



**SPECIFICATION FOR
FIRE PROTECTION SERVICES

AT
38-42 MOSLEY STREET
GRADE 2* LISTED BUILDING CAT A
REFURBISHMENT**

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Author:	JIM ROSE
Checked By:	STEVE KERSHAW
Approved By:	MARK SESSIONS

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TABLE OF CONTENTS

F01	SCOPE OF WORK	8
F010100	INTRODUCTION	8
F010400	DEFINITIONS.....	9
F010700	GENERAL	10
F011000	ASSOCIATED DOCUMENTATION	11
F011300	HEALTH AND SAFETY.....	11
F011600	SERVICES TO BE PROVIDED	11
F011900	TENDERS.....	12
F012200	SPECIALIST SUPPLIERS.....	12
F012500	MANUFACTURERS.....	13
F012800	CONTRACTOR DESIGN.....	13
F013100	EQUIPMENT	14
F013400	ENVIRONMENTAL ASSESSMENT	15
F014000	ELECTRICAL WORKS ASSOCIATED WITH THE FIRE PROTECTION	15
F014001	Installations Provided by Others.....	15
F014004	Electrical Works to be included by the Installer	16
F015000	SERVICES DESCRIPTION.....	17
F015100	Water Mist	17
F015200	Dry Riser	18
F03	DESIGN AND PERFORMANCE PARAMETERS	19
F030100	GENERAL	19
F031000	COMMERCIAL WATER MIST.....	19
F031900	CALCULATIONS.....	19
F032200	DRY RISER.....	19
F06	GENERAL WORKMANSHIP AND MATERIALS.....	20
F060100	GENERAL	20
F060400	DESIGN AND STANDARDISATION.....	20
F060700	MANUFACTURING STANDARDS.....	21
F061000	DELETERIOUS MATERIALS.....	21
F061300	STATUTORY SERVICES	23
F061600	STATUTORY APPROVALS.....	23
F061900	SAMPLES	23
F062200	SPARE PARTS.....	24
F062500	PROTECTION AND STORAGE	24
F062800	EQUIPMENT AND MATERIALS.....	25
F063100	DATE STABILITY	25
F063400	RADIO INTERFERENCE AND ELECTROMAGNETIC COMPATIBILITY	25
F064000	WALL CHARTS AND IDENTIFICATION	26
F064001	Wall Charts.....	26
F064004	Plant and Equipment Labels.....	26
F064007	Pipework	27
F064010	Valve Identification	27
F064300	GALVANIZING	27
F064600	FIXINGS.....	27
F064900	CLEANING AND PAINTING.....	29
F064901	General.....	29
F064904	Internal Surfaces	29

F064907	External Surfaces.....	30
F065200	FIRE PRECAUTIONS.....	30
F065500	TIMBER.....	30
F065800	TOOLS.....	30
F066100	ALIGNMENT AND FIXING OF ACCESSORIES	30
F066400	BUILDING CONSTRUCTION.....	31
F066700	EXPOSED SERVICES INSTALLATIONS	31
F20	PIPEWORK	33
F200100	GENERAL	33
F200400	PIPEWORK GENERALLY	33
F200700	STEEL PIPEWORK.....	33
F200701	Steel Tubes	33
F200704	Screwed Joints.....	34
F200707	Welded Joints.....	34
F200710	Grooved Joints	35
F200713	Flanged Joints.....	36
F200716	Fittings for Mild Steel Pipe.....	36
F201300	STAINLESS STEEL PIPEWORK	37
F201301	Tube and Fittings.....	37
F201304	Installation	37
F25	PIPEWORK INSTALLATION AND COMPONENTS	38
F250100	PIPEWORK INSTALLATION, GENERAL.....	38
F250400	SUPPORT SPACINGS	38
F250700	PIPEWORK SUPPORTS	39
F250701	General.....	39
F250704	Surface Pipework	40
F251000	SPACING OF SERVICES.....	40
F251300	SLEEVES AND FIRE STOPPED SLEEVES.....	40
F251600	MASKING PLATES	41
F251900	DRAIN POINTS	41
F252200	VALVES AND COCKS – GENERAL	41
F252500	FLOAT ACTUATED TANK INLET VALVES.....	42
F252800	EQUILIBRIUM BALL FLOAT VALVE	42
F253100	PRESSURE GAUGES	42
F253400	HYDRAULIC TESTS	43
F253401	General.....	43
F40	COMMERCIAL WATER MIST (BS 8489).....	44
F400100	GENERAL	44
F400700	WATER MIST SYSTEM.....	44
F400701	General.....	44
F400713	Operation and Maintenance Instructions.....	44
F400716	Testing and Commissioning	45
F70	ELECTRICAL SERVICES ASSOCIATED WITH FIRE PROTECTION SERVICES.....	46
F700100	GENERAL	46
F700400	POINT OF DEMARCATION	47
F700700	DESIGN	47
F701000	CABLE ROUTES	48
F701600	TELECOMMUNICATIONS CABLING.....	49

F701601	General.....	49
F701604	OM3 fibre cables for the data backbone	49
F701607	Cat 6a UTP cables for horizontal voice / data distribution	50
F701610	Fire Rated Fibre Optic Cabling.....	50
F701900	ARMOURED POWER CABLES.....	50
F701904	Fire Rated Armoured Power Cables.....	50
F702200	UNARMOURED POWER CABLES.....	51
F702201	Single Core Cables Within Conduit Or Trunking	51
F702207	Fire Alarms and Emergency Lighting.....	51
F702400	MINERAL CABLES	53
F702500	INSTALLATION OF CABLES.....	55
F702501	General.....	55
F702504	Cables on Ladder and Tray.....	57
F702507	Cable Cleats and Fixings.....	58
F702510	Cables in Trunking, Conduit and Flexibles	60
F702513	Cable Lugs	60
F702800	CABLE JOINTING.....	60
F703100	CABLE IDENTIFICATION	61
F703300	CABLE SIZING.....	62
F703600	CABLE CONTAINMENT SYSTEMS GENERAL.....	62
F703900	CABLE LADDER	64
F704200	CABLE TRAY	65
F705100	CABLE TRUNKING	66
F705400	CONDUIT	68
F705401	Steel Conduit.....	68
F705404	Conduit Layout.....	68
F705407	Installation Requirements.....	69
F705410	Conduit Fixings.....	70
F705413	Surface Conduit.....	70
F705416	Concealed Conduit.....	71
F705419	Flameproof Conduit	72
F705425	Flexible Conduit	72
F705700	LOAD BREAK SWITCHES AND ISOLATORS	73
F706000	FUSED CONNECTION UNITS.....	73
F706200	ELECTRICAL SUPPLIES TO FIRE ALARM EQUIPMENT.....	73
F706300	MULTI POLE ISOLATION SWITCHES.....	74
F706600	RCD PROTECTED SOCKET OUTLETS (EXTERNAL USE).....	74
F707200	EARTHING.....	74
F707201	Methods of Earthing	74
F707204	Earthing and Bonding General	75
F707207	Earth Continuity Tests.....	76
F707210	Supplementary Bonding of Metalwork.....	76
F75	INSULATION.....	77
F750100	GENERAL REQUIREMENTS	77
F750400	WORKMANSHIP	77
F750700	INSULATION MATERIALS.....	77
F751000	INSULATION APPLICATION.....	78
F751001	General.....	78
F751004	Mineral (Rock) Wool	79
F751300	INSULATION OF PIPEWORK.....	79

F751600	INSULATION THICKNESSES	80
F751601	General	80
F751604	Protection Against Freezing	80
F751900	VAPOUR SEALS	80
F752200	FINISHES	81
F752201	General	81
F752204	Hammerclad Aluminium	81
F752207	Petrochem Aluzink	81
F752210	PVC Sheet	82
F752213	Class 'O' Finish	82
F752216	Waterproof	82
F90	INSPECTION, TESTING AND COMMISSIONING	84
F900100	GENERAL	84
F900400	INSPECTIONS AND WITNESSING BY THE ENGINEER	84
F900700	ATTENDANCE	84
F901000	TEST EQUIPMENT	85
F901300	TEST CERTIFICATES	85
F901600	FAILURE OF TEST	85
F902200	WORKS TESTS	86
F902500	EQUIPMENT OUTPUT TESTS	86
F902800	SPECIALIST PLANT	86
F903100	COMMISSIONING INSTRUMENTS	86
F904300	COMMISSIONING RESULTS	86
F91	TECHNICAL SUBMITTALS	87
F910100	TECHNICAL SUBMITTALS	87
F92	DESIGN AND CONSTRUCTION DOCUMENTATION	89
F920100	CONCEPT DRAWINGS	89
F920400	CONTRACT DRAWINGS	89
F920700	DIGITAL DATA	89
F921000	3D AND BIM DIGITAL MODELS	90
F921300	MANUFACTURERS DRAWINGS	91
F921600	DESIGN AND WORKING DRAWINGS	91
F921900	WIRING DIAGRAMS	92
F922200	BUILDERS WORK DRAWINGS	93
F922500	ISSUE OF DRAWINGS	93
F922800	DIMENSIONS	94
F923100	SITE COPIES	94
F95	RECORD DOCUMENTATION	95
F950400	ASSET REGISTER	95
F950700	BUILDING LOG BOOK	95
F951000	BUILDING USER GUIDE	95
F951300	MANUALS	95
F951600	ELECTROMAGNETIC COMPATIBILITY TECHNICAL JUSTIFICATION FILE	98
F951900	RECORD DRAWINGS	98
F952200	INSTRUCTION OF EMPLOYER AND OCCUPIER	100
F952500	WORK IN EXISTING BUILDINGS	100
F97	SCHEDULES	101

F970100	FIRE PROTECTION SERVICES TENDER DRAWINGS	101
F970400	PIPEWORK, MATERIALS, JOINTING AND FITTINGS	102
F970700	INSULATION AND FINISHES.....	103
F971000	WATER STORAGE TANKS.....	104
F971300	VALVES	105
F974000	CABLES	106
F974300	SCHEDULE OF SPARES	107
F974600	SCHEDULE OF EQUIPMENT MANUFACTURERS.....	108
F974900	SCHEDULE OF SUBMITTALS REQUIRED.....	109
F975200	SCHEDULE OF COMMISSIONING TESTS	111
F975500	SCHEDULE OF FIRE ALARM INTERFACES.....	112
F975800	SCHEDULE OF BMS INTERFACES	112
F976100	SCHEDULE OF ELECTRIC POWER SUPPLIES	113

F01 SCOPE OF WORK

F010100 INTRODUCTION

- (a) The following specification is for the Cat A refurbishment of 38-42 Mosley Street, in central Manchester. The building is a six-storey Grade 2* listed building that was formerly a retail bank and includes a ground floor Banking Hall that will be let out as a Food & Beverage (F&B) offering.
- (b) The building includes old bank vaults at basement level that are constructed of substantial reinforced concrete walls and builders' work openings at basement level will need to be carefully coordinated with main contractor.
- (c) The Banking Hall at ground floor and the basement area immediately below will form part of a F&B tenant. The rest of the basement area will be used for tenant services including bike store, gym and associated toilets, showers and changing facilities as well as including the main LV switchroom and comms rooms.
- (d) Ground floor includes the main entrance and reception with a lounge area for tenant with the remainder of the ground floor, 1st, 2nd & 3rd floors office accommodation.
- (e) 38-42 Mosley Street shares certain elements with the adjacent building 57 Spring Gardens and a new access is to be created linking the buildings at basement level. In addition to this, the main building supply serving Mosley Street is fed from the main switchboard and ENWL substation located in the basement of Spring Gardens. Both buildings are owned by the same landlord.
- (f) Due to space restrictions within 38-42 Mosley Street, the proposed new mist sprinkler system plant and tank, detailed separately, will be located in the basement of 57 Spring Gardens with electrical works including power and fire alarms to serve this included.
- (g) Mosley Street is currently vacant, and the Cat A refurbishment will be completed whilst the building is empty. The staircase adjacent to both buildings is used as a means of escape from 57 Spring Gardens at all levels and this will need to be retained during the project.
- (h) The Fire Protection Services Installer shall be expected to undertake a full intrusive survey of the basement prior to commencing their Stage 5 installation drawings and shall bring to the Engineer's attention in writing any issues with the existing installation that may affect the scope of works.
- (i) The Fire Protection Services Installer attention is brought to the project preliminaries, issued by others, and the tender schedules included separately. The tenderer shall ensure that these schedules are completed and included as part of their tender submission in addition to any requirements of the contract preliminaries.
- (j) The Fire Protection Services Installer's attention is drawn to the approved manufacturers schedule. Alternative manufacturers shall not be used or tendered without prior written confirmation from the Engineer. Any proposed alternative manufacturers or sub-contractors to be used shall be fully detailed and submitted at the time of tender.

- (k) At each stage of the construction works the Fire Protection Services Installer shall develop and submit detailed Risk Assessments and Method Statements (RAMS) for completing their works. The Fire Protection Services Installer shall develop the RAMS in conjunction with the Main Contractor and allow a minimum period of 4 weeks for review and approval.
- (l) As part of the tender it is essential that the tendering Fire Protection Services Installer visit site and acquaint themselves with the existing building.
- (m) This Specification describes the particular requirements for the Fire Protection Installations and shall be read in conjunction with the following documents.
 - i) Electrical Services Specification 27618-SP-ES-001 and Schedules
 - ii) Mechanical and Public Health Services Specification 27618-SP-MS-001 and Schedules
 - iii) Hilson Moran Fire Strategy Report 28354_RP_FE_001
- (n) The Fire Protection Services Installer shall be responsible for the development of their Stage 5 installation drawings, together with any Contractor Design Portion (CDP), as detailed elsewhere in this Specification, the electrical services based on this Specification and associated design drawings as well as other design and contract documents issued by the Architect, QS, Project Manager and Employer.

F010400 DEFINITIONS

- (a) The following terms are used within this specification and shall be construed accordingly:
 - i) **Contractor** - Contractor shall mean the person or persons appointed to carry out the Main Contract Works and shall have the same meaning as is defined in the Conditions of Contract. They may also be referred to as Principal Contractor, which shall have the same meaning
 - ii) **Employer** - Employer shall mean the person or persons employing the Contractor to carry out the Contract Works and shall have the same meaning as is defined in the Conditions of Contract
 - iii) **Engineer** - Engineer shall mean the person or persons appointed by the Employer to represent him in connection with the installation of the works described in this Specification
 - iv) **Fire Protection Services Installer** - For the purposes of the Tender, the Fire Protection Services Installer shall be the person or persons invited to prepare a Tender for the Works described within this Specification, including all ancillary work and information requirements. Where the successful Tenderer is appointed to carry out the Works as a Trade Sub-Contractor the instructions as to the extent of the work shall be agreed with the Contractor, who shall ensure that the installation is complete and in accordance with this Specification

- v) **Specialist Commissioning Manager** - Specialist Commissioning Manager shall mean the person appointed specifically to monitor and manage the commissioning process in respect of the works described in this technical specification. Where set out in the Conditions of Contract, this may be a separate appointment; otherwise it shall be deemed to be the responsibility of the Fire Protection Services Installer to appoint this person
- vi) **Responsible Person** - For the purposes of the tender shall be the person or persons appointed by the client who manages the installation and its component parts and is able to determine that the configuration of the installation is such that when used it complies with the essential requirements of the Electromagnetic Compatibility Regulations

F010700 GENERAL

- (a) This Specification sets out the standards of materials to be used and standards of workmanship to be adopted for the fire protection installation.
- (b) The contract documentation is to be read as a whole. It is the responsibility of any party issuing any part of the documentation to others to ensure they provide recipients with all parts of the contract documentation, (including but not limited to the specification clauses, technical schedules and drawings) relevant to their scope or involvement and that they comply with the contract requirements in all respects. The issuing party will be responsible for any discrepancies caused by a failure to comply with this clause.
- (c) Materials and equipment shall comply with current issues, including amendments, of relevant British Standard Specifications. Where a British Standard has been superseded by a European Standard adopted within the United Kingdom (BS EN) then the replacement standard shall take precedence. Wherever possible, metric dimensioned equipment shall be employed.
- (d) Manufacturers and specialists shall be advised of the full details of any equipment, including the relevant Standards and any appropriate conditions with the enquiry.
- (e) Electrical equipment and installations shall comply with the requirements of BS 7671.
- (f) The requirements of the following shall be complied with:
 - i) Government Legislation, Local Authority Regulations, Recommendations, Requirements and Bye-laws
 - ii) Water, Gas, Electricity, Fire Officer, British Telecom, Public Authority and Statutory Regulations and Recommendations
 - iii) Health and Safety at Work Act, including current regulations and Statutory Instruments issued by the Health and Safety Executive
 - iv) Chartered Institution of Building Services Engineers current recommendations as described within this Specification
 - v) The current edition of the Building Regulations Approved Documents
 - vi) The EMC Directive 2014/30/EU and the associated UK EMC Regulations

F011000 ASSOCIATED DOCUMENTATION

- (a) The following Specifications will also form part of this building contract and the Fire Protection Services Installer shall satisfy himself that he has understood and included any interfaces required with works described in the current versions of these Specifications:
 - i) Electrical Services Specification 27618-SP-ES-001 and Schedules
 - ii) Mechanical and Public Health Services Specification 27618-SP-MS-001 and Schedules
- (b) The following documents have also been prepared by the professional team in connection with this project and should be reviewed to ensure their contents relevant to this technical specification are understood by the Fire Protection Services Installer:
 - i) Hilson Moran Fire Strategy Report 28354_RP_FE_001

F011300 HEALTH AND SAFETY

- (a) The works shall comprise the supply, delivery, positioning, installation, setting to work, testing and commissioning of the engineering services, as set out below.
- (b) Costs involved in negotiations for Licenses, Police Attendances, Notices, and the like. Involved in temporary road closures in connection with plant deliveries etc. shall be included. Arrangements shall comply with the requirements of the Health and Safety Executive.
- (c) Inspection and approval of the equipment by the Employers Insurance Company, required by British Standard Specifications and by this Specification shall be provided.

F011600 SERVICES TO BE PROVIDED

- (a) A high pressure water mist installation shall be provided throughout the basement and shall comply with all parts of BS 8489, the British Standard for commercial water mist and specific test protocols developed for the proposed system proposed and hazard classification.
- (b) A town's main water supply to the water mist system water storage tanks including isolation valves, filter units and automatic shut of valve and controls all complying with WRAS Water Regulations.
- (c) A dry riser system complying with BS 9990.
- (d) Costs involved in negotiations for Licences, Police Attendance, Notices and the like involved in temporary road closures in connection with plant deliveries and the like shall be included. The requirements of the Health and Safety Executive shall be complied with.
- (e) Inspection and approval of drawing, calculations and equipment by the Employers Insurance Company, required by British Standard Specifications and by this Specification shall be provided.
- (f) The works shall include but not be limited to the following:

- i) Production of design and working drawings, builders work drawings and any other detail drawings necessary to fully describe the extent of the works, including all necessary liaison and coordination with other contractors and the professional team
- ii) Equipment data and samples for acceptance/comment
- iii) Materials and equipment procurement
- iv) Fabrication, erection, and installation of the works described in this specification, including secondary steelwork supports where necessary
- v) Testing at works where specified
- vi) Shipping, delivery and storage and transportation between storage and site
- vii) Thermal insulation
- viii) Electrical works associated with the fire protection installations
- ix) Lifting, setting out, positioning and fixing
- x) Removal of rubbish and surplus materials
- xi) Protection against damage and misuse and removal at completion
- xii) Pre-commissioning test and flushing including pneumatic and hydraulic testing to the Contractors approval
- xiii) Testing and commissioning
- xiv) Demonstration and instruction
- xv) Maintenance until practical completion of the project
- xvi) Record drawings and maintenance manuals
- xvii) Any other items necessary to comply with this Specification

F011900 TENDERS

- (a) Tenders shall be submitted in the format required by the tender documentation. The Tenderer shall complete the technical schedules (and appendices where included) attached to the rear of this Specification as part of the tender submission.
- (b) Tenders shall comply with the requirements of this Specification. Where the Tenderer wishes to submit an alternative for consideration it shall be submitted in an accompanying letter with a full description, including details of the variation from the Specification and the cost effect of the proposal.

F012200 SPECIALIST SUPPLIERS

- (a) Where equipment from specialist suppliers such as pump, tank and equipment has been selected and specified within this Contract, the Contractor and Fire Protection Services Installer shall be responsible for ensuring that the equipment provided complies with the Specification in terms of services requirements and space.

F012500 MANUFACTURERS

- (b) Equipment shall only be selected from the manufacturers listed in this specification as these have been selected from the Hilson Moran Recognised Suppliers List (RSL).
- (c) Manufacturers listed in this specification have been subjected to a technical vetting procedure as part of their inclusion on the Hilson Moran RSL.
- (d) Where the Engineer considers equipment to be critical to the quality and/or resilience of the services installation, no deviation from the RSL will be accepted.
- (e) The Engineer will confirm further acceptable Manufacturers beyond those listed in this specification and which are currently listed on the RSL upon request by the Fire Protection Services Installer.
- (f) Where the Fire Protection Services Installer wishes to offer an alternative manufacturer which is not included on the RSL, they will be required to participate in an equivalent vetting. Any reasonable costs or expenses expended by the Engineer or Client in connection with undertaking such vetting shall be the responsibility of, and borne by, the Fire Protection Services Installer with the appropriate time being allowed in the installation programme to allow this vetting to be undertaken. No claims for delays will be entertained.
- (g) Where the Fire Protection Services Installer wishes to put forward an alternative equipment manufacturer for consideration, it shall be the Fire Protection Services Installer's responsibility to ensure that all associated and consequential aspects are considered and accounted for, including any impact on Part L compliance. Alternative proposals must be accompanied by full technical details, including a specification compliance statement. Any deviations from the specification are to be clearly identified in a comparison matrix. In the absence of a full submission, requests for alternative manufacturers will be rejected.
- (h) The Engineers acceptance of an alternative manufacturer shall not relieve the Fire Protection Services Installer of any obligations under the Building Contract.
- (i) Any costs or consequential design changes necessary to the design resulting from the acceptance of the alternative manufacturer shall be the responsibility of the Fire Protection Services Installer.
- (j) Alternative manufacturers shall not be accepted unless specifically agreed by the Engineer, Contractor and Employer in writing.

F012800 CONTRACTOR DESIGN

- (a) The Fire Protection Services Installer shall take full design responsibility for the fire protection works set out within this Specification. The design shall be based upon the information provided by the Engineer in this Specification and shown on the Concept Drawings provided as part of this Tender.
- (b) The design work shall be carried out under the direct control of suitably qualified and experienced personnel. The Tenderer shall submit, as part of the Tender, the names of the personnel to be employed on the design work, together with their qualifications and a brief summary of their experience.

- (c) Preliminary copies of all design layouts shall be submitted to the Engineer for comment at stages to be agreed with the Engineer, such submissions shall be made in sufficient time to enable the Engineer to comment on the layout within the agreed design programme.
- (d) Copies of design calculations and working drawings shall be submitted to the Engineer and clients insurance company for comment prior to ordering of materials or commencing work. Calculations shall include, but not be restricted to, the calculations described in the Design and Performance Parameters Section of this Specification.
- (e) The Fire Protection Services Installer shall comply with the requirements of the Construction (Design and Management) Regulations as they affect designers, including the preparation of all necessary risk assessments and assistance required by the Planning Supervisor.
- (f) Detailed design of interfaces based on the specific equipment selected to meet the specified performance
- (g) Builders work in connection, including fire stopping to BS EN 1366 and weatherproofing details, including adequate sealing of any shafts
- (h) Incorporate facilities to ensure Shell & Core services/installation can be commissioned to the required fit-out pipework and associated fittings.
- (i) The development and detailing of all access panels, etc. required for the services throughout the building taking into consideration the service access requirements and the architectural aesthetic considerations.
- (j) All plant within plantrooms shall be mounted on 150mm high builders work plinths to ensure that they are kept clear of any local water / fluids that may be present on the floor slab. This shall include, but no limited to storage vessels and tanks, pumping equipment, pressurisation units, water treatment / softening / conditioning plant, etc.
- (k) The services installation throughout the project has some very congested areas where multiple services are run in close proximity to each other. The contractor shall ensure that adequate co-ordinated pre-planning between services is carried out to ensure that where there are levels of services running above each other in corridors, etc., the installation, access requirements and adequate support of all services is developed and agreed with all parties before installation commences. The main contractor shall nominate a specific trade contractor to manage and co-ordinate this process.

F013100 EQUIPMENT

- (a) The Fire Protection Services Installer shall produce detailed schedules of all equipment proposed for use within the Works for comment by the Engineer. Final copies of these Schedules shall be issued as described for Working Drawings. On completion these Schedules shall be considered as the Schedules of Equipment referred to elsewhere in the Specification.
- (b) Equipment and materials shall be selected from the list of Manufacturers at the rear of this Specification.

F013400 ENVIRONMENTAL ASSESSMENT

- (a) It is the responsibility of the Fire Protection Services Installer to establish whether an environmental assessment (BREEAM, WELL, HQM, LEED or similar) is being carried out on the project and if so, to obtain a copy of the Assessors current report and comply with it. Complying with and achieving credits relating to construction activities shall deem to be included within the tender. Where the Fire Protection Services Installer has a design responsibility, credits relating to design activities shall also deem to be included within the tender.
- (b) Where an environmental assessment is being undertaken, this technical specification may include a specific section relating to these requirements, which is to be read in conjunction with all other sections of the specification and complied with in all respects.
- (c) The Fire Protection Services Installer shall at all times undertake his work to ensure targeted credits are achieved in the final Post Construction /Post Fit Out Assessment and shall provide the appropriate evidence as required by the Assessment method being followed. Any “at risk” credits shall be discussed with the Assessor and Engineer at the earliest opportunity.

F014000 ELECTRICAL WORKS ASSOCIATED WITH THE FIRE PROTECTION

F014001 Installations Provided by Others

- (a) The following electrical supplies shall be provided by others, under a separate Trade Contract, and terminated into a suitably sized isolator immediately adjacent or within the equipment control panel. All necessary wiring from the panel isolator out to the equipment shall be provided by the Fire Protection Services Installer:
 - i) Electrical supply to the water mist pump set
 - ii) Electrical supply to air compressor serving the pressure maintenance pump
 - iii) Electrical supplies associated with tank high and low level alarms
 - iv) Electrical supply associated with the incoming town’s main shut off valve
 - v) Electrical supply to trace heating controller
 - vi) Electrical supply to space heater in plant room
 - vii) Wiring of all interfaces to the house fire alarm system/BMS
- (b) The Fire Protection Services Installer shall certify the individual items of equipment as being ready to accept the incoming electrical supplies and shall supervise this work undertaken by other trade contractors.
- (c) The Fire Protection Services Installer shall be responsible for liaising with the Electrical Services Installer to ensure all items of equipment include suitably sized terminals to allow the electrical supply cables to be properly terminated.

F014004 Electrical Works to be included by the Installer

- (a) All other electrical works necessary to provided fully functional fire protection installations shall be provided by the Fire Protection Services Installer as part of the contract. This shall include all the necessary containment systems necessary for the complete installation. All associated electrical systems shall be in accordance with the relevant sections of this specification.
- (b) Equipment shall contain terminals and/or volt free contacts as indicated within the specification, to allow future connection to the Building Management Systems (BMS). All field wiring associated with the BMS installation shall be provided and installed under a separate trade contract. The Fire Protection Services Installer shall allow for wiring to any interface units.
- (c) Equipment shall contain terminals and/or volt free contacts as indicated within the specification, to allow future connection to the fire alarm system. The Fire Protection Services Installer shall allow for wiring to any interface units.
- (d) Wiring work to be included by the Fire Protection Services Installer shall include, but not be limited to the following:
 - i) Wiring to the BMS interface units
 - ii) Wiring to Fire Alarm interface units
 - iii) Wiring between water mist pump set and its respective control panel
 - iv) Wiring between pump control panel and remote indicator panel in reception
 - v) Wiring to pressure switches
 - vi) Wiring to flow switches
 - vii) Wiring to electrically monitored stop valves
 - viii) Wiring to tank float level alarm switches
 - ix) Wiring between air compressor and controller
 - x) Wiring to incoming town's main shut off valve
 - xi) Wiring to trace heating controller
 - xii) Wiring to plant room space heater
- (e) Electrical Installations shall be designed to comply with BS 7671 and with the requirements of the Electrical Services Associated with Fire Protection Section of this Specification. Distribution Systems shall be selected as described elsewhere in this Specification.
- (f) Earthing, bonding and equipotential bonding shall be design to comply with BS 7671, BS 7430 and as described elsewhere in this Specification.
- (g) Electrical supplies will be made available to the Fire Protection services installation at 400/230 V, 3 Phase, 50 Hz with a voltage tolerance as stated by the Regional Electricity Company. The electrical supply shall be independent of any other main or sub-main circuit. Each connection shall be via isolating switch fuse secured against unauthorised operation.

F015000 SERVICES DESCRIPTION

F015100 Water Mist

- (a) A high pressure water mist system shall be provided throughout the building in accordance with the Hilson Moran fire strategy document. It will offer equivalence to that required for an automatic sprinkler system.
- (b) The following 'life safety' features are required;
 - i) Twin water storage tanks (or a single tank with central division)
 - ii) Water mist pump set to have N+1 redundancy
 - iii) Backup electrical power supply
 - iv) Electrical monitoring of valves and system component status
- (c) The water mist plant shall be located in a dedicated room at basement level located in the adjoining building that is under common ownership. The plant room shall be provided with water mist protection.
- (d) The system will comprise of a full holding capacity water tank with central division. The tank will be provided with a permanent water main connection to fill each compartment. An automatic shut off shall be fitted on to prevent the tank overflowing in the case of a high level water alarm condition.
- (e) The tank shall feed a high pressure booster pump set with N+1 redundancy to suit the hazard classification for the system. The pump set shall have 'frequency converters' so as to limit the starting current on the backup electrical supply fed from the standby generator. The pump control panel shall be monitored by the building's fire alarm system.
- (f) The pump set shall feed a single valve set serving the entire basement area. The water mist distribution main shall be wrapped in proprietary 2 hour fire resistant sleeving where passing through any unprotected areas.
- (g) The pipe shall be trace heated and lagged where passing through unheated areas. The thermostat controller shall be monitored for fault condition by the building's fire alarm system.
- (h) The plant room shall be provided with a space heater with integral thermostat to maintain the room temperature above 5degC at all times.
- (i) A network of distribution pipework shall serve the water mist sprinkler heads across the basement. The water mist heads shall be quick response.
- (j) The F&B basement café area is to be fitted out by the shop tenant and therefore the water mist protection in this area shall form a separate works package as part of this contract.
- (k) A remote indicator panel shall be provided in the main reception showing the status of the water mist system. The panel shall incorporate all necessary indicator lamps and warning alarm sounders.

F015200 Dry Riser

- (a) A dry riser system shall be provided to the building. Outlets shall be located on every level including ground floor and basement. A test outlet shall be provided at roof level.
- (b) Monitored isolation valves shall be provided on the rising main at every other floor to satisfy the requirements of BS 9990.
- (c) Inlet cabinets shall be provided at the ground floor fire service entrance or close to.

F03 DESIGN AND PERFORMANCE PARAMETERS

F030100 GENERAL

- (a) This Section sets out the principle design parameters applicable to the Fire Protection Services Installation.

F031000 COMMERCIAL WATER MIST

- (b) The high pressure water mist system shall be in accordance with BS 8489, all parts, and specific test protocol developed for the proposed application.
- (c) This specification and the accompanying drawings have been produced based on a Marioff high pressure water system and the system design hazard classification based on Marioff system testing and capabilities. Other manufacturer's system design parameters could differ.
- (d) The high pressure water mist system shall be designed for the specific area of use and respective hazard classification.
- (e) The hazard classifications have been determined as follows and are subject to confirmation by the water mist specialist's design responsibility:
 - i) Basement level including gym and F&B cafe – Ordinary Hazard Group I (OH1)

F031900 CALCULATIONS

- (a) Calculations as described in the succeeding clauses of this Section shall be prepared and submitted to the Engineer and Clients Insurance Company. Where calculations are carried out by a computer a copy of the input and output data together with the relevant section of the operators manual explaining the input and calculation procedures shall be submitted with the calculations. Calculations shall be submitted to allow a minimum of 10 working days for comment.
- (b) Manually or computer prepared calculations shall be accompanied by diagrams cross referenced to the calculations to permit them to be identified in relation to the building or system concerned.

F032200 DRY RISER

- (a) The system shall be designed to comply with BS 9990

F06 GENERAL WORKMANSHIP AND MATERIALS

F060100 GENERAL

- (a) This section of the Specification describes standards of materials and workmanship applicable to all installations. Particular requirements shall be as described elsewhere in this Specification.

F060400 DESIGN AND STANDARDISATION

- (a) Materials shall be of the best quality and class most suitable for the conditions specified. They shall withstand variations of temperature and atmospheric conditions arising under working conditions without distortion, deterioration or undue stress and without affecting the strength and suitability of the parts for the work, which they have to perform.
- (b) No welding, filling, plugging or jointing of defective parts will be permitted without the agreement in writing of the Engineer.
- (c) Equipment shall operate without undue vibration and with the least practicable amount of noise.
- (d) Equipment shall be suitably selected, designed, manufactured and installed for the environmental conditions in which it will be installed.
- (e) Equipment shall be suitably protected against corrosion.
- (f) Outdoor apparatus shall be designed to avoid pockets in which water can collect.
- (g) Connections to equipment shall be made in accordance with the manufacturer's instructions and in a manner such that any connection does not reduce the equipment's stated rating of ingress protection.
- (h) Electrical connections and contacts shall be of ample section and surface for carrying continuously the specified currents without undue heating. They shall be secured by bolts or set screws of ample size, fitted with locking devices of an agreed type and material.
- (i) Rubbing or wearing surfaces shall be machined faces. Joints employing a gasket material shall be so constructed that the packing is maintained under sufficient compression in all parts to provide an efficient joint without the use of jointing compound. Gasket material shall be of the minimum thickness necessary and of an agreed composition.
- (j) Equipment shall be designed to obviate the risk of accidental short circuit due to animals, birds and vermin.
- (k) Equipment incorporating doors shall be erected so that the doors can be opened to at least 90° after adjacent equipment has been installed and shall be easily removed.
- (l) Openable doors on equipment shall not impede emergency egress.

- (m) Precautions shall be taken to ensure that no chemical or electrolytic action takes place where dissimilar metals or materials are used together. The number of points of contact of dissimilar metals shall be kept to a minimum. Where possible inert barriers shall be provided. Aluminium or aluminium alloy surfaces shall be avoided or protected.
- (n) The Works shall be designed and installed to permit inspection, cleaning and repairs, and for operation in which safety and continuity of service shall be the first consideration.
- (o) Systems shall be designed to ensure satisfactory operation under the atmospheric conditions prevailing and under such sudden variations of load and voltage as may be met under working conditions on the system.
- (p) Equipment shall also be of adequate strength to withstand the electro-mechanical forces that may be set up by the prospective short circuit currents that could occur under fault conditions within the electrical infrastructure, including any contribution that rotating equipment may add to the fault.
- (q) Where it is intended to synchronise any rotating generating equipment with the incoming utility supply for either short term or long term paralleling operations protection shall be provided in accordance with the requirements of Energy Networks Associations recommendations G59/3 and equipment shall be of adequate strength to withstand the electro-mechanical forces that may be set up by the prospective short circuit currents that could occur under fault conditions within the electrical infrastructure when the system is in parallel with the utility supply.

F060700 MANUFACTURING STANDARDS

- (a) Materials and equipment shall be handled and installed strictly in accordance with the manufacturer's recommendations. Operatives shall be experienced in use of the equipment and materials and, where necessary, attend a manufacturer's course on use and installation.
- (b) Any demonstration by manufacturers or others required for operatives who are to install the materials and equipment shall be provided. Special tools recommended by manufacturers for the installation of the material and equipment shall be used by the operatives.
- (c) BS EN ISO 9000 Quality Assurance shall be complied with in relation to design and manufacture of equipment.

F061000 DELETERIOUS MATERIALS

- (a) None of the following materials or products shall be incorporated into the Works:
 - i) Sea dredged aggregates, unless they have been tested in accordance with BS EN 1097; and conform in all respects to BS EN 1992
 - ii) Asbestos based products
 - iii) Resin coated blocks
 - iv) Calcium silicate bricks or tiles
 - v) Slipbricks

- vi) High alumina cement
 - vii) High alkali cement not conforming with British standards
 - viii) CFC's or any product using CFC's in its manufacture
 - ix) Chloride based mixtures
 - x) Glass fibre reinforced concrete
 - xi) Tricovite concrete
 - xii) Chipcrete
 - xiii) Woodcrete
 - xiv) Timber which is not obtained from a managed regulated sustainable source
 - xv) Lead, except where particularly specified for connection to existing cast iron drainage pipes
 - xvi) Asbestos substitutes or any naturally occurring or man made mineral fibres (including rock-wool or slag wool) with a thickness of 3 microns or less and a length of 200 microns or less or which contain any fibres not sealed or otherwise stabilised to prevent migration of fibres
 - xvii) Vermiculite plaster
 - xviii) Extruded polystyrene other than low ozone depletion material
 - xix) Polyurethane Foam
 - xx) Urea-formaldehyde polyurethane, isocyanurates, polyisocyanurates in foams or materials which may release gases in quantities which may be hazardous, with reference to the limits set from time to time by the Health and Safety Executive
 - xxi) Woodwool slabs in permanent formwork or structural elements
 - xxii) Aggregates susceptible to alkali silica reaction
 - xxiii) Any products containing cadmium which are referred to in SI 2006/3311 Controls on dangerous substances and preparation regulations 2006 (including 2007 corrections) or any amendment or re-making thereof
 - xxiv) Any timber treated with pentachlorophenol
 - xxv) Polytetrafluorethylene (known as PTFE) except when used as non-stick sealing with valves or as an isolating tape
 - xxvi) Materials which emit Radon gas
- (b) Other substances which, at the time of Tender, have been publicised by the Health and Safety Executive, Building Research Establishment, British Standards Institution or other Specialist Authority as being deleterious to Health or Safety, shall not be incorporated into any part of the Works.

- (c) Substances, which have been similarly publicised as being deleterious to the durability of property, shall not be used, nor shall any substance, which has been publicised as being damaging to the environment unless the Engineer has agreed to such use in writing. The Engineer will only agree to the use of any such material where it can be shown that the use is essential in connection with the Works and that no suitable alternative exists.

F061300 STATUTORY SERVICES

- (a) The Fire Protection Services Installer shall arrange for Statutory Supply Undertakers to provide gas, water and fire service supplies to the Works. Undertakers shall terminate the supplies at the outlet side of the metering equipment for continuation by the Fire Protection Services Installer.
- (b) Negotiations held with the undertakers, prior to the tender are described elsewhere in this Specification. The Fire Protection Services Installer shall complete these negotiations, obtaining formal quotations where necessary to and instruct the Undertakers to ensure that supplies are available as required by the programme including attendance, builders work requirements and payment of all Undertakers costs.

F061600 STATUTORY APPROVALS

- (a) The Services Installer shall obtain all necessary statutory approvals, including but not limited to:
 - i) Building Control
 - ii) Local Water Authority
- (b) The Services Installer shall notify Building Control and the Local Water Authority of intention to commence works and shall not start until such works have been granted unless otherwise agreed with the Authority.

F061900 SAMPLES

- (a) The Fire Protection Services Installer shall submit to the Engineer, for comment, such samples of workmanship, finishes, materials or equipment proposed for use in the Works as the Engineer shall require. Samples of any items requested shall be forwarded in sufficient time to allow the Engineer to consult with the Architect and Employer before advising of any comments.
- (b) Where in the opinion of the Engineer the samples submitted are not of a high enough standard or are unsuitable for use in the proposed circumstances, alternative samples shall be obtained from such a source as the Engineer shall decide.
- (c) Samples, after comment shall, as the Engineer decides, either remain in the possession of the Engineer until the expiry of the maintenance or guarantee period, whichever is the longer, be embodied in the installation, or be returned to the Manufacturer.

- (d) Where a finish is described in the Specification as being for the Architects agreement or comment, such finishes unless otherwise stated shall be to a BS or RAL colour and gloss factor to be advised by the Architect in writing. Samples of the correct colour and gloss factor shall be provided, prior to placing the equipment on order, either as part of a general sample described above, or as specially prepared plates of the same basic material as the equipment and with the same protection and undercoating.

F062200 SPARE PARTS

- (a) Where described within the Specification, spares, replacement parts or consumables shall be provided. They shall be direct replacements of the same manufacture and quality as the original component, properly protected in the Manufacturer's original packing.
- (b) Spares and replacement consumables shall be clearly by referenced to a spares list within the Operation and Maintenance Instructions, identifying the equipment to which the spare refers.
- (c) The Fire Protection Services Installer shall in addition submit a schedule of spare parts recommended by the manufacturers with their individual prices. Such parts may or may not be ordered.

F062500 PROTECTION AND STORAGE

- (a) The Fire Protection Services Installer shall ensure that all components of the installation, including those provided by specialist or novated suppliers, are adequately protected from mechanical damage, ingress of moisture and foreign bodies, until such time as the installation is handed over to the Employer.
- (b) The Fire Protection Services Installer shall ensure all equipment including that provided by specialist and novated suppliers is, where necessary by the prevailing site conditions, manufactured in sections or modular form, such that it may be delivered, installed, if necessary reassembled and re-tested at site.
- (c) Adequate and safe storage and protection of all materials, plant and equipment shall be provided. Equipment shall be stored in accordance with the relevant British Standard or Code of Practice. Where materials, plant and equipment cannot be stored in purposely built dry and ventilated storage facilities they shall be raised and supported clear of the ground. They shall be protected against frost or damage due to building work with waterproof covers or other appropriate protection.
- (d) Conduits, pipes and similar materials shall be adequately supported and stored on properly made racks to prevent bending and distortion. Ends shall be closed and threads protected by means of purpose made end caps. Storage of pipes, conduits or other materials directly on earth will not be permitted.
- (e) Machined and bright surfaces shall be protected in accordance with the manufacturer's instructions. Items shall be inspected regularly by the Services Installer to ensure that any applied protection has not become damaged either in transit or storage. On completion, surfaces so coated shall be cleaned and where appropriate, polished.
- (f) Plant and equipment shall be left in a condition ready for painting where painting is required. Parts liable to corrode shall be painted immediately after removal of the temporary protection.

- (g) Electrical cables shall be protected from any physical damage and their ends sealed using methods and materials recommended by the cable manufacturer.
- (h) Protection applied to installed equipment shall be non-conductive and fire-retardant.

F062800 EQUIPMENT AND MATERIALS

- (a) A complete schedule of materials included shall be submitted with the Tender. The Schedule shall indicate manufacturer, material, description and identifying reference.
- (b) Equipment of any one type shall be provided by the same manufacturer throughout the Contract. Components provided as part of any equipment shall be of the same type and manufacture throughout all items provided by one manufacturer.
- (c) Equipment and Materials shall be supplied by companies who provide a full after sales service. The supply, in this country, of adequate general spares and components for a period of at least ten years from the date of Practical Completion shall be ensured so far as is reasonably practical.

F063100 DATE STABILITY

- (a) Written confirmation shall be provided by the Services Installer at tender that all software and date dependent programming is date stable for both past and future known date issues e.g. 2000, 2010 and 2038.
- (b) Each system shall be demonstrated to the satisfaction of the Engineer to show that performance and functionality shall be unaffected by dates, months, years and centuries and in particular:
 - i) No value for current date, month, year and century shall cause any interruption in operation
 - ii) Date based functionality must behave consistently for dates. No equipment or product shall use particular date values for special meanings e.g. 99 to signify no end value
 - iii) In all interfaces and data storage, the century in any date must be specified either explicitly or by unambiguous algorithms of interfacing rules
 - iv) 'Leap year' as defined in ISO 8601 must be recognised as leap year

F063400 RADIO INTERFERENCE AND ELECTROMAGNETIC COMPATIBILITY

- (a) The systems have been designed in accordance with the requirements of the EMC Directive 2014/30/EU and the associated UK EMC Regulations UK as they apply to fixed installations.
- (b) The Fire Protection Services Installer shall ensure that the equipment installed and the installation methods adopted do not compromise the design intent.
- (c) As part of the requirements an ongoing review of the installation by the Clients 'Responsible Person' shall be undertaken and the Fire Protection Services Installer shall liaise as necessary with the Responsible Person and provide all documentary evidence of compliance with the EMC directive by providing a technical justification file for the installation.

- (d) The Technical Justification File shall include all necessary certificates of compliance and or design calculations for that part of the installation designed and installed by the Uninterruptable Power Supply System Installer.
- (e) In addition the Fire Protection Services Installer shall provide a Declaration of Conformity and this together with the Technical justification File and supporting documentation shall be forwarded to the to the Clients Responsible Person.
- (f) All equipment supplied to the site shall be either electromagnetically benign or carry the "CE" mark and be provided with copies of the relevant test certificates.

F064000 WALL CHARTS AND IDENTIFICATION

F064001 Wall Charts

- (a) Each Water mist fire suppression pump room, control valve chamber shall be provided with a framed wall chart or charts. The charts shall comprise distribution diagrams of all systems served from the plant room. The charts shall show all items of plant, equipment and controls together with a diagrammatic layout of the pipework including all valves and interfaces with other services.
- (b) Each item of plant, equipment and valves shall be given a unique reference throughout the Record Drawings, Operating Manuals and Control and Wiring Diagrams. Valves shall be scheduled on the Diagram with their function identified.
- (c) Charts shall be produced on A1 or A0 sized Drawings, as appropriate to the amount of information to be incorporated. They shall be photocopied, or otherwise reproduced to resist fading or discolouration. Each chart shall be mounted in a purpose made frame and shall be securely attached to the Plant room wall by brass mirror plates or equal fixings.
- (d) A block plan of the premises shall be placed close to the building entrance detailing the watermist fire suppression zoning, plant location and controlling zone valves.

F064004 Plant and Equipment Labels

- (a) Equipment shall be clearly and permanently labelled, to the satisfaction of the Engineer. Where labels are provided for making clear the method of operation of apparatus they shall be concise and preferably diagrammatic in form. Fire detection devices shall be provided with discrete labelling including their associated address and zone reference. Labels, number plates and their fixing screws for outdoor use shall be of stainless steel or other corrosion resistant material.
- (b) Danger notices shall comply with the Safety Signs Regulations and with BS EN ISO 7010. All other labels and number-plates shall have black lettering on white background. Generally lettering for danger notices shall be 10 mm high, equipment identification labels 12 mm high and all other lettering 6 mm high.
- (c) Labels for similar equipment shall be of uniform appearance and size, dimensions and size of lettering being to the satisfaction of the Engineer. Labels shall be securely attached to the equipment with a minimum of two screws. They shall be located in a clearly accessible position. Labels on equipment in voids and ducts shall be visible when the access is opened.

- (d) A schedule of labels shall be submitted to the Engineer for comment before engraving is carried out.

F064007 Pipework

- (a) Pipework exposed to view but not finished in cladding, foil or other self-finish shall be painted in colours determined by the Architect.
- (b) Pipework, unless exposed in occupied rooms, shall be banded with basic identification colours and colour code indications to BS 1710 to identify the various services. Bands shall be of the dimensions described in the Standard. In addition, arrows indicating the direction of water flow shall be provided.
- (c) Bands shall be applied at intervals not exceeding 10 m, at each junction, valve and at inspection and access positions into service shafts, false ceilings and bulkheads. Additional bands shall be provided either side of void and acoustic barriers.
- (d) The identification system employed on all pipework systems for both insulated and un-insulated services shall be provided as a proprietary product.

F064010 Valve Identification

- (a) 35 mm diameter metal or plastic identification discs shall be securely attached, using chains, to each valve, and control valves.
- (b) The function of each valve shall also be indicated on a schematic of each system which shall be displayed in the plantroom and included within the record documentation.

F064300 GALVANIZING

- (a) The hot dipped process in accordance with BS EN ISO1461 shall be used to apply galvanizing. The preparation for galvanizing and the process shall not adversely affect the mechanical properties of the material being coated. The average thickness of the coating shall be equivalent to not less than 0.6 kg/m² of zinc.
- (b) Pre-site drilling, punching, cutting, bending and removal of burrs shall be completed before treatment of material to be galvanized after manufacture.
- (c) Surfaces in contact with oil shall neither be galvanized nor cadmium plated, unless finished with an oil resisting varnish.
- (d) Where it is necessary to cut and work galvanised materials on site, which result in damage to the original galvanised finish, the Fire Protection Services Installer shall treat the damaged area with two coats of zinc rich paint. The remedial works shall be carried out to the satisfaction of the Engineer prior to the formation of any corrosion and following any necessary de-burring of the cut edges.

F064600 FIXINGS

- (a) Fixings shall be provided to the satisfaction of the Engineer. Supports, brackets, clamps, spacers and any other steelwork, whether or not shown in detail on the drawings, required for the proper and effective fixing of any equipment, shall be provided all in accordance with relevant British standard for the system and manufacturer's instructions.

- (b) Fixings including secondary support steelwork, gantries, channel systems, etc. shall be designed and installed by the Fire Protection Services Installer. The details of such systems shall be submitted to the Structural Engineer for comment.
- (c) Where support systems, brackets, clamps and spacers are assembled from proprietary channel support systems they shall be installed in accordance with the manufacturer's recommendations. Channel support assemblies shall be factory manufactured wherever possible, where they have to be fabricated at site they shall be cut to suit, de-burred, the galvanised finish repaired by two coats of zinc rich paint and all exposed ends fitted with proprietary end caps.
- (d) Fixings to brickwork and blockwork shall be made in the bricks and blocks and not in the bond. Wood screws shall be zinc coated and machine thread screws be solid brass, greased before installation. Accessories mounted in fixed equipment shall incorporate slotted fixing holes.
- (e) Heavy equipment shall be fixed with purpose made clamp brackets, ragbolts or patent fixing bolts. Shot plugs, bolts or welding fixings to structural steelwork shall not be used without the written agreement of the Structural Engineer.
- (f) No structural steelwork shall be drilled for any purpose without the written agreement of the Structural Engineer. In general fixings to steelwork shall be by studs secured to the steelwork by clamp-brackets or by hook bolts. Exterior steelwork fixings shall be galvanised.
- (g) Nuts shall be locked in position with lock nuts, lock washers, castel-nut and split pin or other device. Lock washers shall not be used above M24 size except where a spring type is specially agreed by the Engineer. Each bolt or stud, except for terminal and relay stems, shall show at least one full thread after assembly and not project by more than 10 mm or four threads whichever is the less. Bolts, nuts and washers on outdoor equipment shall be of non-corroding material. Suitable special spanners shall be provided for bolts and nuts, which are not properly accessible by means of an ordinary spanner.
- (h) Damage to previously applied fire protection coverings is to be minimised and any instances where remedial works to the fire protective covering are required shall be notified to the Contractor for the appropriate repairs to be undertaken. Any unnecessary damage to fire protective coating will be repaired at the Fire Protection Services Installers costs.
- (i) Each bolt or stud, except for terminal and relay stems, shall show at least one full thread after assembly and not project by more than 10 mm or four threads whichever is the less. Bolts, nuts and washers on outdoor equipment shall be of non-corroding material. Suitable special spanners shall be provided for bolts and nuts which are not properly accessible by means of an ordinary spanner.
- (j) The Fire Protection Services Installer shall fully acquaint himself with the design of the structural building frame and inspect the Structural Engineers drawings during the tender period. Any secondary steelwork necessary to support the engineering services in accordance with the requirements of this specification shall be designed, provided and fixed by the Fire Protection Services Installer. No additional costs arising from secondary support structures will be accepted. All secondary steel support structures are to be notified to the Structural Engineer and his agreement obtained as to the fixings to be used to connect to either the structural steel frame or associated concrete decking.

- (k) All support systems and proprietary fixings, e.g. unistrut, etc. shall be sealed with end caps, sealing strips and similar devices.

F064900 CLEANING AND PAINTING

F064901 General

- (a) Before painting components shall be thoroughly clean, free from rust, scale, burrs, grit and moisture with external rough surfaces on castings filled.
- (b) Ferrous sheet metal work not galvanised shall be cleaned to remove all grease and rust before painting with an agreed protective coating applied before despatch from works. Any deterioration or damage to protective coatings or finishes during delivery, storage and following installation shall be made good to the satisfaction of the Engineer. Damaged areas shall be made good as if they were bare metal.
- (c) Ferrous metal including brackets, hangers and steelwork not protected by galvanising, works applied primer, protective paint or insulation shall be cleaned to remove grease and rust, given one coat of primer and finished with two coats of non-metallic paint of a colour agreed with the Engineer. Where the surfaces will be subjected to temperatures above 100 °C finishing coats shall be heat resisting paint and the primer omitted.
- (d) The minimum painting requirements described below shall apply to all ferrous parts unless the Engineer agrees, in writing, to any alternatives proposed. Successive coats of paint shall be easily distinguishable by shade or colour and shall be applied to a clean, dry and properly prepared surface. Each coat shall be compatible with the previous coat.
- (e) The Services Installer shall ensure that all paints, varnishes and other surface treatments applied to the engineering services whether applied in situ or in the factory are tested and compliant with the requirements of BS EN 13300. Where the proposed paints, varnishes or other treatments have not been tested and accredited in accordance with BS EN 13300, the Services Installer shall provide proof of compliance with a standard equal to, or more onerous than the requirements of BS EN 13300. The Services Installer shall also provide a full technical validation of the standard applied against BS EN 13300 to demonstrate it is a comparable and applicable standard.

F064904 Internal Surfaces

- (a) Oil filled chambers and tanks shall be finished with an epoxy based enamel.
- (b) Kiosks and apparatus boxes for use outdoors shall be internally finished with three coats of paint, the final coat being an anti-condensation finish coloured white or light grey.
- (c) Cubicles, kiosks and apparatus for use indoors shall be finished with three coats of paint, the final coat being an enamel.

F064907 External Surfaces

- (a) Non-galvanised surfaces other than nuts, bolts and washers which may be removed for maintenance purposes shall be finished at works with one primer coat of corrosion inhibiting paint applied immediately after cleaning, followed by two coats of non-glossy oil and weather resistant paint applied after inspection and testing but before despatch.
- (b) On site, they shall be provided with a finishing coat of glossy, oil and weather resisting, non-fading paint applied after erection. For equipment despatched completely assembled the final coat may be applied at the works unless otherwise required by the Engineer. Exposed ungalvanised nuts, bolts and washers which may be removed for maintenance purposes, shall be finished with one coat of oil and weather resisting non-fading paint applied after erection.
- (c) Careful consideration shall be given to the correct selection of protective coating applied to equipment that is likely to be exposed to acidic or alkaline atmospheres, such as might be present in close proximity to cooling towers.

F065200 FIRE PRECAUTIONS

- (a) Apparatus, connections and cabling shall be designed and arranged to minimise the risk of fire and any damage, which might be caused in the event of fire.

F065500 TIMBER

- (a) All timber used either to facilitate construction or for permanent use shall be FSC Certified. The Services Installer shall be responsible for documenting timber use and providing FSC Certification for all timber to the appropriate person for approval

F065800 TOOLS

- (a) The Fire Protection Services Installer shall supply in steel boxes, complete with keys, any special tools required for making adjustments to equipment during normal operation or maintenance periods. Tools shall be of alloy steel and stamped with identification marking.

F066100 ALIGNMENT AND FIXING OF ACCESSORIES

- (a) Particular attention shall be paid to the fixing of accessories so that they shall, when completed be level and in an exact position relative to the finished surrounding surface permitting the cover plate to be fixed accurately. Accessories shall be positioned to align horizontally and vertically with adjacent accessories in accordance with the Architect's or Engineer's requirements.
- (b) Where electrical accessories are fitted into tiled surfaces the last 150 mm shall be run in flexible conduit to permit accurate adjustment of the accessory.
- (c) Where conduit work is to be concealed, particular care shall be taken with the alignment of outlet boxes. A definite datum line from which all measurements can be taken shall be ascertained, together with the thickness of walls, depths of plaster and final finishes of all relevant surfaces. All accessories shall be co-ordinated with final finishes, particularly wall tiling, to the satisfaction of the Engineer.

F066400 BUILDING CONSTRUCTION

- (a) The Fire Protection Services Installer shall acquaint himself with the finishes to the building fabric as detailed on the Architect's drawings. The installation of pipework, conduits, trunking and cable shall suit the structural beams and reinforced concrete structure.
- (b) The installation shall take account of the structure and finishes to the building as described on the Architect's drawings. They shall co-ordinate with the Architect's reflected ceiling plan for location of luminaires and ceiling mounted electrical and mechanical components.
- (c) The installation shall take account of the appearance and finish of wall mounted control devices and accessories which must be agreed with the Architect prior to ordering and fitting.

F066700 EXPOSED SERVICES INSTALLATIONS

- (a) Where services installations are indicated either on the drawings or in the specification as being exposed, careful attention shall be paid to the final appearance and quality of the installation.
- (b) Exposed installations are likely to include terminal units, grilles and diffusers, ductwork, pipework, cable tray (containing cables and/or refrigerant pipework) or cable trunking. In particular the methods of support adopted for each service shall enhance the appearance of the overall installation.
- (c) Finishes shall be selected to maintain their appearance for the life of the installation and shall be sufficiently robust to withstand the risk of Fire damage appropriate to their location.
- (d) Methods of fixing to the structure or building finishes shall be agreed with the Structural Engineer or Architect as appropriate.
- (e) All services shall follow and shall respond to influences from the building form and structure to achieve an aesthetically pleasing appearance.
- (f) Any exposed or cut edges shall be covered to improve their appearance. Exposed cut ends of drop rods and the like will not be accepted.
- (g) Where multiple services can be supported on common support systems this shall be considered and will generally be encouraged to minimise the overall appearance of the support systems.
- (h) Full installation details shall be submitted to the Engineer and Architect for final acceptance before the installation works are commenced. Typical details shall include as a minimum:
 - i) Methods of support (with details, drawings and samples) for each service
 - ii) Methods of support from the structure
 - iii) Finishes
 - iv) Methods of insulation (where appropriate)
 - v) Colour of finishes available for selection (where not specified herein)

- (i) Where exposed services are proposed, following the submission of the details described above, a sample area shall be installed with all services, for inspection and acceptance by the Engineer and Architect, before other areas are commenced. The sample area shall either be a temporary mock up, or a section of the final works, but shall be kept available for the duration of the overall installation works to allow it to be used to benchmark the quality which shall be achieved in the permanent installations. Any subsequent permanent installations that do not achieve the agreed standard shall be replaced at the services installers cost.
- (j) Where the high level services are wired utilising armoured cabling, pre-fabricated wiring systems or other 'flexible' cabling solution for either power or data the Services Installer shall pay particular attention to the appropriate method of containment which is to be agreed with the Engineer.
- (k) Where the architect requires all high level services to be over sprayed in a particular finish, it is the responsibility of the Services Installer to ensure that the finish does not affect the long term performance of the high level services or the manufacturer's warranty for the equipment. Where the high level services equipment is fitted with safety or operating instruction labels these shall be masked or replaced by the Services Installer.

F20 PIPEWORK

F200100 GENERAL

- (a) This section of the Specification sets out the general standards, methods and processes to be adopted for the supply and erection of pipework, valves and fittings. Particular requirements are described elsewhere in this Specification. Requirements for sprinkler installations are described within the Fire Protection section of this Specification.
- (b) Pipework systems shall comply with the British Standard Code of Practice appropriate to the system. Water services shall, in addition, comply with the Water Supply Regulations appropriate to the Works.
- (c) Materials shall be stored in dry conditions and in such a manner as is required to prevent damage or corrosion. The Engineer shall reject material that is improperly stored.
- (d) Unless otherwise specified, all pipe sizes listed are nominal internal dimensions.

F200400 PIPEWORK GENERALLY

- (a) Tubes shall be new and supplied in the Manufacturer's straight random lengths or coil, but not less than 6 m long except where shorter specific or flanged lengths between fittings are actually required.
- (b) Tubes shall be provided in the manufacturer's standard finish and protection as appropriate to the material. Each length of tubing shall have at least one coloured identification band or identifying mark when delivered. Each delivery shall be accompanied by a mill certificate type 2.2 or 3.1 in accordance with EN 10204. Tubes shall be UK manufacture.
- (c) Pipework shall be free from surface or general corrosion, deleterious film and without scaling, pitting, excess weathering or damage. Bores shall be clean and unobstructed. Pipework so affected shall be removed from site and replaced. Pipes shall be stored clear of the ground on flat and level surfaces or on packing. The area shall be free from protrusions likely to damage the pipes. Pipework stored externally shall be adequately covered to protect it from the weather.
- (d) Pipework shall be cut, where necessary, to leave the tube bore unobstructed and without deformation. Copper tubes shall be cut with a tube cutter and reamed out to full bore at the cut end.

F200700 STEEL PIPEWORK

F200701 Steel Tubes

- (a) Steel tubes up to 150 mm diameter shall comply with BS EN 10255, medium or heavy grade as defined in the schedules. Steel tubes above 150 mm NB shall comply with BS EN 10217-1 Grade P195 TR1 ISO 3183 Grade L245/AP1 5L Grade B PSL1 with classification and wall thickness selected to suit the application. Where particularly specified tubes shall be galvanised. Elsewhere they shall be provided with the manufacturer's standard protective finish.

- (b) Pipes for welding shall have plain or chamfered ends. Elsewhere ends shall be screwed in accordance with BS EN 10226 Part 1 or have grooved ends suitable for shoulder couplings in accordance with clause 4.8.2 of BS EN 10211, unless otherwise specified.

F200704 Screwed Joints

- (a) Screwed joints shall be provided on mild steel pipework, 50 mm nominal bore or smaller, where the pipework will be accessible on completion. They shall also be provided in other areas where specified and at screwed valves and fittings.
- (b) Screwed joints on pipework shall have taper threads to BS EN 1026 Part 1 made with PTFE jointing tape, or with best quality hemp and jointing paste. The amount of hemp and paste used shall be kept to a minimum and excess removed. Where excessive use of hemp is observed the length of pipe and fittings involved shall be replaced with new materials.
- (c) White jointing compound and hemp shall not be used on domestic water services where the jointing material shall comply with the requirements of the Water Byelaws.
- (d) Joints on oil pipework shall comply with BS 799 Part 4. They shall be unaffected by the action of the oil and remain in a slightly plastic condition when set. Hemp and other fibrous materials shall not be used.

F200707 Welded Joints

- (a) Welded joints shall be provided on mild steel pipework of 65 mm nominal bore and above and on all concealed and inaccessible pipework. Welding shall be carried out by Metal-arc welding, conforming to BS 2633 or BS 2971 appropriate to the system temperature and pressure. The metal-arc processes shall be used on all welded flanges.
- (b) Welders shall hold a certificate of competency recognised by the National Joint Industrial Council stating their grade as a welder. They shall only execute work appropriate to their grade and competency. Copies of their welding certificates shall be issued to the Engineer before any works are commenced.
- (c) Welds shall be of clean metal, free from porosity or slag inclusions and of even thickness and contour. They shall be well fused with the parent metal, annealed and finished smooth. Welding metal shall not project into the bore of the pipe.
- (d) Each welder shall be provided with a steel marker die and shall mark each joint with an individual identification symbol. Three sample lengths of pipework, selected by the Engineer shall be removed from the work carried out by each welder. If any sample is found to be unsatisfactory further samples shall be removed and inspected.
- (e) If having inspected further samples the Engineer is still not satisfied that adequate welding standards are being achieved the Engineer shall be entitled to submit the samples for radiographic or ultrasonic testing by an independent body. Unsatisfactory welding shall be cut out and replaced. The Engineer shall have the right to have all welds carried out by an operative, whose welds have failed the above tests, replaced.
- (f) Prior to welding, the pipe ends shall be aligned and secured in position by a suitable bolted clamp with jackscrews in order to maintain the proper gap at the bottom of the welding groove. The groove shall then be tack welded in several places so as to retain the pipe ends in their correct position during the welding operation.

- (g) The bores at the ends of adjacent pipes shall match exactly but in no case shall they differ in diameter by more than the allowance shown in the following table and alignment shall be within the limits shown.

<u>Nominal Bore</u>	<u>Internal Difference in Diameter</u>	<u>Maximum parallel out of alignment</u>
Up to 100 mm	1 mm	1 mm
Over 100 mm up to 254 mm	2 mm	2 mm

- (h) Welds shall be reinforced on external surfaces, the reinforcement running off smoothly at each end of the weld. Welds, which show undercutting, will not be permitted.
- (i) 5% of all welds shall be subject to x-ray examination to confirm that the welding conforms to the required standard. The engineer will be responsible for selecting the welds to be x-rayed.

F200710 Grooved Joints

- (a) Grooved joints on mild steel pipe shall be provided by a manufacturer operating a quality system complying with BS EN ISO 9001. They shall only be used where they are compatible with the pressure, temperature and testing requirements of the system and on systems where stated in the schedules or specifically agreed with the Engineer.
- (b) Joints shall be installed to the manufacturer's requirements using roll formed or cut grooves, prepared to the tolerances required by the joint manufacturer. Joints shall incorporate provision for maintaining earth continuity or be provided with a separate earthing tag. The earthing arrangements shall meet the requirements for earth continuity and equipotential bonding described elsewhere in this Specification.
- (c) Joints shall comprise a two piece clamp manufactured from rolled steel to BS EN 10025, malleable cast iron to BS EN 1562 or ductile iron to BS EN 1563 as required by the system operating conditions. Two mild steel bolts arranged to positively locate within the clamp and complete with hexagonal nuts shall secure the clamp.
- (d) Joints shall be provided with a rigid gasket, capable of maintaining pipe alignment and rigidity. Gaskets shall be suitable for use with the pipe contents, pressures and temperatures. Where the use of flexible joints on long runs is agreed with the Engineer, an elastomeric gasket complying with BS 2494 shall be provided to allow for expansion and contraction. Pipework shall be held in proper alignment by the use of guides and supports

- (e) Joints shall be assembled to prevent the pipes separating under pressure. The manufacturer's instructions regarding expansion and contraction allowances, supports and installation precautions shall be followed, support spacing shall not, however exceed those listed elsewhere in this Section. The manufacturer shall provide demonstrations and instruction courses on the preparation and installation of grooved joints to operatives. Operatives who have not been so instructed shall not be used.
- (f) Only couplings suitable for a pressure rating of +20 bar shall be installed.
- (g) Only installers and fabricators who have been trained by the manufacturer and hold a current certificate of competence shall be approved to undertake pipework grooving.

F200713 Flanged Joints

- (a) Pipe flanges shall conform to BS EN 1092. Flanges shall be machined right across the joint face and on the edges.
- (b) Mild steel pipe flanges on screwed pipework shall be screwed in accordance with BS EN 10226. On galvanised pipework, flanges shall be galvanised with all exposed threads painted with a zinc rich paint immediately after the flange is screwed on. Where pipework is to be galvanised after manufacture, welded flanges shall be used.
- (c) Mild steel pipe flanges on welded pipework shall be slip-on welding type drilled with a slight taper in the bore and provided with a shaped boss. Flanges shall be welded neck and bore. Long neck welding or plate flanges shall not be used and the practice of burning out the threads of a screwed flange will not be permitted.
- (d) Pipework flanges shall, when in position, forming a pair, be flush with one another all round. Flanges shall be bolted together with mild steel bolts and nuts complete with washers. Bolts shall not project more than one and a half threads through the nuts. Where high tensile or other special bolts or nuts are required for an arduous application they shall be so identified at each such flange. Galvanised nuts, bolts and washers shall be used with galvanised pipework.
- (e) Joints between flanges shall be made with full-face brass corrugated rings, or other jointing material, purpose-made and not cut from sheets on site. Joint material and dimensions shall comply with BS EN 1514. Unusual or corrosive services may require special material. Joint rings shall be fixed concentric with the pipe so that they do not obstruct any of the bore.
- (f) Flanges and joints shall be to the correct table to suit the temperature and pressure rating of the services on which they are installed.

F200716 Fittings for Mild Steel Pipe

- (a) Screwed fittings for mild steel pipe shall be malleable cast iron complying with BS EN 10226. Wrought steel fittings shall comply with BS EN 10255 and BS 1740. The fittings shall have screwed threads complying with BS EN 10226 with tapered external and parallel internal threads. Where used on galvanised pipework screwed fittings shall be galvanised.
- (b) Welding fittings shall be of the forged seamless pattern, manufactured from carbon steel and complying with BS EN 10253-1.

- (c) Pipe couplings and fittings shall be approved and listed by the LPC. Fittings, gasket and coupling shall be from the same manufacturer.

F201300 STAINLESS STEEL PIPEWORK

F201301 Tube and Fittings

- (a) Where the use of stainless steel pipework is stated in the schedules which form part of this specification, they shall be limited to the services and locations stated.
- (b) Pipework and fittings shall be supplied by the same manufacturer and installed as a total system to provide a 25 year guarantee from manufacturing defects.
- (c) All fittings and pipework used in the installation shall have current LPCB and WRAS certification, copies of which shall be made available to the Engineer upon request.
- (d) Pipework shall be suitable for operating temperatures up to 110 °C and maximum working pressures of 16 Bar throughout the operational temperature range of the pipework system.
- (e) Stainless Steel pipework shall be 316L grade steel and comply with BS EN 10217-7 or BS EN ISO 1127, as appropriate to the size and application of the pipework system. All tube shall be supplied with verified mill certification.
- (f) Stainless Steel fittings shall be manufactured from 316L grade steel complying with BS EN 10088-1, as appropriate to the size and application of the pipework system.
- (g) Backing flanges shall conform to BS EN 1092-1 (BS 4504).
- (h) Mechanical jointing couplings shall incorporate EPDM gaskets and shall be suitable for rolled grooved pipe complying with BS EN 10217-7.

F201304 Installation

- (a) Installations shall be carried out fully in accordance with the manufacturer's instructions and recommendations.
- (b) Adequate space is to be allowed around all joints and spacing between individual parallel pipes to for future removal of mechanical couplings.

F25 PIPEWORK INSTALLATION AND COMPONENTS

F250100 PIPEWORK INSTALLATION, GENERAL

- (a) Pipework shall follow the contours of the building, and be graded for venting and draining. Pipework shall be formed around all projections and recesses. It shall be off-set as required due to varying thicknesses of walls, floors, ceilings and other structural works or services, whether such changes in direction are indicated on the drawings or not.
- (b) The use of dissimilar materials where they are liable to cause corrosion shall be avoided. Joints shall not be made in the thickness of any wall, floor or ceiling and pipework shall not be embedded in brickwork or concrete unless specially agreed.
- (c) Fittings shall be of the same size as the pipe in which they are installed. Bushing down will not be accepted. Changes in diameter in pipe runs shall be made with reducers. Where necessary to permit venting and draining, eccentric reducers shall be used. Unions or flanged joints shall be installed at plant items and on the dead side of all isolation, valves to permit dismantling. They shall also be provided to allow control valves, and the like to be removed for maintenance purposes.
- (d) Spacing and reinforcement of branches shall comply with BS EN 13480. The distance between any two branches shall not be less than the sum of their outside diameters. The layout of fittings at branch connections or other fixed points of the system shall allow provision for movement without causing undue stress to the pipework. Pipework shall be arranged to reduce the strain on plant and equipment due to expansion.
- (e) Open ends left during the progress of the work shall be blanked off with purpose made metal or plastic plugs, caps or blank counter-flanges. Wood, paper, cloth or other similar materials will not be permitted. Where open or improperly blanked ends are left, the Engineer may require that the pipework is disconnected for inspection. Such disconnection shall be taken sufficiently far back and be carried out in such sections as to determine that the bores have not been obstructed by foreign matter.
- (f) Pipework, fittings, support steelwork and brackets shall be thoroughly cleaned immediately on completion. One coat of zinc based primer shall then be applied to all ferrous pipework, fittings, support steelwork and brackets.
- (g) Before any existing main is cut, it shall be checked to ensure that it is isolated and drained as far as is possible or that the internal pressure has been released. The Fire Protection Services Installer shall ensure that the correct pipe is being cut into and the pipe is dead.

F250400 SUPPORT SPACINGS

- (a) The spacing of pipework supports shall not exceed the centres given in the tables below. Where two or more pipes are supported on one fixing, the support centres shall be based upon the requirements of the smallest diameter pipe.
- (b) Bracket positioning shall be as defined in BS 9990 for dry rising and falling mains and BS8489 for water mist fire suppression installations and as the water mist manufacturer requirements.

- (c) At least one support is to be provided, for each section of pipe except 'arm overs' less than 1000 mm in length.

Support for Mild Steel Pipework (Dry Rising Main)			
Nominal Bore of Pipe mm	Intervals for horizontal runs		Intervals for vertical runs
	<u>Bare (m)</u>	<u>Insulated (m)</u>	<u>Bare or insulated (m)</u>
15	2.0	2	2.5
20-25	2.5	2.5	3.0
32	3.5	2.5	3.0
40-50	3.5	2.5	3.5
65-80	3.5	2.5	4.5
100	4.0	3.0	4.5
125	4.5	3.5	5.5
150	5.5	4.5	5.5
175-200	6.5	5.5	6.5

F250700 PIPEWORK SUPPORTS

F250701 General

- (a) Supports shall be designed by the Fire Protection Services Installer to adequately support the pipework, insulation and contents without deformation of the pipework. The supports shall be designed to allow free movement for expansion and contraction. Details of all supports shall be submitted to the Engineer for comment prior to manufacture.
- (b) Supports shall be fully coordinated with other services.
- (c) Supports shall be positioned adjacent to all valves and other in-line components to ensure that undue strain is not imposed on the adjoining pipework and so that the component may be removed.
- (d) Where services are installed in riser ducts or trenches and where suitably grouped in false ceilings a unitary bracketing system shall be used. External ferrous metal supports shall be hot dip galvanised after fabrication to BS 729. Where such supports are used for non-ferrous pipework an inert liner shall be interposed.
- (e) Vertical pipework shall be supported on load bearing brackets at slab level to withstand the total weight of the riser. Intermediate supports shall be fixed to the walls at the intervals previously described. Branches from the riser shall not be used as a means of support.
- (f) Supports shall be secured to slabs by fixings agreed with the Structural Engineer. Fixings shall be installed in accordance with the manufacturer's recommendations. Drilled fixings to trough floors shall be to the sides of the ribs, not the soffit. Shot fired fixings shall not be used or any reinforcement drilled through.

- (g) Cast iron or mild steel pipe supports shall be malleable iron or mild steel. Brackets for copper tube shall be brass, or gunmetal, Supports shall be of the two piece pattern where one half of the clip shall be detachable without disturbing the fixing. On insulated pipework the bolts securing the two parts shall be clear of the insulation.

F250704 Surface Pipework

- (a) Pipework in exposed positions shall be supported using brackets screwed or plugged to the walls. Mild steel pipe brackets shall be malleable iron with black enamel or galvanized finish to match the pipe. Copper pipework brackets shall be cast brass or gunmetal.

F251000 SPACING OF SERVICES

- (a) Pipework shall be installed to give the following minimum clearances between the pipe, or pipe insulation where appropriate, and adjacent surfaces as follows:

Walls	25 mm
Ceilings	25 mm
Finished Floors	50 mm above top of skirting or 150 mm whichever is greater
Adjacent pipes, both insulated	25 mm
Adjacent pipes, both uninsulated	150 mm
Adjacent pipes, one insulated	75 mm
Insulated pipes to adjacent conduit or trunking	50 mm
Uninsulated pipes to adjacent conduit or trunking	100 mm
Adjacent electrical cables not in conduit or trunking	150 mm

- (b) Notwithstanding the above minimum clearances sufficient space shall be allowed to permit easy application of insulating materials. Pipes shall not be enclosed in a common covering.

F251300 SLEEVES AND FIRE STOPPED SLEEVES

- (a) Where pipework passes through walls, floors or ceilings, tubular pipe sleeves of a non-combustible material compatible with the pipework shall be fitted. The internal diameter of the sleeve shall, except where necessary to allow for expansion and contraction, not exceed the outside diameter of the pipework enclosed by more than 20 mm and shall project 3 mm beyond the finished surfaces.

- (b) Sleeves in a vertical position where washing down of floors is likely to be carried out shall project 40 mm above the finished floor level.
- (c) Puddle flanged sleeves shall be provided for incoming services where they pass through the external wall below ground level. Puddle flanges of the bolt on type shall be of an agreed pattern. Three layers of protective tape shall be wrapped round the barrel of the pipe before the puddle flange is bolted on, to ensure a watertight joint between the pipe and the flange. The annular space shall be sealed with a flexible compound to ensure a watertight joint between the service pipe and the sleeve.
- (d) Where pipes pass through a fire barrier they shall be provided with a fire stop complying with the Local Building Control and Fire Officers requirements. The fire sleeve shall be a proprietary product tested to BS EN 1366-3. Alternatively, on insulated pipework the rock wall insulation may be extended through the wall complete with a metal sleeve and fire stopped. Provided the fire barrier installer certifies this alternative arrangement satisfies the requirements of BS EN 1366-3. The insulation and any vapour barrier shall be continuous. For bare pipework the fire stop shall have sufficient thickness of insulation to accommodate movement due to expansion.

F251600 MASKING PLATES

- (a) Where uninsulated pipework, exposed in rooms, other than plant rooms, passes through floors, walls, ceilings or false ceilings, masking plates shall be fitted. Adequate clearance shall be provided to allow the masking plates to be fitted.

F251900 DRAIN POINTS

- (a) Each system shall be provided with suitable drain connection at all low points. They shall also be provided to allow plant, equipment to be drained.
- (b) Low pressure drain cocks shall be screwed down stop cocks BS 1010 or globe valves BS 5154 with a handwheel. The size shall be in accordance with BS EN 12845. The outlet from all drain valves shall be extended to be no more than 2 m above the floor and fitted with a brass plug.
- (c) Drain and drip points at pumps, safety valves, safety cocks, sprinkler control valves and other equipment shall be provided with drain lines discharging into tundishes adjacent to the equipment.
- (d) Tundishes shall be sized for the expected discharge and shall be constructed from copper or stainless steel sheet. A rolled top rim shall be formed to stiffen the tundish and a hinged lid provided to allow for examination of the drip pipes without disturbing the drain lines. Tundishes shall discharge into convenient floor gullies or sumps.
- (e) Where individual drain points are connected into a permanent common drain line a sight glass shall be incorporated down stream of each valve.

F252200 VALVES AND COCKS – GENERAL

- (a) Valves and cocks shall be provided to permit the isolating of equipment or sections of the installation. They shall be located to allow ease of operation and servicing. Where concealed behind access panels or similar, they shall, be accessible from floor level.
- (b) All valves and cocks shall be securely locked in position by means of a padlock.

- (c) Seats, discs and packing shall be suitable for the operating conditions to provide efficient service with minimum maintenance. Valves and cocks shall be manufactured from non-dezincifiable materials. Spare asbestos free gland packing, of the appropriate grade and sufficient to repack each gland, shall be provided to the Employer. Screwed valves and cocks shall be fitted with a union on the 'dead' side.
- (d) Valves or cocks on domestic water services shall be subject to Local Authority requirements and stamped accordingly.
- (e) Valves and cocks types shall be as specified in the relevant British standard for the system they are to be installed and be suitable for fire services.
- (f) Isolating, check and control valves shall be capable of withstanding the pressures encountered within the system. This is particularly important on high-rise buildings and high pressure systems.
- (g) The same manufacturer shall provide similar valve types throughout the Works.

F252500 FLOAT ACTUATED TANK INLET VALVES

- (a) Each tank water inlet shall be controlled by means of two Aylesbury 'KB' type float valves controlling an 'in-line' Aylesbury 'KP' type flow control valves. The control valves shall be plinth mounted at floor level adjacent to the tank while the float valve assemblies shall be mounted within a 'stilling tube' located away from the main inlet pipe. The inlet control valves shall be set to discharge when the level of water has fallen 200 mm below the normal water level. The 'KP' valves units shall be WRAS approved of cast iron manufacture, epoxy coated, with stainless steel seats, moving parts and pilot tubing assembly. The 'KP' float valves shall be WRAS approved of DZR brass, with polypropylene and polyethylene, actuator arm and float assembly.
- (b) The valve installation shall comply with the requirements of the Water Regulations Byelaws only in Scotland and so located in respect of the overflow level of the tank that the required air gap can be maintained. Float valves shall not be fitted with an isolation valve on the inlet.

F252800 EQUILIBRIUM BALL FLOAT VALVE

- (a) Each tank water inlet shall be controlled by means of an Equilibrium Ball Float Valve.
- (b) The Equilibrium Ball Float Valve shall be an angle pattern valve flanged PN16 and suitable for pressures up to 10 bars.
- (c) The inlet valve shall be 'WRAS' approved and supplied complete with adjustable arm and metal float.
- (d) The inlet valve installation shall comply with the requirements of the water supply industry recommendations in respect of the overflow level of the tank and that the required air gap can be maintained.

F253100 PRESSURE GAUGES

- (a) Dial type pressure gauges shall be black cased Bourdon type to BS 1780 and BS EN 12845. They shall be provided with plain glass front, 150 mm diameter white dial with black numbering, black casing with chrome bezel, concentric pointer and red line at the working pressure. They shall be scaled in bars.

- (b) The range shall be as required and generally to a maximum of one and a half times the working pressure.
- (c) A gauge isolation valve with insulated handle shall be supplied and fixed for each gauge.
- (d) In all cases the complete assembly shall be screwed into a socket welded to the pipeline or in the case of high pressure systems a suitable fitting shall be used to withstand the pressure.
- (e) Liquid filled pressure gauges shall be provided on the discharge of each pump set.

F253400 HYDRAULIC TESTS

F253401 General

- (a) Hydraulic testing shall be carried out in sections as necessary to meet the requirements of the programme and again as a whole on completion. Testing shall be carried out as described in the Inspection, Testing and Commissioning Section of this specification and in full accordance with the British standard of the system being tested.
- (b) Where not specified otherwise, services shall be subjected to a hydraulic test at the pressure stated elsewhere in this Specification for the service concerned for the time indicated. Where no indication is given the pressure shall be 15 bar or one-and-a-half times the maximum working pressure whichever is the greater maintained for a minimum of 2 hours. For high pressure systems the pipe work shall be tested as detailed by the system manufacturer for the durations they require. Safety valves, pressure and altitude gauges shall be effectively isolated or removed prior to the test and subsequently refitted.
- (c) The test pressure shall be maintained for the required period without loss of pressure after dealing with any weak joints, defective fittings and pipes disclosed by the initial application of the test. All sections of the work and joints shall be accessible for inspection and all welds shall be hammer tested.
- (d) Certificates for hydraulic tests on site shall be forwarded to the Engineer before thermal insulation is applied. A separate set of plans shall be kept on site to maintain accurate records of site tests, the same set may be used as for the record drawings.
- (e) Hydraulic testing shall only be carried out using a pressure gauge with a current certified certificate.

F40 COMMERCIAL WATER MIST (BS 8489)

F400100 GENERAL

- (a) This Section of the Specification describes the general requirements for water mist fire suppression installations. The particular requirements for fire protection services shall be as described in the Scope of Works.
- (b) Fire Protection Systems shall comply with the requirements of all local and Statutory Authorities, the Employer's fire insurers and the Fire Officer. The requirements of British Standards, NFPA codes where applicable, Building Regulations, National Water Supply Regulations and the National Fire Regulations shall be incorporated.
- (c) The Fire Protection Services Installer shall acquaint himself with the nature and extent of the building and its services including all details likely to affect the installation. They shall interface with all other works and with the building fabric in respect of design, installation, site arrangement and co-ordination. Any unnecessary works through inaccuracy by the Fire Protection Services Installer shall be made good.

F400700 WATER MIST SYSTEM

F400701 General

- (a) A high pressure water mist sprinkler system shall be provided to protect the areas listed in the scope of works section of this specification.
- (b) The design, supply, installation, testing and commissioning shall only be undertaken by an approved company whose name appears in the current list of approved fire and security products and services by the local Fire Officer.
- (c) The Fire Protection Services Installer shall prepare fully detailed working drawings of each installation for comment indicating all mechanical and electrical components. The working drawings shall accurately show the location of all equipment, routing of pipework, point to point wiring layouts, schematics and connection diagrams, etc.
- (d) The working drawings, elevations, cross sections and other details shall be drawn to a minimum scale of 1:50. Fully detailed computer hydraulic calculations, isometric pipework layouts, sequence of operation, electrical schematics and connection diagrams shall be provided.
- (e) The Fire Protection Services Installer shall be responsible for co-ordinating the design and installation of the fire suppression system with such items as the type of building construction, location of plant and equipment, air distribution systems, and all other building services.
- (f) Written agreement to design principles and drawings shall be obtained by the Fire Protection Services Installer from the Local Fire Authority, Employers Insurance Company and the engineer before commencement of the works.

F400713 Operation and Maintenance Instructions

- (a) Full Operation and Maintenance Instructions shall be provided as required by the Drawings and Documentation Section of this Specification.

F400716 Testing and Commissioning

- (a) The installations shall be tested as described in the Inspection, Testing and Commissioning Section of this Specification.
- (b) The entire pipework system shall be pressure tested to a pressure as required by the water mist manufacturers requirements.
- (c) The correct operation of all components of the system shall be demonstrated in the presence of the Engineer. All costs associated with the test shall be included within the Tender. On completion the Fire Protection System Installer shall issue a certificate that the system is operating correctly and shall leave the system in a 'live' condition.
- (d) The Employer shall be fully trained and instructed in the operation of the system. Such instruction shall comply with the requirements of the Drawings and Documentation Section of this Specification.
- (e) The Fire Protection Services Installer shall include for two inspections of each system to be carried out at 6 and 12 months from practical completion. The inspections shall include the following:
 - i) Inspection of each protected space for any new or altered building works that could adversely affect the performance of the system
 - ii) Testing of controls, alarm devices and associated wiring
 - iii) Check the control panel functions
 - iv) Leave the system fully operational
 - v) Issue a detailed report of the tests/inspections carried out together with a completion certificate stating that the system complied with all appropriate requirements

F70 ELECTRICAL SERVICES ASSOCIATED WITH FIRE PROTECTION SERVICES

F700100 GENERAL

- (a) This section of the specification describes the general requirements for electrical installations carried out by the Fire Protection Systems Installer as part of the works. Particular requirements shall be as detailed within the scope of works and or the specification schedules.
- (b) The Fire Protection Systems Installer shall be solely responsible for the design, supply, installation, testing and setting to work of the electrical installations from the Fire Protection Systems Control Panels or other noted point of demarcation to the specific item of plant including, but not limited to:
 - i) Control cabling and containment
 - ii) Power cabling and containment
 - iii) Network cabling and containment
 - iv) Means of isolation
 - v) Final connections
 - vi) Earthing and bonding
- (c) The design of the Electrical Systems shall be undertaken by suitably qualified staff and career resumes of selected staff should be submitted to the Engineer for his perusal prior to any design works being undertaken.
- (d) The installation of the Electrical systems shall be carried out by companies registered and approved by the National Inspection Council for Electrical Installations.
- (e) Note that the voltage definitions for alternating current utilised within this specification are in accordance with BS EN 50160:
 - i) Extra Low Voltage – 50 Volts (50 Vac) or less
 - ii) Low Voltage – Greater than 50 Volts (50 Vac) and less than or equal to 1000 Volts (1k Vac) between conductors
 - iii) Medium Voltage - Greater than 1000 Volts (1 kV) and less than or equal to 36000 Volts (36 kV) between Conductors
 - iv) High Voltage – greater than 36000 Volts (36 kV) and less than or equal to 150000 Volts (150 kV) between Conductors
 - v) Extra High Voltage – Although not detailed in BS EN 50160 shall refer to any voltage in excess of 150 kV between Conductors
- (f) All Power Cables supplied by the Fire Protection Systems Installer shall be strictly in accordance with those specified in the Schedule of Manufacturers, as listed in the Hilson Moran Electrical Specification. Under no circumstances shall the Fire Protection Systems Installer substitute alternative manufacturers without the written consent of the Engineer.
- (g) The Fire Protection Systems Installer shall submit a Technical Submittal covering all cable types to be installed.

F700400 POINT OF DEMARCATION

- (a) The point of demarcation shall be the point at which the Electrical Services Installer cabling installation is terminated.
- (b) The point of demarcation may vary from project to project and or the particular services. If not defined in the scope of works (Section 1) the following shall apply:
 - i) Incoming terminals of a Fire Protection Systems control panel
 - ii) Fused connection unit for small services e.g.:
 - Trace Heating Tapes
 - Zone Assemblies
 - Fire Panels
 - Jockey Pumps
 - Ancillary Services and Interface Panels
 - iii) Local isolator where dedicated plant is supplied directly from a switchboard
 - iv) The Fire Protection Systems Installer shall be responsible for the final connection from the isolator or fused connection unit to the item fed
- (c) In the case of a Fire Protection Systems control panel the Electrical Services Installer shall terminate his cables in the incoming isolator.
- (d) Where an item of plant is controlled or monitored by the Fire Alarm System the interface unit will be supplied and installed by the Fire Alarm Services Installer. The Fire Protection Systems Installer shall provide tails from the item of plant to the interface unit and the final connection to the interface unit will be made by the Electrical Services or Fire Alarm Installer.
- (e) At each sprinkler valve set the Fire Protection Services Installer shall provide an adaptable box with necessary fixed base terminals in order for the Electrical Services Installer or Fire Alarm Services Installer to install the end of line device.

F700700 DESIGN

- (a) The Fire Protection Systems Installer shall be responsible for the design of all wiring and containment systems from the point of demarcation noted above.
- (b) The Fire Protection Systems Installer shall liaise with the Electrical Services Installer to ensure that the terminal capacity of the incoming isolator at all points of connection is sufficient for the incoming cables without modification to the cables.
- (c) The Fire Protection Systems Installer shall be responsible for obtaining the relevant design information from the Engineer to enable him to complete the design of the final distribution cabling from the point of connection to the items of plant supplied.
- (d) The Fire Protection Systems Installer shall carry out all necessary design calculations for the wiring and containment systems and also select the necessary protection devices for the final distribution.

- (e) The Fire Protection Systems Installer shall, if requested, submit calculations to the Engineer for review.
- (f) The Fire Protection Systems Installer shall take into account the requirements and recommendations of the relevant British Standards and the requirements of the Building Control Officer when selecting the wiring and containment systems including but not limited to:
 - i) BS 7671
 - ii) BS 7430
 - iii) BS 9999
 - iv) BS 8519
 - v) BSRIA BG70
 - vi) Building Regulations Part F
 - vii) The Construction Product Regulations (CPR) as set out in the European Regulations EU/305/2011
 - viii) Loss Prevention Council Regulations
- (g) Where a Fire Protection control panel is located remotely from an item of life safety plant (external to plant room). The cabling to the plant shall be carried out in fire rated cabling in accordance with the relevant clauses.

F701000 CABLE ROUTES

- (a) The cable routes shall be carefully co-ordinated with the routes of other services, particularly other cable routes.
- (b) The wiring for the Fire Protection Systems Installation shall be kept separate from all other wiring except with the express permission in writing of the Engineer.
- (c) Such permission, if given will be subject to the following:
 - i) No claims will be considered due to the need to increase cable sizes to allow for grouping, whether they are associated with the Electrical or Fire Protection Systems Installation
 - ii) The Fire Protection Systems Installer shall obtain the written agreement of the Electrical Services Installer before installing any cables in a wire-way provided by the Installer
 - iii) Cables in common wire-ways shall all be insulated to at least the rating of the cable that is operating at the highest voltage
 - iv) The Fire Protection Systems Installer shall be solely responsible for any damage, caused by him, to the installation provided by the Electrical Services Installer
- (d) Electrical circuits for equipment required to operate in the event of fire shall be in accordance with BS 9999, BS 8519, BS 7671, BSRIA BG 70:
 - i) Cables shall be classified Category 3 in accordance with BS 8519

- ii) Power cables with conductors of 4 mm² csa and above shall comply with BS 8491 with 120 minute fire survival time
 - iii) Control Cables < 20 mm diameter shall comply with BS EN 50200 annexe B and BS 8434-2 with 120 minute fire survival time
 - iv) Follow a route through the building of negligible risk
 - v) Primary and Secondary power supplies shall be diversely routed
 - vi) Be separated from any circuit provided for other purposes and run on dedicated containment
- (e) The switchgear, plant and equipment associated with the life/fire safety installations shall be separated from installations used for other purposes by construction having a standard of fire resistance of not less than 120 minutes.
- (f) The primary and secondary power distribution arrangements shall be such as to ensure that in the event of a local failure of the primary power supply to any life/fire safety equipment, the secondary supply shall be automatically available.
- (g) Independent primary and secondary power supplies shall be provided and separate power supply cables shall terminate in an auto changeover device located within each area housing the life/fire safety equipment.
- (h) Where dual circuit wiring is required under BS 9999 and BS 8519 the cables shall be run in diverse routes to maintain their integrity in the event of localised fire conditions.
- (i) All fuse switches and circuit breakers on switch panels which supply life safety systems shall have their cover plates finished red and labelled LIFE SAFETY SYSTEM DO NOT ISOLATE.
- (j) Cabling for life safety systems shall fully comply with the Loss Prevention Council Guide Lines

F701600 TELECOMMUNICATIONS CABLING

F701601 General

- (a) Telecommunications Data network cabling shall be fully compliant Cat 6 structured cabling system along with fibre back bone cabling and Cat 6a UTP copper lateral distribution.
- (b) Cabling installations shall be designed and installed in accordance with BS 6701, BS EN 50173 and BS EN 50174 series of standards applicable to the building/system type.

F701604 OM3 fibre cables for the data backbone

- (a) The cables shall conform to the OM3 50/125 micron multimode specification with low smoke zero halogen sheath Euro Class Cca-s1b,d2,a2 for indoor use.
- (b) The cables shall be tested to the BS EN 61280-4-1 performance standard and shall be suitable for up to 300 m with IEEE 802.3 Ethernet transmission at 10 Gbps.

F701607 Cat 6a UTP cables for horizontal voice / data distribution

- (a) The cables shall confirm to the Cat 6a UTP specification with low smoke zero halogen sheath Euro Class Cca-s1b,d2,a2.
- (b) The cables shall be suitable for up to 100 m with IEEE 802.3an 10GBASE-T standard to support 10 Gigabit Ethernet requirements.

F701610 Fire Rated Fibre Optic Cabling

- (a) Where specified for critical control systems (Non Life Safety) fire rated fibre optic cabling shall be supplied.
- (b) Cabling shall be manufactured to comply with IEC 60331 Part 25 and the cabling shall maintain less than 1 dB excess loss for a minimum of 3 hours when subjected to a temperature of 750 °C.
- (c) The outer sheeting shall be flame retardant and low smoke and fume zero halogen Euro Class Cca-s1b,d2,a2.
- (d) Cables shall be installed on dedicated containment strictly in accordance with the manufacturer's recommendations.

F701900 ARMOURED POWER CABLES

F701904 Fire Rated Armoured Power Cables

- (a) Power cables feeding life safety and firefighting equipment, such as fire suppression pumps, firefighting lifts, smoke extract and pressurisation fans; shall be classified as Category 3 in accordance with the Code of Practice BS 8519 and BSRIA BG 70 with a fire survival time of 120 minutes, when tested in accordance with the test protocol set out in BS 8491, under defined fire conditions.
- (b) Fire rated cables with conductors less than 4 mm² cross sectional area shall be MICC.
- (c) The cables shall be manufactured to comply with BS 7846. They shall be 600/1000 Volt rated, unless otherwise specified, with standard sector shaped copper conductors, the conductors shall be stranded, with XLPE insulation. The conductors shall incorporate a mica/glass fire resistant tape, in order to achieve the required fire performance. The insulated conductors shall be covered with an overall LSOH extrusion to form the bedding for the single galvanised steel wire armour, the cable shall then be covered with an extruded black flame retardant LSOH sheath.
- (d) The Fire Protection Systems Installer shall include for all necessary tests required in order to gain Local Authority/District Surveyor approval for the cable to supply the life safety and firefighting equipment.
- (e) The cable shall have LPCB approval for the fire performance characteristics and appear on their web site www.redbooklive.com.

- (f) The cable shall be terminated by compression type, gunmetal or brass glands constructed to grip both the inner and outer sheath and so designed that any strain on the cable is taken by the steel wire armouring, which shall be effectively bonded to the gland. Glands shall incorporate an effective seal between the gland itself and the outer cable sheath. Glands shall be weather and moisture proof and complete with LSOH shrouds. The type of gland shall be agreed with the Engineer before any terminations are carried out.
- (g) The cable support systems and fixings for the fire performance cable shall be of suitably up-rated construction to cater for the reduced tensile strength of steel when exposed to fire. The support systems shall maintain their integrity in a fire situation for a minimum of two hours, being designed in accordance with the recommendations given in the Code of Practice BS 8519.
- (h) Where cable cleats are required to support fire rated cables, they shall be of the cast iron type and not the aluminium or PVC equivalent.
- (i) The cables feeding life safety firefighting equipment shall not be routed through areas defined in BS 8519 as areas of special fire risk; these areas include loading bays, underground car parks etc. Where this is unavoidable Category 3 cables shall be installed with the addition of supplementary passive fire protection.

F702200 UNARMoured POWER CABLES

F702201 Single Core Cables Within Conduit Or Trunking

- (a) Single core cables within conduit or trunking and flexibles shall be LSOH insulated. Cables shall comply with BS 7211 and flexible cables with BS EN 50525 respectively. The minimum size of conductor in flexible cords shall be 1.0 mm². No cable with a conductor smaller than 1.5 mm² shall be used for general-purpose circuits or smaller than 2.5 mm² for socket outlet circuits.
- (b) Cables in trunking or conduit shall be 600/1000 volt grade. Flexible cables shall be 300/500 volt grade LSOH insulated and LSOH sheathed. The sheath shall be white unless otherwise specified. Connections to luminaires or other apparatus where the temperature exceeds 80 °C shall be made using silicone coated cable with a non-hygroscopic fixed base connector.
- (c) Where conditions require the use of PVC insulated cables and flexibles instead of LSOH the Engineer must agree such alteration in writing.

F702207 Fire Alarms and Emergency Lighting

- (a) Fire alarm and emergency lighting cables shall be selected in accordance with the requirement of BS 5839-1. The cable shall be Category 3 (enhanced) with a fire survival time of 120 minutes. Only if specifically noted within the services description or cable schedules shall Category 1 (standard) cables with a fire survival time of 30 minutes be used.
- (b) Unless specifically called for elsewhere in this specification only Category 3 enhanced cable shall be installed for fire alarm systems.

- (c) The fire performance characteristics of the Category 3 enhanced cable shall comply with the test protocol in BS EN 50200 incorporating fire, mechanical impact and water, on a single sample of cable; with the elevated test temperature specified in BS 8434-2.
- (d) The cable shall have an outer sheath of LSOH material compliant with the requirements of LTS3 in accordance with BS 7629. The sheath colour shall be red for fire alarm, voice alarm and fire telephone systems.
- (e) The cables shall have been independently tested for data transmission whilst being exposed to tests described in BS 8434-2.
- (f) The cables for central battery powerful emergency lighting systems shall be selected in accordance with the requirements in BS 5266-1, having a fire survival time of 60 minutes, classified as Category 2 according to BS 8519, with a white LSOH sheath.
- (g) The manufacturer shall hold LPCB (Loss Prevention Certification Board) approval for the products they manufacture and supply.
- (h) The manufacturer shall hold BASEC approval (British Approval Services for Cables) for the products they manufacture and supply and in addition, be approved by Quality Assurance Standard BS EN ISO 9001.
- (i) Cable termination shall be via the installation of the cable manufacturer's recommended cable glands complete with LSOH red shroud. These components shall be approved by the cable manufacturer for use with their cables.
- (j) Where the pliable cables are fixed direct to the building fabric, purpose designed coloured LSOH coated stainless steel or copper "P" clips shall be used. The fixings shall be approved by the cable manufacturer for use with these cables and shall be installed in accordance with the manufacturer's recommendations.
- (k) Where pliable cables are fixed to cable tray, purpose designed coloured LSOH coated stainless steel or copper fixings shall be used in accordance with the manufacturer's recommendations.
- (l) Alternative means of cable fixing will not be considered without the written endorsement from the cable manufacturer. Any such approved alternative fixings shall be installed strictly in accordance with the cable manufacturer's installation instructions.
- (m) Where more than two cables follow common routes, cable trays shall be provided, suspended from the structure via suitable galvanised steel brackets.
- (n) The maximum distance between fixings shall be dependent of the size of the cable and shall not be greater than that specified in the table below.

Surface Fixed

Overall Diameter of Cable (mm)	Maximum Spacing of Fixings	
	Horizontal (mm)	Vertical (mm)
Exceeding 9 mm and not exceeding 15 mm	300	400
Exceeding 15 mm and not exceeding 20 mm	400	450

Overall Diameter of Cable (mm)	Maximum Spacing of Fixings	
	Horizontal (mm)	Vertical (mm)
Exceeding 20 mm and not exceeding 40 mm	400	500

Tray Fixed

Maximum Spacing Dependent on Installation	Maximum Spacing of Fixings	
	Horizontal (mm)	Vertical (mm)
Subject to compliance with local regulations	700	900

- (o) All bends shall be neat and uniform and their radius shall not be less than six times the diameter of the cable.
- (p) The fire alarm cables shall be segregated from other circuits in separate conduits or separate trunking compartment to avoid mechanical damage.
- (q) Cables should be installed without joints wherever practicable. All terminations and other accessories shall be such as to minimise the probability of early failure in the event of fire. Terminals used to join the cables shall be constructed of materials that will withstand a similar temperature and duration to that of the cable.
- (r) Pliable cables shall be installed in accordance with BS 7671 and in conjunction with the manufacturer's recommendations.

F702400 MINERAL CABLES

- (a) Mineral insulated cables shall comply with BS EN 60702. They shall be LSOH sheathed 750 volt, heavy duty grade, except where specified elsewhere. The sheath colour shall be orange except for fire alarm circuits which shall be red. Mineral insulated cables shall comply with BS EN 50200/BS 8434-2, with a fire survival time of 120 minute. Where inductive loads are connected using MICC cables, suitable provision shall be made for surge voltage suppression.
- (b) Where moisture ingress to MICC cables is likely to be a problem and fire prevention conditions permit, MICC cables with an organic component to the insulation may be used with the Engineer's permission in writing.
- (c) The insulation resistance of cables shall be tested immediately after installation and termination, using a 500 volt DC instrument. Further tests shall be carried out not less than 24 hours after the cables have been sealed. The tests shall be witnessed by the Engineer, where necessary any defective joints shall be replaced at the expense of the Fire Protection Services Installer.

- (d) A through joint will only be permitted if the cable length exceeds the maximum to which it can be manufactured. Such a joint shall be made within an adaptable box, in which shall be fitted a fixed base mechanical clamp type connector. In such joints, cores forming a circuit whether single of multi-core cable shall be joined in a common box. Where space precludes the use of a box, a purpose made brass joint tube may be utilised conforming to BS EN 60079.
- (e) Where mineral insulated cables cross expansion joints they shall be double set across the joint. Cable fixings on un-plastered walls shall be provided with suitable distance pieces.
- (f) Individual runs of surface fixed cable shall be secured by means of purpose made low smoke zero halogen LSOH coated copper P-clips. Where multiple cable runs are to be installed, purpose made LSOH covered copper two-hole fixing saddles shall be used. The maximum fixing centre shall not exceed the following table, however this only represents a minimum standard, cables shall be supported to prevent any sagging. At bends, boxes and fittings, the cable shall be additionally supported at each side by saddles. The saddles shall be the same colour as the cable sheath.

Cable Diameter	Spacing Horizontal (mm)	Spacing Vertical (mm)
Not exceeding 9 mm	600	500
9 mm – 15 mm	900	1200
15 mm – 20 mm	1500	2000
20 mm – 40 mm	2000	3000

- (g) Wherever cables are grouped cable tray shall be provided unless otherwise agreed with the Engineer. Where single core cables run in a group, the sheaths of the cables shall be copper bonded at intervals not exceeding 5000 mm. The method of grouping shall be agreed before installation. Bare mineral insulated cables shall not be installed on galvanised cable tray.
- (h) Where the cable terminates at a machine or equipment subject to vibration, one complete turn of the cable shall be made, creating an anti-vibration loop, immediately before the cable enters the terminal box or terminating position. A clear space, minimum 12 mm shall be maintained at the point in the loop where the cable passes over itself. The diameter of this loop shall not be less than that stipulated by the cable manufacturer in accordance with the minimum bending radius recommended for the cable size being installed.
- (i) Mineral insulated cables installed in wall or other finishes shall be drawn into a suitably sized conduit to permit rewiring. Cables passing through walls or floors shall be sleeved by conduit. Where necessary protection against mechanical damage shall be provided. Conduit fittings and accessories used in conjunction with mineral insulated cables shall be galvanized.

- (j) Cables with an organic component to the insulation shall be removed from the reel by mounting on a suitable spindle and the cable pulled off. Cables shall be dressed into position by hand. The minimum bending radius on the cable will be 6 times the overall diameter of the cable. Entry into fittings shall be by the use of type A2 brass glands.
- (k) Mineral insulated cables shall be sealed using screw-on pot type seals which shall incorporate integral earthing tails. The seals shall be accommodated in brass ring type glands.
- (l) Seals shall comprise brass sealing pots with a waterproof and oil proof phenolic disc complete with a suitable number of neoprene insulating sleeves. Seals shall be suitable for temperature ranges of up to 105 °C or 302 °C as the situation demands. Insulating sleeves shall be complete with moulded heads to enable the sleeves to be retained in the phenolic disc. Tails shall be identified by means of Hellerman sleeves applied over the neoprene.
- (m) Final connection for conductors larger than 4 mm² shall be made by means of cone grip lug type cable lugs. When joints of three or more ways are to be made in conductors, adaptable or conduit boxes shall be utilised with fixed ceramic block connectors.
- (n) The ends of mineral insulated cables shall be taken into earthed enclosures. Unfixed connectors shall not be used. Glands shall be connected to equipment or boxes by locknuts or, where space is limited, by smooth bore male brass bushes, compression washers and galvanized sockets for multicore cables. Non-ferrous sockets and locknuts shall be used for single core cables. Cable terminations shall be clearly marked with coloured sleeves.
- (o) Sealing compound and sleeving shall be kept clean to prevent copper or brass filings being mixed with the compound or deposited on the insulating sleeving.
- (p) The terminations of cables having an LSOH sheath shall be fitted with a matching LSOH shroud, which shall cover the cable gland, and the length of cable from which the LSOH sheath has been removed.
- (q) Cable gland plates for single core cables shall be slotted between each cable entry, where the gland plates are of ferrous material. Alternatively non-ferrous gland plates shall be utilised.

F702500 INSTALLATION OF CABLES

F702501 General

- (a) Cables shall not be installed or removed from the drum unless the ambient temperature and the temperature of the cable is above 0 °C and has been for the previous twenty-four hours. Where cables have been subjected to temperature below 0 °C care shall be taken to ensure that they are above that temperature before they are removed from the drum.
- (b) Cables once installed shall have their ends sealed to prevent the ingress of moisture, prior to cable termination. Cables installed and left unprotected may be replaced at the expense of the Fire Protection Systems Installer. Similar protection should be applied to cables stored on cable drums prior to installation.

- (c) Cables shall not be left exposed to sunlight for periods of time in excess of installation requirements. All cables shall be covered whether they are being stored or have been installed in open trenches.
- (d) Cables shall run directly from point to point without joints unless the length required is in excess of the length obtainable in one piece from the cable manufacturer.
- (e) Where cables change direction, whether horizontal or vertical then the bending radius shall be kept as large as possible, and no cable shall be bent to a radius less than the minimum specified by the cable manufacturer.
- (f) The inside radius of bends in a cable shall not be less than eight times the overall diameter of the cable or that set out in the manufacturer's recommendations whichever is the greater.
- (g) Cables shall be pulled into position in such a manner as to avoid damage to the cable or its sheath. Cables shall, wherever possible, be pulled directly from the drum, which shall be adequately supported to allow free rotation throughout the installation of the cable.
- (h) An adequate number of cable rollers, each of which shall be in perfect working condition, shall be used to support the cable during installation in such a manner that no part of the cable can touch the ground or any internal part of the trench or cable duct.
- (i) Cables shall wherever possible be pulled into position by hand using a number of operatives positioned along the length of the cable.
- (j) Winches, whether powered or hand operated, shall only be used with prior approval. Whenever a winch or similar appliance is used, an approved tension gauge shall be fitted into the haulage line between the winch and the cable. The pulling tension must at all times be within the limit advised by the cable manufacturer.
- (k) When a cable stocking is used to 'pull-in' cables it shall be of an approved pattern with swivel eye in perfect condition and be fitted with care to avoid damage to the cable sheath.
- (l) The cable shall be checked after the stocking has been removed and if the cable end has been damaged it shall be cut off and the cable immediately sealed.
- (m) During the 'pulling in' operations, the cable shall not be allowed, under any circumstances, to twist or rotate about its longitudinal axis as a result of excessive pulling tension or for any other reason.
- (n) Damage to the armouring or sheath of any cable shall be avoided. If the armouring or sheath becomes damaged at any point, it shall be rectified to the satisfaction of the Engineer. Where the damage is sufficiently severe, the cable shall be pulled out and replaced.
- (o) Unless otherwise specified, sheath colour for low voltage cables shall be black and MV shall be red and cables shall have stranded copper cores. Cores of multi core cables shall be coloured in conformity with the British Standard in order to provide easy identification.

- (p) Terminations shall be in accordance with manufacturer's instructions taking care to avoid stressing the cores during installation. Where junction boxes are required to terminate cables, the size, type and specification of the junction box shall be agreed with the Engineer prior to the works proceeding.
- (q) At terminations of wires and cables the insulation shall be neatly stripped without nicking the conductor. In no case shall bare conductors be allowed to project beyond any insulated shrouding or mounting of a terminal.
- (r) All cables passing through the floor structure or fire rated walls, shall be sleeved utilising proprietary cable sleeving systems. The Fire Protection Systems Installer shall submit samples of the proposed sleeving to be utilised. Cables shall be sealed within the sleeves by suitable intumescent materials recommended by the cable/sleeve manufacturer. The fire rating of the complete assembly shall equal the fire rating of the structure through which it passes.
- (s) All cables passing through walls or foundations to external areas shall be sleeved utilising proprietary cable sleeving systems and puddle flanges so as to maintain the weathering of the finishes and to negate any seepage from the atmosphere or ground to either the internal areas or the building structure. The Fire Protection Systems Installer shall submit samples of the proposed sleeving and or flanges to be utilised. Cables shall be sealed within the sleeves by suitable materials recommended by the cable/sleeve manufacturer.
- (t) Where cables enter IP rated enclosures, they shall do so via bottom entry cable gland plates in order to maintain the IP rating of the enclosure. The Fire Protection Systems Installer shall obtain agreement from the Engineer if top entry is the only option available, a detailed method statement shall be submitted to the Engineer as to how the IP rating will be maintained.
- (u) Cables installed in formed ducts and elsewhere specified shall be fixed with cable cleats, bolted to vertical or horizontal mild steel channel supports embedded in the duct walls to support the cable in accordance with the manufacturer's recommendations.
- (v) Single core armoured cables shall not be installed within areas, where visual display terminals or data processing equipment may be adversely affected by the radiated electromagnetic fields. Single core armoured cables shall only be utilised with the written consent of the Engineer and shall, where installed, be screened by mu-metal to reduce radiated magnetic fields to below recommended levels.

F702504 Cables on Ladder and Tray

- (a) Cables installed on trays or ladder shall be laid in a single layer, leaving 25% of the tray or ladder width as spare capacity for further use.
- (b) Where cables leave ladder or tray they shall be adequately supported and protected so as not to place pressure on the cables.

F702507 Cable Cleats and Fixings

- (a) Single core cables forming part of a three phase circuit shall be installed in trefoil formation, (L1, L2, L3 or Brown, Black, Grey) 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 manufactures recommendations for the given fault level. Where necessary the neutral conductor shall be run adjacent to its set of phase conductors using quadrafoil cleats.
- (b) 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 stainless steel cable ties to the cable tray or ladder at the spacings indicated in Table T1.1. Marker ties shall be provided at 3000 mm intervals which shall encompass all conductors of the circuit. Where the cables run vertically they shall be cleated using non-metallic cable cleats at fixing centres noted in table T1.1.
- (c) Non-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 table reference T1.2. Additional ties shall also be provided within 100 mm of each bend. Where non-life safety cables run vertically they shall be cleated using non-metallic cable cleats with spacings in accordance with table reference T1.2.
- (d) 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 reference T1.2. 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 reference T1.2. 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.
- (e) Where cables are on inverted tray they shall be fixed with cable cleats spaced in accordance table T1.2 or the manufactures recommendations should they be more onerous. Cleats for non-life safety cables shall be insulated 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.
- (f) 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 tables T1.1 or T1.2 or the manufactures recommendations should they be more onerous. Cleats for non-life safety cables shall be insulated 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.
- (g) Coatings for stainless steel cable ties shall manufactured from materials with low smoke zero halogen properties.
- (h) Non-metallic cleats shall be manufactured from materials with low smoke zero halogen properties.

Spacing's of supports for cables in accessible positions Table T1

Maximum spacing's of cable fixings

Overall diameter of cable*	Non-armoured thermosetting, thermoplastic or lead sheathed cables and non-armoured fire resisting cables		Single wired Armoured cables including fire resisting armoured cable		Mineral insulated copper sheathed or aluminium sheathed cables	
	TI.1		TI.2		TI.3	
	General		General			
	Horizontal 2	Vertical 3	Horizontal 6	Vertical 7	Horizontal 8	Vertical 9
mm	mm	mm	mm	mm	mm	mm
Not exceeding 9	300	300	-	-	600	600
Exceeding 9 and not exceeding 15	300	300	300	300	900	1200
Exceeding 15 and not exceeding 20	300	300	300	300	1500	1800
Exceeding 20 and not exceeding 40	300	300	300	600		
Exceeding 40 and not exceeding 50	600	600	900	900		
Exceeding 50 and not exceeding 60	600	900	900	900		
Exceeding 60 and not exceeding 70	900	1200	900	1200		
Exceeding 70 and above	900	1200	1200	1200		

Note:

- i) Fire resistant fixings should be used for fire resistant cables
- ii) For flat cables taken as the dimension of the major axis
- iii) The spacing's shown above apply to multi-core cables
- iv) The spacing of fixings on single core cables in ac. installations must take account of the magnitude of forces generated under fault conditions
- v) The spacing's stated for horizontal runs may be applied to runs at an angle of more than 30° from the vertical. For runs at an angle of 30° or less from the vertical, the vertical spacing's are applicable

F702510 Cables in Trunking, Conduit and Flexibles

- (a) Cables shall only be drawn into conduits or laid in trunking after conduits and trunking have been finally fixed, cleaned out and inspected by the Engineer. Where cables emanate from separate distribution boards, or are serving different parts of an installation, such as lighting and power, or landlord and tenant, they shall be installed in separate conduits or trunking unless otherwise specified.
- (b) Where trunking or adaptable boxes are provided with suitable barriers, cables for differing services may be installed through the same trunking or box provided that the different services are each run in a separate compartment. Each circuit of cables contained in trunking shall be taped and bound at 10 metre intervals throughout the run and suitably labelled at each junction and terminal point for identification purposes. No joints will be permitted and cables shall be looped from point to point.
- (c) Connector blocks will be permitted only where cables cannot be terminated direct into an appliance and if agreed by the Engineer. Connector blocks shall be rated to suit the circuit and shall be manufactured from porcelain. They shall be fixed base type and installed in a conduit or adaptable box. Unfixed connectors will not be permitted. Connector blocks shall not be located within trunking.
- (d) Flexible cords shall incorporate the appropriate level of strain relief as part of each termination to ensure that mechanical stress is not applied to the cables inner cores or the cable terminations.

F702513 Cable Lugs

- (a) Cable lugs rated in excess of 30 Amp shall be brass castings machined on the lug faces to a smooth finish and drilled to meet the conductor size, excessive clearances being avoided. After soldering, all burnt or damaged insulation shall be cut away and the bared conductor wrapped with LSF tape to the thickness of the original insulation.
- (b) Cable lugs for low voltage cables shall be of the crimping type.

F702800 CABLE JOINTING

- (a) Where joints are required on armoured mains cables, they shall only be undertaken with the Engineer's written permission and as described in the succeeding paragraphs of this clause.
- (b) Conductors shall be jointed colour to colour, or number to number. They shall be tested for condition and insulation resistance before jointing is completed. Joints shall be completed on the same day as commenced. Straight through joints will not normally be permitted.
- (c) Joints in copper conductors shall be by means of tinned copper connectors with the conductor firmly butted together and sweated solid with tinman's solder. Joints in rubber insulated or polyvinyl chloride cables shall be insulated with pure rubber tape served to a thickness equal to the cable insulation.

- (d) Joint boxes shall be completely filled with insulating compound of a suitable grade. Each box shall be topped up as necessary to ensure that it is properly filled. Joint box compound shall have a high dielectric strength and insulation resistance suitable for the working voltage of the cables. It shall be non-hygroscopic and be suitable in all respects for the type of joint being made. Where there is any possibility of ingress of oil into the sealing box, the compound shall be oil resistant type. Jointing compounds shall be poured at the correct temperature specified by the makers. No plug or air vent shall be fitted until all air has been released from the joint box. Plugs and air vents shall be sealed with compound after filling.
- (e) Where aluminium sheathed cables are used the jointing method shall be strictly in accordance with the manufacturers recommendations.

F703100 CABLE IDENTIFICATION

- (a) Conductor identification shall be carried out in accordance with clause 514 and table 51 of BS 7671.
- (b) The cores of multi-phase circuits shall be identified by the colours Brown, Black and Grey and the numbers L1, L2 and L3 signifying live conductors with Blue and "N" for the neutral conductor.
- (c) Where 3c armoured cables are utilised to feed single phase loads the brown core shall be utilised as the "live", the grey core shall be over-sleeved with blue to indicate neutral and the black over-sleeved with green/yellow to indicate earth.
- (d) Bare conductors, other than earth continuity conductors and earthing leads shall be identified by means of sleeves or discs of the appropriate colours and alphanumeric labels prescribed in Table 51 of BS 7671.
- (e) The cores of flexible cords shall be coloured throughout with brown for the phase or live conductor, blue for the neutral or return conductor and green/yellow for the earthed conductor.
- (f) Identification of switchboard busbars and connections to individual phases of poles shall be by colouring and alphanumeric labels in accordance with Table 51 of BS 7671.
- (g) On AC systems the phase sequence shall be maintained throughout the installation and all phase connections shall be in the order brown, black, grey from the top to bottom or left to right. Neutral connections, links, and busbars shall always be located above or to the side of the phase connections, links or busbars.
- (h) The particular phase connected to fuse banks and busbars shall be clearly indicated by marking with the appropriate colour and alphanumeric labels in accordance with Table 51. In addition, the cores of cables connecting control gear, etc. with marked terminals shall be identified by ferrules or marker beads bearing the same marking as the terminals to which they are connected and alphanumeric labels in accordance with Table 51 to signify the phase.
- (i) Cables forming special circuits such as extra low and low voltage circuits for bells, alarms etc. shall be distinctively coloured or marked, but the colours shall be different from any of those specified for other purposes as detailed in Table 51 of BS 7671.
- (j) Sub main and final circuit armoured cables shall include a reference tag at each point of termination securely fixed to the cable sheath identifying the cable by cross reference to the main distribution schematic.

F703300 CABLE SIZING

- (a) Cables are sized to take account of volt drop, circuit impedance, grouping, protection and environmental conditions. Sizes are based on the relevant tables and correction factors in BS 7671. Major cable routes are indicated on the drawings and these shall be adhered to. Cable sizes for final circuits are based on direct routes from the distribution equipment to the respective loads, with due allowance for routeing around the structure and other services.
- (b) Cables shall not be installed in or through thermal insulation except where they are required to pass through fire barriers. Any instance where the thickness of the fire barrier exceeds 300 mm shall be brought to the attention of the Engineer prior to installation of the cables. In exceptional circumstances where it is considered that the installation will be improved by installing cables in or through thermal insulation full details of the proposal, including calculations showing the derating effect on cable sizes and relative costs, shall be submitted to the Engineer for comment.
- (c) Cable lengths where indicated are shown only as a basis for design. It is the responsibility of the Fire Protection Systems Installer to ascertain actual cable lengths, include for the actual lengths in the Tender and provide materials accordingly.
- (d) If any cable length varies significantly from that indicated or implied in the Tender Documents, the Fire Protection Systems Installer shall provide the appropriate calculations to show that the cable is suitable for the intended load. Similarly, if any loads vary from those envisaged in the Contract Documents, the Installer shall show that appropriate cables will be provided to suit the revised conditions.
- (e) Thermistors circuits for motors shall be wired in cable not less than 1.5 mm², or greater if particularly specified. Heating and Ventilation Controls 'singles' shall be wired in cable not less than 1.5 mm², or greater if otherwise specified.

F703600 CABLE CONTAINMENT SYSTEMS GENERAL

- (a) Cable containment systems shall comply with the following standards:
 - i) Cable conduit system - BS EN 61386 series
 - ii) Cable trunking and ducting systems - BS EN 50085 series
 - iii) Cable tray and ladder system - BS EN 61537
- (b) The minimum free area of any conduit or trunking shall be such that the installed cables shall not occupy more than 45% of the available capacity, including due allowance for derating to suit grouping factors. Should BS 7671 require a greater space to be allowed then such requirements shall be adopted.
- (c) Conduit, trunking, cable tray, ladder rack and cables shall be installed to give the following minimum clearances to pipework:
 - i) Insulated Pipes - 50 mm for conduit or trunking
 - ii) Uninsulated Pipes - 100 mm for conduit or trunking
 - iii) Insulated Pipes - 50 mm for cables not enclosed
 - iv) Uninsulated Pipes - 150 mm for cables not enclosed

- (d) The Fire Protection Systems Installer shall maintain the following clearance between power and communications cable route where the rated voltage of the supply exceeds 1000 V rms AC.

Type of Installation	Distance		
	Without divider or non-metallic divider	Aluminium divider	Steel divider
Unscreened power cable and unscreened IT cable	200 mm	100 mm	50 mm
Unscreened power cable and screened IT cable	50 mm	20 mm	5 mm
Screened power cable and unscreened IT cable	30 mm	20 mm	2 mm
Screened power cable and screened IT cable	0 mm	0 mm	0 mm

Power Cable Voltage/Volts	Minimum Separation between Power and Signal Cable
3300	1100 mm
6600	1250 mm
11000	1400 mm

- (e) Where the power and communications cable routes are required to cross-over, they shall do so perpendicular to each other. Where the Fire Protection Systems Installer is unable to maintain the above separation distances written notification shall be given to the Engineer in sufficient time to allow the areas of concern to be resolved, and prior to the installation of any cables or containment routes.
- (f) Unless otherwise described elsewhere in this specification, trunking and conduit systems shall be carried out in mild steel. Where multiple parallel conduit runs would occur, use may be made of cable trunking with removable lids, subject to the provisions of this specification and with the agreement of the Engineer. Due regard shall be given to derating of cables due to grouping.
- (g) Any cable systems or non-metallic containment systems, installed within false ceilings or floor voids etc. forming part of an air plenum shall be of low smoke zero halogen material. Plastic cable ties shall not be installed within ceiling voids, where the void is to form part of the return air plenum.
- (h) Cable ties shall be stainless steel or copper. Where coated the coating shall be low smoke zero halogen material.
- (i) Cable ties shall not be used to support cables. They shall only be used to secure cables on to horizontal cable tray.
- (j) The Fire Protection Systems Installer shall be responsible for confirming to equipment suppliers the sizes and types of cables to be connected to the equipment. Equipment shall be arranged to accommodate the specified cable. The Installer shall advise all other parties of the size and type of cable to be connected to items supplied by them.

- (k) Conduit and trunking systems shall be erected completely with all accessories connected. They shall then be offered to the Engineer for inspection and comment before any cables are installed.
- (l) No lubricants shall be used to assist when pulling cables into conduit.
- (m) Draw wires shall be provided where conduits are not to be wired on completion or are to be wired by others.
- (n) Utilising containment or its associated support systems as a 'mansafe' system shall not be permitted unless the systems have been designed, tested and certified for this use.
- (o) The Fire Protection Systems Installer shall provide the appropriate level of detail on their coordinated services working drawings, to demonstrate that sufficient access is provided to allow safe working access for operatives. Including when working from either standard or specialist plant, designed for working at height. The plant shall enable them to safely install, dress and fix the cables, as required, both in open corridors, plant areas and risers. The space allowed shall be consistent with the installation method described in the relevant installation method statement.
- (p) The Fire Protection Systems Installer shall ensure that all plant used for 'pulling' cables onto containment is properly fixed and restrained independently of the containment systems and its supports unless these systems have been specifically designed, tested and certified for that use.

F703900 CABLE LADDER

- (a) Cable ladders shall be either medium or heavy duty with medium duty being fabricated from 1.5 mm hot dipped galvanised mild steel with a 100 mm flange depth. Heavy duty shall be manufactured from hot dipped galvanised mild steel with a minimum thickness of 1.6 mm and 125 mm flange.
- (b) The Fire Protection Systems Installer shall ensure that the tray selected is suitable for the anticipated loading including any spare capacity.
- (c) Ladder greater than 450 mm wide shall heavy duty.
- (d) Cable ladder fittings and accessories shall be factory formed and be of the same construction as the ladder. Where cable ladder is cut, filed or shaped, the ends shall be given one coat of anti-corrosive paint and one finishing coat to match the ladder finish.
- (e) Cable ladders shall be fixed in accordance with manufacturer's recommendations and also the recommendations of BS 8519 where the systems are utilised to support life safety cabling, and no more than at 3 metres intervals for ladders up to 300 mm wide and 1.5 metres intervals for larger sizes. There shall be no perceptible sagging of the ladder when all the cables are in position. Additional fixings shall be provided within 150 mm of each side of any bend, tee, or intersection.
- (f) Fixing brackets shall be manufactured from mild steel channel sections, or alternatively a proprietary fixing channel. The bracket shall be painted with one coat of base paint and a final coat of high quality enamel paint.
- (g) Support rods and channel fixings for ladder supporting life safety systems shall be in accordance with BS 8519.

- (h) Cable ladder shall be mechanically and electrically continuous throughout. Mushroom head bolts shall be used on all joints and for fixing. There shall be not less than two bolts per joint or fixing. Cable ladder shall not be used as the system earth return path for the electrical installation.
- (i) Where trays or ladders do not directly support cables, such as on vertical trays or ladders, load bearing cable cleats or saddles shall be employed and securely fixed to the tray. Cable cleats, saddles and straps shall comply with the cable manufacturer's recommendations and shall be compatible with the tray finish and cable sheath.
- (j) Jumper links shall be provided for all breaks in cable tray or ladder and at connections. A run of tray or ladder shall be earthed using a minimum conductor size of 6 mm².
- (k) Oversized bends shall be used as required to accommodate the bending radii of the cables to be installed.

F704200 CABLE TRAY

- (a) Cable tray shall be medium or heavy duty with double edge return. It shall be manufactured from perforated mild steel hot-dip galvanized sheet complying with BS EN 10346 Cable tray and accessories shall comply with the following requirements:

Width of Tray/Accessory (mm)	Minimum Thickness (mm)
Up to and including 150	Medium Duty 0.8
over 152 up to and including 300	Heavy Duty 1.2
over 300 up to and including 600	Heavy Duty 1.5
over 600 up to and including 914	Heavy Duty 2.0

- (b) Cable tray shall be installed with the greater dimensions in the horizontal position unless otherwise agreed with the Engineer. Where tray is installed in the vertical position, cables shall be supported by cable cleats or in the case of Fire alarm and emergency lighting cables, saddles or clips.
- (c) Tees, intersection units and sets shall be purpose made by the manufacturer. Where this is not possible the units may be made on site only with the agreement of the Engineer.
- (d) Cable tray shall only be cut along a line of plain metal, not through perforations. Cut edges shall be prepared and treated according to the original finish of the metal. Where tray has been welded and on galvanized tray, a zinc rich paint shall be applied. Holes cut in cable tray for the passage of LSOH covered cables shall be provided with grommets or, alternatively, bushed or lined to prevent damage to the cable covering.
- (e) Cable trays shall be securely fixed in accordance with the manufacturer's recommended fixing centres. Support shall ensure that there is no perceptible sagging of the trays when all the cables are in position. Trays shall be fixed at both sides of a change of direction at a maximum distance of 150 mm from the direction change.

- (f) Mushroom headed steel roofing bolts and nuts shall be used for the installation and coupling of trays. Cable tray brackets shall be of sufficient depth to provide access to the rear of the tray for easy installation of PVC saddle type fixings.
- (g) Where cable containment systems are to be installed in IT facilities (i.e. data centres, MERs, SERs, comms rooms etc.) the containment systems shall be fabricated using the Hot Dip Pre-Galvanised process in accordance with BS EN 10346

F705100 CABLE TRUNKING

- (a) Trunking shall comply with the requirements of BS EN 50085. Sizes shall be determined to comply with the requirements of BS 7671, including due allowance for all likely future supplies, unless otherwise described. The requirements for conduits described elsewhere in this specification shall, wherever appropriate, be applied to trunking installations.
- (b) Steel cable trunking shall be manufactured from galvanized steel sheet with a minimum sheet thickness of 1.22 mm
- (c) Trunking shall be a minimum of IP4X in accordance with BS EN 60529.
- (d) Steel cable trunking shall be manufactured from galvanized steel sheet with a minimum sheet thickness of 1.22 mm.
- (e) PVC trunking shall only be used with permission, in writing, from the Engineer. PVC cable trunking shall be manufactured from high impact PVC
- (f) Trunking shall have a removable cover throughout its length with centre turnbuckle type latch fixings.
- (g) Trunking bends shall be gusseted and of factory manufacture unless otherwise agreed with the Engineer in writing.
- (h) Trunking fittings and accessories shall be factory manufactured and finished by the trunking manufacturer. They shall be of a similar construction and finish to the main trunking.
- (i) Lengths of trunking shall be connected by internally fixed rectangular coupling units of sufficient width to provide a minimum bearing face of 25 mm to which the lengths shall be welded or bolted. The length of lids shall be so arranged that the joint always coincides with the centre of the coupling unit.
- (j) Trunking for installation with the lid to the bottom shall be provided with cable retainers near to lid fixings and spacers to ensure that cables cannot be damaged when the lid is secured. They shall be spaced at maximum intervals of 1000 mm.
- (k) Vertical cable trunking shall be provided with cable pin racks arranged to avoid any strain on the cables. They shall be spaced at maximum intervals of 3000 mm.
- (l) Trunking shall be rigidly fixed throughout its length. Fixings directly to the building fabric shall be by at least two roundhead screws spaced at not more than 1000 mm fixing centres and at each side or bends and junctions. Elsewhere trunking shall be supported by substantial brackets at intervals not exceeding those specified in BS 7671. No suspensions or fixings shall intrude into the internal space unless otherwise specified.

- (m) PVC trunking shall be installed strictly in accordance with the manufacturer's recommendations.
- (n) Couplers on PVC trunking shall be fixed in place by a permanent solvent on one end and non-hardening mastic on the other to allow for expansion of the trunking. In addition, fixing holes in the body of the trunking shall be elongated to allow axial movement. Fixing screws shall be provided between ends of trunking or 6 per 3000 mm length.
- (o) Trunking shall be firmly attached to its associated equipment, either by bolted flanges or by hexagonal male bushes, couplings and compression washers, according to the direction of run in relation to the equipment.
- (p) Earth continuity shall be maintained between each section of steel trunking by copper links fixed to the outside of the trunking. For PVC trunking a protective conductor not less than 2.5 mm² with green and yellow insulation shall be installed throughout. The conductor shall be of sufficient length to allow looping in and out of metallic equipment and accessories.
- (q) Where trunking crosses building settlement or expansion joints a connector shall be provided, with slotted fixing holes to permit a movement of 10 mm in both the horizontal and vertical planes. The earth continuity link shall be of braided copper tape not less than 15 mm wide by 2 mm thick having a resistance from fixing to fixing equal to or less than the links used for standard trunking joints. The braid shall be long enough to allow for the maximum movement of the trunking. Braid ends shall be folded and swaged solid.
- (r) A fixed section of lid shall be provided where trunking passes through the building structure, terminating 80 mm from each side of the structure.
- (s) Where trunking passes through building fire barriers, suitable fire resistant barriers shall be provided within the trunking. A sample of the proposed fire barrier shall be submitted to the Engineer for acceptance. The submission shall include certification as to the fire performance offered by the materials and instructions as to how the material is to be installed. The location of all fire barriers shall be recorded on the 'As Fitted' drawings. Care shall be taken to see that no aperture is left between the trunking and the structure through which fire might spread.
- (t) Where access points in ceilings or floors or the like are provided to trunking, the trunking shall be provided with a short removable section of lid.
- (u) Where conduits connect to multi-compartment trunking and their appropriate compartment is not accessible from the side, they shall be provided with skeleton type stop-end boxes securely fixed on to a short section of fixed lid positioned so that direct wiring is possible.
- (v) Care must be taken to ensure that all steel and brass particles and the like are removed from the trunking prior to the installation of the cables. All trunking shall be installed so that cables are not liable to mechanical damage due to abrasion.

F705400 CONDUIT

F705401 Steel Conduit

- (a) Steel conduit shall comprise heavy grade, welded seam conduit complying with BS 4568: Part 1 and provided with screwed ends. Dimensions shall comply with BS EN 60423. Black conduit shall be finished in category class 2, stove enamel. Galvanized conduit shall be finished in category class 4, hot dip zinc coating.
- (b) Inspection bends, solid bends, elbows or tees shall not be installed.
- (c) Where a number of conduits converge they shall terminate in a metal box to prevent bunching. Draw boxes and junction boxes shall be of ample size to permit cables being drawn in and out. Boxes shall be at least 75 mm x 75 mm x 50 mm for cables up to 6 mm² or conduits up to 25 mm diameter. They shall be at least 150 mm x 150 mm x 50 mm for larger cables or conduits.
- (d) Boxes shall be manufactured from cast iron or substantial heavy gauge sheet with welded corners. Lids shall be made of the same material as the box. For flush work, lids shall overlap the box adequately on all sides. For surface work the lids shall make good contact with the box.
- (e) Small circular boxes and extension rings shall be constructed of malleable cast iron. Boxes shall be complete with an earth terminal and be of the same class of finish as the conduit. Where loop-in pattern boxes are required, they shall be of the same circular pattern with back outlets of the appropriate number. Standard conduit boxes complying with BS 4568: Part 2, small or large pattern, shall generally be used at lighting points.
- (f) Circular boxes shall be provided with long spouts, internally threaded, with a shoulder for the proper butting of the conduit. Conduit boxes mounted outside the building or in damp areas shall have external fixing lugs. Each such box shall include a neoprene gasket between the lid and the box. Box lids shall be made of sheet steel for surface work. They shall make good contact with the box. The box lids shall be secured by brass screws. The lids on external boxes shall have machined joint faces mating to machined faces on the box.
- (g) Adaptable boxes shall be grey iron pattern. Where adaptable boxes are fitted flush, the cover plates shall be heavy gauge metal with 12 mm overlap on all sides. The internal depth of the box shall not be less than 40 mm. Covers shall be secured by a screw at each corner and by additional screws as necessary to provide a maximum spacing of 300 mm between adjacent screws. Fixing screws shall be brass with round or cheese heads. Weatherproof boxes and covers shall have machined mating faces complete with a neoprene gasket and shall be fixed to the structure via external fixing lugs. Knockout boxes shall not be used where there is a risk of moisture ingress.
- (h) Flush outlet boxes to which a pull switch or similar is to be fitted shall, unless otherwise specified, be provided with a break joint ring.
- (i) Accessories, switch boxes and associated apparatus used with galvanized conduit shall also be galvanized.

F705404 Conduit Layout

- (a) Steel conduit shall be heavy duty galvanised, unless otherwise specified.

- (b) Where a conduit run passes from a concealed area to an area requiring galvanized conduit, then the whole of the conduit run shall be galvanized. Conduit external to a building shall be weatherproof.
- (c) Conduit runs shall be concealed in ceilings, voids, walls or chases. Where exposure of conduits in rooms is unavoidable they shall be routed through rooms of secondary importance, using back outlets to boxes.
- (d) Particular care shall be taken when setting out conduit runs to outlet points which are to be fitted to furniture, kitchen fittings, etc. Exact details of the construction of furniture and fittings shall be ascertained so that all conduit work shall, wherever possible, be concealed.

F705407 Installation Requirements

- (a) Every conduit and fitting shall be free from internal burrs and other defects. Adequate precautions shall be taken to prevent the ingress of silt or moisture into the conduit system by the use of screwed metal caps and plugs to protect open ends. If fouling should occur, the affected conduit shall immediately be swabbed clean.
- (b) Where the finish of the conduit is damaged during erection or suffers from the effects of corrosion, surfaces shall be wire brushed and painted with rust inhibiting paint to the same standard as the normal surface. Exposed threads shall also be protected by rust inhibiting paint immediately after erection. Galvanized conduit shall be treated with zinc rich paint. The conduits shall be maintained in good condition throughout the duration of the Works.
- (c) Conduit runs shall be so arranged that any condensed moisture can drain to the lowest point, where a screwed plug shall be provided for the purpose of draining off. The conduit routes shall be arranged to avoid traps or low level pockets.
- (d) Bends shall be made on site to suit conditions. Not more than two right angled bends will be permitted without the interposition of a draw box. Generally, long straight conduit runs shall have draw boxes installed at maximum intervals of 8 metres. Bends shall be made using a standard type of bending machine. The radius of any bend shall not be less than 4 times the outside diameter of the conduit. Care shall be taken to prevent conduit deformation. Conduit sets through walls will not be permitted.
- (e) Where running couplers are essential and at any other position where hexagonal lock nuts are not practicable, circular lock nuts with knurled edges shall be utilized. Great care shall be taken to ensure that they seat firmly and evenly on to mating faces of couplings or other accessories.
- (f) Conduit joints shall butt solidly to boxes, couplings, etc. with no exposed threads except at running couplings. Full use shall be made of the total length of threads in accordance with the dimensions of BS EN 61386.
- (g) Where a conduit is exposed to different temperatures, either by surrounding air conditions or by virtue of the surrounding medium with which it is in contact, such as a conduit running from a warmed building to exterior points, the section of the conduit at the higher temperature shall be isolated from the section at the lower temperature. The isolation shall be provided by a conduit box filled with a permanently plastic compound, after completion and testing of all wiring.

- (h) Where a conduit terminates at a main switch, distribution board, sub-switch or other metal clad accessory, a screwed socket shall be provided, arranged to be in good mechanical and electrical contact with the metal case. A brass bush shall be screwed into the socket from inside the case and the two locked together with a compression washer between.
- (i) Where a conduit terminates into an IP rated enclosure, luminaire or panel; a flange coupler complete with lead washer and brass male bush shall be utilised. The entry location shall be in such a position as to prevent the ingress of moisture into the enclosure.
- (j) For boxes with trapped entries and where internal space permits, a ring bush shall be used as a lock nut. Where the space is insufficient a knurled lock nut shall be used on the outside of the box.
- (k) Where conduits cross expansion joints in the building structure, special expansion couplings shall be used or such other methods as are agreed in writing by the Engineer shall be adopted. Continuity through all such joints shall be maintained.

F705410 Conduit Fixings

- (a) Conduit boxes shall be fixed to the structure of the building independently of the conduit except where this fixing would break down any provision for weatherproofing. Conduits shall be fixed to the structure of the building within 150 mm of each box or bend and at centres not exceeding 1000 mm on straight runs.
- (b) Conduit boxes shall be fixed by countersunk screws of the appropriate size, using special plugs or plugging materials. Wooden plugs will not be permitted. Holes in boxes shall be adequately countersunk to ensure complete recession of the fixing screws.
- (c) Purpose made clips shall be fabricated from strip iron or mild steel flat bar. They shall receive one coat of protective paint after fabrication with a further coat after erection. Details of proposed clips and brackets shall be submitted to the Engineer for comment prior to manufacture being commenced.

F705413 Surface Conduit

- (a) Surface conduit layouts shall be shown on the working drawings. Surface mounted conduits shall be installed vertically, horizontally or parallel with features of the building.
- (b) Where the appearance of the conduit runs would be improved by the introduction of dummy lengths of conduit, or where a more secure fixing for the suspension of fittings would be obtained, such dummy conduits and continuations shall be provided.
- (c) Where conduits pass directly through floors and washing down is likely, conduits shall be sleeved. Sleeves shall be flush with the underside of the floor, extend 75 mm above the top surface and be secured to the wall by means of a heavy gauge saddle.

- (d) Unless otherwise specified, surface conduits shall be fixed by means of distance saddles or purpose made clips, manufactured from the same material and with the same finish as the conduits. The saddles or clips shall allow the conduits to be taken directly into the accessories without sets or bends. They shall be fixed using non-ferrous screws. Conduit shall not be mounted directly on building surfaces. A minimum spacing of 6 mm to the back of the conduit shall be maintained.
- (e) Where conduits are to enter an IP rated enclosure the conduit connection shall be made utilising a flange coupler, lead washer and long reach brass male bush, the conduit connection to the enclosure shall maintain as a minimum the same IP rating as the enclosure in question.

F705416 Concealed Conduit

- (a) Concealed conduits shall be securely fixed to prevent movement during building operations. Fixing shall be by means of purpose made clips or other agreed means, so as to ensure that there is no conduit deformation.
- (b) Where conduits are installed in multi-storey buildings, a substantial right angle shall be interposed at every third storey to ensure adequate support of the installed cabling and to prevent undue stress on the terminal connections.
- (c) Where conduits are installed in ducts or voids, fixing shall be in the manner specified for surface conduits. Supports for conduits in ceiling cavities shall be independent of the suspended ceilings.
- (d) Conduit boxes buried in plaster shall permit a full 6 mm depth of cover over its entire length. Conduits shall be mechanically and electrically continuous throughout so that cables are fully protected. Deep boxes, or extension rings on standard circular conduit boxes shall be used where necessary to bring boxes flush with the surface.
- (e) Conduits in chases shall be firmly secured by wrought iron pipe hooks or crampets. The fixings shall themselves be sufficient to hold the conduits in place. Conduits mechanically damaged by crampets will be rejected and shall be replaced. Conduits installed in chases shall be painted with one coat of rust inhibiting paint before erection. A further coat shall be applied to all accessible surfaces, including the hooks and crampets, after erection.
- (f) Conduit boxes and draw boxes cast into concrete shall be held in place so that they are absolutely rigid until and while the concrete is poured and vibrated. The depth of such boxes shall be such that the open side is flush with the finished surface of the concrete.
- (g) Where conduits are laid direct on the shuttering of reinforced slab construction, conduit extension rings or deep boxes shall be used to space the conduit to run between the top and bottom reinforcing. PVC tape shall be wrapped round butt joints on extension rings to prevent the ingress of wet concrete.
- (h) Where conduits are laid in concrete slabs or screeds and the like, a competent person shall be in attendance while the concrete pouring or screeding operation is being carried out. The competent person shall ensure that damage to the conduit is avoided and that the conduit work is in sound condition, properly and efficiently maintained, during this period.

- (i) Conduit buried in the ground shall be wrapped with PVC self-adhesive tape, half lapped. The taping shall extend for a distance of 150 mm beyond the point where the conduit emerges from the ground. Joints in the conduit system shall be made watertight using aluminium paint and hemp, or alternatively, neoprene gaskets. The joints shall be partially screwed up before the paint and hemp are applied to maintain electrical continuity.
- (j) Where the system of wiring is concealed, the "Looping-in" system of conduit shall be used.

F705419 Flameproof Conduit

- (a) The installation shall comply with the relevant sections of the documents listed below:
 - i) BS EN 60079 - Code of practice for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres (other than mining applications or explosive processing and manufacture)
 - ii) Institute of Petroleum Model Codes of Safe Practice in the Petroleum Industry: Part 1 - Electrical Safety Code, and/or Part 2 - Marking Safety Code
- (b) Conduit shall be galvanized heavy gauge solid drawn to BS EN 61386, screwed to flame proof requirements.
- (c) All fittings and boxes, etc. shall be certified flameproof equipment.
- (d) Where it is necessary to employ a joint, other than a screwed coupler, certified flameproof unions shall be used.
- (e) All screwed joints, whether entering switchgear, junction boxes or couplings, shall be secured with a locknut.
- (f) Stopper boxes shall be included in conduit runs entering or leaving a hazardous area. Stopper boxes shall be filled with compound after all cables have been installed.
- (g) Where flameproof unions are used on vertical runs, they shall be fitted with the shouldered portion at the bottom, with a ring locknut. The hexagon locknut shall hold the top portion.
- (h) Upon completion of wiring all machined faces of the accessories shall be thoroughly cleaned and greased prior to the screwing or bolting of cover plates into position.

F705425 Flexible Conduit

- (a) Final conduit connections to motors or other apparatus likely to transmit vibration shall be by means of a through type box with a galvanized watertight pattern flexible metallic conduit complete with LSF over sheath. Mechanical brass adaptor glands, providing a male thread for connection to the through box, shall incorporate a positive means of preventing the conduit becoming loose.
- (b) An earth wire, minimum size 2.5 mm² shall be drawn through the length of the flexible conduit. It shall be connected to the conduit system at one end and to the apparatus at the other end.
- (c) Connections to small motors, such as in small ventilating fans, shall be made by means of multicore LSOH cable with brass packing gland type adaptors at each end.

- (d) Flexible conduit will not be permitted in lieu of sets and bends in a rigid conduit system.

F705700 LOAD BREAK SWITCHES AND ISOLATORS

- (a) Load Break Switches and Isolators shall be constructed in accordance with BS EN 60947-3.
- (b) All devices utilised for switching or isolating motors shall be Load Break type.
- (c) Load Break Switches shall have a utilisation category (at 400 Volts) of AC 23 A in accordance with BS EN 60947-3 and be suitable for switching motor loads.
- (d) Isolators and off-load switches utilised for the local isolation of fixed stationary equipment or resistive loads and incoming isolators on distribution boards and panel boards shall have a minimum utilisation category at 400 Volt of AC 22 A in accordance with BS EN 60947-3.
- (e) Load break switches and isolators shall generally switch all poles. Where switched neutrals are specified, the neutral shall be arranged to make first and break last.
- (f) Visual on/off indicators shall be provided on all load break switches and isolators.
- (g) Load break switches and isolators shall be lockable in the off position.

F706000 FUSED CONNECTION UNITS

- (a) Fused Connection units shall comply with BS 1363.
- (b) Fused Connection Units shall, where specified, be switched and shall contain a fuse of the appropriate rating for the appliance served.
- (c) Switches shall be double pole.
- (d) Where specified, the fused connection unit, shall incorporate an integral illuminated indicator.
- (e) Where located adjacent to the item of fixed equipment that they supply the fused connection unit may be fitted with a flex outlet with integral cord grip. The Fire Protection Systems installer shall provide a suitably rated flexible cord from the fused connection unit and make the final connection to the item of equipment.
- (f) Where remote from the equipment being served a separate flex outlet plate complying with BS 5733, with fixed base connectors shall be provided adjacent to the item of equipment. The Fire Protection Systems installer shall provide a hard wired connection between the fused connection unit and flex outlet plate in conduit and make the final connection to the item of equipment in a suitably rated flexible cord.
- (g) Connection units shall be engraved with the name of the appliance served and shall be connected into ring circuits wherever possible.

F706200 ELECTRICAL SUPPLIES TO FIRE ALARM EQUIPMENT

- (a) Electrical supplies to fire alarm panels, voice evacuation amplifier racks, emergency voice communication master stations and sprinkler panels etc. Shall be carried out as individual radial circuits and terminate in a double pole key switch complying with BS EN 60699-1 in accordance with BS 5839-1 located adjacent to the item of plant.

- (b) Keys shall be suited throughout the building allowing a single key to operate any of the devices but only these devices.
- (c) The key utilised for the fire alarm system switches shall be of a different type to any others provided at the site.

F706300 MULTI POLE ISOLATION SWITCHES

- (a) Where specified fixed equipment shall be supplied via radial circuits and provided with local multi pole isolators of the specified rating complying with BS EN 60699-1.
- (b) Isolation switches shall be rated to suit the equipment they supply and the protective device at their source.
- (c) Where specified isolators shall be provided with an integral illuminated indicator.
- (d) Where located adjacent to the item of fixed equipment that they supply the isolator may be fitted with a flex outlet with integral cord grip. The Fire Protection Systems installer shall provide a suitably rated flexible cord from the fused connection unit and make the final connection to the item of equipment.
- (e) Where remote from the equipment being served a separate flex outlet plate complying with BS 5733, with fixed base connectors shall be provided adjacent to the item of equipment. The Fire Protection Systems installer shall provide a hard wired connection between the isolator and flex outlet plate in conduit and make the final connection to the item of equipment in a suitably rated flexible cord.

F706600 RCD PROTECTED SOCKET OUTLETS (EXTERNAL USE)

- (a) Where specified BS 1363 socket outlets incorporating an integral residual current device shall be provided complying with BS 7288 shall be supplied and installed in an IP 56 enclosure conforming to BS EN 60529.
- (b) The trip device shall be rated at 30 mA and shall be fitted with mechanical test buttons and separate reset button.
- (c) Socket Outlets shall be either single or two gang as indicated on the drawings.
- (d) The residual current device shall not, unless otherwise specified, be sensitive to voltage fluctuations and dips and shall remain closed in the event of loss of supply.

F707200 EARTHING

F707201 Methods of Earthing

- (a) Any metal work exposed in an electrical system including exposed metal work in fittings, shall be connected to earth to ensure at all times an immediate discharge of electrical energy without endangering personnel or equipment. Earthing shall be in accordance with BS 7671 and BS 7430. Should there be any conflict between these standards then the former shall take precedence.
- (b) Exposed or extraneous metalwork shall be connected to earth via one or more of the following methods:
 - i) The metallic sheath of the supply cables
 - ii) An earth continuity conductor carried in the cable

- iii) Metallic conduit, trunking or duct containing the wiring
- iv) A special conductor or tape run to a suitable earth point
- v) A separate earth wire enclosed in conduit or trunking

F707204 Earthing and Bonding General

- (a) Copper earthing leads, bonding leads and circuit protective conductors, unless otherwise specified herein, shall be sized in accordance with BS 7671.
- (b) Circuit protective and bonding conductors, other than copper tape or where contained in a composite cable or flexible cord, shall be protected by LSOH or heat resisting insulation as appropriate, identified as detailed in regulation 514.3.1 of BS 7671. Copper earthing or bonding tape run under floors, in ducts, or damp situations shall be LSF sheathed.
- (c) Copper earthing tapes, bare or LSOH sheathed, shall be fixed by means of a single hole fixing gun metal "Holdfast" type saddle of a correct size to hold the tape firmly at intervals not greater than 600 mm.
- (d) The armouring of LSOH sheathed cables shall terminate in a suitable compression gland fitted with a purpose made earth tag. A suitable protective conductor shall connect the earth tag with the apparatus earthing terminal. The earth tag shall be manufactured from a high conductivity material compatible with the cable gland.
- (e) Connections between earth bars, equipment frames etc. and stranded copper cables shall be made with the appropriate compression lug, bolt, washers, nut and lock nut. Contact surfaces shall be thoroughly cleaned and tinned prior to connection. The ends of every earth continuity conductor, whether stranded or solid, shall be connected with spring washers and lock nuts, pinching screws or to pipes with a clamp.
- (f) Bonding connections to gas or water services shall be made as near as practicable to the point of entry of those services into the building. Should there be any insulated section in the service run, the connection shall be made to the metalwork on the building premises side of the insulated section. These bonding connections shall be made with the appropriate pipe clamps and precautions shall be taken to avoid damage to these pipes.
- (g) A label complying with BS 7671 and embossed with the words **SAFETY ELECTRICAL EARTH - DO NOT REMOVE**, shall be permanently fixed at the main earth terminal and the bonding connection of all incoming services.
- (h) The earth continuity of metal conduits, metal trunking and metal sheathing and armouring of cables shall be maintained by efficient bonding between the conduit, trunking, cable sheath, armouring or gland and the metal case of the main switch fuse, distribution board or other metal clad accessory or appliance at which they terminate. Where the length of armoured cable is excessive, additional earth connections shall be made to provide an earth loop impedance within the value allowed for the protective device. Metal fittings, accessories, enclosures and cable tray shall be efficiently earthed.
- (i) For PVC conduit installations and for LSOH insulated, LSOH sheathed wiring systems circuit protective conductors shall be run to lighting points, switches, socket outlets and other accessories. For ring circuits the earth continuity conductor shall also be connected in the form of a ring.

- (j) Each conduit installation shall be electrically continuous throughout, forming completely bonded systems. Every complete final circuit earth loop impedance comprising conduits, cable sheaths, core conductors and transformer windings shall be tested.

F707207 Earth Continuity Tests

- (a) The electrical installation earthing system shall be subject to earth loop impedance tests in accordance with BS 7671: Part 6. Tests shall be carried out on all systems, plant and equipment. Earthing systems shall be re-tested thirty days prior to the end of the Defects Liability period. The Engineer shall be given at least seven working days' notice of the visit to site to carry out the tests.
- (b) Tests shall be carried out on all socket outlets.
- (c) All Miscellaneous plant, machinery and equipment shall be tested for earth fault loop impedance.
- (d) Equipotential bonding to extraneous metal work shall be visually inspected and tested for earth fault loop impedance.
- (e) Faults discovered during the tests shall be corrected.

F707210 Supplementary Bonding of Metalwork

- (a) Conductive parts simultaneously accessible to other conductive parts shall be bonded to ensure that in the event of an earth fault, the voltages between all simultaneously accessible parts are of such magnitude and duration as not to cause danger. The requirements shall include consideration of portable appliances connected from socket outlets.
- (b) Where necessary, supplementary equipotential bonding shall be provided. In areas where the system of wiring is concealed, the supplementary bonding conductor shall also be concealed up to the point of termination.
- (c) Tests shall be carried out during construction to ensure that where supplementary bonding conductors are required, they can be installed within the construction programme and without the need to disturb finishes.
- (d) Consideration shall be given to the necessity of bonding to metallic hand rails and window frames.

F75 INSULATION

F750100 GENERAL REQUIREMENTS

- (a) This Section of the Specification sets out the standards, methods and processes to be adopted for the supply and installation of thermal insulation and shall be read in conjunction with each and every other relevant section of the Specification.
- (b) Adequate precautions shall be taken against any hazard to health involved in the use of any solvent, cleaner or material in connection with insulation and the manufacturer of any such materials shall be consulted about safe handling of his products.

F750400 WORKMANSHIP

- (a) Thermal insulation shall not be commenced until the Engineer has witnessed the pressure tests for all sections of the various systems.
- (b) A firm of repute shall carry out insulation work, as specialists employed by the Fire Protection Services Installer, the latter remaining responsible for the quality of material and workmanship. The Engineer will neither accept poor quality nor badly finished work, nor irregularities in the thickness of the insulating material or in any covering. All work is to be left smooth, clean and properly finished. Materials shall be of reputable manufacture and in accordance with the relevant British Standard Specifications.
- (c) Samples of insulating materials and finishes together with their Manufacturer's Technical Data, suitably highlighted shall be submitted to the Engineer. Samples submitted may be sent to the National Physical Laboratory for a report at the discretion of the Engineer. Work undertaken without agreement to the samples may be rejected by the Engineer and, if so rejected, shall be removed and replaced.
- (d) The Engineer may ask for a test of thermal conductivity of a sample of one or more materials removed from the Works. This test may be carried out at the Manufacturer's works or at the National Physical Laboratory at the Engineer's option. Should the tests show that the thermal conductivity is not appropriate to the thickness required the Engineer may require the insulation to be removed and replaced with material of the proper thermal conductivity.
- (e) The Engineer may test for thickness of applied insulating material by means of a probe. If the test shows that insufficient insulating material has been applied, the Engineer may call for additional material to be applied to bring up the thickness to that required.

F750700 INSULATION MATERIALS

- (f) Insulation materials shall be non-corrosive to ferrous and non-ferrous metals. They shall be fire resistant and non-combustible, resistant to water ingress, sterile, free from odour and offer no sustenance to vermin.
- (g) Materials shall be resistant to settlement. They shall be easily cut and fitted to shape during installation and shall be resistant to damage or alternatively provided with suitable and adequate protection.

- (h) Thermal insulation shall comprise one of the following materials as described elsewhere in this Specification:
 - i) Mineral (Rock) Wool
 - ii) Phenolic foam will not be permitted on pipework installations
- (i) Under no circumstances shall any insulation material requiring the use of CFC's or HCFCs in its manufacture or containing asbestos be used. Thermal conductivity values shall be determined in accordance with BS EN ISO 8990.
- (j) All insulation materials shall have a Global Warming Potential (GWP) of less than 5 and an Ozone Depletion Potential of zero.
- (k) 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.
- (l) Pre-formed mineral wool insulation shall be manufactured from mineral wool based on rock bonded into a rigid form with heat resistant resin in accordance with BS 3958: Part 4 or Part 5 as appropriate with the following properties:
 - i) Nominal density of not less than 85 kg/m³ for pipework insulation applied to systems up to 100 °C. For system temperatures above 100 °C the nominal density shall be not less than 120 kg/m³. Thermal Conductivity shall not be greater than 0.044 W/mK at a mean temperature of 100 °C. Pipework insulation shall have an A Rating in the BRE Green Guide to Specification, except for system temperatures above 100 °C, where it shall be B Rated.
 - ii) Pre-formed mineral wool insulation shall have a factory applied facing that is a laminate of close mesh reinforcement between two layers of foil, including an integral lap for fixing, complying with BS 5422 and BS 5970 water permeance and Building Regulations Class O definition.
- (m) Thermal insulating materials shall have a Euroclass of either A1, A2 or B, shall have a FIGRA RCT of less than 1.0 and shall not have a potential to flashover. The thermal conductivity value of the insulation must also be quoted, both manufactured and aged.
- (n) Adhesives where required shall be non-inflammable and shall be compatible with the insulation. In no circumstances shall an adhesive or solvent, which attacks or dissolves the pipework, the insulation, be used.

F751000 INSULATION APPLICATION

F751001 General

- (a) Only skilled operatives, under close supervision shall carry out application by the insulation specialist firm. Insulation, which is incorrectly applied or damaged, shall be replaced.
- (b) Before application of insulation surfaces shall be thoroughly cleaned. Ferrous surfaces where not galvanised shall be treated with a corrosion inhibiting paint. Surfaces shall be dry before application of the insulation.

- (c) The insulation material shall be applied in the sequence and thicknesses specified with adequate time for drying out where appropriate. Joints shall be close butted or overlapped. They shall be staggered and sealed.
- (d) Support and reinforcement of the insulation and finishes shall be incorporated to ensure that there is no sag and that the insulation is securely attached in close contact with the surface. Cut ends of insulation shall be capped with aluminium of a substantial gauge, correctly fitted to provide an end seal.
- (e) Finishing coats shall be properly finished smooth, neat and straight and, unless inherently impermeable, shall be sealed before painting.
- (f) Painting of insulation where required shall be carried out by a specialist painter employed by the Fire Protection Services Installer, unless otherwise specified elsewhere. Identification of pipework as described elsewhere in this Specification shall be carried out by the Fire Protection Services Installer.
- (g) Pipework shall be erected such that supports and hangers are clear of the insulation. Vapour sealed insulation must have the vapour seal restored to provide an unbroken seal.

F751004 Mineral (Rock) Wool

- (a) Precautions shall be taken to ensure that, during installation of mineral wool insulation materials, persons applying the material or within the building are not subjected to maximum exposure limits in excess of those in the current COSHH Regulations. When requested, a Material Safety-Data sheet shall be made available to assist in the preparation of risk assessments, as required by the Control of Substances Hazardous to Health Regulations (COSHH).
- (b) All insulation materials shall comply with current HSE "CHIP" Regulations and EU directive 97/69/EC.

F751300 INSULATION OF PIPEWORK

- (a) Where considered at risk pipework shall be insulated against the risk of freezing. Where necessary such insulation shall be carried out after trace heating has been applied.
- (b) Where valves, strainers and the like are installed in the pipework system including control valves, regulating valves and isolating valves, these shall also be insulated and vapour sealed to the same integrity as the pipework system.
- (c) Insulation shall be tapered and stopped off at all flanges, unions, valves and the like, which shall then be fitted with shaped and formed boxes as required. The boxes shall be fitted with quick release toggle clips for easy removal and shall be lined with the same material and to the same thickness as the adjacent pipework. The insulation shall terminate short of the fitting to allow for bolt withdrawal and the boxes shall extend over the pipework insulation and finish. Samples of boxes shall be submitted for comment prior to manufacture.

- (d) Thermal insulation on pipework shall comply with BS 5970. It shall comprise properly formed sections securely fixed in close contact with the pipework. Pipes shall not be insulated together. Pipework insulation requiring a vapour seal shall incorporate treated hardwood block rings within the support detail to match the insulation thickness.

F751600 INSULATION THICKNESSES

F751601 General

- (a) The minimum thickness of sectional insulation shall be determined as listed in the subsequent parts of this Clause, unless otherwise amended to suit specific conditions described elsewhere in the Specification. Where the Engineer agrees alternative materials, in writing, minimum thickness' shall comply with the appropriate Table from BS 5422.
- (b) Packaged and other equipment supplied, as pre-insulated units shall, as a minimum, be provided with the thickness of insulation listed in the appropriate Table of BS 5422.

F751604 Protection Against Freezing

- (a) Water pipework located externally or in uninsulated areas liable to freezing shall be insulated to the following minimum thickness:

NOMINAL DIAMETER (MM)		INSULATION THICKNESS (MM)	
Steel	Copper	Glass or mineral fibre	
		External	Internal
15	Up to 22	60	60
20	28	30	25
25	35	25	25
32	42	25	25
40	54	25	25
50	67	25	25
65	76	30	25
80	108	30	25
100		30	25
150		40	25
Larger sizes & flat surfaces		40	25

- (b) The above requirements for insulation thickness shall be provide whether the system incorporates trace heating or not.

F751900 VAPOUR SEALS

- (a) Vapour seals forming complete and effective vapour barriers shall be applied to all pipework carrying, cold water services. They shall also be applied to all other surfaces liable to condensation.

- (b) Vapour barriers incorporating glass cloth shall be wet applied of the cut back bitumen type, bitumen emulsion with or without elastomer latex and solvent based polymers. They shall conform to the recommendations as set out in Table 1 of BS 5422. Glass cloth shall be of the open weave type numbers 10 or 20 and shall have a minimum weight of 70 gm/m.
- (c) Class 'O' finish, integral with sectional, slab or mattress insulation shall comprise a bright glass reinforced aluminium foil, with easy clean surface.
- (d) Lap joints shall be sealed with a suitable adhesive and butt joints sealed with 100 mm wide matching tape. Bends shall be mitred and sealed with adhesive and matching tape. Exposed ends of insulation shall be sealed to preserve the integrity of the vapour barrier. Bends and elbows shall be coated with two coats of vapour seal.
- (e) Vapour barriers shall also be provided between sections of insulation at intervals of not greater than 4 metres to prevent moisture migrating along the insulation in the event of perforation of the vapour barrier.
- (f) Pipe support blocks shall extend a minimum of 25 mm either side of the pipe bracket and insulation shall butt neatly against the block. A vapour seal comprising 0.8 mm thick aluminium sheet shall be incorporated into the bracket and fitted before the bracket is bolted up. The joint shall be neatly taped to the bracket vapour seal to provide a continuous vapour seal.

F752200 FINISHES

F752201 General

- (a) Finishes shall be applied to insulation as described elsewhere in this Specification for the particular service and its location. Such finishes shall be in addition to any vapour seal or waterproofing requirements.

F752204 Hammerclad Aluminium

- (a) Rigid section insulation shall be securely attached. The insulation shall then be clad with Hammerclad aluminium sheet having a minimum thickness of 0.8 mm secured by rivets, PK screws or bands.
- (b) On vapour sealed pipework PK screws shall not be used. On straight pipework bands at 300 mm centres shall secure the finish. The finish on bends, elbows and the like shall be secured by self-sealing pop rivets protected internally to prevent damage to the vapour seal or by banding where appropriate.
- (c) Valves, flanges, etc. on vapour sealed systems shall be packed around with Densofil before being fitted with boxes.
- (d) Where installed outdoors the sheet shall have 50 mm overlaps arranged to shed water. All joints shall be sealed with gun applied silicone mastic.

F752207 Petrochem Aluzink

- (a) Rigid section insulation shall be securely attached before cladding with Petrochem Aluzink sheet having a minimum thickness of 0.5 mm secured by stainless steel rivets, or bands.

- (b) On straight pipework bands at 300 mm centres shall secure the finish. The finish on bends, elbows and the like shall be secured by self-sealing stainless steel pop rivets protected internally to prevent damage to the vapour seal.
- (c) Valves, flanges, etc. on vapour sealed systems shall be packed around with Densofil before being fitted with Petrochem Aluzink boxes. The boxes shall be manufactured from Aluzink flat sheet of 0.5 mm minimum thickness.
- (d) Where installed outdoors the sheet shall have 50 mm overlaps arranged to shed water. All joints shall be sealed with gun applied silicone mastic.

F752210 PVC Sheet

- (a) Rigid Section Insulation shall be securely attached. The insulation shall then be clad with PVC sheet having a minimum thickness of 0.35 mm.
- (b) The sheet shall conform to the requirements of BS 476: Part 7, Class 1 with surface of very low flame spread. Sheets shall be secured by nylon rivets or solvent.
- (c) Fittings shall be finished using pre-formed sections of sheeting.
- (d) Where installed outdoors the sheet shall have 50 mm overlaps arranged to shed water. All joints shall be sealed with gun applied silicone mastic.

F752213 Class 'O' Finish

- (a) Insulation sections shall be provided with a Class 'O' facing.
- (b) All lap joints shall be sealed with a suitable adhesive and butt joints sealed with 100 mm wide matching tape. Bends, fittings, flanges and pipework clips shall be neatly cut on site and finished to match adjacent pipework. Three aluminium bands per section shall additionally support the insulation.

F752216 Waterproof

- (a) Insulation shall be applied as rigid sections and shall be securely attached as previously described.
- (b) The insulation shall then be covered with two layers of polyisobutylene sheet not less than 0.8 mm thick and with a minimum tensile strength of 3.4 MN/m. The inner layer shall be bonded to the insulation using the manufacturers contact adhesive. All laps shall be secured with the manufacturer's recommended solvent adhesive. Any opening in the sheet shall be sealed around with the recommended sealant. The outer layer shall be bonded to the inner layer using the manufacturers solvent adhesive.
- (c) Valves and flanges shall be insulated by using oversized sections and finally wrapping with polyisobutylene sheet. Removable Hammerclad aluminium valve boxes shall then be fitted.
- (d) Laps of sheeting shall be at least 75 mm for lateral joints and 50 mm for circumferential joints. All laps shall be arranged to assist water shedding.
- (e) Where the weatherproof insulation is exposed to possible damage a 1.00 mm thickness galvanised metal cover shall be fitted and secured with pop rivets, such pop riveting carried out so as not to cause any damage to the weatherproof membrane.

- (f) Where any of the other finishes, as described earlier, is to be applied over the waterproof covering, particular care shall be taken to ensure that the fixings do not penetrate the waterproofing.

F90 INSPECTION, TESTING AND COMMISSIONING

F900100 GENERAL

- (a) The entire Works shall be inspected, tested and commissioned in accordance with all relevant British Standard Specifications and Codes of Practice together with and the details given in this Specification to the entire satisfaction of the Engineer.
- (b) Installations shall be inspected and tested in sections as the work proceeds and test certificates issued accordingly. The Engineer or an Insurance Company may require inspecting or testing of any equipment during manufacture
- (c) No section of the Works shall be insulated or in any other way concealed prior to testing and inspection. Subsequent concealment, where applicable, shall only take place following written authority from the Engineer.
- (d) System commissioning shall be undertaken by an experienced commissioning engineer. The specialist shall be advised to the Engineer at the time of Tender for agreement to their suitability. The specialist shall produce a comprehensive report on all systems.

F900400 INSPECTIONS AND WITNESSING BY THE ENGINEER

- (a) The Engineer will undertake site inspections to specific areas only, for quality and specification compliance, which shall then be used as a benchmark for other similar areas. Other areas shall be installed to the agreed benchmark standard, inspected by the Contractor and signed off as ready for final inspection. The Contractor shall provide certification to show an area has been inspected and is in compliance with the benchmark before being offered to the Engineer for final inspection. Final inspections will form the Defects Inspection for Practical Completion.
- (b) The Engineer will carry out sample witnessing, where required, only after the submission of documentation demonstrating that testing and commissioning has been successfully completed and witnessed by the Contractor or Specialist Commissioning Manager. The extent of sample witnessing shall be at the discretion of the Engineer.

F900700 ATTENDANCE

- (a) Tests shall be arranged in co-operation with the Fire Protection Services Installer and Engineer who shall be given five working days' notice in writing of the time, location and nature of the test to be performed. No test shall be considered valid unless the Engineer or his appointed representative is present.
- (b) All necessary skilled and unskilled labour shall be provided for attendance duties during testing and commissioning, including pre- and post-test activities. Test media shall be provided and subsequently disposed of except where specifically stated otherwise. Fuel, water, electricity, gas and other consumables required for testing and commissioning shall be provided by the Fire Protection Services Installer. All fuel tanks, lubrication systems and the like shall be left fully charged at Practical Completion. Batteries shall be left in a fully charged condition.

- (c) Representatives present during inspection and testing shall be fully conversant with the system concerned and the method of system and instrument operation. Manufacturers or specialist's representatives shall attend where indicated elsewhere in the Specification or where necessary to ensure that the Works are tested and commissioned in accordance with the requirements of the specification.
- (d) Equipment with electrical supplies shall be certified ready for use.
- (e) The commissioning engineer shall attend site regularly during the month prior to commencing work in order to fully familiarise himself with the Works, to monitor the progress of the installation and to ensure that all test points, commissioning valves and other facilities required for commissioning are correctly installed.

F901000 TEST EQUIPMENT

- (a) All necessary facilities, measuring and recording instruments including test pumps and gauges for inspection or testing purposes shall be provided and shall be checked or calibrated by the Fire Protection Services Installer as necessary before use. The Engineer reserves the right to call for a demonstration of the accuracy of any instruments provided.
- (b) Test points necessary to carry out the specified test and commissioning requirements shall be provided including facilities for temperature, pressure, pressure drop, volume flow, velocity, or other relevant conditions to be measured. Such points shall be fitted with removable plugs, flanges or other devices appropriate to the service concerned. Permanent test or reading points shall be provided only where specified elsewhere.

F901300 TEST CERTIFICATES

- (a) Duplicate signed test certificates shall be provided. Test certificates shall identify the Fire Protection Services Installer, the Project name and the date of test. They shall list the apparatus or section under test, makers number (if any), the nature, duration and conditions of test. The certificate shall include details of the test instrument including serial number and the details of its calibration certificate. The result of the test shall be declared and the certificate signed by the person conducting the test.
- (b) Where a test has been independently verified, the witness shall countersign the certificate. The name of the company represented by the witness shall be added.
- (c) No test shall be valid until the test certificate is provided.

F901600 FAILURE OF TEST

- (a) Any defects occurring at any time during the test duration shall be made good and a complete re-test carried out.
- (b) Where failure during a test, inspection or commissioning process results in damage to the building fabric to any services not provided as part of this Contract, or requires subsequent builders work in connection to be carried out, then the remedial works shall be the responsibility of the Fire Protection Services Installer.
- (c) Leakages shall be repaired by properly remaking or replacing the defective component. Caulking will not be permitted.

F902200 WORKS TESTS

- (a) The Engineer will be entitled, at all reasonable times during the manufacture, to inspect, examine and test equipment to be provided. The Engineer shall inform the Fire Protection Services Installer which equipment is to be inspected or tested at works.
- (b) The Fire Protection Services Installer shall give the Engineer written notice of the date and place at which such equipment will be ready, at least 10 working days before such date. The Fire Protection Services Installer will be responsible for any costs arising from witnessing the works tests.
- (c) Such inspection, examination or testing shall not release the Fire Protection Services Installer from any obligation under the Contract.

F902500 EQUIPMENT OUTPUT TESTS

- (a) Equipment, which has a specified output or throughput, shall be tested and the recorded output or throughput, method of calculation and relevant test conditions indicated on test certificates.
- (b) Where a British Standard has been published, tests shall comply with the Standard.

F902800 SPECIALIST PLANT

- (a) The Fire Protection Services Installer shall be responsible for manufacturers attending site to carry out specialist commissioning of plant items and controls.
- (b) Where described elsewhere in this Specification particular items of plant shall be tested and commissioned in accordance with their relevant clauses.

F903100 COMMISSIONING INSTRUMENTS

- (a) Instruments for testing shall be provided including the following:
 - i) Ammeter
 - ii) Tachometer
 - iii) Pressure pump sets and gauges
 - iv) Flow meter

F904300 COMMISSIONING RESULTS

- (a) On completion of each section of work the results shall be typed in schedule form and submitted to the Engineer for comment. Following comment by the Engineer the tabulated commissioning results shall be incorporated into the Fire Protection Services maintenance manuals.

F91 TECHNICAL SUBMITTALS

F910100 TECHNICAL SUBMITTALS

- (a) Technical submittals which do not comply with the following requirements will be rejected.
- (b) Technical submittals must be specific for the project. Standard literature and extracts from manufacturers catalogues will not be acceptable.
- (c) Technical submittals shall be submitted for each item of equipment and system components proposed prior to placement of orders. Submittals shall be issued to the Engineer allowing a minimum of 10 working days for comment by the Engineer (unless otherwise agreed), and giving adequate time for comments to be incorporated before equipment orders need to be placed. The issue dates and commenting periods for all technical submittals shall be scheduled by the Fire Protection Services Installer and agreed with the Engineer at the commencement of the contract. Once agreed, this schedule shall be updated by the Fire Protection Services installer to reflect any changes in programme. Technical submittals issued not in accordance with the agreed date schedule may take longer to return.
- (d) The first page of each technical submittal must contain a specific compliance statement confirming that equipment is fully in compliance with the specification, or if not, stating which clauses are not being complied with and in what specific regard. Any variations from the specified requirements must be clearly and specifically stated on this first page submittal. General comments regarding compliance will not be acceptable.
- (e) Technical submittals shall include an assessment of the impact on the design resulting from the equipment proposed, including the impact of any non-compliance to the required specification.
- (f) The Technical Submittals for each item of equipment shall include the following information as a minimum:
 - i) Confirmation of all data contained within the technical schedules which form part of this specification
 - ii) All data identified in the technical schedules as 'to be confirmed by the manufacturer' specified design conditions, the actual conditions achieved by the proposed equipment and the performance of the equipment at the specified design conditions
 - iii) Manufacturer's specifications and data sheets for the equipment proposed
 - iv) Performance curves and noise data
 - v) Confirmation of any details which may potentially impact on the Building Regulations Part L compliance, such as fan, pump and motor powers, pressure drops, SFP's, plant efficiencies, etc.
 - vi) Type test certification where requested elsewhere within this specification
- (g) Technical Submittals will be reviewed using the following notation:

- i) A - No comments. Fabrication, manufacture, procurement or installation can proceed
 - ii) B - Fabrication, manufacture, procurement or installation can proceed provided any comments are incorporated into the works. If the Fire Protection Services Installer cannot incorporate all comments, the submission is to be amended and re-submitted
 - iii) C - The submission is rejected for the reasons noted and is to be re-submitted
- (h) Technical Submissions will be reviewed for compliance with the design intent and any comments made do not relieve the Fire Protection Services Installer of his obligations under the Contract to coordinate the works and comply with the Contract Documents in all respects unless specifically agreed otherwise.
- (i) Technical submittals are expected to achieve A Status within two submittals. Multiple submittals for the same item as a result of not achieving the requisite standard, or failing to address previous Engineers comments may attract a charge levied to the submitting party for the additional time spent reviewing non-compliant submissions.

F92 DESIGN AND CONSTRUCTION DOCUMENTATION

F920100 CONCEPT DRAWINGS

- (a) The Concept Drawings are prepared by the Engineer to show the general arrangement of the plant, equipment and services which form the intended Contract. The drawings are prepared in sufficient detail to, in conjunction with the Specification, allow competitive Tenders to be submitted.
- (b) The Fire Protection Services Installer shall be responsible for interpreting the drawings, making due allowance for offsets to avoid the building structure or other services, whether indicated or not. The Fire Protection Services Installer shall take all necessary steps to fully acquaint himself with the nature and extent of the works by visiting the site and inspecting the architectural, structural and other services drawings.
- (c) The Fire Protection Services Installer shall be responsible for the preparation of Design and Working Drawings and for full compliance with BS 8489 and other regulations in terms of the quantity, type and location of watermist heads and equipment.
- (d) No claim for loss or expense due to the above factors will be considered.

F920400 CONTRACT DRAWINGS

- (a) The Contract drawings are issued by the Engineer when the Contract is placed. They will comprise the Concept drawings as described, modified to include any variation to the Contract since the issue of the Concept Drawings.
- (b) Variations to the Contract, requiring the further drawing or information will be carried out by the Engineer issuing updated copies of the Contract Drawings or supplementary sketch drawings until such times as the working drawings are available for marking up or in such other manner as the Engineer decides.

F920700 DIGITAL DATA

- (a) A digital copy of the Engineers drawings (in 2D or 3D Format) may be made available to the Fire Protection Services Installer to assist in the preparation of the Installers working drawings should a request for the information be made to the Engineer in writing. Drawings will be issued in the current version of AutoCAD or in DXF format as required.
- (b) The Fire Protection Services Installer shall be solely responsible for the modification of the digital information to provide the installation drawings as required by this specification. The modified drawings shall accurately reflect the equipment and installation proposed by the Fire Protection Services Installer as if the drawings had been drawn without the benefit of the digital data. They shall also take account of the most recent Architectural and Structural information. The Fire Protection Services Installer's particular attention is drawn to the following conditions which apply to the use of any digital information provided by the Engineer:
 - i) Any 3D Digital models made available to the Fire Protection Services Installer are provided for information only unless explicitly stated otherwise

- ii) It is an express condition of the contract under which data is supplied that the Fire Protection Services Installer is responsible for satisfying himself regarding its accuracy, correctness and completeness. The drawings and data have not specifically been prepared for use by the Fire Protection Services Installer and may not fully reflect his needs
- iii) The Engineer accepts no liability or responsibility whatsoever for any loss or damage suffered by the recipient arising out of or in connection with the use or misuse of this digital data
- iv) While all reasonable steps have been taken to ensure that the digital data is free from computer viruses, the Engineer cannot be held responsible for any damage or loss that might subsequently occur from their presence
- v) The copyright of the digital data belongs to the Engineer. Measurements taken from information which is not dimensioned are at the Fire Protection Services Installers own risk

F921000 3D AND BIM DIGITAL MODELS

- (a) Where the design has been carried out in 3D, the 3D Digital Model will be issued to the Fire Protection Services Installer on the understanding that it is a Design Stage Model and is being issued for information only. This Design Stage Model may be used by the Fire Protection Services Installer in order to develop his Installation Model and 3D Coordinated Services Drawings.
- (b) The 3D Digital Design Stage Model will contain privileged data and shall only be used by the Fire Protection Services Installer (or any other recipients) solely in connection with the project for which it is issued. Any use of the data or content of the Model beyond this purpose is expressly forbidden.
- (c) The Tender Drawings will have been produced from the 3D Design Stage Model and shall form the basis of the Contract but shall be read in conjunction with the 3D Model.
- (d) Should there be an apparent discrepancy between the Drawings and the Model, the discrepancy is to be brought to the Engineers attention and clarification sought. In the absence of clarification, the information indicated on the Drawing shall prevail.
- (e) Where equipment metadata, technical schedules or specification data are contained within the 3D Model, they will follow the format and protocols outlined in the BIM Execution Plan.
- (f) Where manufacturer's specific content is included within a Digital Model, this is provided to illustrate the design intent only and not to indicate or infer this manufacturer is to be used. Manufacturers shall be selected from the Schedule of Acceptable Manufactures as included in this specification shall be used in the construction of the Works.
- (g) Any further development of the 3D Model shall follow the same protocols as set out in the BIM Execution Plan.
- (h) Where specified within the Contract, the Fire Protection Services Installer shall further develop the Installation Model to produce an Asset Information Model (AIM) which can be used for the future operation and maintenance of the engineering services assets by the building operators.

- (i) Only data and information relevant to the future operation and management of the building shall be incorporated into the AIM Model. The extent and format of information in the AIM Model shall be as set out by the Client and in accordance with the protocols set up for the project.

F921300 MANUFACTURERS DRAWINGS

- (a) Four copies of manufacturer's drawings and details of all plant and equipment shall be forwarded to the Engineer for comment. Drawings and details shall be certified by the Manufacturer as being applicable to the particular items being supplied.
- (b) Drawings shall include general layouts and assembly drawings, details of materials and construction, methods of support and fixing and electrical wiring diagrams. The information shall be in sufficient detail to allow the Engineer to comment. Where particular requirements for drawings are listed in the appropriate clauses for equipment or systems then these shall also be provided.

F921600 DESIGN AND WORKING DRAWINGS

- (a) The Fire Protection Services Installer shall produce fully detailed and dimensioned design and working drawings of each service to be installed, including all purpose made plant and equipment. The location of all plant, equipment and services shall be fully dimensioned from each other, from other work and from the building structure.
- (b) The Fire Protection Services Installer shall ensure that all services, including those provided by others, are fully co-ordinated with each other and with the building structure and finishes, including obtaining the necessary information from others and for the indication of the service routes for all trades on composite drawings.
- (c) Design and working drawings shall include fully dimensioned details and positions of supports and fixings. They shall clearly define the detail and arrangement of installed equipment and systems including access allowances for service and maintenance. Where plant is to be supported on steelwork, the Fire Protection Services Installer shall provide setting out dimensions for the steelwork and fixing details of the particular plant to be supported. Weights of plant items with point loads shall be provided.
- (d) Design and working drawings shall be produced in accordance with a programme which is to be agreed with the Employer to suit the overall programme for the Works. Reasonable allowance shall be made for incorporating any comments made by the Engineer.
- (e) The design and working drawings shall include the following fully co-ordinated drawings, in addition to any separate trades drawings which may be required:

	Area	Minimum Scale
i)	Floor Layouts	1:50
ii)	Ceiling Layouts	1:50
iii)	Plant Room Layouts and Sections	1:20
iv)	Roof Plant Layouts and Steelwork Layouts	1:20
v)	Riser Shafts and Service Voids Layouts	1:20

- | | | |
|-------|-------------------------------------|-------------|
| vi) | Services Layouts in Congested Areas | 1:20 |
| vii) | Schematic Diagrams of each Service | |
| viii) | Controls Schematics | |
| ix) | Details | As required |
- (f) Plant and equipment shall be shown in outline with positions of connections and access space clearly shown including space for withdrawal of internal parts. On 1:50 scale drawings pipework, or electrical distribution equal to or larger than 100 mm shall be shown to scale in double line. Circular distribution shall also have the centre line shown. 1:20 and larger scale drawings shall be similarly detailed, except that distribution equal to or larger than 40 mm shall be shown to scale in double line. Where appropriate the thickness of insulation shall also be shown on 1:20 or larger scale drawings.
- (g) Dimensions shall be clearly shown to locate plant, equipment and distribution from the building structure or fabric and from each other. Inverts or levels above datum shall be shown for all distribution services.
- (h) Drawings shall be produced to a scale suitable for the application but at least to the scale listed above. Only recognized metric scales shall be used. Drawings shall be presented on A1 or A0 sheets as appropriate. A3 or A4 drawings may be used for specific component details such as typical brackets with the agreement of the Engineer. Drawings shall be produced using CAD software.
- (i) All drawings shall conform to the requirements of BS 8489.

F921900 WIRING DIAGRAMS

- (a) The Fire Protection Services Installer shall produce fully detailed wiring diagrams of all electrical work. The diagrams shall include the following:
- | | |
|------|---|
| i) | Control Wiring Layouts |
| ii) | Power Wiring Layouts |
| iii) | Switchgear and Panel Wiring Diagrams |
| iv) | Wiring Diagrams for Fire Alarm Systems, Specialist and Ancillary Services |
- (b) Wiring diagrams shall generally be presented on A1 size sheets. Computer generated diagrams on A3 or A4 sheets may alternatively be produced, provided the information is clearly legible. Where diagrams have to be produced on more than one sheet then information shall be grouped as far as possible to minimise cross-referencing between sheets. Diagrams which, due to non-compliance with the above are difficult to read shall be rejected by the Engineer.
- (c) Wiring diagrams shall clearly indicate the extent of the wiring system, including numbers and sizes of cables with loadings, layouts of cable trays, trunking and conduits and locations of all equipment requiring electrical connection.
- (d) The drawings shall fully detail the requirements and location of points of connection.

F922200 BUILDERS WORK DRAWINGS

- (a) In addition to the working drawings of the engineering services, the Fire Protection Services Installer shall be required to produce drawings indicating builders work requirements in connection with the services. These drawings shall include details of penetrations through the structure, builders work supports and bases. Full details of access requirements for commissioning, servicing and maintenance through suspended ceilings and floors, together with access to riser ducts and the like shall also be provided.
- (b) The drawings shall only be prepared after the working drawings have been finally agreed with the Engineer and shall be based on the detail of these working drawings. The drawing production programme shall take this fully into account.
- (c) Builders work drawings shall be prepared in good time to meet the requirements of the construction programme.

F922500 ISSUE OF DRAWINGS

- (a) Copies of installation drawings, wiring diagrams and builders work drawings shall be submitted to the Engineer for comment. Where an electronic document control system is employed for the project this shall be used for the transfer of all drawings and other documentation utilising the protocols agreed for the project. Where an electronic document control system is not being employed, electronic and/or printed copies of all drawings shall be distributed by the Fire Protection Services Installer as directed by the Engineer. A period of fifteen working days shall then be allowed for comment on the drawings by the Professional Team.
- (b) Where drawings are submitted for comment they will be reviewed by the Engineer and any comments returned, either by marking directly on the drawing, or by correspondence. Drawings will be marked with A, B or C status with the definition of each category being as follows:
 - i) A – No comments. The drawing is to be re-issued for Construction and installation works can proceed
 - ii) B – Comments provided by the Engineer. The drawing is to be amended to incorporate all of the Engineers comments and marked for Construction. Installation work can proceed but must incorporate all comments made by the professional team
 - iii) C – The drawing is inadequate and is to be redrawn and resubmitted for comment. No installation work can proceed until a Status A or B is achieved

The giving of an 'A' status does not relieve the Fire Protection Services Installer from ensuring that the drawings meet the requirements of the contract documentation
- (c) The status of working drawings does not relieve the Fire Protection Services Installer from his obligations to progress and complete the works in line with the agreed programme. Should the Fire Protection Services Installer elect, in order to meet the programme, to proceed with installation work before an A status working drawing is achieved, this shall be at his own risk. Should unacceptable work be installed, it will be the responsibility of the Fire Protection Services Installer to ensure it is removed and replaced in a manner acceptable to the Engineer. No claims for delay or payment will be entertained in this respect.

- (d) When the drawings have been amended to incorporate any comments, they shall be issued as the construction issue to the Employer and the Engineer. The same preliminary and construction issue distribution of drawings shall apply to any subsequent revisions of working drawings.

F922800 DIMENSIONS

- (a) The Fire Protection Services Installer shall take site dimensions during the preparation of the drawings and be responsible for their accuracy. Setting out of the works on site shall be carried out by the Fire Protection Services Installer and any errors arising from inaccuracies in setting out shall be the Fire Protection Services Installer's responsibility.
- (b) The Fire Protection Services Installer shall be solely responsible for the accuracy of the drawings and for any equipment shown being suitable for the purpose for which it is intended and in accordance with the design drawings and specifications.

F923100 SITE COPIES

- (a) One set of prints of working drawings, manufacturing drawings and installation drawings as necessary to provide a complete record of the Works shall be kept on site. The drawings shall be available at all times for inspection by the Engineer
- (b) The drawings shall be kept in good condition and be marked up, at least once a week, to show the progress of work on site and incorporate all alterations, omissions, variations and amendments agreed during the progress of the works.

F95 RECORD DOCUMENTATION

F950400 ASSET REGISTER

- (a) The Fire Protection Services Installer shall complete an asset register of all equipment supplied under the contract. A standard form may be provided by the Employer and shall be used for this purpose. Where no standard form is provided, the Fire Protection Services Installer shall provide a template and obtain the Engineers agreement. All information shall be incorporated in the operation and maintenance manuals and supplied separately to the Employer in electronic format for inclusion in an overall asset document.

F950700 BUILDING LOG BOOK

- (a) The Fire Protection Services Installer shall produce all required information for the Building Log book, to meet the requirements of the Building Regulations Approved Documents, in accordance with CIBSE TM31: Building Log books and Standard Templates.
- (b) The Building Log Book shall be issued one week prior to Practical Completion. Failure to issue the completed Log Book will prejudice the issue of the Practical Completion certificate.
- (c) Where the Fire Protection Services Installer is not the Building Log Book author, he shall issue the required information to the Contractor in good time for onward transmission to the Log book Author to allow the completed log book to be issued one week prior to Practical Completion. Failure to issue the required information may prejudice the issue of the Practical Completion certificate.

F951000 BUILDING USER GUIDE

- (a) The Fire Protection Services Installer will be required to contribute to a non-technical building user guide which describes the operation and environmental performance of the building.
- (b) The Fire Protection Services Installers contribution shall include guidance on all engineering systems covered by this specification and shall be issued to the Building User Guide author promptly when requested.

F951300 MANUALS

- (a) All record documentation shall be available in a digital format. Where a Computer Aided Facilities Management (CAFM) system is used by the Employer or identified within the Contract, all record documentation shall be issued to accommodate the software platform in use by the Employer and adopt any protocol required by that system.

- (b) Where no specific requirements are specified, manuals should consist of one electronic copy and up to four sets of printed manuals. Both electronic and printed copies shall incorporate all test certificates and acceptances. The manuals shall be fully compliant with BS EN 12845. Six weeks prior to Practical Completion draft copies of the manuals shall be submitted to the Employer and Engineer for comment. One week before Practical Completion final agreed manuals shall be handed over to the Employer.
- (c) Failure to issue the manuals in time for incorporation into the Health and Safety File will result in failure to achieve Practical Completion.
- (d) The manual shall be arranged as follows:
 - i) **Section 1** **Index**
 - ii) **Section 2** **Description of the Design Intent**
 - iii) **Section 3** **Description of the Individual Equipment** Components together with the Operation Routine. The description shall include specific instruction for start-up, operation and shut down of each system, procedures for emergency shut down, making safe potentially dangerous plant, precautions necessary to overcome known hazards when operating each system, bringing into operation standby equipment, instructions on fault finding and emergency in case of plant malfunction or equipment failure and control sequences for all systems. Health and safety matters identified in the Health and Safety Plan and relevant to the operation, maintenance and replacement of the installation shall be described with precautions envisaged as necessary
 - iv) **Section 4** **Planned and unplanned shutdown procedures.** These shall fully detail the procedures appropriate to the maintenance tasks. Instructions shall include dismantling and reassembly, replacements, adjustment, calibration and testing, reference to parts, identification lists, special tools, test equipment and auxiliary services, hazards which may arise and precautions to be taken, fault finding routines. Actions to be taken following a system operation
 - v) **Section 5** **Maintenance Schedules.** These shall detail recommendations for the nature and frequency of inspections, examinations, tests and maintenance to keep the equipment in a safe and efficient working order. Guidance shall be given on the nature of deterioration and defects to be looked for. Activities shall be listed for daily, weekly, monthly, quarterly, bi-annual and annual routines in a consolidated planned maintenance, inspection and testing schedule

- vi) **Section 6** **Dismantling.** Description of the methods and processes to be used in draining down and emptying of all systems including safe disposal of the contents. Description of the methods envisaged for dismantling of systems to comply with health and safety requirements, including schedules of hazardous substances and methods of disposal
- vii) **Section 7** **Equipment Schedules and Parts Lists.** The schedules shall locate each item with details of the design and actual operating conditions, including replaceable assemblies. Sufficient information shall be provided to identify each item, with the source of supply, ratings, dimensions and appropriate standards. Equipment schedules shall include the name and address of the manufacturer, reference number, name and address of supplier, order number and date of purchase. A separate parts list shall be provided for each item detailed in the equipment schedule
- viii) **Section 8** **A set of Record Drawings.** If necessary, due to the number of drawings which have to be included in the manual, each drawing shall be photographically reduced in size to suit the manual
- ix) **Section 9** **Emergency Measures.** This shall include telephone numbers of Fire Protection Services Installer's emergency staff and name, address and telephone number of all manufacturers
- x) **Section 10** **Copies of all:**
- Test certificates and commissioning data for each service and item of plant and equipment
 - Works test reports
 - Certificate of completion for each system
 - Maintenance and test schedule
 - Log book
 - Hydraulic calculations. Suitably amended to incorporate any on site modifications or deviations from the Contract Issue
 - Valve schedule
 - Schematics
 - Manufacturers technical data sheets, instructions, etc.
- (e) They shall be final copies of the data produced as required by the Inspection, Testing and Commissioning Section of this Specification. Where such data is not available for inclusion in the draft copy of the manual required by paragraph b of this Clause, the draft shall be forwarded without them. Inability to include these items will not be accepted as a reason for non-production of the rest of the draft manual.

- (f) Covers of printed manuals shall be substantial, of adequate size, distinctive and of sufficient strength to protect the contents for the life of the installation. The binding shall give a permanent anchorage along the left hand side whilst allowing the text to be flat without damage to the spine.
- (g) The contents shall be prepared with an agreed type face on top quality A4 paper suitable for direct insertion into the manuals.
- (h) The front cover and where appropriate the spine shall have the name or logotype of the Employer, the name of the building and details of the services included in the manual clearly displayed in permanent lettering. Where the manual is contained in more than one volume, a volume number shall be added.
- (i) The title page shall identify the building, describe the Services referred to in the manual and give the full name and address of the Employer. It shall also contain, date of completion and date of handover of the services to the Employer. The date of issue of the manual with the name and address of the manual author and the Author's reference number
- (j) The preliminary pages shall contain the full name, address and telephone number of the Engineer, the Fire Protection Services Installer and specialists. A description of how to use the manual with any limitations on its use shall be included. The preliminary pages shall include a contents list, list of supplementary documents, a record of amendments to the manual, emergency call out procedures, telephone numbers, etc.
- (k) Each section of the manual shall be divided by a stiff divider of the same size as the holder. The divider shall be labelled to identify the section of the manual which is following.
- (l) All pages comprising the manual shall be sequentially numbered within each Section.

F951600 ELECTROMAGNETIC COMPATIBILITY TECHNICAL JUSTIFICATION FILE

- (a) The Fire Protection Services Installer shall maintain a Technical Justification File in respect of Electromagnetic Compatibility.
- (b) The file shall incorporate all necessary EMC test certificates for equipment and or components.
- (c) The Fire Protection Services Installer shall provide a Declaration of Conformity on completion and this together with the Technical Justification File and supporting documentation shall be forwarded to the Clients Responsible Person as part of the Operation and Maintenance Manuals.

F951900 RECORD DRAWINGS

- (a) Record Drawings shall be provided by the Fire Protection Services Installer for comment 28 days prior to Practical Completion.
- (b) The Record Drawings, as described, shall be drawn using the current version of AutoCAD. Where record drawings are generated from a 3D Model, each drawing shall be annotated in sufficient detail to fully describe the engineering installations without the need to refer to the 3D Model. Printed copies shall be reproduced on quality paper using international A series sizes. Lettering shall be not less than 5 mm in height.

- (c) Each Record Drawing shall show the name of the Contract and, where appropriate, the zone or floor designation. They shall include a description of the drawing, drawing number and scale. The name and address of the Fire Protection Services Installer and the Engineer shall be included. Each Drawing shall include the words 'Record Drawing' in 18 mm upper case lettering in the bottom right hand corner adjacent to the title block.
- (d) Failure to issue the Record Drawings in time to form part of the Health and Safety File will result in failure to achieve Practical Completion.
- (e) The Engineer will review and comment upon the draft Record Drawings and other relevant contributions to the Health and Safety File. This review will not relieve the Fire Protection Services Installer of this responsibility to ensure the information included is accurate and complete.
- (f) When agreement with the contents of the Drawings is received, digital and paper copies, in quantities to match the Manuals, shall be issued by the Fire Protection Services Installer. The Drawings shall comply with the requirements of the Construction (Design and Management) Regulations for incorporation into the Health and Safety File for the Contract.
- (g) Record drawings shall show the work as completed and shall record the following:
 - i) The location, including levels if buried, of public service connections provided within the Contract, whether installed as part of the Contract or the appropriate authority, together with the points of origin and termination, size and materials of services
 - ii) The layout, location and extent of all services showing sizes
 - iii) Location, identification size and details of all apparatus and controls equipment served by, or associated with, each of the various services
 - iv) Fully indicate with accurate dimensions, the sizes and positions of all plant, equipment, conduits, trunking and piped services. Each service shall be clearly identified
 - v) The location and identity of each room including spaces housing plant, machinery or apparatus
 - vi) Sections, elevations, isometrics and schematics of the plant spaces
 - vii) Control and wiring diagrams incorporating details of each instrument and equipment item with a written description of the sequence of operation of each system. Diagrams shall include full details of internal panel wiring and connections to field mounted items
 - viii) Layout, location and extent of electrical switchgear distribution boards, cables and termination points
 - ix) The complete symbol notation used for all Record Drawings shall be shown on a separate drawing. The symbols used for individual Record Drawings shall be identified on each drawing

F952200 INSTRUCTION OF EMPLOYER AND OCCUPIER

- (a) The Employer's and Occupiers Representatives shall be fully instructed by experienced personnel in the operation, testing, servicing and maintenance of the Works. Instruction shall include the provision of such specialist instruction as is required from any suppliers or specialists.
- (b) Such instruction shall be given for a minimum period of one week unless otherwise specified elsewhere in this document. On completion a signed receipt shall be obtained from the Employer stating that such instruction has been received.
- (c) A week's refresher course shall be provided three months after Practical Completion. On completion a signed receipt shall be obtained from the Employer stating that such instruction has been received.

F952500 WORK IN EXISTING BUILDINGS

- (a) Where works are to be undertaken in an existing building, it shall be the Fire Protection Services Installer's responsibility to locate the existing Health and Safety File, (or Operating and Maintenance Manuals and Record Drawings where no Health and Safety File exists), at an early stage during the contract. The existing documentation shall be updated by cross referencing it to the new record documentation provided as part of the new contract works.
- (b) Where the final installations incorporate elements retained from the original installation, they shall be clearly identified within the record manuals and on the record drawings so as to clarify the demarcation between the existing and new contract works.
- (c) Where no Health and Safety File or original record documentation exists, or is incomplete, the Fire Protection Services Installer shall allow to provide the record documentation for the new contract works and take further instruction from the Engineer with regard to the existing works.

F97 SCHEDULES

F970100 FIRE PROTECTION SERVICES TENDER DRAWINGS

Drawing No.	Title
27618-HM-ZZ-B1-DR-FP-5200	Basement Level Water Mist Layout
27618-HM-XX-ZZ-DR-FP-2101	Dry Riser Schematic

F970400 PIPEWORK, MATERIALS, JOINTING AND FITTINGS

Service	Location	Material & BS Reference No.
Incoming Water Mains	Basement	Tube: Stainless Steel 316 compression jointed elbows are to be pulled to the minimum radius set out by the system manufacturer for the diameter of the pipe
Water Mist	All Areas	Tube: Stainless Steel 316 compression jointed elbows are to be pulled to the minimum radius set out by the system manufacturer for the diameter of the pipe
Test Drain Stacks	Pipework downstream of control valves.	Tube: Medium weight galvanised mild steel to BS EN 10255 (previously BS 1387). Fittings: Galvanised screwed malleable iron to BS EN 10226 (previously BS 143).
Dry Riser	All Areas	Tube: Heavy weight galvanised mild steel to BS EN 10255 (previously BS 1387). Fittings: Welded to BS 2633 or BS 2971 as appropriate (previously BS 1965) galvanised after manufacture long radius bends, pitcher ties Galvanised mechanical couplings with earth continuity clips
Tank Overflows, Washouts, Fire Brigade Tank Fill Lines	Basement	Tube: Medium weight galvanised mild steel to BS EN 10255 (previously BS 1387) Fittings: Galvanised screwed malleable iron to BS EN 10226 (previously BS 143) up to 50 mm Welded to BS 2633 or BS 2971 as appropriate (previously BS 1965) galvanised after manufacture 65 mm and above Galvanised mechanical grooved fittings with earth continuity clip

F970700 INSULATION AND FINISHES

Service	Location	Finish
Incoming Water Main	Basement	Anti-condense thermal insulation Class 'O' foil face vapour seal
Dry Riser	All areas	Unpainted (Galvanised Pipe)
Tank Overflows, Washouts, Fire Brigade Tank Fill Lines	All areas	Unpainted (Galvanised Pipe)
Water Mist	All areas	Self-finish stainless steel

F971000 WATER STORAGE TANKS

Service	Water Mist System
Location	Basement
Actual capacity with division	24m ³ (contractor design)
Material	GRP
Construction	Externally flanged with flat weatherproof cover, complete with all necessary stays, cleats, bolts, nuts, washers and jointing compound.
Size	4m long x 3m wide x 2m high (contractor design)
Compartment sizes	2 number compartments of equal capacity (contractor design)
Tank plate size	1 m ²

Fittings	No. off
Low level and roof level access hatches	2no each
150 mm dia screened roof vent	4no
Internal ladder	2no
External ladder (with safety hoops)	1no
Raised ballvalve box 1200x1220x610 mm high with side access	2no
Spillover weirs to give 'Type A' air gap	2no
Hydrostatic dial type level gauge (Normond Type G6)	2no
Vortex inhibitor pipe and elbow LPCB approved	2no
Overflow pipe extend to floor/gully	2no
PVC or Traffolite name plate	1no
Pipe Connections	No. off
Inlet	2no 50mm dia
Outlet	2no 80mm dia
Drain	2no 50mm dia
Overflow	2no
Warning	2no 40mm dia with PVC screen unit
Test	2no 65mm dia
High & Low level controls	4no 25mm dia
Brigade fills	N/A
Shop finish	N/A

Accessories	No. off
Peter Smith ballvalve	2no
Miltronic ultrasonic alarm contents monitor	2no

F971300 VALVES

Location	Type	Specification
Incoming Mains	Gate valve Globe valve	BS 5163 (subject to water BS 5150 authority approval) BS 5152
Dry rising main isolation valves	Butterfly	Grooved, geared and monitored
Pump Suction	Gate valve/butterfly valve	Low pressure stainless steel or internally unpainted noncorrosive
Pump Delivery Main Top Valves	Ball lever	High pressure Stainless steel
Pump Delivery	Ball lever	High pressure Stainless steel
Subsidiary Stop Valve	Ball lever	High pressure Stainless steel
Test Valves	Ball lever	High pressure Stainless steel
Drain Valves	Ball lever	High pressure Stainless steel
Flushing Valves	Ball lever	High pressure Stainless steel

All water mist system valves to comply with manufacturers specifications.

F974000 CABLES

Location/System	Type	Manufacture	Product Name	Comments
Detection Wiring	'Enhanced' fire rated	Prysmian (Pirelli)	FP Plus	All cable ties to be metal
	'Enhanced' fire rated	Draka	Firetuf Plus	All cable ties to be metal
Power wiring to sprinkler pump sets	Armoured	Prysmian	FP600S	All cable ties to be metal
	Armoured	Draka	Powerplus	All cable ties to be metal

F974300 SCHEDULE OF SPARES

The Fire Protection Services Installer shall provide a quantity of spare sprinklers of each type/temperature used in the installation together with the necessary spanners or tools to suit the different types supplied as recommended by the relevant authorities/organisations.

These items shall be contained in a cabinet specifically made for the purpose with a suitable locking arrangement. The cabinet shall be wall mounted in the sprinkler valve chamber.

Description	No. of Replacements
Water Mist Sprinkler Heads	24 in metal box

F974600 SCHEDULE OF EQUIPMENT MANUFACTURERS

Item	Acceptable Manufacturers
High pressure water mist system	Marioff
Valves	Marioff Valvestock Rapidrop
Dry Riser Fittings	Rapidrop JD Fire Angus Fire
Detection and Power Cable	Prysmian Draka
Flow meter	Platon Instrumentation Ltd Influx Measurements Ltd
Water Flow Detectors	System Sensor Potter Electric Signal Co.
Tank and associated tank components	Franklin Hodge Balmoral Braithwaite
Auto-Transfer Switches	ASCO model 200 or approved equivalent

F974900 SCHEDULE OF SUBMITTALS REQUIRED

Drawing Submittals

Item No	Description	Information required
1	Pipework layout	Fully co-ordinated with all services
2	Reflective ceiling plan	Fully coordinated with all services
3	Plant room layout	Larger scale plans & sections
4	Schematic	
5	Hydraulic calculations	Including noded diagrams
6	Builders work details	

Samples

Item No	Description	Information required
1	Watermist heads	One of each type / finish

Technical Submittals

Item No	Equipment Description	Information required
1	Pumps, Starters, Jockey Pump & Starter	Indicating duties for each stage. Manufacturers spec, model No. GA drawing Pump curves Electric loads Remote status panel Auto Changeover Panels
2	Gate Valves	Full Technical details
3	Wafer / Grooved Butterfly Valves	Full Technical details
4	Non Return Valves	Full Technical details
5	Screwed Valves	Full Technical details
6	Test & Drain Valves	Full Technical details
7	Motorised shut off valve	Full Technical details & method of control
8	Full Valve Schedule	Detailing location of each valve.
9	Pump Test Flow Meter	Full Technical details
10	Pressure Switch	Full Technical details
11	Control Valves & Trim	Full Technical details
12	Water mist Heads	Full Technical details for each head type
13	Water Storage Tank	Full Technical details
14	Tank Float control valves	Full Technical details
15	Tank Contents Gauge	Full Technical details
16	Tank High/Low level alarm	Full Technical details
17	Fire Brigade Inlet Breeching piece	Full Technical details
18	FBI Cabinet	Full Technical details
19	Dry Riser outlet valve	Full Technical details
20	Water Flow Switch	Full Technical details
21	Valve Supervisory Switch	Full Technical details
22	Pipe/couplings/Fittings	Full Technical details
23	Town's Main Back Flow Preventor	Full Technical details

Item No	Equipment Description	Information required
24	Power cabling	Full Technical details
25	Detection / control cabling	Full Technical details
26	Cable tray / containment	Full Technical details

F975200 SCHEDULE OF COMMISSIONING TESTS

The list of commissioning tests indicated below is not intended to be a finite list but the minimum requirement necessary to demonstrate that the systems comply with the relevant standards. Further tests may be required by the district surveyor, fire officer, insurance company or other organisation having jurisdiction.

Water Storage Tanks
• Verification of the float control on incoming town's main supply • Confirmation of high and low level tank alarm settings • Tank contents gauge readings are accurate
Pumped Water Supplies
• Verification of fire pump 'cut in' pressures • Verification of jockey pump 'cut in and out' pressures • Individual pump performance flow/pressure • Demonstrate any automatic changeover facility on electrical supply • Confirm 'pump status' indications • Verify 'system low pressure' alarms • Pump alignment check • Pump suppliers 'works' performance test • Demonstrate the N+1 pump change over • Demonstrate fault and activation signals
Town's Main Supply
• Verify non return valve operation • Sterilisation of incoming mains
Watermist Control Valves
• Wet Systems ○ Operation test ○ 'System Operated' pressure switch activated
General
• Test and verify flow switches and monitored valves • Wet systems – hydraulic test on all pipework • Verify any relief valve settings
Dry Riser
• Flow and pressure test

F975500 SCHEDULE OF FIRE ALARM INTERFACES

Level	Description	Source	Signal
Water Mist Pump Room			
B1	Isolating Valve Supply 1	Tamper	Fault
B1	Isolating Valve Supply 2	Tamper	Fault
B1	Upstream Isolating Valve	Tamper	Fault
B1	Downstream Isolating Valve	Tamper	Fault
B1	Bypass Isolating Valve (N/C)	Tamper	Fault
B1	Tank No. 1 Infill Isolating Valve	Tamper	Fault
B1	Tank No. 2 Infill Isolating Valve	Tamper	Fault
B1	Tank No. 1 Outlet Isolating Valve	Tamper	Fault
B1	Tank No. 2 Outlet Isolating Valve	Tamper	Fault
B1	Tank No. 1 High Level Alarm	Level switch	Fault
B1	Tank No. 1 Low Level Alarm	Level switch	Fault
B1	Tank No. 2 High Level Alarm	Level switch	Fault
B1	Tank No. 2 Low Level Alarm	Level switch	Fault
B1	Electric Pump No.1 Suction Valve	Tamper	Fault
B1	Electric Pump No.1 Delivery Valve	Tamper	Fault
B1	Electric Pump No.2 Suction Valve	Tamper	Fault
B1	Electric Pump No.2 Delivery Valve	Tamper	Fault
B1	System activated	Pump Panel	Fire
B1	System on Demand	Pump Panel	Fault
B1	Pump Start Failure	Pump Panel	Fault
B1	Electric Power Failure	Pump Panel	Fault
B1	Pump Test Isolating Valve	Tamper	Fault
B1	System Low Pressure	Press Switch	Fault
B1	System General fault	Pump panel	Fault
Installation Control Valve			
B1	Basement Valve (common up tamper switches)	Tamper	Fault
B1	Basement Valve System Operated	Flow Switch	Fire
B1	Trace Heating	Controller	Fault

F975800 SCHEDULE OF BMS INTERFACES

Level	Description	Source	Signal
Water Mist Pump Room			
B1	Mist Pump Unit Running	Pump control panel	Fire
B1	Mist Pump Unit Common Fault	Pump control panel	Fault
B1	Mist Tank Common Alarm	Pump control panel	Fault
B1	Trace Heating	Controller	Fault

F976100 SCHEDULE OF ELECTRIC POWER SUPPLIES

Location	Equipment	Quantity	Electric Load
B1	Electric LPU3+1 water mist pump set with frequency convertors	1	Total Load Current 81 kW
			Starting Current 151 Amps
			Locked Rotor Current 156 Amps
B1	Jockey Pump	1	13 amp 230V/1ph/50Hz
B1	Tank No. 1 High Level Alarm	1	13 amp 230V/1ph/50Hz
B1	Tank No. 1 Low Level Alarm	1	13 amp 230V/1ph/50Hz
B1	Tank No. 2 High Level Alarm	1	13 amp 230V/1ph/50Hz
B1	Tank No. 2 Low Level Alarm	1	13 amp 230V/1ph/50Hz
B1	Motorised Shut Off Valve	1	13 amp 230V/1ph/50Hz
B1	Trace Heating Controller	1	13 amp 230V/1ph/50Hz
B1	Plant Room 3kW Space Heater	1	13 amp 230V/1ph/50Hz