General Specification for Mechanical Installations 2007 Edition (Incorporating Corrigendum No. GSMI01)

The 2007 edition (Incorporating Corrigendum No. GSMI01) of the General Specification for Mechanical Installations comprises considerable updating and revisions to the 2007 edition.

The updating of specification is a continuous process. With the benefit of information technology, electronic version of this new 2007 edition (Incorporating Corrigendum No. GSMI01) can be kept up-to-date and may be viewed on the ArchSD Homepage.

In view of the revisions and new additions, there will be an introductory period of 3 months whereby the General Specification for Mechanical Installations 2007 Edition will still be the Contractual Document, whilst the new General Specification for Mechanical Installations 2007 Edition (Incorporating Corrigendum No. GSMI01) may be viewed in parallel in preparation for full implementation by 1 April 2011.

- **Hence, for tenders to be invited on or after 1 April 2011, General Specification for Mechanical Installations 2007 Edition (Incorporating Corrigendum No. GSMI01) shall be used.**

- **Existing contracts (including contracts using previous editions tendered before 1 April 2011) would not be affected.**

MAJOR CHANGES IN THE CORRIGENDUM OF THE GENERAL SPECIFICATION FOR MECHANICAL INSTALLATIONS IN GOVERNMENT BUILDINGS OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION - 2007 EDITION

Old Ref. No.	New Ref. No.	Major Changes
TABLE OF CONTENTS		
A4.1 – A4.5	A4.1 – A4.4	Delete the paragraph "STANDARD DRAWINGS" and renumber the other paragraphs.
PART A – SCOPE AND GENERAL REQUIREMENTS		
SECTION A2 – STATUTORY OBLIGATIONS AND OTHER REGULATIONS		
A2.1.2(i)	A2.1.2(i)	Replace "EMSD" by "the Electrical and Mechanical Services Department, the Government of the HKSAR".
SECTION A4 – DRAWINGS AND MANUALS		
A4.1		Delete the paragraph "STANDARD DRAWINGS".
A4.2 – A4.5	A4.1 – A4.4	Renumber the paragraphs.
A4.3.6	A4.2.6	Replace "Gas Office" by "Gas Standards Office".
PART B – GENERAL TECHNICAL REQUIREMENTS		
SECTION B2 – PLANT REQUIEMENTS		
B2.1	B2.1	Replace "BS 1486-1" by " BS 1486-1:1959".
B2.2	B2.2	Replace "IEC 60947-4-1:2001" by "IEC 60947-4-1:2009".

Old Ref. No.	New Ref. No.	Major Changes
SECTION B3 – INSTALLATION AND WORKMANSHIP		
B3.1	B3.1	Replace “BS 4” by “BS 4-1:2005”. Replace “BS EN 10067” by “BS EN 10067:1997”.
B3.3	B3.3	Replace “ ISO 2560:2005” by “ISO 2560:2009”. Replace “BS EN 1011:2006” by “BS EN 1011:2009”.
B3.4.2	B3.4.2	Replace “ ISO 8501:2006” by “ISO 8501:2007”.
PART C – TECHNICAL REQUIREMENTS		
SECTION C1 – STEAM BOILER		
C1.3.1	C1.3.1	Replace “BS EN 1515:1998” by “BS EN 1515:2000”. Replace “BS EN 1092-1:2002” by “BS EN 1092-1:2007”.
C1.3.1.5(a)	C1.3.1.5(a)	Replace “BS 2742:1969” by “BS 2742:2009”.
C1.3.2.1	C1.3.2.1	Replace “BS EN 590:2004” by “BS EN 590:2009”.
C1.3.2.4	C1.3.2.4	Replace “BS EN 88:1991” by “BS EN 88:2007”.
C1.3.2.7(a)	C1.3.2.7(a)	Replace “BS EN 590:2004” by “BS EN 590:2009”.
C1.4.4	C1.4.4	Replace “BS1449:1991-304-S16” by “BS EN 10048:1997”.

Old Ref. No.	New Ref. No.	Major Changes
C1.4.9	C1.4.9	Replace “BS EN 105” by “BS EN 12449:1999”. Replace “Part 1 Copper tubes for water, gas and sanitation & Part 2 Tubes for general purposes” by “Copper and copper alloys. Seamless, round tubes for general purposes”. Replace “BS EN 29453:1994, ISO 9453:1990” by “BS EN ISO 9453:2006”. Replace “BS 7786:1995” by “BS 7786:2006”.
C1.5.7	C1.5.7	Delete “and BS 1724:1990”.
C1.5.12	C1.5.12	Replace “BS 5422:2001” by “BS 5422:2009”.
SECTION C2 – MILD STEEL CHIMNEY		
C2.2(c)	C2.2(c)	Replace “BS 6651:1999 – Code of Practice for Protection of Structures Against Lightning” by “ BS EN 62305:2006 – Protection Against Lightning”;.
C2.4.2	C2.4.2	Replace “BS 5422:2001” by “BS 5422:2009”.
SECTION C3 - CRANE AND HOIST		
C3.3.1.1	C3.3.1.1	Replace “BS2573-1:1983 and 2573-2:1980” by “BS EN 13001-1:2004 and BS EN 13001-2:2004”.
C3.3.1.5	C3.3.1.5	Replace “BS302:1987” by “ BS EN 12385”.
C3.3.1.8(c)	C3.3.1.8(c)	Replace “ IEC 60529: 1992” by “IEC 60529:2001”.

Old Ref. No.	New Ref. No.	Major Changes
C3.3.1.9	C3.3.1.9	(a) Replace “IEC 60529: 1992” by “IEC 60529:2001”. (f) Replace “IEC 60529: 1992” by “IEC 60529:2001”. (j) Replace “IEC 60947-4-1: 2002” by “IEC 60947-4-1: 2009”. (m) Replace “IEC 60947-2: 2006” by “IEC 60947-2: 2009”. (n) Replace “IEC 60947-3:2005” by “IEC 60947-3:2008”; and replace “IEC 60529:1992” by “IEC 6 0529:2001”
C3.3.2.1	C3.3.2.1	Replace “BS 3243:1990” by “BS EN 13157:2004”.
C3.5.1	C3.5.1	Replace “BS2573-1:1983 and 2573-2:1980” by “BS EN 13001-1:2004 and BS EN 13001-2:2004”.
SECTION C4 – FUEL SUPPLY SYSTEM		
C4.3.2	C4.3.2	Replace “ISO 2560:2005” by “ISO 2560:2009”.
C4.4.3	C4.4.3	Replace “IEC 60529:1992” by “ IEC 60529:2001”.
C4.4.4(b)	C4.4.4(b)	Replace “IEC 60079-0:2004” by “IEC 60079-0:2007”.

Old Ref. No.	New Ref. No.	Major Changes
SECTION C5 – GARAGE EQUIPMENT		
C5.3.9.3	C5.3.9.3	Replace “BS EN 55014:2001” by “BS EN 55014:2006”. Replace “IEC 60085” by “IEC 60085:2007”.
C5.4.1	C5.4.1	Replace “BS 1600” by “BS 1600:1991”.
SECTION C6 - GONDOLA		
C6.3.14.3	C6.3.14.3	Replace “BS7671:2001” by “BS7671:2008”.
C6.3.14.4	C6.3.14.4	Replace “BS6651:1999” by “BS EN 62305:2006”.
SECTION C7 - HOT WATER SYSTEM		
C7.3.1.1	C7.3.1.1	Replace “BS 845” by “BS 845:1987”.
C7.3.2	C7.3.2	Replace “BS EN 10028:2003” by “BS EN 10028:2009”.
C7.3.3	C7.3.3	Replace “BS EN 10028:2003” by “BS EN 10028:2009”. .
C7.3.6	C7.3.6	Replace “BS 5422:2001” by “BS 5422:2009”.
C7.4.7	C7.4.7	Replace “IEC60529:1992” by “IEC60529:2001”. Replace “IEC60085:2004” by “IEC60085:2007”.
SECTION C8 - INDUSTRIAL COMPRESSED AIR SYSTEM		
C8.2(e)	C8.2(e)	Replace “ISO1217:1996” by “ISO1217:2009”.

Old Ref. No.	New Ref. No.	Major Changes
C8.4.8	C8.4.8	Replace “BS EN 1515:1998” by “BS EN 1515:2000”.
C8.4.14	C8.4.14	Replace “ISO 4126” by “ISO 4126:2006”.
SECTION C9 - SEWAGE PUMPING SYSTEM		
C9.4.1	C9.4.1	Replace “BS 3486-1:1996” by “BS EN 13835:2002” . Replace “EN 10084:1998” by “EN 10084:2008”.
C9.4.2 & C9.4.3	C9.4.2 & C9.4.3	Replace “IEC60529:1992” by “IEC60529:2001”.
C9.4.5	C9.4.5	Replace “EN598:1995” by “EN598:2007”.
SECTION C10 – PNEUMATIC TUBE TRANSPORT SYSTEM		
C10.5.1	C10.5.1	Replace “I.E.E. Wiring Regulations” by “BS7671:2008”.
SECTION C11 - VEHICLE TURNTABLE		
C11.3.6	C11.3.6	Replace “IEC60529:1992” by “IEC60529:2001”. Replace “IEC60947-4-1:2001” by “IEC60947-4-1:2009”. Replace “BS 7956” by “BS 7956:2000”.
C11.3.7	C11.3.7	Replace “IEC60529:1992” by “IEC60529:2001”.
C11.4	C11.4	Replace “BS EN 10210-1:1994” by “BS EN 10210-1:2006”.
C11.4.1	C11.4.1	Replace “BS EN 10084:1998” by “BS EN 10084:2008”.

Old Ref. No.	New Ref. No.	Major Changes
C11.4.4	C11.4.4	Replace “BS7671:2001” by “BS7671:2008”.

ANNEX	
ANNEX I – LIST OF TECHNICAL STANDARDS QUOTED IN THIS GENERAL SPECIFICATION	
Standard Number	**Description**
BS 302:1987	Stranded Steel Wire Ropes.
BS 436	Spur and Helical Gears.
BS 845-1:1987	Methods for Assessing Thermal Performance of Boilers for Steam, Hot Water and High Temperature Heat Transfer Fluids Part 1: Concise Procedure.
BS 845-2:1987	Methods for Assessing Thermal Performance of Boilers for Steam, Hot Water and High Temperature Heat Transfer Fluids Part 2: Comprehensive Procedure.
BS 853-1:1996	Specification for Vessels for use in heating systems. Calorifiers and Storage Vessels for Central Heating and Hot Water Supply.
BS 1486-1:1959	Lubricating nipples, Lubricating nipples and adaptors for use on machinery and vehicles.
BS 2573	Rules for Design Cranes.
BS 2573-1:1983	Rules for the Design of Cranes Part 1: Specification for Classification, Stress Calculations and Design Criteria for Structures.
BS 2573-2:1980	Rules for the Design of Cranes Part 2: Specification for Classification, Stress Calculations and Design of Mechanisms.
BS 2742:2009	Use of the Ringelmann and Miniature Smoke Charts.

BS 3243: 1990	Specification for Hand Operated Chain Blocks.
BS 3486-1:1996	Wheels for Agricultural Machinery, Implements and Trailers Part 1: Specification for Wheel-to-Hub Fixing Dimensions.
BS 3790:2006	Specification for Belts Drives, Endless Wedge Belt, Endless V-Belt, Banded Wedge Belts, Banded V-belts and their Corresponding Pulleys.
BS 6346:1997	Electric Cables. PVC Insulated Armoured Cables for Voltages of 600/1000V and 1900/3300V.
BS 6651:1999	Code of Practice for Protection of Structures Against Lightning.
BS 7671:2008	Requirements for Electrical Installations. IEE Wiring Regulations. Seventeenth Edition.
BS 7786:2006	Specification for Unsintered PTFE Tape for General Use.
BS EN 88:2007	Pressure Regulators and Associated Safety Devices for Gas Inlet Pressures up to and including 500 mbar.
BS EN 590:2009	Automotive Fuels - Diesel - Requirements and Test Methods.
BS EN 1011-1:2009	Welding - Recommendations for welding of metallic materials. General guidance for arc welding.
BS EN 1092-1:2007	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated Part 1: Steel flanges.
BS EN 1171:2002	Industrial valves Cast iron gate valves.
BS EN 1515-1:2000	Flanges and their joints. Bolting. Selection of bolting.
BS EN 1759-1:2004	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, class-designated. Steel flanges, NPS 1/2 to 24.

BS EN 10028:2009	Flat Products Made of Steels for Pressure Purposes.
BS EN 10084:2008	Case Hardening Steels - Technical Delivery Conditions.
BS EN 10210-1:2006	Hot Finished Structural Hollow Sections of Non-Alloy and Fine Grain Structural Steels Part 1: Technical Delivery Requirements.
BS EN 10250-4:2000	Open steel die forgings for general engineering purposes. Stainless steels.
BS EN 12385	Steel Wire Ropes- Safety.
BS EN 13001-1:2004	Crane Safety. General Design. General Principles and Requirements.
BS EN 13001-2:2004	Crane Safety. General Design. Load Activities.
BS EN 13157:2004	Cranes. Safety. Hand-Powered Lifting Equipment.
BS EN 13480-1:2002	Metallic Industrial Piping - Part 1: General.
BS EN 13480-2:2002	Metallic Industrial Piping - Part 2: Materials.
BS EN 13480-3:2002	Metallic industrial piping Part 3: Design and Calculation.
BS EN 13480-4:2002	Metallic industrial piping Part 4: Fabrication and Installation.
BS EN 13835:2002	Founding. Austenitic cast iron.
BS EN ISO9453:2006	Soft Solder Alloys - Chemical Compositions and Forms.
BS EN 62305:2006	Protection Against Lightning.

BS EN 60085:2008	Electrical Insulation. Thermal Classification.
EN 598:2007	Ductile Iron Pipes, Fittings, Accessories and Their Joints for Sewerage Applications - Requirements and Test Methods.
EN 969:2009	Specification for Ductile Iron Pipes, Fittings, Accessories and their Joints for Gas Pipelines - Requirements and Test Methods.
EN 1011-1:2009	Welding Recommendations for Welding of Metallic Materials Part 1: General Guidance for Arc Welding.
EN 10084:2008	Case Hardening Steels - Technical Delivery Conditions.
EN 10250-1	Open Steel Die Forgings for General Engineering Purposes - Part 1: General Requirements.
IEC 60079-0:2007	Explosive Atmospheres Part 0: Equipment General Requirements.
IEC 60085:2007	Electrical insulation - Thermal Classification, Evaluation and Designation.
IEC 60529:2001	Degrees of Protection provided by Enclosures.(IP Code).
IEC 60947-1:2007	Low-voltage Switchgear and Controlgear Part 1: General Rules.
IEC 60947-2:2009	Low-voltage Switchgear and Controlgear Part 2: Circuit-breakers.
IEC 60947-3:2008	Low-Voltage Switchgear and Controlgear - Part 3: Switches, Disconnectors, Switch-Disconnectors and Fuse-Combination Units.
IEC 60947-4-1:2009	Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-Starters - Electromechanical Contactors and Motor-Starters.
ISO 1217:2009	Displacement Compressors - Acceptance Tests.

ISO 2560:2009	Welding Consumables - Covered Electrodes for Manual Metal Arc Welding of Non Alloy and Fine Grain Steels – Classification.
ISO 8501-1:2007	Preparation of Steel Substrates Before Application of Paints and Related Products. Visual Assessment of Surface Cleanliness. Part1- Rust Grades and Preparation Grades of Uncoated Steel Substrates and of Steel Substrates after Overall Removal of Previous Coatings.
ISO 9453:2006	Soft Solder Alloys - Chemical Compositions and Forms.

ARCHITECTURAL SERVICES DEPARTMENT
BUILDING SERVICES BRANCH

GENERAL SPECIFICATION FOR MECHANICAL INSTALLATION IN GOVERNMENT BUILDINGS OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION
2007 EDITION

Corrigendum No. GSMI01
(December-2010)

The following content and clauses are amended in the above General Specification.

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PART A – SCOPE AND GENERAL REQUIREMENTS

SECTION A2

STATUTORY OBLIGATIONS AND OTHER REQUIREMENTS

A2.1 STATUTORY OBLIGATIONS AND OTHER REQUIREMENTS

A2.1.2 Other Requirements

(i) Code of Practice on Prevention of Legionnaire's Disease, by the Electrical and Mechanical Services Department, the Government of the HKSAR;

SECTION A4

DRAWINGS AND MANUALS

A4.1 DRAWINGS IN ELECTRONIC FORMAT

The Contractor shall provide drawings in electronic format as required in the following clauses. These drawings shall conform to the latest version of CAD Standard of Works Projects (CSWP) as posted in the web site of the Works Branch, Development Bureau and in accordance with the latest version of CAD Manual for Architectural Services Department Projects. Should any technical conflict between the CSWP and the CAD Manual arise, the CSWP shall take precedence.

A4.2 INSTALLATION DRAWINGS

A4.2.1 Drawing Submission Schedule

The Contractor shall submit a detailed installation drawing submission schedule and programme to the Architect. The Contractor shall allow reasonable time in the programme for vetting of the installation drawings by the Architect and for drawing resubmissions as necessary.

The Contractor shall submit to the Architect a comprehensive "Submission Schedule" of installation drawings and builder's work drawings within 2 weeks after the acceptance of Tender, taking into account of the overall programme of the Works including any Specialist Works and works by the utility undertakings. No equipment shall be delivered to the Site and no works shall be executed until the installation drawings have been approved by the Architect. The Contractor shall ensure that the installation drawings and builder's work drawings are progressively submitted in accordance with the approved "Submission Schedule".

The Contractor shall provide at least 6 hard copies and one electronic copy, unless otherwise specified in the Contract, of the approved installation drawings to the Architect for distribution.

A4.2.1.1 Information To Be Provided

Within 4 weeks from commencement of Works, the following information shall be submitted:

(a) A technical specification of various equipment in duplicate including copies of manufacturer's descriptive literature;

(b) Detailed description of the safety features in operation complete with product catalogues;

(c) Full technical data of the equipment to be supplied and installed including performance curves, normal expected economic life, etc.;

(d) General arrangement drawings detailing the plant and ancillary equipment to be supplied under the Contract which shall include leading dimensions, weights and foundation details, etc.;

(e) Builder's work drawings indicating clearly the position and sizes of all holes and cuttings, bolt holes and bolts, loads on beam and structure, details of railing foundations, conductor anchors, rail mounting and suspension method and all other necessary information to enable the design and construction of the building to proceed; and

(f) Wiring diagram for each item of electrical equipment together with a cable schedule showing connections between the various items of equipment. The terminal markings on the diagrams shall correspond to those used on the equipment.

A4.2.1.2 During Works Period

During Works period, the Contractor shall submit monthly progress reports prior to the date for commencement of site work and fortnightly progress reports thereafter to show the progress of production, scheduling, any anticipated delivery delays, other relevant information against each activity reference and confirming that the agreed date of completion of each item of work will be met or give a detailed explanation shall there be any possibility of delay.

The birth certificates and test certificates of all the equipment / materials from the manufacturers shall be submitted to the Architect for record and information one month before shipment to site.

On the request of the Architect, the Contractor shall submit additional drawings and documents to the Architect for approval at no additional cost.

The Contractor shall not manufacture any items of plant until the Architect's written approval has been obtained.

The approval of the Contractor's equipment/materials and drawings given by the Architect does not relieve the Contractor from contractual responsibility to fulfil the requirements of the Contract.

A4.2.1.3 Before and After Commissioning Test

Eight weeks prior to the commencement of testing and commissioning, draft as-fitted drawings and 'Operation and Maintenance Manuals', in English and/or Chinese, bound in book form with hard plastic cover to withstand constant use and properly indexed to facilitate quick reference shall be submitted for the Architect's approval prior to producing formal copies of as-fitted drawings and O&M manuals.

Each manual shall include original copies of:

(a) General arrangement drawings of power supply, driving and control system including schematic drawings, control diagrams and wiring diagrams;

(b) Drawings showing the internal construction of all major items, with part lists and reference numbers for spare identification and ordering purpose;

(c) Principle of operations;

(d) Details of installation and setting up procedures;

(e) Details of specification, maintenance and operation instructions for all the equipment;

(f) Schematic diagrams for all electrical systems;

(g) The names and addresses of the manufacturers and

their local agents for all the equipment; and

(h) List of recommended lubricants and other consumable materials.

Within 4 weeks after the commissioning test, three copies each of as-fitted drawings (plus one set of CD-ROM) and O&M manuals bound in book form with hard plastic over to withstand constant use and properly indexed to facilitate quick reference shall be submitted. At least one copy of the O&M manuals must contain original documents from the original equipment manufacturers/ suppliers.

A4.2.2 Size of Installation Drawings

Drawings submitted by the Contractor shall only be of standard sizes from A0 to A4 or B1 size as stipulated in ISO 5457:1999.

A4.2.3 Contents of Installation Drawings

The Contractor shall ensure all installation drawings are accurate representation of the Works, before submitting them to the Architect. All installation drawings shall be fully dimensioned and suitably scaled showing construction, sizes, weights, arrangements, operating clearances and performance characteristics.

A4.2.4 Builder’s Work Drawings

Unless otherwise approved by the Architect, the Contractor shall submit to the Architect in accordance with the approved "Submission Schedule", 6 copies of drawings showing details of all builder’s work required e.g. the weight and the load on each support of equipment. Such drawings shall clearly indicate the details and positions of all openings, trenches, ducts and cutting required and construction details for plinths and equipment bases.

A4.2.5 Manufacturer’s Shop Drawings

The manufacturer’s shop drawings are drawings for equipment or plant to be manufactured by a specialist manufacturing supplier in their own workshops and places away from the Site.

The drawings shall show detailed construction, principal dimensions, weights and clearances for maintenance, etc. Immediately after placing of any order or at any event within 4 weeks unless otherwise approved in writing by the Architect, the Contractor shall forward to

the Architect for comment, 4 copies of manufacturer's shop drawings indicating detailed construction, principal dimensions and weights, clearances for withdrawals and/or cleaning, etc. No work shall proceed on or off Site unless drawings requiring approval are so approved in writing by the Architect.

A4.2.6 Drawings for Submission to Other Authority (FSD / Gas Standards Office / EMSD / WSD etc)

Hot Water Installation
4 sets of the schematic plumbing diagram shall be submitted to the Architect and 2 endorsed sets of drawings would be returned to the Contractor for onward submission to WSD for perusal. Works should only be commenced after the set of drawings are accepted by WSD and the Architect. 6 sets of all such approved drawings shall then be submitted to the Architect for record.

A4.3 AS-BUILT DRAWINGS

A4.3.1 Submission of As–built Drawings

The Contractor shall submit 3 sets of the first draft prints of as-built drawings within 28 days of the issuance of the certification of completion to the Architect for checking. The Architect after checking the above draft prints shall return one set of the marked up copies of these as-built drawings to the Contractor within 42 days from the date of submission of the Contractor's draft prints with comments. The Contractor shall within a further 28 days from the date of receiving the Architect's comments on the draft as-built drawings re-submit to the Architect for his approval another 3 sets of the second draft prints of as-built drawings with the Architect's comments incorporated. This process of submission and approval shall continue until the final approval of the Architect on these as-built drawing is obtained.

The final approved as-built drawings shall be in 3 sets of hard copy and 3 sets of electronic copies. These shall be submitted within 21 days from the date of final approval. Each electronic copy shall be in the form of CD-ROM, labelled, with cross reference to a printed list of files explaining the contents and purpose of each file and supplied in sturdy plastic containers.

The detailed requirements and the media of as-built drawings set out in the Preliminaries of the Bills of Quantities or the Specification Preliminaries shall be followed as appropriate.

A4.3.2 Size of As-built Drawings

As-built drawings shall only be of standard sizes of A0, A1 or B1 size as stipulated in ISO 5457:1999. Smaller size (A2 to A4) is accepted for installation drawings.

A4.3.3 Content of As-built Drawings

The Contractor shall ensure all as-built drawings are accurate representation of the Works, before submitting them to the Architect. The as-built drawings required to be provided by the Contractor for various types of BS/E&M installations shall include, but not limited to the following:

(a) Building services layout plans such as ducting arrangement, trunking arrangement, piping arrangement, etc;

(b) System schematic diagrams, control diagrams and wiring diagrams;

(c) Concealed work layout plan such as concealed conduit routing, etc; and

(d) Installation details and assembly drawings such as LV cubicle switchboard layout, motor control cubicle layout, etc.

A4.3.4 Framed Drawings

The Contractor shall provide framed drawings to each major control room showing the schematic wiring diagrams, tables or charts to indicate the type and composition of circuits.

A4.4 OPERATION AND MAINTENANCE (O&M) MANUAL AND USER MANUAL

A4.4.1 General

The Contractor shall provide two types of manuals to the Architect with all changes made to the installation during the course of the Contract suitably incorporated.

The O&M Manual is for use by the maintenance agent of the completed installation. It shall contain detailed technical information covering both operation and maintenance aspects of the installation.

The User Manual seeks to give users of the completed installation an

overview of the essential information of the installation. The contents of the manual should be concise and succinct for ease of comprehension by people with a non-technical background.

A4.4.2 Presentation

All manuals shall be written in English, unless otherwise specified. The text of descriptive parts shall be kept concise while at the same time ensure completeness. Diagrammatic materials shall also be supported by comprehensive descriptions.

The manuals shall comprise A4 size loose-leaf, where necessary, A3 size folded loose-leaf. The loose-leaves shall be of good quality paper that is sufficiently opaque to avoid "show-through". Unless otherwise specified in the Contract, the manuals shall be bound in durable loose-leaf four ring binders with hard covers. The manuals shall have labels or lettering on the front cover and spine. The Architect's approval shall be obtained on this at the draft manual stage. The softcopy of manuals including the technical literatures, shall be in PDF format readable by Acrobat Reader Freeware.

A4.4.3 Checking and Approval

The Contractor shall submit 3 sets of the first draft of O&M Manuals together with a list of recommended spare parts for one year's operation and a list of special tools, both complete with prices to the Architect for comment within 28 days of the issuance of the completion certificate.

The Contractor shall submit 2 sets of the first draft of the User Manual to the Architect for comment at least 56 calendar days before the date of completion.

The Architect will check the drafts and return them to the Contractor within 42 days from the date of submission with comments necessary for a final and approved set of document. The Contractor shall then make all necessary amendments to the documents and resubmit them to the Architect within 21 days from the date of receipt of comments.

The Contractor shall submit 3 sets of hard copies (one of which shall be the original) and one set of electronic copy of the final approved O&M Manuals in CD-ROM within 21 days from the date of approval by the Architect.

The Contractor shall submit 2 sets of hard copies and one electronic copy of the final approved User Manuals in CD-ROM within 21 days from the date of approval by the Architect.

A4.4.4 Structure and Content of O&M Manual

The detailed requirements, structure and contents of the O&M Manual shall be as specified in elsewhere in the Contract and shall include the following information under separate sections where appropriate:

(a) Project Information

This shall include:

Project title, site address, contract no., contract title, contractor/sub-contractor name, address, contact persons and their telephone/fax nos., contract commencement date, substantial completion date and end date of the Maintenance Period.

(b) System Description

(i) Type(s) of system(s) and equipment installed;

(ii) Design criteria, design data and parameters;

(iii) Locations of the system and major equipment, and what they serve;

(iv) Description of operation and functions of the system and equipment; and

(v) General operating conditions, expected performance and energy and resources consumption where applicable.

(c) List of Installed Equipment

Schedule of all items of equipment and plant stating the location, name, model no., manufacturer's serial or reference no., manufacturer’s design duties and data.

(d) Spare Parts and Special Tools Lists

(i) List of Spare Parts supplied by the Contractor:
Item descriptions, supplied quantities, model nos., manufacturer’s serial or reference nos. and storage locations; and

(ii) Recommended Spare Parts List and Special Tools List:
Manufacturers’/suppliers’ recommendations for spare

parts and special tools with item description, unit rate, recommended stock quantities as well as the agents for the spare parts and special tools.

(e) Manufacturers' Certificates/Guarantees

(i) Manufacturers' certificates such as factory test certificate, laboratory test reports and guarantees and any others where required for the equipment and plants etc.; and

(ii) Originals of Statutory Inspection Certificate for various installations, including:

Electrical installations (Work Completion Certificate Form WR1),
Surveyor's test certificates for high pressure vessel,
Surveyor's load certificates for lifting devices/appliances, etc.

[Note: Testing records & commissioning data (other than the types prescribed above), which are required under the Contract such as the T&C procedures, etc to verify the compliance of the BS/E&M system's/equipment's performance with the Contract requirements, are checked and endorsed separately by the Architect and do not form part of the O&M manuals.]

(f) Safety Precautions for Operation and Maintenance

State, where applicable, hazard warnings and safety precautions of which the operation and maintenance staff need to be aware:

(i) mandatory requirements relating to safety;

(ii) known hazards against which protection measures shall be taken; and

(iii) known features or operational characteristics of the installed equipment or systems which may cause hazard and the related safety precautions.

(g) Operation Instructions

Instructions for the safe and efficient operation, under both

normal and emergency conditions, of the installed system which shall comprise:

(i) an outline of the operating mode;

(ii) control logic and data (sequence, effect, limits of capability, modes and set points);

(iii) procedures and sequences for start-up and shut-down;

(iv) interlocks between equipment/system;

(v) calling on of stand-by equipment;

(vi) precautions necessary to overcome known hazards;

(vii) means by which any potentially hazardous equipment can be made safe;

(viii) estimation of energy consumption and energy costs;

(ix) forms for recording plant running hours, energy consumption and energy costs; and

(x) operating data such as running current, operating pressure, operating flow rates etc.

(h) Maintenance

(i) Maintenance instructions

Manufacturers' and the Contractor's recommendations and instructions for the maintenance of the installed equipment. Clear distinction should be made between planned tasks (preventive maintenance) and fault-repair tasks (corrective maintenance). Instructions shall be given on each of the following, as appropriate :

- nature of deterioration, and the defects to be looked for;
- isolation and return to service of plant and equipment;
- dismantling and reassembly;
- replacement of components and assemblies;
- dealing with hazards which may arise during maintenance;
- adjustments, calibration and testing; and
- special tools, test equipment and ancillary services.

(ii) Maintenance schedules

Proposed maintenance schedules for all the preventive maintenance tasks identified above. The schedules shall be based on both manufacturers' recommendations and other authoritative sources (e.g. statutory or mandatory requirements) and should include :

- routine servicing;
- inspections;
- tests and examinations;
- adjustments;
- calibration; and
- overhaul.

The frequency of each task may be expressed as specific time intervals, running hours or number of completed operations as appropriate. Collectively, the schedules will form a complete maintenance cycle, repeated throughout the whole working life of the installation.

(i) Drawing Lists

(i) A complete list of as-built drawings identified with drawing number/reference;

(ii) A complete list of manufacturers' shop drawings with drawing number/reference, where applicable; and

(iii) A brief description of CD-ROM for these drawings.

(j) Technical Literatures

A complete set of manufacturers' literatures for all the plant and equipment installed in the system. The contents of these literatures shall cover the following areas where applicable:

(i) description of equipment with model numbers highlighted;

(ii) performance - behavioural characteristics of the equipment;

(iii) applications - suitability for use;

(iv) factory/laboratory test reports, detailed drawings,

circuit diagrams;

(v) methods of operation and control;

(vi) operation instructions;

(vii) cleaning and maintenance requirements;

(viii) plants, materials and space required for maintenance;

(ix) protective measures and safety precautions for operation & maintenance; and

(x) part lists.

(k) Contact addresses and telephone numbers of suppliers of major equipment.

A4.4.5 Structure and Content of User Manual

The detailed requirements, structure and contents of the User Manual shall include, where applicable, the following information:

(a) Project Information

The following information shall be provided:

Project title, site address, contract no., contract title, contract commencement date, substantial completion date and end date of Maintenance Period.

(b) System Description

(i) Type(s) of system(s) and equipment installed, and their purposes;

(ii) Locations of major plant rooms and riser ducts;

(iii) Brief description of the operation and functions of the systems and equipment; and

(iv) Listing of set points which can be adjusted by the user to suit their operation needs.

(c) Schedule of Major Plant Rooms and Installed Equipment

(i) Schedule of major plant rooms and riser ducts including their locations; and

(ii) Schedule of major equipment and plants including their locations and serving areas.

(d) Safety Precautions for Operation

Any safety precautions and warnings signals that the users shall be aware of in the daily operation of the various systems and equipment in the installation including:

(i) mandatory requirements relating to safety;

(ii) features or operational characteristics of the installed systems or equipment which may cause hazard and the related safety precautions;

(iii) protective measures and safety precautions for operation; and

(iv) list of warning signals and the related meanings that the user shall be aware of and the actions to be taken.

(e) Operation Instructions

Instructions for the safe and efficient operation, under both normal and emergency conditions, of the installed system which shall comprise:

(i) an outline of the operating mode;

(ii) step by step operation instructions for systems and equipment that are to be operated by the user, including at least procedures for start-up and shut-down;

(iii) means by which any potentially hazardous situation can be made safe; and

(iv) cleaning and basic maintenance procedures.

(f) List of Statutory Periodic Inspections and Tests

A schedule of periodic inspections and tests that owner and/or user of the installation have to arrange to achieve compliance with the requirements stipulated in the relevant Laws of Hong Kong. The frequency of such inspections and tests shall be expressed in specific time intervals.

(g) Drawings

A set of selected as-built drawings which shall be able to illustrate to the user the general layout of the completed installation.

(h) Photographs

A set of photographs with suitable captions to illustrate to the user the appearance and locations of devices which require their setting and operation.

A4.4.6 Intellectual Property Rights

The Government shall become the absolute and exclusive owner of the Operation & Maintenance Manuals and the User Manual and all intellectual property rights subsisting therein free from all encumbrances.

In the event that the beneficial ownership of any intellectual property rights subsisting in the above Manuals are vested in anyone other than the Contractor, the Contactor shall procure that the beneficial owner shall grant to the Employer a transferable, non-exclusive, royalty-free and irrevocable licence (carrying the right to grant sub-licences) to utilize the intellectual property rights in the manuals for the purposes contemplated in the Contract. For the avoidance of doubt such purposes shall, but not limited to, include providing free copying of the materials in the manuals by any subsequent owner or user of the installation, and/or any party responsible for the operation and maintenance of the installation in connection with any subsequent alteration, extension, operation and maintenance of the installation.

PART B – GENERAL TECHNICAL REQUIREMENTS

SECTION B2

PLANT REQUIREMENTS

B2.1 GENERAL

The equipment shall be new and of up-to-date model (but in general with proven design not less than 2 years) designed for a nominal serviceable life of 15 years. In general, the mechanical and electrical equipment shall be so designed as not to require frequent maintenance attention.

All the equipment and material supplied shall be proven products which shall have local agents or representatives. The Tenderers shall submit with their tenders full details of their offered equipment and material.

All items of equipment shall be rated for continuous service at the specified duties under the prevailing atmosphere and operational conditions on site.

All component parts of the equipment shall be manufactured to a strict system of tolerance limits so that complete interchangeability of similar parts is possible.

All items of equipment for which spare parts may be required shall have attached to them untarnishable metal plates clearly showing the manufacturer's name, serial numbers and basic information as to rating, etc., in sufficient detail to allow the unit or assembly to be identified in correspondence and when ordering spare parts.

All parts subject to wear shall be readily accessible for replacement.

Adequate and, as far as practicable, automatic means of lubrication shall be provided for all moving parts.

The position of all greasing and oiling points shall be arranged so as to be readily accessible for routine servicing. Where necessary, to achieve this, suitable extension pipes shall be fitted.

Lubrication grease points shall comply with BS 1486-1:1959 – Lubricating Nipples and Adaptors for Use on Machinery and Vehicle except where the lubrication required is of a special nature. In such event they shall be fitted with metal labels to indicate the special lubricant required.

Where continual grease or oil feeding is required, the capacity of the reservoir shall be sufficient for not less than seven days' continuous service with indicators in the form of meters or alarms.

In accordance with the Electricity Ordinance Chapter 406, all electrical works and electro-mechanical work on site and electrical tests shall be undertaken by registered electrical contractors/workers.

All machined surfaces which are liable to corrosion shall be appropriately wrapped or greased for protection after manufacture. Care shall be taken with the electrical control gear in order that the contacts or mechanisms remain in good working conditions.

B2.2 ELECTRICAL WORK

The Contractor shall supply, install and test all the electrical installation as required for the completion of work which includes:

(a) all necessary suitably sized switches, cables, cable conduits and trunking from supply source to the equipment; and

(b) Wiring up of the equipment including motor starters.

In accordance with the Electricity Ordinance Chapter 406, all electrical installation within the scope of this Contract shall be carried out by a Registered Electrical Contractor/Worker. After the electrical installation of the Contract is completed, it shall be inspected, tested and certified by a Registered Electrical Worker to confirm that the requirements of the Electricity (Wiring) Regulations have been met. The Registered Electrical Worker and Contractor shall sign the Work Completion Certificate for their individual electrical installation and submit it to the Architect before the electrical installation is energized.

All the equipment supplied shall be designed for operation on electrical supply of 380V, 3-phase, 4-wire at 50 Hz, and/or 220V, single phase, 50 Hz.

Unless otherwise specified in the Particular Specification, adequately sized multi-core armoured cables shall be supplied and installed in outdoor underground G.I. pipes provided by others with draw wire as shown in the Drawings. PVC cables of adequate size shall be used indoor and shall be run in concealed conduits provided by others with draw wires as shown in the Drawings.

Cable changing baskets shall be supplied and installed for connecting outdoor armoured cables with indoor cables. Cable entries into a building shall be resealed by approved means to prevent the ingress of moisture and vermin. Armoured cables shall be terminated in a gland fitted with an armour clamp. A watertight seal shall be made between the gland and the inner cable sheath. A shroud shall be fitted to cover the body of the gland and the armoured wires.

In case heavy gauge conduits or trunking system are used, all surface cable trunkings and conduits shall be supplied and installed in such a way as not to

cause obstruction to water pipes, drainage and other services. Cable route must be approved by the Architect.

All metal work associated with the electrical installation including the metal casing of the equipment supplied under the Contract, not forming part of phase or neutral circuits, shall be bonded together and shall be solidly and effectively earthed.

Motors shall comply with IEC 60034-1:2004 and BS 5000-11:1973 or unless otherwise specified, and shall be of such size and type to adequately drive the equipment under all normal conditions of service without overloading. Insulation shall be of minimum Class F for tropicalised conditions.

The continuous rating of the motor is to be such as to cover the full specified range of duty plus a further 5% margin for compressors, 15% margin for fans and 10% margin for pumps.

Motor starters shall be rated to intermittent class 0.1 60% on-load factor and utilisation category AC-3 in accordance with IEC 60947-4-1:2009. Suitably rated thermal overload relays shall be incorporated into each starter circuit with inherent single-phase protection. Each starter shall incorporate fuse protection.

Each starter for the motor shall comply with IEC 60947-4-1:2009, and shall be provided with an adjustable motor overload protection device and under-voltage release suitable for the motor load and having manual resetting facilities. Direct-on-line starters shall be used for motors smaller than 3.8 kW and for motors over 3.8 kW, star delta starters shall be used unless otherwise specified.

All secondary wiring shall be complete with numbered ferrules for identification which shall be carried out in a neat and systematic manner and finished at a terminal board at the junction of small wiring and incoming cables.

All electrical testing of the installation shall be carried out by the Contractor and witnessed by the Architect. Any material or workmanship found not in accordance with the regulations specified above shall be rectified and completed in a satisfactory manner by the Contractor at no extra charge to the Employer.

SECTION B3

INSTALLATION AND WORKMANSHIP

B3.1 STRUCTURE STEEL

Structural steel work shall comply with the provision of the following internationally recognized standards:

BS 7668:2004	Weldable Structural Steel: Hot Finished Structural Hollow Sections in Weather Resistant Steels
BS EN 10029:1991	Tolerances on Dimensions, Shape and Mass for Hot Rolled Steel Plates 3 mm Thick or Above
BS EN 10025:2004	Hot Rolled Products of Structural Steels. Technical Delivery Notes for Long Products, Thermomechanical Rolled Weldable Fine Grain Steels, Structural Steels with Improved Atmospheric Corrosion Resistance, Plates and Wide Flats of High Yield Strength Structural Steels in the Quenched and Tempered Condition
BS EN 10210	Hot Finished Structural Hollow Sections of Non-Alloy and Fine Grain Structural Steels
ISO 14713:1991	Protection against corrosion of iron and Steel in Structures, Zinc and Aluminum Coating

All forms of steel used shall be of standard section with dimensions, tolerances and properties complying with BS 4-1:2005, BS EN 10210-2:2006, BS EN 10056-1:1999 and BS EN 10067:1997.

All exposed edges shall be ground to produce a chamfer of not less than 2 mm in width.

B3.3 WELDING

All welding shall be carried out only by welders of the recognized proficiency, and to the satisfaction of the Architect. The welding electrodes, equipment and process shall also be subject to the Architect's approval and in accordance with:

BS 638	Arc Welding Power Sources, Equipment and Accessories
BS 2633: 1987	Specification for Class I Arc Welding of Ferritic Steel Pipework for Carrying Fluids

BS 2971: 1991	Specification for Class II Arc Welding of Carbon Steel Pipework for Carrying Fluids
ISO 2560:2009	Welding Consumables - Covered Electrodes for Manual Metal Arc Welding of Non Alloy and Fine Grain Steels – Classification
BS EN 1011:2009	Welding – Recommendations for Welding of Metallic Materials
IEC 60974-6:2003	Arc Welding Equipment. Limited Duty Manual Metal Arc Welding Power Sources

Welding shall not be carried out under unfavourable conditions. The Contractor shall make certain that all welded surfaces are clean and dry before any welding is done.

B3.4 PAINTING

B3.4.2 Removal of Scale and Rust

Unless specially specified in the Drawings or elsewhere in this Specification, rust and mill-scale must be removed by manual cleaning before painting.

Manual cleaning shall be carried out by a power tool operated carborundum disc followed by steel wire brushing and dusting to remove all loosened material.

Excess burnishing of the metal through prolonged application of rotary wire brushes or carborundum disc shall be avoided. Visible peaks and ridges produced by the use of mechanical cleaning tool shall be removed.

If blast cleaning is required, it shall be carried out in accordance with ISO 8504:2000 – Surface Preparation Methods. The quality of blast-cleaning shall be to the preparation grade Sa 2.5 as given in ISO 8501:2007 unless otherwise specified. The Contractor shall select the most appropriate method of blast-cleaning according to the shape and size of the steel work and the type of surface deposit to be removed.

The maximum grade of metallic abrasive permitted shall be as specified in ISO 8501:2007. The abrasive used for blasting shall be free from harmful contamination and any recovered material shall be filtered and cleaned before reuse.

The blast-cleaned surface shall have a small profile size. Blast-cleaned surfaces shall be dusted by brush or vacuum and shall not be touched by hand or other contaminated materials.

PART C – TECHNICAL REQUIREMENTS

SECTION C1

STEAM BOILER

C1.3 DESIGN

C1.3.1 Boiler

The steam boiler shall be constructed to BS 2790:1992 for a maximum working pressure of 800kPa gauge and tested to 1 200kPa gauge at the manufacturer's works unless otherwise specified in the Particular Specification. Manufacturer's test certificate in quadruple is required. The boiler shall be of the genuine 3-pass wet back, radiant heat type with a combustion chamber concentric with the horizontal cylindrical shell and complete with a purpose made fully automatic burner. Non 3-pass boilers are not acceptable and reverse flame is counted as one pass only.

Cradles or footings shall be designed so that no distortion of the boiler shell and footings will take place due to thermal expansion or any static or dynamic loads.

The boiler shall have front tube removal facilities and shall not be supplied with swinging back door. Inspection door shall, however, be fitted at the back of each boiler. Boilers that required a space in the boiler room for fire tube removal larger than available shall not be accepted. Connections shall be flanged to BS EN 1515:2000, BS EN 1092-1:2007, BS EN 1092-2:1997, BS EN 1092-3:2003 as appropriate.

C1.3.1.5 Boiler Instrumentation

(a) Smoke Density Meter –

In each boiler flue, between the boiler and the first expansion joint as indicated in the Drawings, a smoke density detector of the approved manufacture shall be fitted to monitor the smoke density leaving each boiler. Appropriate tubes shall be installed diametrically opposed for mounting a light source monitoring unit. Both tubes should be readily accessible for cleaning. The detector shall be wired in conduit to the smoke density meter on the boiler control panel. A smoke density meter shall be provided for each

boiler together with indication lights and audible alarm. Each meter shall be calibrated to energize a green light when operating at normal smoke density and a red light and audible alarm when smoke density exceeds Ringelmann(s) number 1 to BS 2742:2009 "Notes on the Use of the Ringelmann and Miniature Smoke Charts". In addition, the smoke density meter shall be installed with self-cleaning facilities by means of blowing of air.

C1.3.2.1 Diesel Oil Burner

The burner shall be designed and constructed to BS 5410-2:1978 for boilers firing with light diesel oil to BS EN 590:2009 class A2. It shall be designed for force draught, of the pressure jet type with suitable automatic air/fuel ratio control to achieve maximum fuel economy throughout the entire operating range of the equipment served. Firing sequence controls shall be fully automatic with appropriate safety timers and controls for pre-purge, post-purge, ignition, flame establishment to BS EN 303-1:1999 and 303-4:1999. Flame detector shall be of the photo-electric type. Failure of the safety timers or malfunction of the burner shall cause fuel shut-off and lock-out. Lock-out shall be manual reset and shall have audible-visual alarm. A burner 'normal' indicator shall also be incorporated. The diesel oil pump shall be of the positive displacement type, have built-in pressure relief, oil pressure adjustment, inlet strainer, integrating oil meter in litres, necessary valves and fittings.

Burner motor shall be rated at 380V/3/50 ±2% Hz, of insulation class F to BS 4999, type of protection IP54 to IEC 60947-1:2004, with motor starter to BS EN 1906:2002 and have low volt release, adjustable thermal overload protection and manual re-setting facilities.

C1.3.2.4 The Gas Burner System

The burner shall be designed and manufactured to BS EN 676:2003 and BS 5885-1:1988 "Specification for industrial gas burners of input rating 60 kW and above". The burner shall be fully automatic with modulating air/fuel control, fail safe and fool proof.

Each gas burner system shall be provided with a quick acting manual isolating valve upstream followed by a gas booster or compressor with its protection devices, governor, safety shut-off valves system, gas modulating butterfly valve, pilot ignited burner with combustion air blower & modulating air damper for multi-stage burner and all accessories & control suitable for use with towngas and complying also with the regulations and requirements of the Gas Supply Company.

The main gas and start-gas supplies shall be under the control of constant pressure governor(s) to BS EN 88:2007 or BS EN 12864:2001, BS EN 13785:2005 or BS EN 13786:2004 as appropriate. All flow setting restrictors shall be downstream of the governor.

Separate pilot burner shall be provided with the start-gas supply taken from such a position as to avoid starvation of the pilot.

The safety shut-off system shall comply with BS EN 676:2003 and BS 5885-1:1988: Clause 4.6. The main gas safety shut-off valve system shall be of the double block type including suitable system check or proving systems to the requirements in BS ISO 10770:1998. Separate safety shut-off valve(s) or start-gas rate controlling device to BS EN 676:2003 and BS 5885-1:1988 Clause 4.6.2.2 shall be provided for the pilot burner. To facilitate commissioning and testing of the safety system, a manual valve downstream of the main gas safety shut-off valves to isolate the main gas flow other than the start-gas flow shall be provided. Another manual valve to isolate the gas supply to pilot burner independently of gas supply to the main burner shall also be provided. Inlet strainer to BS EN 676:2003 and BS 5885-1:1988 Clause 4.1 shall be provided for each safety shut-off valve.

A sequence controller and all necessary timers, relays, contactors, wirings, flame detectors, sensors and switches for temperatures, pressures, positions and flow shall be provided to effect all the pre-start system checks or proving for safety shut-off valves, combustion air and air/fuel ratio; the safety timers for pre-purge, post-purge, start-gas flame and main flame establishment; and the safety shut-down and lock-out for supply gas over pressure, gas booster/compressor inlet low pressure, air flow failure, loss of pilot flame or main flame, electric

power failure, failures of the system checks or proving or safety timers, and other system faults all in accordance with BS EN 676:2003 and BS 5885-1:1988.

Control, wring and electrical components shall comply with BS EN 676:2003 and Clause 6 and 8 of BS 5885-1:1988. Audible and visual indications shall be provided for individual fault conditions and lock-out to enable easy fault diagnosis. The combustion air blower motor shall be suitable for operation on 380V, 3 phase, 4 wire, 50±2% Hz, of insulation Class F to BS 4999, and with type of protection IP54 to BS EN 60947-1:2004. Motor starter shall comply with BS EN 1906:2002 and shall have low volt release, adjustable thermal overload protection, phase failure protection and having manual re-setting facilities. There shall be earthing continuity throughout the gas pipework.

The air/fuel ratio control for two or multi-stage burner shall be fully modulating with the air damper and the butterfly gas flow valve linked pneumatically, electrically or mechanically. The air/fuel ratio system shall be designed to minimize the risk of off-ratio firing. Suitable pressure or temperature transducers shall be provided with the firing modulating control to give maximum efficiency of the equipment served throughout its entire operating range.

C1.3.2.7 Requirements on Dual Fuel Burners

(a) In addition to the requirements for gas flow pipework and controls in BS EN 676:2003 and BS 5885-1:1988, the design of dual fuel burners when operating on light diesel oil (BS EN 590:2009 Class A2) shall comply with BS EN 230:2005, BS 799-3:1981, 4:1991 and BS 5410-2&3:1978, and the British Gas Publication No. 1M/7 "Code of Practice for large gas and dual fuel burners";

C1.4 EQUIPMENT AND MATERIAL

C1.4.4 Strainer

Strainer shall be Y type with stainless steel screen to BS EN 10048:1997 and cast iron body. It shall be suitable for operating temperature up to 250^{o}C on the steam and condensate pipeline.

C1.4.9 Condensate/Feed Tank and Make-up Water Demineralising

The condensate/feed tank shall be mild steel and fabricated in accordance with the Drawings. The tank shall be painted internally and externally with 2 coats of anti-corrosion solution.

The mixing tank of the chemical dosing system shall be constructed of heavy-duty polyethylene.

Materials used for towngas service riser and pipes at pressure exceeding 7.5 kPa but not exceeding 200 kPa shall comply with the following requirements where appropriate.

(a) BS EN 10255:2004: Steel tubes and tubular (heavy) suitable for screwing to BS 21:1985 pipe threads.

(b) BS EN 1092-2:1997: Flanges and bolting for pipes, valves and fittings.

(c) BS 21:1985: Pipe threads for tubes and fittings where pressure tight joints are made on the threads. (metric dimensions)

(d) BS EN 10242:1995, BS 143 and 1256:2000: Malleable cast iron and cast copper alloy screwed pipe fittings for steam, air, water, gas and oil.

(e) ISO 4145:1986, BS EN 10241:2000: Wrought steel pipe fitting. (screwed BSP thread)

(f) BS 1552:1995: Control plug cocks for low pressure gas.

(g) BS 6956:1988: Jointing materials and compounds for water, low pressure steam installations, 1st, 2nd and 3rd family gases.

(h) BS 3063:2005: Dimensions of gaskets for pipe flanges.

(i) BS EN 1514:1998: Dimensions of Gaskets for pipe flanges to BS EN 1092-1:2002 and BS EN 1092-2:1997 Part I Dimensions of non-metallic gaskets for pressure up to 64 bar.

All materials used for gas installation pipes and fittings at pressure not exceeding 7.5 kPa should comply with the requirements of the Standards listed below and any relevant International Standards, in addition to those stated above where appropriate. Where no such standard exists, materials used should be as specified by the Gas Supply Company.

(a) BS EN 1057:2006: Copper and copper alloys tubes.

(b) BS EN 12449:1999: Copper and copper alloys. Seamless, round tubes for general purposes.

(c) BS EN ISO 9453:2006: Soft solders.

(d) BS EN 1254-2:1998: Capillary and compression tube fittings of copper and copper alloy.

(e) BS EN 1254-1:1998 & BS EN 1254-2:1998 Part 2 Metric units.

(f) BS 2051-1:1973 & BS 2051-2:1984: Tube and pipe fittings for engineering purposes.

(g) BS EN 10312:2002: Light gauge stainless steel tubes.

(h) BS 61:1969: Threads for light gauge copper tubes and fittings.

(i) BS 7786:2006: Unsintered PTFE tape for thread sealing applications.

C1.5 ERECTION AND INSTALLATION

C1.5.7 Welding

All welding on pipework shall be carried out generally by the electric arc process to BS 2633:1987. Where steel pipework of 50mm dia. and below is to be welded, gas welding by the oxy-acetylene process to BS 2640:1982 may be used. Gas welding on pipework 65mm and above will not be permitted unless prior permission is obtained.

Where brazing or bronze welding is undertaken, such welding shall be carried out in accordance with, and satisfy the testing procedures described in BS EN 14324:2004. In all other respects, particulars relating to the welding of steel pipework shall apply equally to copper.

Test welds on both steel and copper by each welder employed on the site shall be carried out in the presence of the Architect prior to the operator undertaking any work on the Contract. All such test welds must be made in position as directed by the Architect and shall be subjected to visual examination and bend tests in accordance with BS 2971:2006. Each weld shall be given a suitable mark enabling the operator to be identified.

The quality of welding in steel or copper shall be subjected to careful inspection and testing by the Architect and where so deemed necessary may be subject to non-destructive and/or destructive tests under the supervision of the Architect.

C1.5.12 Insulation

Pipework insulation shall be deemed to include all open vents, cold feeds, valves, flanges, fittings, heat exchangers, equipment items whether specifically mentioned or not.

All thermal insulation, including fixings shall comply with ISO 12241:1998, BS 5970:2001 and BS 5422:2009. All surface finishes shall comply with Class 0 surface spread of flame.

No insulation shall be applied before the relevant service has been satisfactorily tested, cleaned and painted.

Each pipe/duct shall be separately insulated with a minimum space of 50 mm between finished services.

All materials of the same type shall be supplied by a single manufacturer to ensure uniformity of standards and appearance.

All materials delivered to site shall be new, and where appropriate, colour coded and labelled at the factory to identify different grades, sizes and types.

Before ordering any insulating materials, the co-efficient of thermal conductivity for each of the materials being supplied for the Works shall be stated and shall allow for carrying out tests on representative samples (of each material) taken at Site and/or at markers' works as directed by the Architect and tested in accordance with the methods laid down in relevant Standards. In the event of test results not being in the Architect's opinion satisfactory, the Architect shall have the right to order the removal and replacement of all material represented by the unsatisfactory samples.

Before ordering any painting materials, the Contractor shall submit to the Architect for approval the type and manufacture of materials.

All materials including the thermal insulation itself, together with adhesives, paint, bands, sheeting, etc. shall be supplied with a reasonable margin for cutting, wastage and making good damage and loss. All materials shall be stored in a suitable manner so as to protect them from damage or deterioration before fixing.

Where a pipework or ductwork system or item of equipment is listed in the schedules in this Section or otherwise requires to be insulated, then the entire system or items shall be insulated to prevent condensation and reduce heat loss or gain.

All valves, flanges, strainers, expansion joints, etc., for heating system shall be insulated in conformity with the pipework in which they are incorporated, and to the same thickness all such items shall be provided with fibreglass filled 0.8 mm thick hammered aluminium split boxes, arranged for easy removal, the box to enclose valve handle and to have a lid for valve access.

All insulation shall be applied so as to give a smooth, homogeneous and lineable surface. All rigid sections shall be concentric, and accurately matched for thickness. Steps and undulations in the surfaces shall not be acceptable. Any sections or slabs having damaged ends or edges shall be rejected.

All insulation shall fit tight to surfaces to be covered, and all slabs and sections shall be built up close, butting edges being mitred, chamfered or shaped as necessary. Any minor interstices left in insulation shall be filled and sealed.

Insulation shall be applied to clean and dry surfaces, free of foreign material such as oil, grease, rust, scale or dirt.

Any surface to be insulated, which shows any signs or rusting or damage shall, prior to insulating, be thoroughly scraped and wire brushed as necessary to remove all rust, scale, etc. Surfaces shall then be solvent cleaned to remove all oil, grease, salts and dirt prior to the application of a coat of primer. Application of primer shall be as specified in the Clause B3.4 of this Specification.

Only clean and dry insulation shall be used. Insulation shall generally be applied in accordance with the manufacturers' recommendations.

Continuous insulation shall be provided through all sleeves and insulation joints shall be staggered with respect to joints on the associated pipework or ductwork system.

The insulation on the pipes immediately adjacent to such flanges, etc., shall be neatly terminated to allow for easy removal of bolts. A canvas insertion shall be provided to allow the insulated boxes to be removed without damage to the pipe insulation.

SECTION C2

MILD STEEL CHIMNEY

C2.2 COMPLIANCE WITH SPECIAL REGULATORY REQUIREMENTS AND STANDARDS

(c) BS EN 62305:2006 - Protection Against Lightning;

C2.4 EQUIPMENT AND MATERIAL

C2.4.2 Exterior Insulation

All thermal insulation, including fixings shall comply with BS 5970:2001, ISO 12241:1998, BS 5422:2009 and ISO 12241:1998. All surface finishes shall comply with BS 476 Class 0 surface spread of flame.

Insulation shall be mineral wool of approved quality, suitable for use up to 300^{o}C and having a thermal conductivity of not greater than 0.06 W/m^{o}C. The thickness of insulation shall be properly selected for personal protection.

All materials of the same type shall be supplied by a single manufacturer to ensure uniformity of standards and appearance.

Before ordering any painting materials, the type and manufacture of all materials shall be submitted to the Architect for approval.

All insulating, finishing and painting materials shall be suitable for the surfaces to which they are applied and for the environmental conditions in each area.

No asbestos based insulation shall be used.

All equipment and materials used shall be fire resistant and shall comply with the requirements of the National Fire Protection Association (NFPA) and the Hong Kong Fire Services Department.

C2.5.3 Lightning Protection

Suitable protection against lightning, in accordance with the recommendations of the relevant clause of BS EN 62305:2006 shall be provided for the chimney.

SECTION C3

CRANE AND HOIST

C3.3 DESIGN

C3.3.1 Crane

C3.3.1.1 General

The crane shall be designed in accordance with BS EN 13001-1:2004 and BS EN 13001-2:2004 and the electrically operated cranes shall also be in accordance with ISO 4301-1:1986. For the crane and mechanism as a whole, the class of Utilization, Stage of Loading and Group Classification shall be in accordance with BS EN 13001-1:2004 and BS EN 13001-2:2004 and ISO 4301-1:1986.

The crane shall either be of a double-girder construction with the crab travelling on the girder rails, or a single-girder construction with the hoist hanging onto the girder. The girder(s) complete with end plates shall be designed to withstand maximum lateral and vertical stresses and be within the permissible deflection ratio in accordance with ISO 4301-1:1986.

The crane bridge shall be carried on end carriages of ample size to carry the rated load when lifted at one end of the crane bridge. The end carriages shall be fabricated, welded and stiffened internally throughout their length to produce a box section of high torsional resistance and shall be of approved design.

The track wheel, reduction gear and motor shall be combined to form one assembly. The end carriages shall be designed so as to enable the track wheels to be withdrawn or mounted readily. The wheelbase of an end carriage shall be not less than 1/7 of the crane span.

The electric overhead travelling cranes shall be carried on four roller-bearing double-flanged wheels mounted on steel axles driven by two geared motors simultaneously. The end carriage front plates shall be fitted with resilient buffers to absorb the shock in case of collision with the end stops of the gantry rails. The end carriages of the

cranes shall be designed so as to give at least 100mm clearance from the nearest structure during operation.

The universal beams complete with gantry rails shall be designed in accordance with ISO 4301-1:1986. The beams shall be secured onto the steel brackets or reinforced concrete corbel provided by the builder with spans as shown on the design. The gantry rails shall be complete with end stoppers and limit switches at the extreme ends of travel. Access to the crane shall be by ladder with necessary safety hoop to be installed at a corner of the building.

The capacity of the drum shall be sufficient for the height of lift designed. The hoist drum shall be accurately machined to contain the hoist rope in a single layer. The drum shall have flanges at both ends and the flanges shall not project less than two rope diameters above the rope. No fewer than two and a half dead turns shall remain on the drum at each anchored end at the lower limit of hoisting. The drum shall accommodate one further turn of rope at the upper limit of hoisting. Rope guides and hardened pressure ring/rollers shall be provided to ensure correct rope reeving during operation.

C3.3.1.5 Hooks and Ropes

Top hooks if required to swivel shall be fitted with plain bearings; bottom swivel hook shall be free to rotate under load. The hook shall be tested to 150% full load before assembly and complete with safety catch.

Rope and rope sheaves shall conform to BS EN 12385 . The wire rope must be replaced if a wire is broken or if it is found to suffer from swelling, fraying bruises, kinks, permanent bends, damage or corrosion.

The steel rope sheaves shall revolve on anti-friction bearings and shall be guarded for protection against rope displacement and completely protected by steel casings. Where two or more ropes are used in a system, means shall be provided to ensure that the tensile forces in the ropes are distributed in the designed proportions.

The factor of safety of the wire rope, which is determined by dividing the product of the minimum breaking strength of the rope and the number of falls by the safe working load for the crane, shall be not less than 5.

C3.3.1.8 Controls

(c) The pendant control unit shall have a die-cast metal or glass fibre reinforced polyester enclosure rated IP 54 to IEC 60529:2001. The enclosure shall be resistant to mechanical shock. Push buttons shall be provided for the following functions:

(i)	Main Hoist:	Fast Raise, Slow Raise, Fast Lower, Slow Lower
(ii)	Cross Travel:	Left, Right
(iii)	Long Travel:	Forward, Reverse
(iv)	Control:	Stop, Reset

C3.3.1.9 Electrical Installation

(a) The control cubicle for a crane shall be to a degree of protection of IP 54 to IEC 60529:2001. The control cubicle and the components shall be of bulk manufacture with endurance and reliability test records. The panels shall be suitably braced to form rigid structures, taking due account of the vibrations that may be encountered during the operation of the crane;

(f) Electric motors shall comply with IEC 60034:2004 and BS 5000-11:1973 as appropriate. Motor enclosures shall have a degree of protection of IP 54 to IEC 60529:2001. Motor bearings shall be with minimum working life of 40,000 hours. Bearings shall be arranged so that thermal expansion of the motor shaft does not impose thrust loading unless they are designed to accept thrust. Motor winding shall be of Class F insulation in operation at rated operating conditions;

(j) Starters shall be of air-break contactor type rated for Class B operation. Reversing contactors shall have mechanical and electrical interlocks. Contactors shall comply with IEC 60947-4-1:2009 with assemblies to IEC 60439-1:1999. Direct-on-line starters shall comply with

IEC 60947-4-1:2009;

(m) Miniature circuit-breakers shall comply with IEC 60947-2:2009. Triple pole MCBs shall be integral units and shall not be comprised of three single phase units mechanically strapped together; and

(n) Fuse switchgear and isolators shall comply with IEC 60947-3:2008. Fuses and fuse holders for short circuit protection shall be high breaking capacity (HBC) fuses to BS 88:1998. Indicating lamp units shall have a degree of protection of IP 54 to IEC 60529:2001. Push button units and limit switches shall have a degree of protection of IP65 to IEC 60529:2001.

C3.3.2.1 General

The hoist shall be to BS EN 13157:2004 or equivalent. The frame of the hoist shall maintain alignment under all expected conditions of service. The reduction gear shall be incorporated inside the hoist unit. The casing shall be strong and rigid. It shall be sealed for protection against dust and dirt.

All gears sprockets and shafts shall be of strength commensurate with the working load and shall be mounted on anti-friction bearings and sealed against ingress of dirt/moisture or leakage of oil. Adequate facilities for lubrication shall be provided, unless equipment with lifelong lubrication is used. All suspension fittings shall be detachable without damage for inspection.

The load chain shall pass through close-tolerance guide to minimise wear. Slack chain collecting bag to hold all the length of slack chain shall be provided for all hoists. The hook shall comply with EN 1677-5:2001 complete with safety catch. Top hooks if required to swivel shall be fitted with plain bearings, bottom swivel hook shall be free to rotate under load. The hook shall be tested to 150% full load before assembly.

C3.5.1 Crane

The crane shall be erected and installed in accordance with BS EN 13001-1:2004 and BS EN 13001-2:2004 and the electrically operated cranes shall also be in accordance with ISO 4301-1:1986.

The high tensile bolts and tapered washers etc. shall be supplied to the builder for installation of the bolts into the reinforced concrete corbel. The gantry rails shall be supplied, installed and secured onto the steel brackets or reinforced concrete corbel provided by the builder with spans as shown in the Drawings.

Wire rope and its tensioner shall be cleaned before the grease is applied.

The constructional and testing requirements for this automatic safe load indicator shall conform to the requirements in the Factories and Industrial Undertakings (Lifting Appliances and Lifting Gears) Regulations and BS 7262:1990.

Electrical connections between crane platform and the cross travel hoist assembly shall be with insulated flexible cables on rail-runners. The crane structures, motor frames and metal cases of all electrical equipment shall be effectively bonded to earth.

The control pendent shall be suspended from a stainless steel wire to prevent any strain on the supply/control cable at a height suitable for operation from the ground level. If this straining wire is integral with the cable, the wire must be terminated in a crimped-on ring terminal rigidly fixed at both ends such that the weight of the pendent is not carried by the conductors of cable at any time. Where remote control pendent is specified, it shall be free to move along the crane girder by the operator but independent of the movement of the hoist unit.

Epoxy resin based paint shall be used for the finish. Doors shall be fitted with gaskets. Each component within the control cubicle shall be identified with an engraved label which shall be fixed directly to or adjacent to the component.

SECTION C4

FUEL SUPPLY SYSTEM

C4.3 DESIGN

C4.3.2 Underground Horizontal Fuel Storage Tank

The construction of the underground fuel storage tank shall comply with EN 12285-1:2003 or other technically equivalent national or international standards.

All joints in the tank shell and dished ends shall comply with BS EN 1011-1 and ISO 2560:2009.

Tank shells shall be made of rings and each ring shall be formed from a single plate or from not more than two plates welded together, rolled into a true circle. No longitudinal weld in any ring shall lie within the bottom third of the tank circumference EN 12285-1:2003. Longitudinal seam welds in adjoining rings of plate shall be staggered from one another by a minimum of 45 degrees. Joints or seams shall not be placed in the positions of the cradles. All openings in the tank shall be located clear of the welding seams.

An end plate shall be made up from two smaller plates and the welded joint between which shall be horizontal and above the centre of the tank.

The internal surfaces of the tank shall be smooth and free from any obstruction apart from essential pipe connections. No internal bracing or gusset plate shall be permitted inside the tank.

Tank-hole covers and all flanges and pads associated with each manhole cover shall be provided and completed with bolts, washers and joint rings.

C4.4 EQUIPMENT AND MATERIAL

C4.4.3 Control Equipment

The cubicle shall be of the wall-mounted type, type of protection EEx d flameproof enclosures for operation in Zone 1 hazardous area as classified in IPMCSP and IP 65 enclosure to IEC 60529:2001. The drawings and the official certificate issued by BASEEFA or equivalent certification body of the cubicle shall be submitted.

C4.4.4 Level Switches

(b) The level switch shall be of Group IIA and Temperature Class T1 in accordance with IEC 60079-0:2007.

SECTION C5

GARAGE EQUIPMENT

C5.3 DESIGN

C5.3.9 Roller Brake Tester

C5.3.9.3 Power Drives

One electric motor shall be provided per pair of rollers for nearside and offside wheels. Nominal rating of each motor shall be suitable to drive vehicle with a maximum axle weight as given in the Particular Specification and able to react the applied braking force up to (3 times the axle load in tonnes) kN.

Motors shall be to BS 4999 and shall be protected up to a minimum of IP 44 of IEC 60034-5:2006. Cooling of motor shall be to IEC 60034-6:1991 Class IC0A1 and motor windings insulation shall be Class F to IEC 60085:2007. The roller drive is to be via a gear box to give an equivalent road speed of 2-3 km/hr.

The roller brake tester shall operate on a 380 V 50 Hz 3-phase AC supply. To avoid heavy starting current, suitably rated star-delta starter with overload protection shall be provided.

The roller brake tester shall be suppressed against electro-magnetic interference to BS EN 55014:2006.

Means shall be provided to enable a vehicle to be driven off the machine with the rollers stationary or with the rollers turning in the opposite direction to that used for a brake test (vehicle driving off forwards) or turning in the same direction to that used for a brake test (vehicle reversing off).

C5.4 EQUIPMENT AND MATERIAL

C5.4.1 Pipes and Fittings

All pipes less than 80 mm diameter shall conform to ISO 65/ BS EN 10255:2004 heavy quality and pipes of 80 mm diameter and above shall be to BS EN 10216-1:2002 and BS EN 10217-1:2002 with dimensions to BS 1600:1991.

Flanges shall be of the slip-on-welding type in accordance with ISO 7005:1992/BS EN 1759:2004 Class 150. Screwed fittings shall be made of malleable iron and threads shall comply with ISO 7-1:1999/BS 21:1985.

All jointing materials shall be oil resistant for the respective lubricating oil systems. Gaskets made of rubber or compressed asbestos fibre shall not be used.

Square elbows shall not be used, where practicable, long sweep bends shall be used in preference to round elbows.

Valves shall be of 'full way' type to allow free flow of waste oil. A sample valve shall be submitted to the Architect for approval before installation.

SECTION C6

GONDOLA

C6.3 DESIGN

C6.3.14 Electrical Installation

C6.3.14.3 Earthing

All exposed metal parts of the roof carriage and the gondola cradle shall be connected together and earthed in accordance to BS 7671:2008: and BS 7430:1998.

C6.3.14.4 Lightning Protection

All parts of the gondola system shall be designed to have good electrical conductivity and shall comply with BS EN 62305:2006 or other relevant international standards.

All sections including movable sections of the rail tracks shall be bonded together using soft annealed copper strip of 25 x 3 mm or flexible copper strand of 475/0.5 mm diameter. The rail tracks shall be connected to the roof lightning protection conductor using soft annealed copper strip of 25 x 3 mm. All connections shall be of negligible resistance, metal to metal and mechanically sound with non-ferrous nuts, bolts and washers using clamps where necessary.

SECTION C7

HOT WATER SYSTEM

C7.3 DESIGN

C7.3.1 Low Pressure Hot Water Boiler

The hot water boiler shall be constructed to BS 855:1990 for a maximum working pressure of 1000 kPa and tested to 1500 kPa at the manufacturer's works, unless otherwise specified in the Particular Specification. Manufacturer's test certificate in triplicate is required. The boiler shall be of the genuine 3-pass wet back, radiant heat type with a combustion chamber concentric with the horizontal cylindrical shell and complete with a purpose made fully automatic burner. Non-3-pass boilers are not acceptable and reverse flame is counted as one pass only.

An internal water circulator in the form of a guide vane shall be incorporated to provide positive circulation within the boiler, thus ensuring a more uniform temperature gradient within the shell. The hot water boiler shall have a hydraulic resistance compatible to the hot water system. Cradles or footings shall be designed so that no distortion of the boiler shell and footings will take place due to thermal expansion or any static or dynamic loads.

The boiler shall be designed for front tube removal unless otherwise specified, and facilities should be provided for this purpose. Inspection door shall be fitted at the back of each boiler. Swing type back door shall not be provided. The maximum room length available, allowing for fire tube withdrawal from front of boiler, shall be as indicated in the Drawings. Boilers that require a space larger than available in the boiler room for fire tube removal will not be accepted. Connections of 50 mm N.B. or smaller shall be screwed to BS 21:1985 and connections of 65 mm N.B. or larger shall be flanged to BS EN 1092-1:2002, BS EN 1092-2:1997 or BS EN 1092-3:2003 as appropriate.

C7.3.1.1 Boiler Rating

The boiler rating shall be as given in the Particular Specification. The boiler water flow temperature shall not be less than 85^{o}C with the return temperature approximately 15^{o}C below the flow temperature. The overall thermal efficiency of the boiler to BS 845:1987shall not be less than 80% fired by the specified fuel as stated in the Particular Specification over the whole operating range.

C7.3.2 Semi-Storage Type Water-Heated Hot Water Calorifier

The semi-storage type water-heated hot water calorifier (hereinafter referred to as semi-storage calorifier) shall be manufactured to BS 853-1:1996 to a Grade as specified in the Particular Specification. The maximum working pressure in the shell and battery shall be as specified in the Particular Specification. The semi-storage calorifier shall be hydraulically tested to 1.5 times the maximum working and design pressure respectively for both shell and heater battery at the manufacturer's works. Manufacturer's test certificate of each semi-storage calorifier shall be submitted, in triplicate, to the Architect before the equipment depart the factory and prior to shipment.

The shell of the semi-storage calorifier shall be mild steel to BS EN 10028:2009, BS EN 10029:1991, BS EN 10048:1997, BS EN 10051:1992, BS EN 10258:1997 and BS EN 10259:1997. The mild steel shell shall be lined internally with copper to BS EN 1172:1997, BS EN 1652:1998, BS EN 1653:1998 and BS EN 1654:1998/C106. The copper lining shall have a minimum thickness of 1.2 mm. The copper lining shall be constructed in such a way that no part of the mild steel shell shall come into contact with water. The mild steel shell and the copper lining shall be accurately rolled to shape and the ends shall be formed in presses with generous heel radii.

The heater battery shall be copper to BS EN 1057:2006 and shall be formed from solid drawn fined copper U-tubes with brass tubeplate to BS EN 1652:1998 and BS EN 1653:1998/CZ123 or CZ112. The heater battery shall have tube removal arrangement to facilitate cleaning and inspection of the battery. The position of the heater battery shall be designed to give proper access for inspection/maintenance.

The semi-storage calorifier shall be configured to horizontal or vertical type as specified in the Particular Specification. Cradles or footings shall be designed so that there shall be no distortion of the calorifier due to thermal expansion or any static or dynamic loads.

A bolted inspection opening of minimum 455 mm in diameter shall be provided. Manhole shall be provided at suitable position to give proper access for inspection/maintenance.

Connections of 50 mm N.B. or smaller shall be screwed to ISO 7-1:1999/BS 21:1985 and those above 50 mm N.B. shall be flanged to BS EN 1092-1:2002, BS EN 1092-2:1997 or BS EN 1092-3:2003 as appropriate. Sparge pipe fittings shall be installed for maintaining good thermal stratification of secondary water to ensure effective heat exchange.

The semi-storage calorifier shall be designed to combat the development of Legionnaires Disease. It shall be fitted with a built-in heater battery and an integral circulating pump to circulate water from the storage section through the heater battery and back into the storage section such that no stagnant cold water areas shall exist in the storage section during the operation of the calorifier.

The water shall be heated from cold to the set temperature in a single pass through the heater battery. The set temperature shall be regulated by a direct acting thermostatic control valve fitted on the primary side, which shall have quick response and modulation.

C7.3.3 Non-Storage Type Water-Heated Hot Water Calorifier

The non-storage type water-heated hot water calorifier (hereinafter to be referred as non-storage calorifier) shall be manufactured to BS 853-1:1996 to a Grade as specified in the Particular Specification. The maximum working pressure in the shell and the maximum design pressure in the heater battery shall be as specified in the Particular Specification. The non-storage calorifier shall be hydraulically tested to 1.5 times the maximum working and design pressure respectively for both shell and heater battery at the manufacturer's works. Manufacturer's test certificate of each non-storage calorifier shall be submitted, in triplicate, to the Architect before the equipment depart the factory and prior to shipment.

The shell of the non-storage calorifier shall be mild steel to BS EN 10028:2009, BS EN 10029:1991, BS EN 10048:1997, BS EN 10051:1992, BS EN 10258:1997 and BS EN 10259:1997. The mild steel shell shall be lined internally with copper to BS EN 1172:1997, BS EN 1652:1998, BS EN 1653:1998 and BS EN 1654:1998/C106. The copper lining shall have a minimum thickness of 1.2 mm. The copper lining shall be constructed in such a way that no part of the mild steel shell shall come into contact with water. The mild steel shell and the copper lining shall be accurately rolled to shape and the ends shall be formed in presses with generous heel radii. Connections of 50 mm N.B. or smaller shall be screwed to ISO 7-1:1999/BS 21:1985 and those above 50 mm N.B. shall be flanged to BS EN 1092-2:1997 and BS EN 1092-1:2002, BS EN 1092-2:1997 or BS EN 1092-3:2003 as appropriate.

The calorifier shall be configured to horizontal or vertical type, unless otherwise specified in the Particular Specification. Cradles of footing shall be designed so that there shall be no distortion of the calorifier due to thermal expansion or any static or dynamic loads.

The heater battery shall be copper to BS EN 1057:2006 shall be

formed from solid drawn fined copper U-tubes with brass tubeplate to BS EN 1652:1998 and BS EN 1653:1998/CZ123 or CZ122. The heater battery shall have tube removal arrangement to facilitate cleaning and inspection of the battery. Manhole shall be provided at suitable position to give proper access for inspection/maintenance.

C7.3.6 Thermal Insulation

Thermal insulation shall be applied to all pipework and fittings carrying hot fluid.

Pipework insulation shall include all pipework, valves, flanges, fittings, pumps and other plant items whether specifically mentioned or not.

All thermal insulation, including fixings shall comply with ISO 12241:1998, BS 5970:2001 and BS 5422:2009. All surface finishes shall comply with Class O surface spread of flame.

Thermal insulation shall be preformed rigid sections or slabs of glass or mineral fibre, protected and finished by fabricated hammered aluminium casings.

Preformed rigid insulation of glass or mineral fibre for hot fluid pipes shall comply with ISO 12241:1998 and BS 5422:2009.

C7.4.7 Hot Water Circulating Pumps

The Circulating Pump shall be of the centrifugal type with direct drive and mounted on a common bed-plate or flange mounted. Circulating Pumps of small flow rate shall be of the vertical in-line type of mounting which shall be either floor mounted or pipe mounted.

The pump shall have cast iron casing, gun metal impeller and stainless steel shaft and shall be suitable for an operating temperature of up to 100 ^{o}C. Bearings shall be of the seal-for-life ball or roller type.

Pump motors shall be suitable to operate on 380V/3/50 ±2% Hz, of totally enclosed fan-cooled type, type of protection IP54 to IEC 60529:2001 "Specification for Degrees of Protection provided by Enclosures", with insulation class F to IEC 60085:2007, and provided with motor starters with adjustable overload protection relay and under-voltage release.

The continuous rating of all motors shall cover the full specified range of duty plus a further 10% margin for the pumps

SECTION C8

INDUSTRIAL COMPRESSED AIR SYSTEM

C8.2 COMPLIANCE WITH SPECIAL REGULATORY REQUIREMENTS AND STANDARDS

(e) ISO 1217:2009 Methods for Acceptance Testing of Positive Displacement Compressors and Exhausters.

C8.4 EQUIPMENT AND MATERIAL

C8.4.8 Pipework

Compressed air pipework including vent pipes shall comply with the following current standards:

(a) BS EN 10255:2004 for steel tube sizes up to 80 mm nominal bore, 'Medium' grade tube for pressure up to and including 1000 kPa, and 'Heavy' grade tube for pressure above 1000 kPa; and

(b) BS EN 13480:2002 and BS EN 10217-2:2002 steel tube for sizes greater than 100 mm nominal bore.

All steel tube used for compressed air pipework shall be galvanised both internally and externally. Screwed fittings shall be of galvanised malleable iron conforming to BS EN 10242:1995.

Screw joints, excluding screwed on flanges, shall be used for steel pipes up to and including 80 mm nominal bore, provided that the maximum permissible pressure does not exceed those specified BS EN 13480:2002. Taper pipe threads shall be used with taper threaded fittings and shall comply with BS 21:1985.

Welded flange joints shall be used for steel pipe with maximum permissible pressure in excess of those specified in BS EN 13480:2002 and for steel pipe above 80 mm nominal bore irrespective of pressure.

Flanges and bolting of flanges shall be in accordance with the recommendations made in BS EN 1515:2000: Sections 3.1 & 3.2 and BS EN 1092-2:1997.

Gasket materials for use with flanges complying to BS EN 1092 shall comply with the dimensions given in BS EN 1514-1:1997.

C8.4.14 Pressure Gauges

Pressure gauges shall have their scale marked in kPa and comply with ISO 4126:2006 and BS EN 837-1:1998. A gauge cock fitted with anti-syphon pipe shall be provided at the points which require pressure readings.

The operating pressure of the gauge shall be within the middle of the full scale reading and provided with a red field on the scale to indicate the maximum allowable working pressure.

The dial of the pressure gauge at a level above 1.8 metre shall be 150mm whilst that at a level below 1.8 metre shall be 75mm.

SECTION C9

SEWAGE PUMPING SYSTEM

C9.4 EQUIPMENT AND MATERIAL

C9.4.1 Pump

Pumps shall be manufactured to meet the following requirements:

Pump casing	Cast Iron to EN 1564:1997 Grade 220
Impeller	Austenitic Cast Iron to BS EN 13835: 2002 Grade L – Ni Cu Cr 1563
Shaft	High Tensile Stainless Steel to EN 10084:2008, EN 10087:1999, EN 10088, EN 10095:1999 and EN 10250-1 & 4:2000 Grade 431S29
Bearing	Ball/Ball, no regreasing shall be required until after 3 years of continuous operation
Seals	Carbon/Tungsten Carbide
Bolts, nuts, screw & washer	Stainless Steel to EN 10084:2008, EN 10087:1999, EN 10088, EN 10095:1999 and EN 10250-1 & 4:2000 Grade 316
Hold-down bolts	Stainless Steel to EN 10084:2008, EN 10087:1999, EN 10088, EN 10095:1999 and EN 10250-1 & 4:2000 Grade 316

The sewage pump shall meet the designed capacity on normal operation.

The sewage pump shall be arranged with flanged connection to the discharge pipe. Each pump shall be closely coupled to the totally enclosed built-in submersible electric motor suitably rated for the pump.

Two mechanical seals, made of the material specified in above, shall be provided to seal off the leakage of sewage from the pump to motor.

The hydraulic efficiency of the pump shall be within the highest efficiency range at the specified operating point.

C9.4.2 Pump Motor

The motor shall comply generally with BS 4999 and shall operate on a 3 phase, 380 volt, 50 Hz supply.

The motor shall be of the squirrel cage, totally enclosed type with insulation of Class "F" to IEC60085:2004. Enclosure type of IP 68 to IEC 60529:2001 shall be used.

The motor shall be capable of supplying its rated output at rated speed at any voltage in the range 94% to 106% of the nominal voltage and shall satisfactorily operate continuously at its rated duty without excess temperature rise within this range.

The motor shall have its own built-in cooling system which shall enable the motor to operate continuously at its rated current regardless of whether the electric motor is above or below the surface of the liquid.

C9.4.3 Control Panel

The cubicle of the control panel shall be vermin proof and lockable to prevent vandalism. The thickness of sheet steel shall not be less than 2 mm and shall be properly reinforced with angle iron. The cubicle shall be constructed to conform to IP 44 to IEC 60529:2001 for indoor use and IP 65 for outdoor use.

All indicators, relays, control switches, push-buttons, fuses and other auxiliary apparatus shall be provided with labels clearly stating their function. The labels supplied shall be inscribed in English and Chinese characters.

C9.4.5 Pipework

Pipes and fittings shall be of ductile iron.

Ductile iron pipes and fittings shall be to EN 598:2007. Pipes shall be to Class I. Flanges shall be PN16 to EN 1092-2:1997 but made of ductile iron. The first and last flanges shall match the building contractor’s provision.

Flanges shall be machined smooth, drilled to EN 1092-2:1997: PN16 and jointed with a 3 mm thick full face rubber gasket to EN 1514-1:1997. All fixing and holding down bolts, nuts and anchors etc. shall be of stainless steel to EN 10084:1998, EN 10087:1999, EN 10088, EN 10095:1999 and EN 10250-4:2000 Grade 316.

SECTION C10

PNEUMATIC TUBE TRANSPORT SYSTEM

C10.5 ERECTION & INSTALLATION

C10.5.1 Pipework

All pipework shall be adequately supported in such a manner as to permit free movement due to expansion and contraction. Pipework supports shall be arranged as near as possible to joints, valves and changes in direction. The spacing of the supports shall not exceed 4.5m.

Vertically rising pipes shall be adequately supported at base of riser to withstand its total weight. Branches shall not be used to support the riser.

Pipes shall be arranged so as to provide subsequent access to any pipe for maintenance or removal purposes.

The anchors and supports shall be constructed of galvanized steel sections of appropriate strength and stiffness to an acceptable international / material standards.

Galvanized steel anchors capable of resisting the maximum stresses shall be provided. Cast-iron chairs with at least two wrought-iron stirrup bolts shall be used, the bolts being provided with sufficient thread to ensure an effective grip on the tube.

The system shall be supplied, and fixed in position ready for building in, all cleats, brackets and steelworks required for anchor points. Anchor steelworks secured to the bottoms of tube shall be coated with hot-poured bitumen.

The design of the network shall permit assembly and disassembly so as to accommodate future extension and modification.

Except for the section of tubing immediately connected to the Station, all transfer tubing shall be installed above the suspended ceiling level.

Suitable airtight compound shall be applied for seal joints.

For identification purpose, the tubing network shall be clearly marked / labelled.

As tubing network is prone to build up dust due to an electro-static

charge created by the transport of the carriers through the tubing network, action shall be taken to earth the network so as to eliminate the electro-static charge in addition to the electrical bonding as required by BS 7671:2008.

Tubes shall not be built solidly into walls and joints, and must not be positioned within the thickness of walls, floor or in any other inaccessible position.

Joints shall be clean threaded pulled up tightly. No caulking shall be allowed in any circumstance. Particular care shall be taken that all tubes shall be absolutely free from internal obstructions. To ensure this, all tubes and fittings shall be carefully reamed to ensure that the full bore of the tube is maintained, and where necessary shall be cleaned out before erection. Plugs shall be inserted in all open ends during the progress of the works to prevent the ingress of dirt and moisture.

Any stoppage which is found to impede passage through the pipework shall be removed after the system having been put into commission including making good of all pipework concerned.

All pipework shall have joints in positions which will facilitate erection and dismantling.

All fittings shall be of the same size as the tubes connected to them.

SECTION C11

VEHICLE TURNTABLE

C11.3 DESIGN

C11.3.6 Control Panels

Unless otherwise specified, all electrical equipment shall be suitable for use in ambient temperature up to 40^{o}C and relative humidities up to 100%. All electrical equipment shall be suitable for a rated voltage as specified.

The control panel shall be ergonomically designed to suit the physique of the average Hong Kong operators.

Control cubicles shall be vermin proof and shall also meet the requirements of IP54 enclosures with interior finished to an approved Matt White and exterior opaline green to BS 381C:1996.

All control cubicles shall have labels made from laminated self-coloured materials and engraved with descriptions in both English and Chinese to be approved by the Architect.

The contactors, switch fuses, relays and all other necessary items shall be housed in the appropriate control panel which shall be arranged with front access for maintenance. It shall also be lockable to prevent unauthorised access and malicious damage to the equipment inside.

Each relay shall be labelled appropriately to its service either by function or by code, in which case a code index shall be securely attached to the panel for easy and positive identification.

A wall-mounted lockable control panel shall be installed to include the operation and protection system for the vehicle turntable.

The panel shall be made of galvanised steel sheet of 2 mm minimum thickness and the enclosure shall be protected to IP54 as per IEC 60529:2001. The panel shall be coated with one coat of metallic zinc-rich primer to BS 4652:1995, type 2 or lead primer to BS 7956:2000, two undercoats and one finish coat. Undercoats and finish coat shall be of properly matching type and the finish coat give a hard gloss finish as required. The external paint finish shall be light grey to colour 631 of BS 381C:1996.

All circuits shall be accommodated in accordance with IEC

60439-1:2004. Permanent labels of the approved type shall be provided for the identification of major components.

Each control panel for the vehicle turntable shall include but not limit to the following major items:

(a) Triple pole motor starters to IEC 60947-4-1:2009 for power pack motor. Each starter shall be equipped with triple pole thermal overload protection device complete with manual reset.

(b) Associated power and control circuits with appropriate HRC fuse protection.

(c) One set of outgoing terminals and auxiliary terminals.

(d) Key-operated on/off main switch.

(e) Heavy duty push-buttons for the following purposes:

(i) deadman type push-buttons for the forward and reverse modes of operation;

(ii) lamp test; and

(iii) fault reset.

(f) Heavy-duty, mushroom head, hold-down type emergency stop push button with manual reset.

(g) Indication lamps for the following purposes:

(i) power on;

(ii) modes of peration (forward and reverse);

(iii) motor overload; and

(iv) high water level alarm in the turntable pit.

C11.3.7 Power Pack Motor

The power pack motor shall be totally enclosed, squirrel cage, high torque induction motor to BS 4999 and designed for intermittent operation capable to tolerate a maximum starting frequency of 12 times per hour at rated voltage without overheating. The motor shall have a minimum of Class F insulation and Index of Protection to IP55 in accordance with IEC 60529:2001.

C11.4 EQUIPMENT AND MATERIALS

The main members of the turntable frame shall be fabricated from beams, channels and angle iron of high grade structural steel to BS 7668:2004, BS EN 10029:1991, Parts 1 to 3 of BS EN 10025:2004, BS EN 10210-1:2006 and shall be so designed to withstand the laden vehicle load.

All steelwork shall be shot blasted to ISO 8501-1:2006 2nd quality (SA 2.5) and painted in accordance with B3.4 of this Specification.

The centre pivot shall consist of bronze bush with suitable vertical thrust bearing arrangement.

C11.4.1 Speed Reduction Gear Unit

The reduction gearbox shall be totally enclosed and shall be capable of transmitting the maximum rated power of the drive motor continuously.

The reduction gears shall be practically submerged in and lubricated by oil bath which can be drained off conveniently at an accessible position on the bottom of the gearbox. The gearbox casing shall be with access for routine inspection and maintenance.

The minimum grade of material of the gearbox components shall be as follows:

Components	Material
Casing & Baseplate	Cast iron
Shaft and Gears	Steel to BS EN 10095:1999, BS EN 10250:2000, BS EN 10084:2008 & BS EN 10087:1999
Drive nut & sleeve	Aluminium bronze

C11.4.4 Cabling

The power cables shall be steel wire armoured cable to BS 6724:1997 with copper conductor and suitably rated in accordance with BS 7671:2008.

The cables shall be suitable for installation in the piping provided by others between the control panel and the drive unit.

ANNEX I

LIST OF TECHNICAL STANDARDS QUOTED IN THIS GENERAL SPECIFICATION

Standard	Description
BS 4-1:2005	Structural Steel Sections - Part 1: Specification for Hot-Rolled Sections
BS 21: 1985	Specification for Pipe Threads for Tubes and Fittings Where Pressure-Tight Joints Are Made on the Threads (Metric Dimensions)
BS 61:1969	Threads for Light Gauge Copper Tubes and Fittings
BS 88:1988	Cartridge Fuses for Voltages up to and Including 1000 V a.c. and 1500 V d.c.
BS 143 and 1256:2000	Threaded Pipe Fittings in Malleable Cast Iron and Cast Copper Alloy
BS 227:1995	Specification for H-Section Steel Arches for Use in Mines
BS 381C:1996	Specification for Colours for Identification, Coding and Special Purposes
BS 417-2:1987	Specification for Galvanized Low Carbon Steel Cisterns, Cistern Lids, Tanks and Cylinders. Metric Units
BS 436	Spur and Helical Gears
BS 466:1984	Specification for Power Driven Overhead Travelling Cranes, Semi-goliath and Gliath Cranes for General Use
BS 476	Fire Tests on Building Materials and Structures
BS 545:1982	Specification for Bevel Gears (Machine Cut)
BS 638	Arc Welding Power Sources, Equipment and Accessories
BS 721	Specification for Worm Gearing
BS 799-3:1981	Oil Burning Equipment Part 3: Automatic and Semi-Automatic Atomizing Burners up to 36 Litres per Hour

Standard	Description
BS 799-4:1991	Oil Burning Equipment Part 4: Specification for Atomizing Burners (Other Than Monobloc Type) Together with Associated Equipment for Single Burner and Multi Burner Installations
BS 845-1:1987	Methods for Assessing Thermal Performance of Boilers for Steam, Hot Water and High Temperature Heat Transfer Fluids Part 1: Concise Procedure
BS 845-2:1987	Methods for Assessing Thermal Performance of Boilers for Steam, Hot Water and High Temperature Heat Transfer Fluids Part 2: Comprehensive Procedure
BS 853-1:1996	Specification for Vessels for Use in Heating Systems. Calorifiers and Storage Vessels for Central Heating and Hot Water Supply.
BS 855:1990	Specification for Welded Steel Boilers for Central Heating and Indirect Hot Water Supply (Rated Output 44 kW to 3 MW)
BS 1449:1991	Steel Plate, Sheet and Strip
BS 1486-1:1959	Lubricating Nipples, Lubricating Nipples and Adaptors for Use on Machinery and Vehicles
BS 1552:1995	Open Bottomed Taper Plug Valves for 1st, 2nd and 3rd Family Gases up to 200 mbar
BS 1600:1991	Specification for Dimensions of Steel Pipe for the Petroleum Industry
BS 1710:1984	Specification for Identification of Pipelines and Services
BS 1724:1990	Specification for Bronze Welding by Gas
BS 1821:1982	Specification for Class I Oxyacetylene Welding of Ferritic Steel Pipework for Carrying Fluids
BS 2051-1:1973	Tube and pipe fittings for engineering purposes. Copper and Copper Alloys Capillary and Compression Tube Fittings for Engineering Purposes
BS 2051-2:1984	Tube and Pipe Fittings for Engineering Purposes. Specification for Olive Type Copper Alloy Compression Tube Fittings

Standard	Description
BS 2633:1987	Specification for Class I Arc Welding of Ferritic Steel Pipework for Carrying Fluids
BS 2640:1982	Specification for Class II Oxyacetylene Welding of Carbon Steel Pipework for Carrying Fluids
BS 2742:2009	Use of the Ringelmann and Miniature Smoke Charts
BS 2790:1992	Specification for Design and Manufacture of Shell Boilers of Weld Construction
BS 2971:2006	Class II Arc Welding of Carbon Steel Pipework for Carrying Fluids-AMD 9773
BS 3063:1994	Dimensions of Gaskets for Pipe Flanges
BS 3486-1:1996	Wheels for Agricultural Machinery, Implements and Trailers Part 1: Specification for Wheel-to-Hub Fixing Dimensions
BS 3790:2006	Specification for Belts Drives, Endless Wedge Belt, Endless V-Belt,, Banded Wedge Belts, Banded V-belts and their Corresponding Pulleys
BS 4076:1989	Specification for Steel Chimneys
BS 4652:1995	Specification for Zinc-Rich Priming Paint (Organic Media)
BS 4800:1989	Schedule of Paint Colours for Building Purposes
BS 4872-1:1982	Specification for Approval Testing of Welders When Welding Procedure Approval Is Not Required. Fusion Welding of Steel
BS 4999	General Requirements for Rotating Electrical Machines
BS 5000:1981	Specification for Rotating Electrical Machines of Particular Types or for Particular Applications
BS 5154:1991	Specification for Copper Alloy Globe, Globe Stop and Check, Check and Gate Valves
BS 5169:1992	Specification for Fusion Welded Steel Air Receivers
BS 5378:1980	Safety Signs and Colours

Standard	Description
BS 5410-2:1978	Code of Practice for Oil Firing - Part 2: Installations of 45 kW and Above Output Capacity for Space Heating, Hot Water and Steam Supply Services
BS 5410-3:1978	Code of Practice for Oil Firing Part 3: Installations for Furnaces, Kilns, Ovens and Other Industrial Purposes
BS 5422:2001	Method for Specifying Thermal Insulating Materials for Pipes, Tanks, Vessels, Ductwork and Equipment Operating within the Temperature Range -40 Degrees C to +700 Degrees C
BS 5885-1:1988	Automatic Gas Burners Part 1: Specification for Burners with Input Rating 60kW and Above
BS 5970:2001	Code of Practice for Thermal Insulation of Pipework and Equipment in the Temperature Range -100 Degrees C to +870 Degrees C
BS 6037-1:2003	Code of Practice for the Planning, Design, Installation and Use of Permanently Installed Access Equipment. Suspended Access Equipment.
BS 6068 SEC 6.7:1994	Water Quality Part 6: Sampling Section 6.7: Guidance on Sampling of Water and Steam in Boiler Plants
BS 6346:1997	Electric Cables. PVC Insulated Armoured Cables for Voltages of 600/1000V and 1900/3300V
BS 6405:1984	Specification for Non-Calibrated Short Link Steel Chain (Grade 30) for General Engineering Purposes: Class 1 and 2
BS 6724:1997	Electric Cables Thermosetting Insulated, Armoured Cables for Voltages of 600/1 000 V and 1 900/3 300 V, Having Low Emission of Smoke and Corrosive Gases when Affected by Fire
BS 6956:1988	Jointing Materials and Compounds
BS 7262:1900	Specification for Automatic Safe Load Indicators
BS 7430:1998	Code of Practice for Earthing
BS 7668:2004	Weldable Structural Steel: Hot Finished Structural Hollow Sections in Weather Resistant Steels
BS 7671:2008	Requirements for Electrical Installations. IEE Wiring Regulations. Seventeenth edition

Standard	Description
BS 7786:2006	Specification for Unsintered PTFE Tape for General Use
BS 7956:2000	Specification for Primers for Woodwork
BS 10255:2004	Non-alloy Steel Tubes Suitable for Welding and Threading Technical Delivery Conditions
BS EN 88:2007	Pressure Regulators and Associated Safety Devices for Gas Inlet Pressures up to and including 500 mbar
BS EN 105-1	Part 1 Copper Tubes for Water, Gas and Sanitation.
BS EN 105-2	Part 2 Tubes for General Purposes
	Automatic Burner Control Systems for Oil Burners
BS EN 303-1:1999	Heating Boilers - Part 1: Heating Boilers with Forced Draught Burners - Terminology, General Requirements, Testing and Marking
BS EN 303-4:1999	Heating Boilers - Part 4: Heating Boilers with Forced Draught Burners - Special Requirements for Boilers with Forced Draught Oil Burners with Outputs up to 70 kW and a Maximum Operating Pressure of 3 Bar - Terminology, Special Requirements, Testing and Marking
BS EN 590:2009	Automotive Fuels - Diesel - Requirements and Test Methods
BS EN 676:2003	Automatic Forced Draught Burners for Gaseous Fuels
BS EN 837-1:1998	Pressure Gauges Part 1: Bourdon Tube Pressure Gauges - Dimensions, Metrology, Requirements and Testing
BS EN 1011:2006	Welding – Recommendations for Welding of Metallic Materials
BS EN 1011-1:2009	Welding - Recommendations for Welding of Metallic Materials. General Guidance for Arc Welding
BS EN 1057:2006	Copper and Copper Alloys - Seamless, Round Copper Tubes for Water and Gas in Sanitary and Heating Applications
BS EN 1092	Flanges and Their joints. Circular flanges for pipes, valves, fittings and accessories, PN Designated
BS EN 1092-1:2007	Flanges and Their joints. Circular Flanges for Pipes, Valves, Fittings and Accessories, PN Designated Part 1: Steel flanges

Standard	Description
BS EN 1092-2:1997	Flanges and Their Joints. Circular Flanges for Pipes, Valves, Fittings and Accessories, PN Designated Part 2: Cast Iron Flanges
BS EN 1092-3:2003	Flanges and Their Joints. Circular Flanges for Pipes, Valves, Fittings and Accessories, PN Designated Part 3: Copper Alloy Flanges
BS EN 1171:2002	Industrial Valves Cast Iron Gate Valves
BS EN 1172:1997	Copper and Copper Alloys - Sheet and Strip for Building Purposes
BS EN 1254:1998	Copper and Copper Alloys - Plumbing Fittings
BS EN 1254-1:1998	Copper and Copper Alloys - Plumbing Fittings - Part 1: Fittings with Ends for Capillary Soldering or Capillary Brazing to Copper Tubes
BS EN 1254-2:1998	Copper and Copper Alloys - Plumbing Fittings - Part 2: Fittings with Compression Ends for Use with Copper Tubes
BS EN 1514:1998	Flanges and Their Joints - Dimensions of Gaskets for PN-designated Flanges
BS EN 1514-1:1997	Flanges and their joints - Dimensions of Gaskets for PN-designated Flanges. Non-metallic Flat Gaskets With or Without Inserts
BS EN 1515-1:2000	Flanges and Their Joints. Bolting. Selection of Bolting
BS EN 1652:1998	Copper and Copper Alloys - Plate, Sheet, Strip and Circles for General Purposes
BS EN 1653:1998	Copper and Copper Alloys Plate, Sheet and Circles for Boilers, Pressure Vessels and Hot Water Storage Units
BS EN 1654:1998	Copper and Copper Alloys Strip for Springs and Connectors
BS EN 1759-1:2004	Flanges and Their Joints. Circular Flanges for Pipes, Valves, Fittings and Accessories, Class-designated. Steel Flanges, NPS 1/2 to 24
BS EN 1808:1999	Safety Requirements on Suspended Access Equipment. Design Calculations, Stability criteria, Construction. Tests.

Standard	Description
BS EN 1906:2002	Building Hardware. Lever Handles and Knob Furniture. Requirements and Test Methods
BS EN 1984:2000	Industrial Valves - Steel Gate Valves
BS EN 10025:2004	Hot Rolled Products of Non-alloy Structural Steels
BS EN 10028:2009	Flat Products Made of Steels for Pressure Purposes
BS EN 10029:1991	Specification for Tolerances on Dimensions, Shape and Mass for Hot Rolled Steel Plates 3 mm Thick or Above
BS EN 10048:1997	Hot Rolled Narrow Steel Strip - Tolerances on Dimensions and Shape
BS EN 10051:1992	Specification for Continuously Hot-Rolled Uncoated Plate, Sheet and Strip of Non-Alloy and Alloy Steels - Tolerances on Dimensions and Shape
BS EN 10056-1:1999	Specification for Structural Steel Equal and Unequal Angles. Dimensions
BS EN 10067:1997	Hot Rolled Bulb Flats. Dimensions and Tolerances on Shape, Dimensions and Mass
BS EN 10084:2008	Case Hardening Steels - Technical Delivery Conditions
BS EN 10087:1999	Free Cutting Steels - Technical Delivery Conditions for Semi-Finished Products, Hot-Rolled Bars and Rods
BS EN 10095:1999	Heat Resisting Steels and Nickel Alloys
BS EN 10210	Hot Finished Structural Hollow Sections of Non-Alloy and Fine Grain Structural Steels
BS EN 10210-1:2006	Hot Finished Structural Hollow Sections of Non-Alloy and Fine Grain Structural Steels Part 1: Technical Delivery Requirements
BS EN 10210-2:2006	Hot Finished Structural Hollow Sections of Non-alloy and Fine Grain Steels. Tolerances, Dimensions and Sectional Properties
BS EN 10216-1:2002	Seamless Steel Tubes for Pressure Purposes. Technical Delivery Conditions

Standard	Description
BS EN 10217-1:2002	Welded Steel Tubes for Pressure Purposes. Technical Delivery Conditions. Non-alloy Steel Tubes with Specified Room Temperature Properties
BS EN 10217-2:2002	Welded Steel Tubes for Pressure Purposes. Technical Delivery Conditions. Electric Welded Non-alloy and Alloy Steel Tubes with Specified Elevated Temperature Properties
BS EN 10241:2000	Steel Thread Pipe Fittings
BS EN 10242:1995	Threaded Pipe Fittings in Malleable Cast Iron
BS EN 10250-4:2000	Open Steel Die Forgings for General Engineering Purposes. Stainless Steels
BS EN 10255:2004	Non-alloy Steel Tubes Suitable for Welding or Threading. Technical Delivery Conditions
BS EN 10258:1997	Cold-Rolled Stainless Steel and Narrow Strip and Cut Lengths - Tolerances on Dimensions and Shape
BS EN 10259:1997	Cold-Rolled Stainless and Heat Resisting Steel Wide Strip and Plate/Sheet – Tolerances on Dimensions and Shape
BS EN 10312:2002	Welded Stainless Steel Tubes for the Conveyance of Aqueous Liquids Including Water for Human Consumption. Technical Delivery Conditions
BS EN 12165:1998	Copper and Copper Alloys - Wrought and Unwrought Forging Stock
BS EN 12334:2001	Industrial valves - Cast Iron Check Valves
BS EN 12385	Steel Wire Ropes- Safety
BS EN 12864:2001	Low-pressure, Non Adjustable Regulators Having a Maximum Outlet Pressure of Less Than or Equal to 200 mbar, With a Capacity of Less Than or Equal to 4kg/h, and Their Associated Safety Devices for Butane, Propane or Their Mixtures
BS EN 13001-1:2004	Crane Safety. General Design. General Principles and Requirements
BS EN 13001-2:2004	Crane Safety. General Design. Load Activity
BS EN 13157:2004	Cranes. Safety. Hand-Powered Lifting Equipment

Standard	Description
BS EN 13480:2002	Metallic Industrial Piping
BS EN 13480-1:2002	Metallic Industrial Piping - Part 1: General
BS EN 13480-2:2002	Metallic Industrial Piping - Part 2: Materials
BS EN 13480-3:2002	Metallic industrial piping Part 3: Design and Calculation
BS EN 13480-4:2002	Metallic industrial piping Part 4: Fabrication and Installation
BS EN 13785:2005	Regulators with a Capacity of Up To and Including 100 kg/h, Having a Maximum Nominal Outlet Pressure of Up To and Including 4 bar, Other Than Those Covered by EN 12864 and Their Associated Safety Devices for Butane, Propane or Their Mixtures
BS EN 13786:2004	Automatic Change-over Valves Having a Maximum Outlet Pressure of Up To and Including 4 bar With a Capacity of Up to and Including 100 kg/h, and Their Associated Safety Devices for Butane, Propane or Their Mixtures
BS EN 13789:2002	Industrial valves. Cast iron globe valves
BS EN 13835:2002	Founding. Austenitic cast irons
BS EN 14324:2004	Brazing. Guidance on the application of brazed joints
BS EN ISO9453:2006	Soft Solder Alloys - Chemical Compositions and Forms
BS EN 55014:2001	Electromagnetic Compatibility. Requirements for Household Appliances, Electric Tools and Similar Apparatus.
BS EN 62305:2006	Protection Against Lightning
BS EN 60085:2008	Electrical Insulation. Thermal Classification
EN 545:2006	Ductile Iron Pipes, Fittings, Accessories and Their Joints for Water Pipelines - Requirements and Test Methods
EN 598:2007	Ductile Iron Pipes, Fittings, Accessories and Their Joints for Sewerage Applications - Requirements and Test Methods
EN 837-1:1998	Pressure Gauges Part 1: Bourdon Tube Pressure Gauges - Dimensions, Metrology, Requirements and Testing

Standard	Description
EN 969:2009	Specification for Ductile Iron Pipes, Fittings, Accessories and their Joints for Gas Pipelines - Requirements and Test Methods
EN 1011-1:2009	Welding Recommendations for Welding of Metallic Materials Part 1: General Guidance for Arc Welding
EN 1092-2:1997	Flanges and Their Joints - Circular Flanges for Pipes, Valves, Fittings and Accessories, PN Designated Part 2: Cast Iron Flanges
EN 1171:2002	Industrial Valves. Cast Iron Gate Valves
EN 1514-1:1997	Flanges and Their Joints - Dimensions of Gaskets for PN-Designated Flanges Part 1: Non-Metallic Flat Gaskets with or without Inserts
EN 1564:1997	Founding - Austempered Ductile Cast Irons
EN 1677-5:2001	Components for Slings, Safety, Forged Steel Lifting Hooks with Latch. Grade 4
EN 10084:2008	Case Hardening Steels - Technical Delivery Conditions
EN 10087:1999	Free Cutting Steels - Technical Delivery Conditions for Semi-Finished Products, Hot-Rolled Bars and Rods
EN 10088	Stainless Steels
EN 10095:1999	Heat Resisting Steels and Nickel Alloys
EN 10242:1995	Threaded Pipe Fittings in Malleable Cast Iron
EN 10250-1	Open Steel Die Forgings for General Engineering Purposes - Part 1: General Requirements
EN 10250-4:2000	Open Steel Die Forgings for General Engineering Purposes - Part 4: Stainless Steels
EN 12285-1:2003	Workshop Fabricated Steel Tanks. Horizontal Cylindrical Single Skin and Double Skin Tanks for The Underground Storage of Flammable and Non-flammable Water Polluting Liquids
EN 12334:2001	Industrial Valves Cast Iron Check Valves

Standard	Description
EN 50060:1989	Specification for Power Sources for Manual Arc Welding with Limited Duty
EU standard 55014	Limits and Methods of Measurement of Radio Disturbance Characteristics of Electrical Motor-Operated and Thermal Appliances for Household and Similar Purposes, Electric Tools and Similar Electric Apparatus
IEC 60034:2004	Rotating Electrical Machines
IEC 60034-5:2001	Rotating Electrical Machines - Part 5: Degrees of Protection Provided by the Integral Design of Rotating Electrical Machines (IP Code). Classification
IEC 60034-6:1994	Rotating Electrical Machines Part 6: Methods of Cooling (IC Code)
IEC 60072:1994	Dimensions and Output Series for Rotating Electrical Machines
IEC 60079	Electrical Apparatus for Explosive Gas Atmospheres
IEC 60079-0:2007	Explosive Atmospheres Part 0: Equipment General Requirements
IEC 60085:2007	Electrical Insulation - Thermal Classification, Evaluation and Designation
IEC 60439	Low-voltage Switchgear and Controlgear Assemblies
IEC 60439-1:1999	Low-voltage Switchgear and Controlgear Assemblies. Type-tested and Partially Type-tested Assemblies
IEC 60529:2001	Degrees of Protection Provided by Enclosures (IP Code)
IEC 60947-1:2007	Low-voltage Switchgear and Controlgear Part 1: General Rules
IEC 60947-2:2009	Low-voltage Switchgear and Controlgear Part 2: Circuit-breakers
IEC 60947-3:2008	Low-Voltage Switchgear and Controlgear - Part 3: Switches, Disconnectors, Switch-Disconnectors and Fuse-Combination Units

Standard	Description
IEC 60947-4-1:2009	Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-Starters - Electromechanical Contactors and Motor-Starters
IEC 60974:2003	Arc Welding Equipment.
ISO 7-1:1999	Pipe Threads where Pressure-tight Joints are made on the Threads - Part 1: Dimensions, Tolerances and Designation
ISO 65:1988	Carbon Steel Tubes Suitable for Screwing in accordance with ISO 7-1
ISO 606:2004	Short-pitch Transmission Precision Roller and Bush Chains, Attachments and Associated Chain Sprockets
ISO 657:2000	Hot-rolled Steel Sections
ISO 1217:2009	Displacement Compressors - Acceptance Tests
ISO 2560:2009	Welding Consumables - Covered Electrodes for Manual Metal Arc Welding of Non Alloy and Fine Grain Steels – Classification
ISO 4126:2006	Safety Devices for Protection Against Excessive Pressure
ISO 4126-1:2004	Safety Devices for Protection Against Excessive Pressure. Safety Valves
ISO 4145:1986	Non-alloy Steel Fittings Threaded to ISO 7-1
ISO 4301-1:1986	Cranes and Lifting Appliances - Classification - Part 1: General
ISO 5388:1981	Stationary Air Compressors -Safety Rules and Code of Practice
ISO 5457:1999	Technical Product Documentation. Sizes and Layout of Drawing Sheets
ISO 5667-7:1993	Guidance on Sampling of Water and Steam in Boiler Plants
ISO 7005:1992	Metallic Flanges
ISO 8501:2006	Preparation of Steel Substrates before Application of Paints and Related Products - Visual Assessment of Surface Cleanliness

Standard	Description
ISO 8501-1:2007	Preparation of Steel Substrates Before Application of Paints and Related Products. Visual Assessment of Surface Cleanliness. Part1- Rust Grades and Preparation Grades of Uncoated Steel Substrates and of Steel Substrates after Overall Removal of Previous Coatings
ISO 8504:2000	Preparation of Steel Substrates before Application of Paints and Related Products - Surface Preparation Methods
ISO 9453:2006	Soft Solder Alloys - Chemical Compositions and Forms
ISO 10434:2004	Bolted Bonnet Steel Gate Valves for the Petroleum, Petrochemical and Allied Industries
ISO 10770:1998	Hydraulic Fluid Power - Electrically Modulated Hydraulic Control Valves
ISO 12241:1998	Thermal Insulation for Building Equipment and Industrial Installations - Calculation Rules
ISO 12944:1998	Paints and Varnishes: Corrosion Protection of Steel Structures by Protective Paint Systems.
ISO 17292:2004	Metal Ball Valves for the Petroleum, Petrochemical and Allied Industries

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