - Pipework: Complete, securely fixed, free from defects, obstruction and debris before testing.
3. Testing
   - Supply clean water, assistance and apparatus.
   - Do not use smoke to trace leaks.
4. Records: Submit a record of tests.

910 GUTTER TEST

1. Preparation: Temporarily block all outlets.
2. Testing: Fill gutters to overflow level and after 5 minutes closely inspect for leakage.

915 MAINTENANCE INSTRUCTIONS

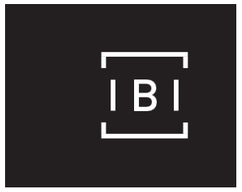
1. General: At completion, submit printed instructions recommending procedures for maintenance of the rainwater installation, including full details of recommended inspection, cleaning and repair procedures.

920 IMMEDIATELY BEFORE HANDOVER

1. Construction rubbish, debris, swarf, temporary caps and fine dust which may enter the rainwater system: Remove. Do not sweep or flush into the rainwater system.
2. Access covers, rodding eyes, outlet gratings and the like: Secure complete with fixings.

NBS Specifications - IBI





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Morriston Environmental Modernisation - Phase 2

Z11 - Purpose made metalwork RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/16	RIBA Stage 4 issue.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

Z11 Purpose made metalwork UNCHANGED 1

Z11
PURPOSE MADE METALWORK UNCHANGED

TO BE READ WITH PRELIMINARIES/ GENERAL CONDITIONS.

310 MATERIALS GENERALLY

1. Grades of metals, section dimensions and properties: To appropriate British Standards. When not specified, select grades and sections appropriate for the purpose.
2. Prefinished metal: May be used if methods of fabrication do not damage or alter appearance of finish, and finish is adequately protected.
3. Fasteners: To appropriate British Standards and, unless specified otherwise, of same metal as component being fastened, with matching coating or finish.

320 STEEL LONG AND FLAT PRODUCTS

1. Hot rolled structural steels (excluding structural hollow sections and tubes): To BS EN 10025-1.
2. Fine grain steels, including special steels: To BS EN 10025-3 and -4.
3. Steels with improved atmospheric corrosion resistance: To BS EN 10025-5.

330 STEEL PLATE, SHEET AND STRIP

1. Plates and wide flats, high yield strength steel: To BS EN 10025-6.

340 HOT ROLLED STEEL PLATE, SHEET AND STRIP

1. Flat products, high yield strength for cold forming: To BS EN 10149-1, -2 and -3.
2. Carbon steel sheet and strip for cold forming: To BS EN 10111.
3. Narrow strip, formable steel and steel for general engineering purposes: To BS 1449-1.8 and BS 1449-1.14.

350 COLD ROLLED STEEL PLATE, SHEET AND STRIP

1. Steel sections: To BS EN 10162.
2. Flat products, high yield strength micro-alloyed steels for cold forming: To BS EN 10268.
3. Carbon steel flat products for cold forming: To BS EN 10130 and BS EN 10131.
4. Uncoated carbon steel narrow strip for cold forming: To BS EN 10139 and BS EN 10140.
5. Narrow strip steel for general engineering purposes: To BS EN 10132-1, -2, and -3.
6. Carbon steel flat products for vitreous enamelling: To BS EN 10209.

360 COATED STEEL FLAT PRODUCTS

1. Hot dip zinc coated carbon steel sheet and strip for cold forming: To BS EN 10346 and BS EN 10143.
2. Hot dip zinc coated structural steel sheet and strip: To BS EN 10143 and BS EN 10346.
3. Hot dip zinc-aluminium (za) coated sheet and strip: To BS EN 10346.
4. Hot dip aluminium-zinc (az) coated sheet and strip: To BS EN 10346.
5. Organic coated flat products: To BS EN 10169.

400 STAINLESS STEEL PRODUCTS

1. Chemical composition and physical properties: To BS EN 10088-1.
2. Sheet, strip and plate: To BS EN 10088-2.
3. Semi-finished products bars, rods and sections: To BS EN 10088-3.
4. Wire: To BS EN 1088-3.
5. Tubes

Z11
Purpose made metalwork

132740 - Morriston Environmental Modernisation - Phase 2

- Welded circular: To BS EN 10296-2.
- Seamless circular: To BS EN 10297-2.

410 ALUMINIUM ALLOY PRODUCTS

1. Designations
   - Designation system, chemical composition and forms: To BS EN 573-1, -2, -3 and -5.
   - Temper designations: To BS EN 515.
2. Sheet, strip and plate: To BS EN 485-1 to -4.
3. Cold drawn rods, bars and tubes: To BS EN 754-1 and -2.
4. Extruded rods, bars, tubes and profiles: To BS EN 755-1 and -2.
5. Drawn wire: To BS EN 1301-1, -2 and -3.
6. Rivet, bolt and screw stock: To BS 1473.
7. Structural sections: To BS 1161.

420 COPPER ALLOY PRODUCTS

1. Sheet, strip, plate and circles for general purposes: To BS EN 1652.
2. Sheet and strip for building purposes: To BS EN 1172.
3. Rods: To BS EN 12163.
4. Profiles and rectangular bars: To BS EN 12167.
5. Wire: To BS EN 12166.
6. Tubes: To BS EN 12449.

FABRICATION

515 FABRICATION GENERALLY

1. Contact between dissimilar metals in components: Avoid.
2. Finished components: Rigid and free from distortion, cracks, burrs and sharp arrises.
   - Moving parts: Free moving without binding.
3. Corner junctions of identical sections: Mitre.

520 COLD FORMED WORK

1. Profiles: Accurate, with straight arrises.

525 ADHESIVE BONDING

1. Preparation of surfaces of metals to receive adhesives
   - Degrease.
   - Abrade mechanically or chemically etch.
   - Prime: To suit adhesive.
2. Adhesive bond: Form under pressure.

527 WELDING

1. Description:
2. Welding procedures
   - Method and standard: TIG or MIG welding to BS EN 1011-4
   - Welding Procedure Specification (WPS): Submit two copies before commencement of welding
3. Preparation
   - Joint preparation: Clean thoroughly.

- Surfaces of materials that will be self-finished and visible in the completed work: protect from weld splatter.

4. Jointing
   - Joints: Fully bond parent and filler metal throughout with no inclusions, holes, porosity or cracks.
   - Dissimilar metals: Welding not permitted
   - Strength requirements: Welds to achieve design loads.
   - Heat straightening: Submit proposals
   - Complex assemblies: Agree priority for welding members to minimize distortion caused by subsequent welds.
   - Tack welds: Use only for temporary attachment.
   - Jigs: Provide to support and restrain members during welding.
   - Filler plates: Submit proposals
   - Lap joints: Minimum 5 x metal thickness or 25 mm, whichever is greater.
   - Weld terminations: Clean and sound.

530 STAINLESS STEEL FABRICATION

1. Guillotining or punching: Do not use for metal thicknesses greater that 10 mm.
2. Thermal cutting
   - Carbonation in the heat affected zone: Remove, after cutting.
3. Bending
   - Plates or bars: Cold bending radius not less than material thickness.
   - Tubes: Cold bending radius not less than 2 x tube diameter.
4. Welding: In addition to general welding requirements:
   - Protect adjacent surfaces from weld spatter.
   - Pickle all welds before post fabrication treatments.
5. Protection: Provide protection to fabricated components during transit and on site.

555 BRAZING

1. Standard: To BS EN 14324.
2. Testing
   - Destructive testing: To BS EN 12797.
   - Nondestructive testing: To BS EN 12799.

FINISHING

710 FINISHING WELDED AND BRAZED JOINTS VISIBLE IN COMPLETE WORK

1. Standard: To BS EN ISO 8501-3.
   - Preparation grade: P1
2. Butt joints: Smooth, and flush with adjacent surfaces.
3. Fillet joints: Neat.
4. Grinding: Grind smooth where indicated on drawings.

745 PREPARATION FOR APPLICATION OF COATINGS

1. General: Complete fabrication, and drill fixing holes before applying coatings.
2. Paint, grease, flux, rust, burrs and sharp arrises: Remove.

750 LIQUID ORGANIC COATING FOR ALUMINIUM ALLOY COMPONENTS

1. Standard: To BS 4842.

760 ZINC AND CADMIUM PLATING OF IRON AND STEEL SURFACES

1. Zinc plating: To BS EN ISO 2081.
2. Cadmium plating: To BS EN ISO 2082.

770 CHROMIUM PLATING

1. Standard: To BS EN ISO 1456.

780 GALVANIZING

1. Standard: To BS EN ISO 1461.
2. Preparation
   - Vent and drain holes: Provide in accordance with BS EN ISO 14713-1 and -2. Seal after sections have been drained and cooled.
   - Components subjected to cold working stresses: Heat treat to relieve stresses before galvanizing.
   - Welding slag: Remove.
   - Component cleaning: To BS EN ISO 8501-3.
   - Grade:

790 VITREOUS ENAMELLING

1. Standard: To BS EN ISO 28722.
2. Substrate metal: Steel to BS EN 10209.

COMPLETION

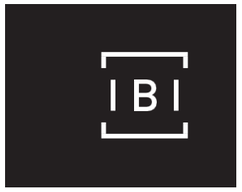
910 DOCUMENTATION

1. Submit
   - Manufacturer's maintenance instructions.
   - Guarantees, warranties, test certificates, record schedules and log books.

920 COMPLETION

1. Protection: Remove.
2. Cleaning and maintenance: Carry out in accordance with procedures detailed in fabricators' guarantees.





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Morriston Environmental Modernisation - Phase 2

Z20 - Fixings and adhesives RIBA STAGE 4 ISSUE

132740

Revisions

Date	Revision	Rev
2021/11/16	RIBA Stage 4 issue.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

Z20 Fixings and adhesives UNCHANGED 1

Z20
FIXINGS AND ADHESIVES UNCHANGED

PRODUCTS

310 FASTENERS GENERALLY

1. Materials: To have:
   - Bimetallic corrosion resistance appropriate to items being fixed.
   - Atmospheric corrosion resistance appropriate to fixing location.
2. Appearance: Submit samples on request.

320 PACKINGS

1. Materials: Noncompressible, corrosion proof.
2. Area of packings: Sufficient to transfer loads.

340 MASONRY FIXINGS

1. Light duty: Plugs and screws.
2. Heavy duty: Expansion anchors or chemical anchors.

350 PLUGS

1. Type: Proprietary types to suit substrate, loads to be supported and conditions expected in use.

360 ANCHORS

1. Types
   - Expansion: For use in substrate strong enough to resist forces generated by expansion of anchor.
   - Adhesive or chemical
     - For use in substrate where expansion of anchor would fracture substrate.
     - For use in irregular substrate where expansion anchors cannot transfer load on anchor.
   - Cavity: For use where the anchor is retained by toggles of the plug locking onto the inside face of the cavity.

370 WOOD SCREWS

1. Type
   - Wood screws (traditional pattern).
     - Standard: To BS 1210.
   - Wood screws.
     - Pattern: Parallel, fully threaded shank or twin thread types.
2. Washers and screw cups: Where required are to be of same material as screw.

380 MISCELLANEOUS SCREWS

1. Type: To suit the fixing requirement of the components and substrate.
   - Pattern: Self-tapping, metallic drive screws, or power driven screws.
2. Washers and screw cups: Where required to be of same material as screw.

390 ADHESIVES

1. Standards

   - Hot-setting phenolic and aminoplastic: To BS 1203.
   - Thermosetting wood adhesives: To BS EN 12765.
   - Thermoplastic adhesives: To BS EN 204.

410 POWDER ACTUATED FIXING SYSTEMS

1. Types of fastener, accessories and consumables: As recommended by tool manufacturer.

EXECUTION

610 FIXING GENERALLY

1. Integrity of supported components: Select types, sizes, quantities and spacings of fixings, fasteners and packings to retain supported components without distortion or loss of support.
2. Components, substrates, fixings and fasteners of dissimilar metals: Isolate with washers/ sleeves to avoid bimetallic corrosion.
3. Appearance: Fixings to be in straight lines at regular centres.

620 FIXING THROUGH FINISHES

1. Penetration of fasteners and plugs into substrate: To achieve a secure fixing.

630 FIXING PACKINGS

1. Function: To take up tolerances and prevent distortion of materials and components.
2. Limits: Do not use packings beyond thicknesses recommended by fixings and fasteners manufacturer.
3. Locations: Not within zones to be filled with sealant.

640 FIXING CRAMPS

1. Cramp positions: Maximum 150 mm from each end of frame sections and at 600 mm maximum centres.
2. Fasteners: Fix cramps to frames with screws of same material as cramps.
3. Fixings in masonry work: Fully bed in mortar.

650 NAILED TIMBER FIXING

1. Penetration: Drive fully in without splitting or crushing timber.
2. Surfaces visible in completed work: Punch nail heads below wrot surfaces.
3. Nailed timber joints: Two nails per joint (minimum), opposed skew driven.

660 SCREW FIXING

1. Finished level of countersunk screw heads
   - Exposed: Flush with timber surface.
   - Concealed (holes filled or stopped): Sink minimum 2 mm below surface.

670 PELLETED COUNTERSUNK SCREW FIXING

1. Finished level of countersunk screw heads: Minimum 6 mm below timber surface.
2. Pellets: Cut from matching timber, match grain and glue in to full depth of hole.
3. Finished level of pellets: Flush with surface.

680 PLUGGED COUNTERSUNK SCREW FIXING

1. Finished level of countersunk screw heads: Minimum 6 mm below timber surface.
2. Plugs: Glue in to full depth of hole.
3. Finished level of plugs: Projecting above surface.

690 USING POWDER ACTUATED FIXING SYSTEMS

1. Powder actuated fixing tools: To BS 4078-2 and Kitemark certified.
2. Operatives: Trained and certified as competent by tool manufacturer.

700 APPLYING ADHESIVES

1. Surfaces: Clean. Adjust regularity and texture to suit bonding and gap filling characteristics of adhesive.
2. Support and clamping during setting: Provide as necessary. Do not mark surfaces of or distort components being fixed.
3. Finished adhesive joints: Fully bonded. Free of surplus adhesive.

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Morriston Environmental Modernisation - Phase 2

Z21 - Mortars RIBA STAGE 4 ISSUE

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Revisions

Date	Revision	Rev
2021/11/16	RIBA Stage 4 issue.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

Z21 Mortars UNCHANGED 1

Z21
Mortars

132740 - Morriston Environmental Modernisation - Phase 2

Z21
MORTARS UNCHANGED

CEMENT GAUGED MORTARS

110 CEMENT GAUGED MORTAR MIXES

1. Specification: Proportions and additional requirements for mortar materials are specified elsewhere.

120 SAND FOR SITE MADE CEMENT GAUGED MASONRY MORTARS

1. Standard: To BS EN 13139.
2. Grading: 0/2 (FP or MP).
   - Fines content where the proportion of sand in a mortar mix is specified as a range (e.g. 1:1: 5-6):
     - o Lower proportion of sand: Use category 3 fines.
     - o Higher proportion of sand: Use category 2 fines.
3. Sand for facework mortar: Maintain consistent colour and texture. Obtain from one source.

131 READY-MIXED LIME:SAND FOR CEMENT GAUGED MASONRY MORTARS

1. Standard: To BS EN 998-2.
2. Lime: Nonhydraulic to BS EN 459-1.
   - Type: CL 90S.
3. Pigments for coloured mortars: To BS EN 12878.

135 SITE MADE LIME:SAND FOR CEMENT GAUGED MASONRY MORTARS

1. Permitted use: Where a special colour is not required and in lieu of factory made ready-mixed material.
2. Lime: Nonhydraulic to BS EN 459-1.
   - Type: CL 90S.
3. Mixing: Thoroughly mix lime with sand, in the dry state. Add water and mix again. Allow to stand, without drying out, for at least 16 hours before using.

160 CEMENTS FOR MORTARS

1. Cement: To BS EN 197-1 and CE marked.
   - Types: Portland cement, CEM I.
     - o Portland limestone cement, CEM II/A-L or CEM II/A-LL.
2. Portland slag cement, CEM II/B-S.
3. Portland fly ash cement, CEM II/B-V.
   - Strength class: 32.5, 42.5 or 52.5.
4. White cement: To BS EN 197-1 and CE marked.
   - Type: Portland cement, CEM I.
   - Strength class: 52.5.
5. Sulfate resisting Portland cement
   - Type: To BS EN 197-1 Sulfate resisting Portland cement, CEM I/SR and CE marked.
6. To BS EN 197-1 fly ash cement, CEM II/B-V and CE marked.
   - Strength class: 32.5, 42.5 or 52.5.
7. Masonry cement: To BS EN 413-1 and CE marked.
   - Class: MC 12.5.

180 ADMIXTURES FOR SITE MADE CEMENT GAUGED MORTARS

1. Air entraining (plasticizing) admixtures: To BS EN 934-3 and compatible with other mortar constituents.
2. Other admixtures: Submit proposals.
3. Prohibited admixtures: Calcium chloride, ethylene glycol and any admixture containing calcium chloride.

190 RETARDED READY TO USE CEMENT GAUGED MORTAR

1. Standard: To BS EN 998-2.
2. Lime for cement:lime:sand mortars: Nonhydraulic to BS EN 459-1.
   - Type: CL 90S.
3. Pigments for coloured mortars: To BS EN 12878.
4. Time and temperature limitations: Use within limits prescribed by mortar manufacturer.
   - Retempering: Restore workability with water only within prescribed time limits.

200 STORAGE OF CEMENT GAUGED MORTAR MATERIALS

1. Sands and aggregates: Keep different types/ grades in separate stockpiles on hard, clean, free-draining bases.
2. Factory made ready-mixed lime:sand/ ready to use retarded mortars: Keep in covered containers to prevent drying out or wetting.
3. Bagged cement/ hydrated lime: Store off the ground in dry conditions.

210 MAKING CEMENT GAUGED MORTARS

1. Batching: By volume. Use clean and accurate gauge boxes or buckets.
   - Mix proportions: Based on dry sand. Allow for bulking of damp sand.
2. Mixing: Mix materials thoroughly to uniform consistency, free from lumps.
   - Mortars containing air entraining admixtures: Mix mechanically. Do not overmix.
3. Working time (maximum): Two hours at normal temperatures.
4. Contamination: Prevent intermixing with other materials.

LIME:SAND MORTARS

310 LIME:SAND MORTAR MIXES

1. Specification: Proportions and additional requirements for mortar materials are specified elsewhere.

320 SAND FOR LIME:SAND MASONRY MORTARS

1. Type: Sharp, well graded.
   - Quality, sampling and testing: To BS EN 13139.
   - Grading/ Source: As specified elsewhere in relevant mortar mix items.

340 POZZOLANIC ADDITIVES FOR NONHYDRAULIC LIME:SAND MORTARS

1. Manufacturer/ Supplier:
   - Product reference:
2. Mixing: Mix thoroughly into mortar during knocking up.

345 ADMIXTURES FOR HYDRAULIC LIME:SAND MORTARS

1. Air entraining (plasticizing) admixtures: To BS EN 934-3 and compatible with other mortar constituents.

2. Prohibited admixtures: Calcium chloride, ethylene glycol and any admixture containing calcium chloride.

350 STORAGE OF LIME:SAND MORTAR MATERIALS

1. Sands and aggregates: Keep different types/ grades in separate stockpiles on hard, clean, free-draining bases.
2. Ready prepared nonhydraulic lime putty: Prevent drying out and protect from frost.
3. Nonhydraulic lime:sand mortar: Store on clean bases or in clean containers that allow free drainage. Prevent drying out or wetting and protect from frost.
4. Bagged hydrated hydraulic lime: Store off the ground in dry conditions.

360 MAKING LIME:SAND MORTARS GENERALLY

1. Batching: By volume. Use clean and accurate gauge boxes or buckets.
2. Mixing: Mix materials thoroughly to uniform consistency, free from lumps.
3. Contamination: Prevent intermixing with other materials, including cement.

370 SITE PREPARED NONHYDRAULIC LIME:SAND MORTARS

1. Mixing: Mix materials thoroughly by compressing, beating and chopping. Do not add water.
   - Equipment: Roller pan mixer or submit proposals.
2. Maturation period before use (maximum): Seek instructions

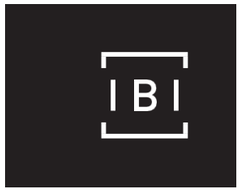
390 KNOCKING UP NONHYDRAULIC LIME:SAND MORTARS

1. Knocking up before and during use: Achieve and maintain a workable consistency by compressing, beating and chopping. Do not add water.
   - Equipment: Roller pan mixer or submit proposals.

400 MAKING HYDRAULIC LIME:SAND MORTARS

1. Mixing hydrated hydraulic lime:sand: Follow the lime manufacturer's recommendations for each stage of the mix.
   - Water quantity: Only sufficient to produce a workable mix.
2. Working time: Within limits recommended by the hydraulic lime manufacturer.





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Morriston Environmental Modernisation - Phase 2

Z22 - Sealants RIBA STAGE 4 ISSUE

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2021/11/16	RIBA Stage 4 issue.	P1

Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

Z22 Sealants UNCHANGED 1

Z22
SEALANTS UNCHANGED

PRODUCTS

310 JOINTS : EXTERNALLY & INTERNALLY

1. Description:
2. Manufacturer:: CARLISLE®,
   Adshead Ratcliffe & Co Ltd.,
   Derby Road, Belper,
   Derbyshire,
   DE56 1WJ

   T: 01773 826661
   E info.arbo@ccm-europe.com
3. Reference:: Arbomeric MP10)modified polymer sealant)
4. Primer, backing strip, bond breaker: Types recommended by sealant manufacturer.
5. Installation:: In accordance with the manufacturers recommendations and specifications.

EXECUTION

610 SUITABILITY OF JOINTS

1. Presealing checks
   - Joint dimensions: Within limits specified for the sealant.
   - Substrate quality: Surfaces regular, undamaged and stable.
2. Joints not fit to receive sealant: Submit proposals for rectification

620 PREPARING JOINTS

1. Surfaces to which sealant must adhere
   - Remove temporary coatings, tapes, loosely adhering material, dust, oil, grease, surface water and contaminants that may affect bond.
   - Clean using materials and methods recommended by sealant manufacturer.
2. Vulnerable surfaces adjacent to joints: Mask to prevent staining or smearing with primer or sealant.
3. Backing strip and/ or bond breaker installation: Insert into joint to correct depth, without stretching or twisting, leaving no gaps.
4. Protection: Keep joints clean and protect from damage until sealant is applied.

630 APPLYING SEALANTS

1. Substrate: Dry (unless recommended otherwise) and unaffected by frost, ice or snow.
2. Environmental conditions: Do not dry or raise temperature of joints by heating.
3. Sealant application: Fill joints completely and neatly, ensuring firm adhesion to substrates.
4. Sealant profiles
   - Butt and lap joints: Slightly concave.
   - Fillet joints: Flat or slightly convex.
5. Protection: Protect finished joints from contamination or damage until sealant has cured.

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Morriston Environmental Modernisation - Phase 2

Z31 - Powder coatings RIBA STAGE 4 ISSUE

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Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

Z31 Powder coatings UNCHANGED 1

Z31
Powder coatings

132740 - Morriston Environmental Modernisation - Phase 2

Z31
POWDER COATINGS UNCHANGED

TO BE READ WITH PRELIMINARIES/ GENERAL CONDITIONS.

120 POWDER COATING MATERIALS

1. Selected manufacturer: Submit details before commencement of powder coating including:
   - Name and contact details.
   - Details of accreditation schemes.
   - Technical data of product including current Agrément certificates.

210 WORKING PROCEDURES

1. Comply with the follow following standards.
   - Aluminium components: To BS 6496 or BS EN 12206-1.
   - Steel components: To BS EN 13438.
   - Safety standards: To British Coatings Federation 'Code of safe practice: Powder coating. Application of coating powders by electrostatic spraying'.
   - Health and safety guidance: Health and Safety Executive 'Reducing risk associated with using coating powders - employers' web page.

220 POWDER COATING APPLICATORS

1. Applicator requirements
   - Approved by powder coating manufacturer.
   - Currently certified to BS EN ISO 9001.
   - Comply with quality procedures, guarantee conditions, standards and tests required by powder coating manufacturer.
   - Selected applicator: Submit details before commencement of powder coating including:
     - o Name and contact details.
     - o Details of accreditation schemes.

225 GUARANTEES

1. Powder coating manufacturer and applicator guarantees
   - Submit sample copies before commencement of powder coating.
   - Submit signed project specific copies on completion of work.

230 CONTROL SAMPLES

1. Sequence: Prior to ordering materials for the works, obtain approval of appearance for:
   - Powder coated samples: Of various grades and forms of background metal to be used, showing any colour, texture and gloss variation.
   - Fabrication samples: Showing joint assembly, how powder coating is affected and how any cut metal edges are finished and protected.
   - Where manual application is required, controlled samples should be coated and inspected for colour and gloss stability.
2. Samples to include the following information
   - Product reference.
   - Colour.
   - Reference number.
   - Name.

- Gloss level.

235 INDEPENDENT INSPECTION AT PLANT

1. Requirement: Contractors/ suppliers of the following designated components must commission an approved Independent Inspection Authority to carry out acceptance inspections to confirm that powder coating application complies with this specification.
   - Designated components: All powder coated components
2. Acceptance inspections: Carry out for each variation of colour and finish of each component work package at applicator's plant prior to any fabrication of units, in accordance with the following:
   - Where three of more production runs are required for application of coatings, not less than three acceptance inspections must be carried out in accordance with BS 6001-1, general inspection level 2, with an acceptance quality limit of 1%.
   - Where less than three production runs are required for application of coatings, one acceptance inspection must be carried out in accordance with BS 6001-2, with a limiting quality of 5% where the probability of acceptance is 10%.
3. Components failing inspection: Reprocess or replace and reinspect.
4. Inspection reports: Independent Inspection Authority must submit copies.

240 QUALICOAT QUALITY ASSURANCE SYSTEM

1. Requirement: Powder and coating application to the following designated components is to be tested and approved in accordance with the Qualicoat system.
   - Designated components: All powder coated components

250 COMPONENT DESIGN

1. Condition of components to be powder coated
   - To comply with relevant recommendations of BS 4479-1, -3, and -4.
   - Of suitable size to fit plant capacity.
   - Of suitable thickness to withstand oven curing.

310 PRETREATMENT OF ALUMINIUM COMPONENTS

1. Condition of components to be pretreated
   - Free from corrosion and damage.
   - All welding and jointing completed and finish off as specified.
   - Free from impurities including soil, grease and oil.
   - Suitable for and compatible with the pretreatment process.
2. Conversion coating requirements
   - Chromate system: To BS 6496 or BS EN 12206-1.
   - Chromate-free system: To BS EN 12206-1. Submit details before using.
3. Rinsing requirements: Use demineralized water. Drain and dry.

320 PRETREATMENT OF STEEL COMPONENTS

1. Condition of components to be pretreated
   - Free from corrosion and damage.
   - All welding and jointing completed and finish off as specified.
   - Free from impurities including soil, grease and oil.
   - Suitable for and compatible with the pretreatment process.
2. Conversion coating requirements: To BS EN 13438.
3. Rinsing requirements: Use demineralized water. Drain and dry.

330 PRETREATMENT FOR PROTECTION IN AGGRESSIVE ENVIRONMENTS

1. Minimum thickness of 60 microns across significant and/ or primary surfaces.
2. Minimum thickness of 25 microns on non-significant and/ or secondary faces ensuring a coherent film layer.
3. All cut edges, drilled holes and mitres to be fully sealed.
4. Cleaning and maintenance: Carried out once every three to twelve months (dependent on proximity to pollutant).

430 EXTENT OF POWDER COATINGS

1. Application: To visible component surfaces, and concealed surfaces requiring protection. Coated surfaces will be deemed 'significant surfaces' for relevant BS 6496 or BS EN 13438 performance requirements.

435 APPLICATION OF POWDER COATINGS

1. Surfaces to receive powder coatings: Free from dust or powder deposits.
2. Powder colours: Obtain from one batch of one manufacturer.
3. Commencement of powder coating: To be continuous from pretreatment.
4. Components to be installed on site in order of application.
5. Jig points: Not visible on coated components.
6. Curing: Controlled to attain metal temperatures and hold periods recommended by powder coating manufacturer.
7. Stripping and recoating of components: Only acceptable by prior agreement of powder coating manufacturer. Stripping, pretreatment and powder coating are to be in accordance with manufacturer's requirements.
8. Overcoating of components: Not acceptable.

440 PERFORMANCE AND APPEARANCE OF POWDER COATINGS

1. For aluminium components
   - Standard: To BS 6496 or BS EN 12206-1.
2. For steel components
   - Standard: To BS EN 13438.
3. Visual inspection after powder coating: Significant surface viewing distances to be as specified in the relevant Standard, unless specified otherwise.
4. Colour and gloss levels: To conform with approved samples.

450 ALUMINIUM ALLOY FABRICATIONS

1. Units may be assembled
   - Before powder coating.
   - From components powder coated after cutting to size.
   - Where approved, from components powder coated before cutting to size.
2. Exposure of uncoated background metal: Not acceptable.
3. Assembly sealants: Compatible with powder coatings. Obtain approval of colour if sealants are visible after fabrication.

460 STEEL FABRICATIONS

1. Unit assembly: Wherever practical, before powder coating.
2. Exposure of uncoated background metal: Not acceptable.
3. Assembly sealants: Compatible with powder coatings. Obtain approval of colour if sealants are visible after fabrication.

470 FIXINGS

1. Exposed metal fixings: Powder coat together with components, or coat with matching repair paint system applied in accordance with the powder coating manufacturer's recommendations.

480 DAMAGED COMPONENTS – REPAIR OR REPLACEMENT

1. Before delivery to site: Check all components for damage to powder coatings. Replace damaged components.
2. Site damage: Submit proposals for repair or replacement.

510 PROTECTION

1. Powder coated surfaces of components: Protect from damage during handling and installation, or by subsequent site operations.
2. Protective coverings must be
   - Resistant to weather conditions.
   - Partially removable to suit building in and access to fixing points.
3. Protective tapes in contact with powder coatings must be
   - Low tack, self adhesive and light in colour.
   - Applied and removed in accordance with tape and powder coating manufacturers' recommendations. Do not use solvents to remove residues as these are detrimental to the coating.
4. Inspection of protection: Carry out monthly. Promptly repair any deterioration or deficiency.

520 PROTECTION IN HAZARDOUS LOCATIONS

1. Minimum thickness of 60 microns across significant and/ or primary surfaces.
2. Minimum thickness of 25 microns on non-significant and/ or secondary faces ensuring a coherent film layer.
3. All cut edges, drilled holes and mitres to be fully sealed.
4. Cleaning: Carried out once every three to twelve months (dependent on proximity to pollutant).

535 DOCUMENTATION

1. Submit the following information for each batch of powder coated components
   - Supplier.
   - Trade name.
   - Colour.
   - Type of powder.
   - Method of application.
   - Batch and reference number.
   - Statutory requirements.
   - Test certificates.
   - Maintenance instructions.

540 COMPLETION

1. Protection: Remove any protective coverings.
2. Cleaning and maintenance of powder coatings: Carry out in accordance with procedures detailed in powder coating manufacturer and applicator guarantees.

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Morriston Environmental Modernisation - Phase 2

Z33 - Anodising RIBA STAGE 4 ISSUE

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Notes

- Specification to be read in conjunction with IBI Group drawings
- Any discrepancies in Specification or between Specification and drawings to be reported to IBI Group

Contents

Z33 Anodizing UNCHANGED 1

Z33
Anodizing

132740 - Morriston Environmental Modernisation - Phase 2

Z33
ANODIZING UNCHANGED

TO BE READ WITH PRELIMINARIES/ GENERAL CONDITIONS.

110 ANODIC COATING

1. Selected anodizer: Submit details before commencement of anodizing, including:
   - Name and contact details.
   - Details of accreditation schemes.
   - Technical data of product including current Agrément certificates.

210 WORKING PROCEDURES

1. Standard: To BS 3987 for anodic coatings on wrought aluminium.

220 ANODIZER REQUIREMENTS

1. Processing
   - Approved: By the Aluminium Finishing Association.
   - Certified: To BS EN ISO 9001.
   - Anodizing plant: Each anodizer to use only one plant.

230 GUARANTEES

1. Anodizer guarantees: Submit sample copies before commencement of anodizing.
2. Project specific guarantees: Submit signed copies on completion of work.
3. Guarantees to cover
   - Life expectancy.
   - Colour: Opacity and consistency.
   - Texture: Gloss, satin or matt.
   - Quality of coating.

240 CONTROL SAMPLES

1. Sequence: Prior to ordering materials for the works, obtain approval of appearance for:
   - Anodic coated samples: Showing colour and texture variation.
   - Fabrication samples: Showing joint assembly, how anodic coating is affected and how cut metal edges are finished and protected.

250 INDEPENDENT INSPECTION AT PLANT

1. Requirement: Contractors/ suppliers of the following designated components must commission an approved Independent Inspection Authority to carry out acceptance inspections to confirm that anodic coating application complies with this specification.
   - Designated components: All anodised components
2. Acceptance inspections: Carry out for each variation of colour and finish of each component work package at anodizer's plant prior to any fabrication of units, in accordance with the following:
   - Where three of more production runs are required for application of coatings, not less than three acceptance inspections must be carried out in accordance with BS 6001-1, general inspection level 2, with an acceptance quality limit of 1%.
   - Where less than three production runs are required for application of coatings, one acceptance inspection must be carried out in accordance with BS 6001-2, with a limiting quality of 5% where the probability of acceptance is 10%.
3. Components failing inspection: Reprocess or replace and reinspect.

4. Inspection reports: Independent Inspection Authority must submit copies.

255 QUALITY ASSURANCE SYSTEM

1. Requirement: Powder and coating application to the following designated components is to be tested and approved in accordance with the Qualanod system.
   - Designated components: All anodised components

270 COMPONENT DESIGN

1. Condition of components to be anodized
   - To comply with relevant recommendations of BS 4479-1, and -5.
   - Of suitable size to fit plant capacity.

310 PRETREATMENT

1. Condition of components to be anodized
   - Free from corrosion and damage.
   - Suitable for and compatible with the pretreatment and anodizing process.
2. Process: In accordance with the specification requirements for the finish.

410 EXTENT OF ANODIC COATINGS

1. Application: To visible component surfaces, and concealed surfaces requiring protection. Coated surfaces will be deemed ‘significant surfaces’ for relevant BS 3987 performance requirements.

420 APPLICATION OF ANODIC COATINGS

1. Surfaces to receive anodic coatings: Clean.
2. Commencement of anodic coating: To be continuous from pretreatment.
3. Jig points: To be agreed. Not on visible areas of anodic coated components.
4. Use of touch-up paint: Not acceptable.

430 PERFORMANCE AND APPEARANCE OF ANODIC COATINGS

1. Standard: To BS 3987.
2. Visual inspection after anodizing: Significant surfaces to be free from visible coating/ defects when viewed from a distance of not less than 5 m for external and 3 m for internal applications.

440 FABRICATION

1. Units may be assembled
   - Before anodizing, providing sufficient drainage holes are included in components to fully drain components.
   - From components anodized after cutting to size.
   - Where approved, from components anodized before cutting to size.
   - Exposure of uncoated background metal: Not acceptable.
   - Assembly sealants: Compatible with anodic coatings. Obtain approval of colour if sealants are visible after fabrication.

450 DAMAGED COMPONENTS – REPAIR/ REPLACEMENT

1. Before delivery to site: Check all components for damage to anodic coatings. Replace damaged components.
2. Site damage: Submit proposals for repair or replacement.

510 PROTECTION

1. Anodic coated surfaces of components: Protect from damage during handling and installation, or by subsequent site operations.
2. Protective coverings: Must be:
   - Resistant to weather conditions.
   - Partially removable to suit building in and access to fixing points.
3. Protective tapes in contact with anodizing to be
   - Low tack, self adhesive and light in colour.
   - Applied and removed in accordance with tape and anodizers recommendations.
4. Inspection of protection: Carry out weekly. Promptly repair any deterioration or deficiency.

530 DOCUMENTATION

1. Submit the following information for each batch of anodic coated components
   - Supplier.
   - Trade name.
   - Colour (if required).
   - Batch and reference number.
   - Statutory requirements.

540 COMPLETION

1. Protection: Remove.
2. Cleaning and maintenance of anodic coatings: Carry out in accordance with procedures detailed in anodizer's guarantees.

NBS Specifications - IBI

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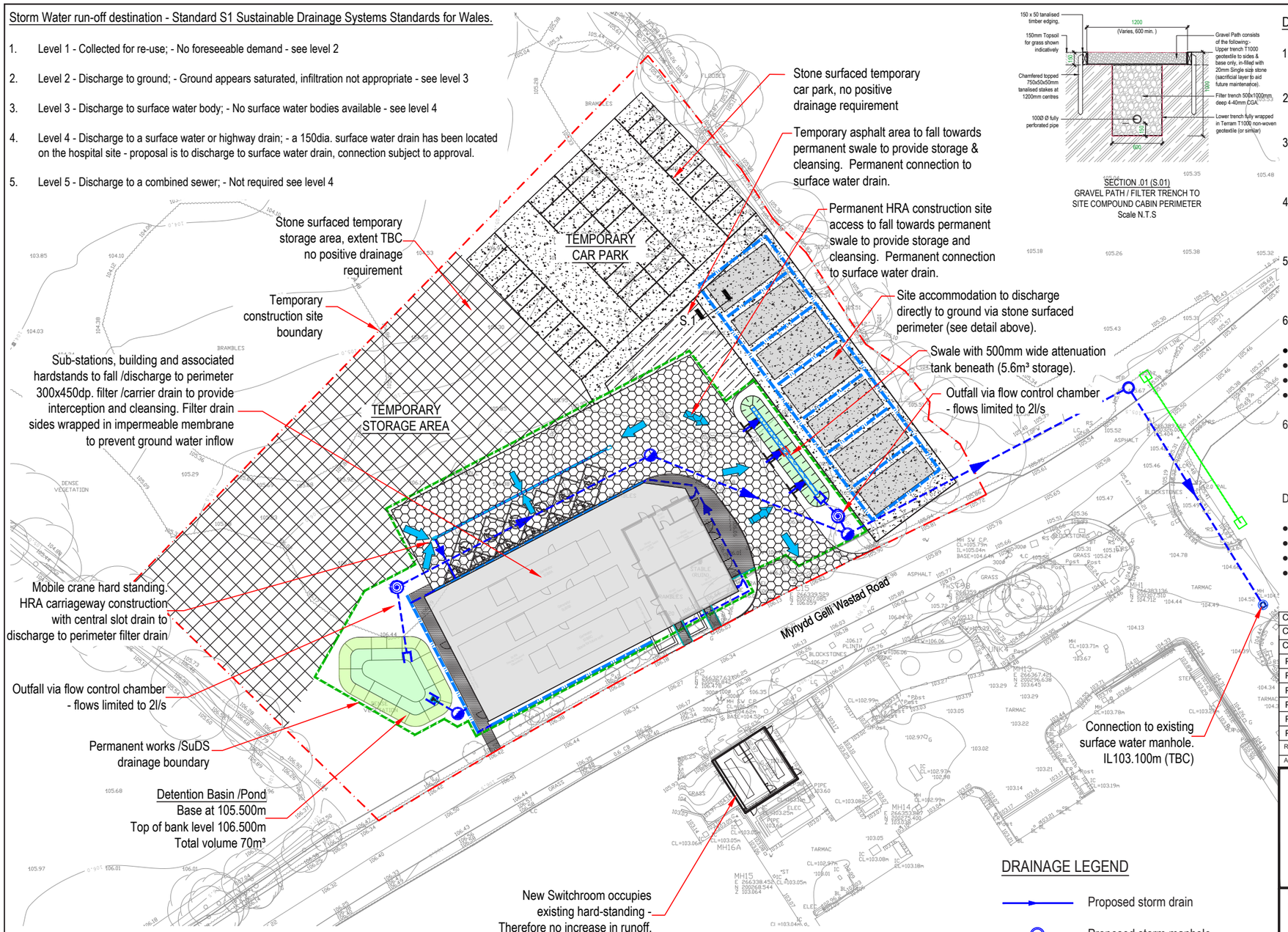
MORRISTON HOSPITAL - INFRASTRUCTURE WORKS

6A: SAB INFORMATION

SAB Information

Storm Water run-off destination - Standard S1 Sustainable Drainage Systems Standards for Wales.

1. Level 1 - Collected for re-use; - No foreseeable demand - see level 2
2. Level 2 - Discharge to ground; - Ground appears saturated, infiltration not appropriate - see level 3
3. Level 3 - Discharge to surface water body; - No surface water bodies available - see level 4
4. Level 4 - Discharge to a surface water or highway drain; - a 150dia. surface water drain has been located on the hospital site - proposal is to discharge to surface water drain, connection subject to approval.
5. Level 5 - Discharge to a combined sewer; - Not required see level 4



SECTION .01 (S.01)
GRAVEL PATH / FILTER TRENCH TO SITE COMPOUND CABIN PERIMETER
Scale N.T.S

DESIGN EVALUATION NOTES

1. Construction Site Area 0.51Ha. Development site area =0.08Ha
2. Assumed little potential for discharge via infiltration - ground saturated
3. Surface water to be directed to Highway Drain in accordance with hierarchy of Standard S1 Sustainable Drainage Systems Standards for Wales.
4. Surface water discharge to mimic Greenfield Run-off Rates in accordance with Standard S2 - Sustainable Drainage Systems Standards for Wales.
5. Drainage system to prevent first 5mm of rainfall from leaving the site for majority of rainfall events (interception)
6. Greenfield run-off rates calculated as;
   - QBAR - 0.65l/s
   - Q1 - 0.57l/s
   - Q30 - 1.15l/s
   - Q100 - 1.41l/s
6. Flows to be limited to 2l/s to minimise blockage risk Attenuation storage requirements;

   Design flow - 2l/s from site.

Design assumptions as below

- Total Site area - 0.457Ha - Permanent 0.145Ha
- Climate change allowance 30%
- Urban Creep allowance 1.1
- Interception rainfall depth 5mm

DRAINAGE LEGEND

- Proposed storm drain
- Proposed storm manhole
- Proposed Catchpit /Sump Chamber
- Proposed Detention Basin/Pond
- Proposed Swale & attenuation tank

Refer to Drawing Number
MHP2-RVW-SS6-00-DR-C-000002
For Typical Construction Details

Rev.	Date.	Details.	By.	Chk.
C03	04.07.22	Annotation amended.	AJH	ABP
C02	24.12.21	Attenuation tank added to swale, levels & notes amended to suit.	AJH	ABP
C01	21.12.21	Construction Issue - detention basin & annotation amended, boundary lines updated to suit.	AJH	ABP
P7	19.12.21	Achitectural layout, drainage runs & boundary lines updated.	AJH	ABP
P6	12.11.21	SAB drainage outfall position revised to enable road crossing point to coincide with other services. Drawing number revised to show S6.	KJW	ABP
P5	12.10.21	Revised to suit new substasion layout.	KJW	ABP
P4	05.10.21	Layout revised following new topo survey and co-ordinate information. SAB drainage outfall position revised to connect to existing SW drain.	KJW	ABP
P3	12.08.21	HRA access and mobile crane hardstanding area with slot drain added. Perimeter filter drain revised to suit.	KJW	ABP
P2	20.05.21	Drawing Tittle and number revised in accordance with Contractor's comments. Note added - no positive drainage requirement storage area	DRW	JF

Amendments

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Project:
MORRISTON GENERAL HOSPITAL - PHASE 2

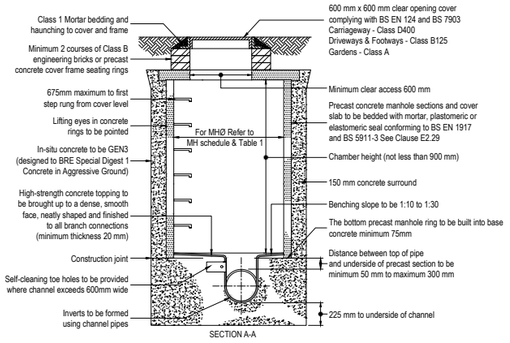
Title:
SAB Application External Arrangements

Drawn:	Checked:	Scale(s) at A3:	
DRW	ABP	1:500	
Date:	RVW Job N°:	Revision:	Suitability:
08.05.21	**C6986**	**C03**	**A1**

Drawing Status: **CONSTRUCTION**

Drawing N°: **MHP2-RVW-S6-00-DR-C-000001**

SAB Information



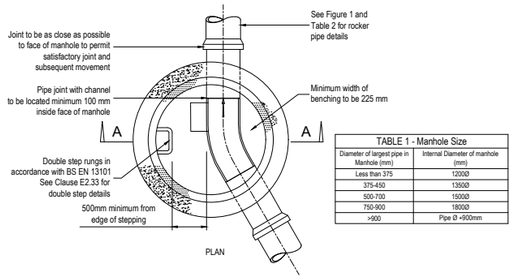
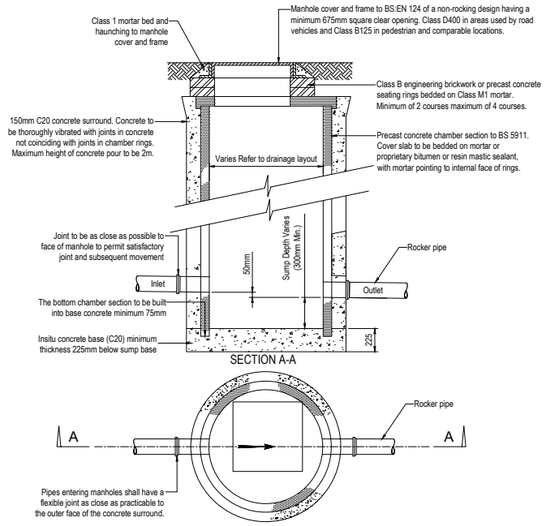


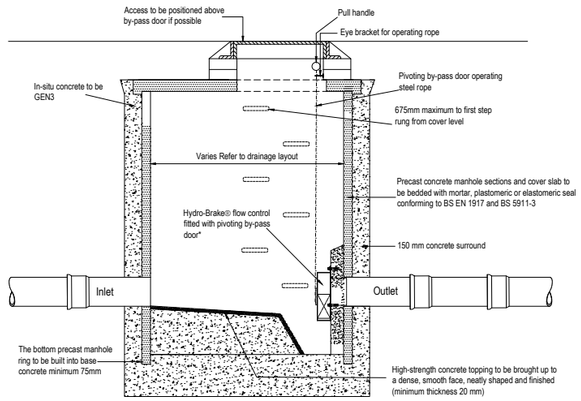
TABLE 1 - Manhole Size	
Diameter of largest pipe in Manhole (mm)	Internal Diameter of manhole (mm)
Less than 375	1200Ø
375-450	1350Ø
500-700	1500Ø
750-900	1800Ø
>900	Pipe Ø +900mm

TYPICAL MANHOLE DETAIL - TYPE 2

Maximum depth from cover level to soffit of pipe 3.0m Not to scale



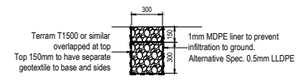
TYPICAL PPC CATCHPIT DETAIL



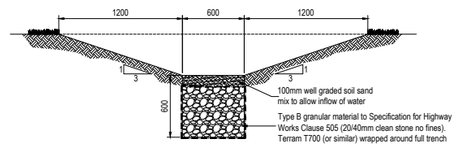
TYPICAL HYDROBRAKE CHAMBER DETAIL

NOTES:-

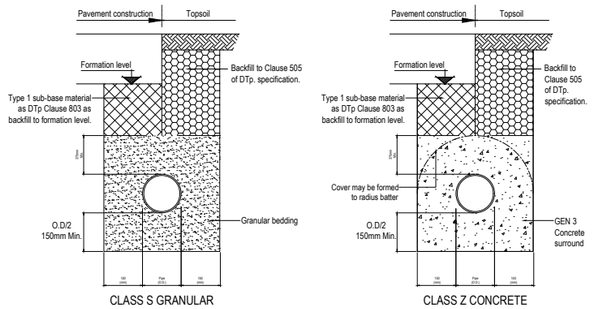
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RVW CONSULTING LIMITED PROJECT DRAWINGS AND SPECIFICATIONS.
2. ALL EXISTING DRAINAGE LEVELS AND OUTFALL POINTS SHALL BE SURVEYED AND VERIFIED BY THE CONTRACTOR PRIOR TO THE COMMENCEMENT OF THE WORKS. ANY DISCREPANCIES SHALL BE REPORTED TO THE ENGINEER IMMEDIATELY.
3. PIPEWORK UNDER ADOPTABLE HIGHWAY WITH LESS THAN 1.2m COVER, AND OTHER TRAFFICKED AREAS WITH LESS THAN 0.9m COVER TO RECEIVE CONCRETE ENCASEMENT.
4. MANHOLE/INSPECTION CHAMBER COVERS SHOULD NOT BRIDGE DIFFERENT SURFACES.
5. WHERE TWO PIPELINES (OTHER THAN PLASTIC PIPES) CROSS WITH LESS THAN 300mm SEPARATION PIPES ARE TO BE SURROUNDED WITH CLASS Z CONCRETE SURROUND FOR NOT LESS THAN 1m CENTERED ON THE CROSSING POINT. CONCRETE SURROUND TO BE EXTENDED AS NECESSARY TO WITHIN 150mm OF NEAREST FLEXIBLE JOINTS.
6. ALL PIPEWORK TO BE LAID WITH SOFFIT TO SOFFIT CONNECTIONS UNLESS NOTED OTHERWISE.
7. ALL CONNECTIONS TO THE PUBLIC SEWERAGE SYSTEM ARE TO BE MADE TO THE SATISFACTION OF THE ADOPTING AUTHORITY AND WILL BE SUBJECT TO A SECTION 106 APPLICATION.



300x450 DEEP FILTER/CARRIER DRAIN DETAIL



TYPICAL SECTION THROUGH SWALE



NOTES: (CLASS S & CLASS Z)

1. Bedding beneath and at sides of the pipe to be well compacted.
2. The first 300mm of fill above the crown of the pipe is to be lightly compacted by hand. Mechanical compaction may be used only above this level.
3. Concrete cradles and arches may be extended to the sides of the trench.
4. Geotextiles may be used where directed or approved by the Engineer to contain bedding material in certain soils e.g. running sand.
5. In very wet conditions, where directed or approved by the Engineer a temporary land drain may be laid within the granular bed.

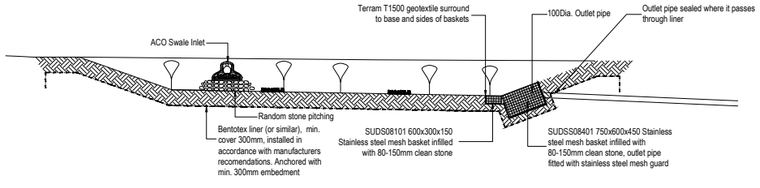
NOTES: (CLASS Z ONLY)

6. Where pipes with flexible joints are used, the concrete protection is to be interrupted over its full cross section at intervals not exceeding 5 metres (or as directed by the Engineer) by a shaped former of bitumen-impregnated insulating board to BS EN622-1 & BS EN 622-4. These interruptions shall coincide with pipe joints. See dimensions on Table 3 for thickness of compressible filler.
7. Concrete to be Class GEN3
8. Where flexible pipes are used, care must be taken to prevent the pipes from floating.

TABLE 3 - Filler Thickness	
Nominal Ø of pipe	Thickness of compressible filler (mm)
Less than 450	18
450-1200	36
>1200	54

Granular Bedding & Sidefill For Rigid & Flexible Pipes			
Pipe Dia.	Class of Bedding		Imported Granular Material (Note 1)
<150mm	S	B	10/14mm Single Size or 14 to 5mm Graded
150 to 500mm	S	B	10/14/20mm Single Size or 14 to 5mm Graded or 20 to 5mm Graded
>500mm	S	B	10/14/20/40mm Single Size or 14 to 5mm Graded or 40 to 5mm Graded

PIPE BEDDING & SURROUND DETAILS



TYPICAL LONG SECTION DETENTION BASIN/POND

This drawing to be read in conjunction with drawing number:
MHPS-RVW-SS6-00-DR-C-000001 SAB Application External Arrangements

"The specification in all respects shall be in accordance with the current Design Manual for Road and Bridges and The Specification for Highway Works and any other construction publication in force in the county at the time of construction."

Rev.	Date.	Details.	By.	Chk.
P1	19.12.21	Preliminary Issue	AJH	ABP

Amendments

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Project:
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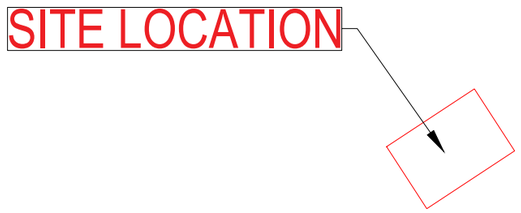
Title:
SAB Application Construction Details

Drawn:	Checked:	Scale(s) at A1:	
KJW	ABP	N.T.S.	
Date:	RVW Job N°:	Revision:	Suitability:
11.08.21	**C6986**	**P1**	**S0**

Drawing Status:
PRELIMINARY

Drawing N°:
MHP2-RVW-S6-00-DR-C-000003

SAB Information



Rev.	Date.	Details.	By.	Chk.
P01	19.12.2021	Preliminary Issue.	NT	ABP

Amendments

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Project:
MORRISTON GENERAL HOSPITAL - PHASE 2

Title:
Location Plan

Drawn:	Checked:	Scale(s) at A1:	
NT	BP	NTS @A1	
Date:	RVW Job N°:	Revision:	Suitability:
DEC '21	**C6986**	**P01**	**S0**

Drawing Status:
PRELIMINARY

Drawing N°:
MHP2-RVW-S6-00-DR-C-000010