WATER SUPPLIES DEPARTMENT

STANDARD SPECIFICATION EM-00-02

SITE INSTALLATION AND TESTING OF MECHANICAL,

ELECTRICAL AND INSTRUMENTATION PLANT AND EQUIPMENT

- GENERAL

CONTENTS

SITE INSTALLATION AND TESTING OF MECHANICAL, ELECTRICAL AND INSTRUMENTATION PLANT AND EQUIPMENT - GENERAL

1. SCOPE

This Specification stipulates the general requirements for site installation, testing, commissioning and test on completion of mechanical, electrical and instrumentation plant and equipment / Plant and Materials in waterworks premises.

It shall be read in conjunction with the following WSD Standard Specifications:-

EM-00-03 General Requirements for Supply of Mechanical, Electrical and Instrumentation Plant and Equipment

EM-00-04 Site Safety, Health and Environmental Management of Mechanical and Electrical Works

EM-90-01 Drawing for Mechanical, Electrical and Instrumentation Plant and Equipment

EM-90-02 Instruction Manual for Mechanical, Electrical and Instrumentation Plant and Equipment

It shall also be read in conjunction with the following WSD Standard Specifications for specific requirements on particular plant and equipment / Plant and Materials:-

E-00-02 Site Installation and Testing of Electrical and Instrumentation Plant and Equipment

E-00-05 Site Installation and Testing of Building Services Equipment

2. GENERAL REQUIREMENTS

2.1 Logistics

(1) Unless otherwise specified, vehicular access to the Site / Working Areas (hereafter referred to as the Site) is available. However, the plant or equipment / Plant or Materials may not be installed on the same floor of the vehicular access. The Contractor / *Contractor* (hereafter referred to as the Contractor) shall observe the headroom and loading limitations for delivery of plant or equipment / Plant or Materials required for the completion / Completion of Works / *works* (hereafter referred to as the Works).

(2) Uninterrupted access shall be maintained for daily activities of the Site. Full attention and extreme care shall be required when driving in the Site. The Contractor's staff and vehicles may be required to log in and out of the Site at the entrance or apply for entrance permission in advance. They shall also wear approved / accepted (hereafter referred to as approved) means of identification for checking by the Engineer / *Project Manager* (hereafter referred to as the Engineer) and his Representatives and the Employer's / *Client*'s (hereafter referred to as the Employer) operational staff.

(3) If the Contractor requires access to the Site for work other than during the normal working hours of the Employer's staff (08:30 to 17:30, Monday to Friday), he shall serve a notice together with a works programme and a list of staff for carrying out the work two (2) working days in advance to the Engineer for approval / acceptance (hereafter referred to as approval). The Contractor shall observe the general requirements and noise limitations stipulated in the relevant Noise Control Ordinances during and after normal working hours.

2.2 Possession of the Site / Access to and use of the Site

2.2.1 General

(1) Possession of the Site / Access to and use of the Site (hereafter referred to as possession of the Site) will be given / allowed from time to time after commencement of the Works according to the works programme as notified. Except if and to the extent otherwise provided for in the Contract the Site shall not be used for purposes other than the execution of the Works.

(2) The Contractor shall submit a request for possession of the Site to the Engineer at least one (1) month in advance. The Engineer shall give the Contractor seven (7) days of notice in writing of the date of possession of the whole/part of the Site.

(3) Possession of any parts of the Site shall not be exclusive to the Contractor. Access shall be provided to the Employer's staff for the daily operations of the relevant waterworks installation(s) or other purposes.

(4) The Site shall be fenced off by approved type barriers for the safety of other persons in the waterworks installation(s).

2.2.2 Storage Areas

(1) The Contractor shall make his own arrangements for storage of plant, materials and equipment / Plant, Materials and Equipment on the Site until they are required for installation or incorporation into the Works. Prior agreement of the Engineer shall be sought with regard to the storage location on the Site.

(2) The Contractor shall be responsible for taking delivery of and transporting all items into and out of storage and distributing within the Site. The Contractor may, with the prior agreement of the Engineer's Representative and at no extra cost to the Employer, make arrangements for any other contractors on the Site or any other agent to take delivery of, unload and store the items on his behalf.

(3) The Contractor shall be fully responsible for the safe custody of the plant, equipment, and materials / Plant, Materials and Equipment delivered to Site and shall maintain the Site in good order to the satisfaction of the Engineer.

(4) The Contractor shall be responsible for all access to his storage area and for fencing, guarding, lighting and watching. Sufficient watchmen shall be provided to safeguard the plant, materials and equipment / Plant, Materials and Equipment in the storage. The Contractor shall vacate the area designated for his site office and storage compound, and reinstate the conditions of the area to the satisfaction of the Engineer within one month after the issue of the Certificate of Completion.

(5) All electrical and instrumentation plant, equipment and materials / Plant, Materials and Equipment likely to suffer from exposure, loss or damage under outdoor conditions shall be separately packed and kept in the Contractor's covered store.

2.3 Liaison with Others

(1) All necessary arrangements and approvals shall be made with and obtained from Government departments, utility undertakings and other duly constituted authorities for carrying out the Works.

(2) Prior to and during shutting down of any existing plant and system for facilitating connection/disconnection work or for execution of other Works, the Contractor shall liaise closely with the operational staff of the Employer and obtain prior approval from the Engineer on the proposed work sequence and the duration of the shutting down.

(3) The Contractor shall maintain close liaison with other contractors employed by the Employer, utility undertakings or other authorities who are concurrently carrying out work on or adjacent to the Site for ensuring as far as possible that the progress of the Works is not adversely affected by the activities of other contractors and no disruption to other contractors.

(4) The Contractor shall liaise on Site closely with the Employer's contractors for civil construction to ensure that the civil work so provided will suit his plant and equipment / Plant and Materials installation and the contract requirements.

2.4 Coordination of Works

(1) Once access to the buildings and structures is available, the Contractor shall ensure that all operations and activities for the execution of the Works shall be carried out so as not to interfere with the activities of other contractors working on the Site. All necessary measures shall be taken to ensure that whenever interference is unavoidable, the delivery, storage, installation or testing of plant, equipment and materials / Plant, Materials and Equipment shall be planned in consultation with the Engineer's Representative and the other contractors as appropriate.

(2) The Employer’s normal activities within the waterworks installation may affect the Contractor's work progress. The Contractor shall be deemed to have reasonably allowed for the interruption so caused to his work progress and shall adjust his work sequence to suit accordingly.

(3) The Engineer's Representatives, upon the request of the Contractor, will convene necessary meetings with the Employer's staff and other contractors of the Employer as appropriate to discuss matters affecting or likely to affect the execution of the Works, including, but is not limited to the possession of the Site, availability of buildings and structures, delivery of plant, equipment and materials / Plant, Materials and Equipment.

2.5 Photograph

(1) The Contractor shall, after commencement of site work, provide monthly of not less than eight (8) colour photographs (in JPEG format of at least 1 Megapixel) showing the progress of work on Site and the installed plant and equipment / Plant and Materials by email or shown in the progress report. The time and date when each photograph is taken along with the title showing the plant or equipment / Plant or Materials and the work concerned shall be included in the body of the photograph.

(2) All prints, soft copies shall become the property of the Employer. The Contractor shall ensure that no use is made of any soft copies or prints without permission from the Employer to whom all copyrights shall be transferred. The Contractor shall also ensure that no unauthorised photography is allowed on the Site.

(3) The Contractor shall provide as and when required “instant” photographs of subjects selected by the Engineer.

2.6 Utilities

(1) The Contractor shall exercise the greatest care to avoid damage to or interference with any utility services and shall be responsible for any such damage caused by him or his agents directly or arising indirectly from anything done or omitted to be done.

(2) Where diversions to utility services are necessitated by the Works any work which may affect the existing services shall not be commenced until the diversions have been made. All diversions shall not be commenced until approval is given by the Engineer.

(3) Where damage to utility services may be caused by operation of mechanical construction equipment / Equipment, the Contractor shall excavate by hand.

2.7 Progress Reports and Meetings

(1) Upon request by the Engineer's Representative, at monthly intervals after the commencement of the Contract, the Contractor shall submit to the Engineer one (1) copy of a written detailed progress report giving information on forecast and actual payment, and the progress in design, drawing / plant / Plant / equipment / Materials / manual submission, ordering of plant and equipment / Plant and Materials, manufacture, inspection, delivery, installation, testing and commissioning. These reports shall be accompanied by critical path network diagrams and/or schedules in approved format, such that the actual progress to the end of the preceding month can be compared with the Contractor's work programme. The reports shall be forwarded promptly so that on receipt by the Engineer the information contained therein is not more than seven (7) days out of date.

(2) From time to time the Engineer or his Representatives may call meetings two (2) working days in advance, in his or at the Contractor's office or at the Site, as he deems necessary and normally at intervals of one month for the purpose of control of the Contract which shall include discussion on the progress of Works, matters affecting or likely to affect the execution of the Works, possession of the Site, availability of buildings and structures, delivery of plant and equipment / Plant and Materials, Contractor's labour resources, workmanship and site safety and health matters.

(3) The Contractor's agent shall attend, and shall arrange for the representatives of sub-contractors, Government departments, transport companies, utility undertakings and other contractors to attend meetings, when required by the Engineer or his Representatives.

(4) The Contractor shall inform the Engineer two (2) working days in advance, or a shorter period agreed by the Engineer, before a meeting is to be held with Government departments, transport companies, utility undertakings and other contractors and shall give the Engineer and his Representatives the opportunity to attend such meeting.

2.8 Drawings

2.8.1 Drawings for the Contract

(1) The drawings as listed in the Particular Specification are provided to indicate the general arrangement of the plant / Plant and system and to illustrate the Works required under the Contract.

(2) The Contractor shall be responsible for verifying the actual as-built conditions and dimensions of the Site. Adjustment of the positions of plant / Plant may be required to suit site conditions. Any adjustment of the plant / Plant shall be at the Contractor's cost.

(3) The numbers and sizes of the plant or equipment / Plant or Materials shown on the drawings are for illustration only. The Contractor shall check the numbers and sizes of the plant and equipment / Plant and Materials given and make adjustment to suit the intended purpose.

(4) In the case of any discrepancy arising between the drawings and the Specification, the Contractor shall draw the attention of the Engineer for deciding which shall be followed.

(5) Amended or supplementary drawings will be issued from time to time as and when deemed necessary by the Engineer.

(6) The arrangement and configuration of the plant or equipment / Plant or Materials shown on the drawings are for reference only. The Contractor shall be responsible for checking the actual arrangement and configuration of the plant or equipment / Plant or Materials at the Site prior to commencement of the Works and make adjustment to the plant or equipment / Plant or Materials to suit as necessary.

2.8.2 Drawings Provided by the Contractor

(1) The drawings to be provided by the Contractor for the Works shall be prepared and submitted in accordance with WSD Standard Specifications EM-00-03 and EM-90-01.

(2) All drawings to be provided by the Contractor shall show the following particulars:

(a) Title of the project

(b) Contract number

(c) Title of drawing

(d) Details of electricity supply (where applicable)

(e) Plant and equipment / Plant and Materials serial number (where applicable)

(f) Scale of drawing

(g) Date of drawing

(h) Contractor's drawing number

(i) Name of Contractor

(3) The Engineer shall give his comment / approval on the Contractor's submission within three (3) weeks from the receipt of the said submission. One copy of the submission, if approved, shall be duly stamped, signed and returned by the Engineer to the Contractor. If a drawing is not approved, the Contractor shall suitably amend the drawing without delay and resubmit within three (3) weeks from the receipt of the Engineer's comments one (1) copy of the amended drawing to the Engineer for approval. Non-approval of drawings shall not entitle the Contractor to an extension of time. If a drawing is in the opinion of the Engineer acceptable subject to minor amendment, the Engineer shall give an approval subject to the Contractor's incorporation of all the marked up comments provided thereto.

(4) Within three (3) weeks from the issue of the notice of approval or conditional approval of drawings, the Contractor shall supply to the Engineer one (1) hardcopy and one (1) softcopy of the approved drawings. The approved drawings supplied should be stamped and certified by the Contractor as true copy.

(5) The Contractor shall submit one (1) set of record drawings of the plant / Plant as constructed for the Engineer's approval prior to his request for the issue of the Certificate of Completion.

(6) The Contractor shall supply for record purposes direct to the Engineer within one month from the issue of the Certificate of Completion one (1) hardcopy and one (1) softcopy of the final approved drawings of the plant / Plant as constructed. The softcopy shall be in the format as required, conforming to the latest version of Computer-Aided-Drafting (CAD) Standard for Works Projects as posted on the Development Bureau's web site or in Building Information Modelling (BIM) models.

(7) Payment of the final certificate will not be made until the final approved record drawings, including all amendments to the satisfaction of the Engineer, have been provided.

(8) Approval by the Engineer of the Contractor's design or drawings shall not relieve the Contractor of any of his obligations or liabilities under the Contract except in so far as provided for by the Conditions of Contract.

2.9 Operation and Maintenance Manual

(1) Operation and maintenance (O&M) manual shall comply with WSD Standard Specifications EM-00-03 and EM-90-02.

(2) The O&M manual shall be submitted in two parts. The Part 1 manual shall incorporate the general specification, maintenance requirements, spare part and special tools list and other information related to individual plant and equipment / Plant and Materials supplied by the manufacturers whilst the Part 2 manual shall incorporate the detailed overall description, design calculation, operation principle, control philosophy, plant register, record drawings and test reports of the plant / Plant and system.

(3) The Contractor shall submit one (1) set of draft Part 1 manual not later than one (1) month before the delivery of the plant and equipment / Plant and Materials to the Site for approval / comment of Engineer.

(4) One (1) set of draft Part 2 manual shall be submitted by the Contractor at least one (1) month before completion / Completion of erection of the plant / Plant for approval / comment of Engineer.

(5) During delivery and installation, the Contractor shall update, amend, modify and supplement the draft manuals taking into account the comments from the Engineer. The Contractor shall provide to the satisfaction of the Engineer one (1) set of the revised draft manuals within one (1) month after the plant and equipment / Plant and Materials delivered to the Site and prior to the issue of the Certificate of Completion for Part 1 and 2 manuals respectively.

(6) The Engineer's approval to the draft manuals shall be a pre-requisite condition to satisfy the meaning of substantial completion / Completion leading to the issue of the Certificate of Completion.

(7) Within one (1) month from the issue of the Certificate of Completion, the Contractor shall supply four (4) complete sets of the approved instruction manual as final instruction manual. The final instruction manuals shall be on paper form in bound and indexed volumes of A4 size. One additional electronic version of the complete set of final manual, including the as-fitted drawings shall also be supplied.

(8) Payment of the final certificate will not be made until all the final instruction manuals, including all amendments to the Engineer’s satisfaction, have been supplied.

2.10 Training of Employer’s Staff

(1) Where specified in the Contract, the Contractor shall provide full training and comprehensive instruction by the manufacturer’s representative to the Employer’s staff and personnel for the proper operation and maintenance of

the plant / Plant preferably during the testing and commissioning of the Plant. A training programme with details of topics covering the operation and maintenance of the plant / Plant shall be submitted one (1) month prior to the proposed commencement of training for the approval of the Engineer. The qualification and experience of the trainer(s) shall also be submitted in conjunction with the training programme for consideration by the Engineer.

The training shall include, but not limited to:

(a) Working principles of the plant and equipment supplied;
(b) Operation and configuration of the equipment;
(c) Operations and maintenance procedures and measures to be adopted in case of abnormal conditions;
(d) Fault diagnosis and operations precautions; and
(e) Emergency shut down procedures, re-starting after stoppage / emergency shutdown.

(2) The number of Employer's staff attending the training shall be up to 15 in each session. The Contractor shall arrange the required training sessions and provide sufficient sets of the necessary training notes/documentation for the attendees.

2.11 Programme

(1) The Contractor shall complete the Works within the time stated in the Form of Tender or Contract Data Part one.

(2) The Contractor shall prepare the programme for the agreement / acceptance by the Engineer within three (3) weeks from the date of Contract commencement / Contract Date. The breakdown of the Works on the programme shall be comprehensive including, but not limited to, the key activities, key dates, milestones, constraints, other specific requirements and the following stages of work:

(a) Provision of necessary information and civil requirements to others and liaison with others;

(b) Submission of design, plant and equipment / Plant and Materials details and drawings for approval;

(c) Activities for which the Employer or Engineer's input is required, including the issue of critical drawings and other information, provision of materials by the Employer, consideration and approval of drawings and proposals;

(d) Placement of plant and equipment / Plant and Materials orders;

(e) Manufacture and delivery of individual plant, equipment and material / Plant, Equipment and Materials, in particular those originating from outside Hong Kong;

(f) Works to be carried out by Government departments, utility undertakings and other contractors;

(g) Decommissioning, dismantling and removal of existing plant, equipment and material / Plant, Equipment and Materials;

(h) Installation, testing and commissioning of plant and equipment / Plant and Materials;

(i) Application and approval of Dangerous Goods Licence from Fire Services Department as appropriate;

(j) Submission of test procedures, operation and maintenance manuals, method statements for installation for approval; and

(k) Other information required in the relevant NEC Clauses such as float time as appropriate.

(3) Programmes submitted shall be in the form of bar charts showing the earliest and latest start and finish dates for each activity, and the critical path for completion / Completion of the Works.

(4) The Contractor shall highlight all BIM related works content in the programme as appropriate to identify BIM related activities and BIM generated deliverables which shall comply with the requirements of the Particular Specification.

(5) One (1) softcopy of the updated programme should be submitted to the Engineer's Representatives for comment seven (7) days prior to the monthly progress meeting. The Engineer's Representative shall check and agree with the Contractor's agent the percentages of completion of the individual activities and the sequence of execution of the remaining work to avoid, as far as possible, interruption to the normal operations of the waterworks installations concerned. The Contractor, after discussion and agreement with the Engineer's Representative, present one (1) softcopy of the updated programme for discussion at least one (1) day before the monthly progress meeting.

(6) The updated programme shall show the work completed to date, a detailed breakdown of the work to be carried out in the following month and an updated outline for the remainder of the Works.

3. MATERIALS FOR SITE INSTALLATION

3.1 Flanges

(1) All flanges shall comply with BS EN 1092, dimensioned and drilled to pressure rating of PN16 unless specifically stated otherwise.

(2) All blank flanges and ring flanges shall be truly faced over their full width, and the bolt holes shall be drilled off centre lines, truly in line end to end with the longitudinal axis. All flanges shall have their jointing surfaces machine finished to comply with the requirements of BS EN 1092 or specified otherwise on the drawings.

(3) Ring (loose) flanges shall be machined to a bore diameter larger than the outside diameter of the pipe according to the relevant international standards.

3.2 Bolts, Nuts and Washers

(1) Steel hexagonal headed bolts, tap bolts, and nuts shall comply with BS 3692 or BS 4190 and the strength grade designation for bolts shall be at least 4.6 and that for nuts shall be at least 4.

(2) Studbolts and tie bolts threaded at each end with nominal diameter portion at centre shall comply with BS 4882.

(3) Washers shall be standard normal series black steel washers complying with BS EN ISO 887 (formerly BS 4320).

(4) Black cup and countersunk head bolts, screws and nuts shall be to BS 4933.

(5) Zinc coated items of M10 and larger shall have the nuts cut oversize and shall be spun galvanized (or equivalent) to BS EN ISO 1461. Smaller zinc coated items shall be to BS EN ISO 2081.

(6) Stainless steel bolts and nuts shall comply with BS EN ISO 3506-1 and 2, steel grade A4/316 and property class 80. Stainless steel washers shall comply with BS EN 10088, Grade 1.4401.

(7) Bright (high tensile) items to Grade 8.8 of BS 3692 may be used instead of black items.

(8) Bolts for pipes and fittings shall comply with the relevant requirements of BS EN 1515-1.

(9) Bolt lengths shall be sufficient to ensure that nuts are full-threaded when tightened in their final position and that at least two but no more than four threads are protruded.

3.3 Gaskets

(1) For joint surfaces without gasket slot, gaskets shall be of full faced type or "inside bolt circle" type, depending on the diameter and to be approved by the Engineer's Representative, and complying with BS 3063 and BS EN 1514 (formerly BS 4865).

(2) Gaskets shall be manufactured from appropriate material compatible with the substances in contact, in particular shall be suitable in case of fresh water application. Appropriate thickness shall be adopted and in general not thinner than 3 mm.

3.4 Steel Pipework

Unless otherwise specified in the Particular Specification, stainless steel pipeworks with nominal size smaller than 150 mm shall be made of material grade EN 1.4401 / 1.4404, ASTM 316/316L or superior and conform to

(1) BS EN 10216-5 (seamless), BS EN 10217-7 (welded) or ASTM-A312 / ASTM-A928 as appropriate;

(2) EN ISO 4144 for threaded fittings and BS EN 10253-3 for welded fittings or ASME B16.11 / ASME B16.9 / ASME B16.28 as appropriate; and

(3) Schedule 40S under ASME B36.19M with pressure rating PN16.

3.5 Copper Pipework

Copper tubes shall conform to BS EN 1057. Copper pressure piping shall conform to BS 1306. Compression fittings shall conform to BS EN 1254-1 and BS EN 1254-2.

3.6 Nylon, Plastic and Other Pipework

(1) All nylon, polythene or other plastic pipes, tubes and fittings shall conform to BS 5409 : Part 1, BS EN 12201, BS EN ISO 1452 and other relevant international standards.

(2) Plastic pipes or tubes exposed to ultra-violet light or susceptible to physical damages such as stepping by operational staff shall be physically protected.

(3) Double containment preferably made of transparent material shall be provided for pipework containing corrosive or dangerous substances, such as strong acids / alkalis, hydrogen and chlorine gas, etc. which is of safety concern.

3.7 Instrumentation Piping

(1) Piping or tubing for instrument air shall be PVC covered heavy gauge seamless copper of soft annealed type conforming to BS EN 1057 and connected by

compression joints. Pipe fittings shall be compatible with the materials, application and service conditions called for.

(2) Piping or tubing shall run neatly on the walls or PVC covered tray to prevent movement. Piping or tubing routes shall not obstruct traffic through process plant / Plant nor interfere with the accessibility or removal of plant / Plant. They shall be routed away from hot environments, places of potential fire risk or where they may be subjected to mechanical injury or vibration.

3.8 Fixing of Metal Work and Machinery

(1) Where the type of fixings is not specified, approval shall be obtained to the type and position of fixing proposed before proceeding. Proprietary fixings supplied by reputable manufacturers will generally be allowed. The type selected shall suit the particular situation and loadings.

(2) The installation of such fixings shall be strictly in accordance with the manufacturer's instructions or recommendations.

(3) Detailed design concerning the design, layout, erection, use and/or removal of supports for plant and equipment / Plant and Materials shall be provided by the Contractor to the Engineer for approval.

(4) If so specified in the Particular Specification that the design of fixing of metal work and machinery shall be carried out by Registered Structural Engineer (RSE) and verified by Independent Checking Engineer (ICE):

i. The Contractor shall employ a Registered Structural Engineer (RSE) registered in the list of Registered Structural Engineer of Buildings Department, The Government of the HKSAR, for the design and structural calculation of all structural supports, including method of mounting and supporting structure such as plinths and framework for specific plant and equipment / Plant and Materials. The calculation shall detail all possible loading to be borne by the structural supports.

ii. The Contractor shall also employ an Independent Checking Engineer (ICE) registered in the list of Registered Structural Engineers of Buildings Department, The Government of the HKSAR, to check and certify the RSE’s design and structural calculations and submit to the Engineer for record prior to the commencement of manufacture and installation.

iii. In designing the structural supports, the Contractor and his RSE and ICE shall make themselves fully aware of all existing environment, constraints and conditions of the Site. Upon the advice of the Engineer, the RSE shall amend his design to suit accordingly and ICE shall require to verify and certify the RSE’s amended design. The Contractor

and his RSE shall provide their own labour, equipment and tools to carry out any site investigation so required.

iv. The proposed RSE and ICE shall have relevant qualifications and experience, and shall be submitted by the Contractor for the approval of the Engineer.

(5) Unless otherwise specified in the Particular Specification, design of pipe supports shall comply with the following requirements:

i. All pipework shall be adequately supported to prevent distortion with supports and clamps. The support span for mounting straight pipe shall in general not exceed 2000 mm for stainless steel pipe and not exceed 1000 mm for plastic pipe. Extra support shall be installed at turning location (i.e. elbow or tee) of the pipe to reduce the bending moment on the pipework due to unsupported loading.

ii. All pipe support materials shall conform to BS EN10088-2 grade 1.4401 or 1.4404.

iii. Pipe supports shall be designed and fabricated in accordance with BS EN13480-3 to carry all static and dynamic loads. Rubber padding of at least 3 mm shall be provided between the pipe support, pipe and clamp.

(6) If so specified in the Particular Specification, the structural support materials shall be certified to BS EN10204-3.1.

3.9 Fixing Bolts, Concrete Anchors etc.

(1) Foundation (rag) bolts shall be to BS 4185: Part 9 or other type approved by the Engineer.

(2) Concrete anchors suitable for fitting in drilled holes shall be of flush expanding type and of a make approved by the Engineer who may require tests to confirm their suitability.

(3) Fixing bolts, nuts and washers of stainless steel when used for fixing aluminium items shall have non-metallic sleeve and under-washer or other approved insulating system.

3.10 Metal Work

(1) Structural steel shall comply with BS EN 10025. Hot rolled sections shall comply with BS EN 10365, BS EN 10210-2, BS EN 10056-1 or BS EN 10067 as appropriate.

(2) Stainless steel items, unless otherwise specified, shall be made from steel Grade 1.4401 to BS EN 10088 and BS EN ISO 9445 as appropriate.

3.11 Welding and Cutting

(1) Welding, flame, plasma or laser cutting shall be carried out according to the relevant international standards, in particular, BS EN 1011, and the relevant Code of Practices issued by the Labour Department.

(2) Welders shall possess valid welder's certificates in accordance with the relevant international standards for the appropriate type of welding.

(3) Welding consumables shall be compatible with the parent metals and the selected welding process.

(4) All welded joints and heat affected zones shall be thoroughly cleaned, pickled and passivated in accordance with Annex A of BS EN 13480-4.

(5) Non-destructive tests if required shall be performed and assessed by qualified examiners in accordance with BS EN 13480-5.

3.12 Working Platforms, Fixed Ladders, Staircases and Guard-rails

(1) The Contractor shall provide permanent working platform for the plant or equipment / Plant or Materials installed at a level higher than 2 m, which requires regular attendance and maintenance. Platforms shall also be provided at suitable locations for access across ground cables, pipes, etc. with tripping hazards.

(2) Design of working platforms, fixed ladders, staircases and guard-rails shall comply with the following:

(a) Cap. 59I Construction Sites (Safety) Regulations, in particular the minimum width of the platform, height of guard-rails and toe-boards
(b) Cap. 123Q Building (Construction) Regulation
(c) Code of Practice for the Structural Use of Steel 2011 (2023 Edition)
(d) Code of Practice on Wind Effects in Hong Kong 2019
(e) BS EN ISO 14122 and BS 4592

(3) All working platforms shall be complete with guard-rails, toe-boards, flooring, and ladders or staircases.

(4) Design of fixed ladders shall conform to BS 4211 and WSD Standard Drawings WSD 7.2F, 7.3J and 7.4D, complete with safety cage and safety chains / floor grating at the top opening. Platform shall be provided at an interval not greater than 9 m along the ladder.

(5) Design of staircases shall comply with Cap. 123F Building (Planning) Regulations and the Code of Practice for Fire Safety in Buildings, complete with guard-rails and toe-boards.

(6) Design of guard-rails shall conform to WSD Standard Drawings WSD 7.5F and 7.6E.

(7) Open mesh grating or chequer plate flooring shall be chosen as required in the application.

(8) All grating / flooring shall be designed to take a 5 kN/m^2 load, unless otherwise specified or required, and the mass of any individual panel shall not be greater than 25 kg.

(9) Open mesh grating shall incorporate slip resistance bars and secured with clips.

(10) Chequer plate flooring shall be provided with lifting holes and secured with countersunk-head screws.

(11) Where pipework or other items pass through grating / flooring, cut-outs shall be sized to minimise clear openings and clearance shall generally not exceed 30 mm.

(12) Unless otherwise specified in the Particular Specification, all working platforms, fixed ladders, staircases, guard-rails, flooring and toe-boards shall be made of hot dip galvanised steel conforming to BS EN ISO 1461.

(13) The Contractor shall provide the design and layout of the platform to the Engineer for approval.

(14) The Contractor shall employ a RSE registered in the list of Registered Structural Engineer of Buildings Department, The Government of the HKSAR, for the design and structural calculation of all structural elements, including method of mounting and supporting structure for the working platforms. The calculation shall detail all possible loading to be borne by the support framework.

(15) The Contractor shall also employ an ICE registered in the list of Registered Structural Engineers of Buildings Department, The Government of the HKSAR, to check and certify the RSE's design and structural calculations and submit to the Engineer for record prior to the commencement of manufacture and installation.

(16) In designing the working platform and supporting framework, the Contractor and his RSE and ICE shall make themselves fully aware of all existing environment, constraints and conditions of the Site. Upon the advice of the Engineer, the RSE shall amend his design to suit accordingly and ICE shall require to verify and certify the RSE's amended design. The Contractor and his RSE shall provide their own labour, equipment and tools to carry out any site investigation so required.

(17) The proposed RSE and ICE shall have relevant qualifications and experience, and shall be submitted by the Contractor for the approval of the Engineer.

(18) In case of discrepancies between the above requirements, the relevant statutory ordinances, orders or regulations giving the force of law in Hong Kong shall take precedence.

4. REQUIREMENTS FOR SITE INSTALLATION

4.1 General

(1) The Contractor shall be responsible for the supply and installation of all plant and equipment / Plant and Materials necessary to form a complete system which shall perform all the functions required in the Specifications. All the plant / Plant, equipment / Equipment, ancillaries and materials / Materials required to render the system fully operational shall be provided by the Contractor even if they are not explicitly specified in the Specifications.

(2) The Contractor shall submit a method statement one (1) month prior to the commencement of the site work with full description of the proposed sequence of work giving full details on the plant / Plant to be shut down and the period of shutdown time required under each phase of work to the Engineer's Representative for comment. The installation of the plant and equipment / Plant and Materials shall not cause any shutdown and interruption to the existing plant processes. Such sequence of work shall be detailed with the remaining plant availability, emergency measures and fallback procedures under each phase of work. The Contractor shall conduct adequate offline testing before making such requests.

(3) Isolation of the power supply to the existing switchboard shall be carried out by the Employer's Competent Person in accordance with the Electricity Safety Regulations. The Contractor shall submit request for isolation work two (2) working days in advance to the Engineer's Representative.

(4) The location at which each item of the plant and equipment / Plant and Material is installed shall be shown in the approved drawings or as otherwise agreed with the Engineer's Representative. Each mounting position shall be chosen to give correct operation of the plant and equipment / Plant and Materials. Ease of operation, reading, maintenance and servicing freedom from any condition which could have adverse effects and with particular regard to the safety of personnel and plant and equipment / Plant and Materials.

(5) The Contractor shall carry out necessary measurement and checking on Site under the supervision of the Engineer's Representative, to ensure that the equipment to be installed is compatible with site conditions.

(6) The Contractor shall be responsible for the true and proper setting out of the Works and for the correctness of the positions, level, dimensions and alignment of all parts of the Works.

(7) The Contractor shall be responsible for making modifications on the existing plant and equipment to suit the newly supplied plant and equipment / Plant and Materials. Any proposed modification shall be submitted for approval by the Engineer and shall not affect the normal operation of the existing plant.

(8) The Contractor shall provide all temporary power supply, equipment / Equipment and arrangement during the construction period at his own cost.

(9) All surface finishing and final coating/painting damaged during the course of the installation work shall be made good by the Contractor to the satisfaction of the Engineer's Representative after the installation work is completed.

(10) The Contractor shall carry out all minor civil work necessary for the installation of the plant and equipment / Plant and Materials including breaking up and sealing up cable holes, small wall and floor slab openings, mounting brackets, erection of supporting steelwork, floor surface finishing and grouting of plant and equipment / Plant and Materials bases. The sizes and location of the openings shall be agreed with the Engineer in advance. The sealing shall have the same properties of the wall or the structure in respect of fire resistance, water tightness and air tightness.

(11) Any temporary modifications to the existing structures, fixtures and plant / Plant and holes / openings left during the course of the installation work shall be made good afterwards by the Contractor to the satisfaction of the Engineer's Representative.

(12) The Contractor shall be responsible for transportation of all the dismantled and scrap equipment and materials / Equipment and Materials to the designated area within the Site or other locations within Hong Kong Special Administrative Region except outlying islands as directed by the Engineer's Representative at no extra cost to the Employer.

(13) The dismantled equipment and materials / Equipment and Materials shall remain the properties of the Employer unless specifically confirmed by the Engineer's Representative as scrap. The Contractor shall then dispose of the scrap at his own cost.

(14) All temporary works associated with the Works, including temporary access platform and/or scaffolding as necessary for high level installation and/or cabling works shall be provided by the Contractor.

(15) Except those mounted on vertical wall, all exposed pipes shall be properly protected by weatherproof covers with adequate strength to withstand the loading when being stepped on by operation personnel. The covers shall be

anti-slip and made in stainless steel grade 316 with steel plate thickness not less than 6mm. Exact dimension of the covers shall be submitted by the Contractor to the approval of the Engineer's Representative.

(16) Sufficient pipe identification labels including coloured band with descriptions of the pipe and flow direction arrow shall be provided on the pipe external surface and the protection covers. Exact location of the identification shall be decided by the Engineer's Representative with the Contractor on the Site. The Contractor shall design the pipe identification system and submit the design to the approval of the Engineer.

4.2 Supporting Steelwork, Plinths and Grouting

(1) Supporting steelwork for mounting the plant / Plant shall be designed and provided where necessary and required.

(2) The configuration, dimensions and pocket hole details of the concrete plinths/blocks/supports necessary for supporting the plant and equipment / Plant and Materials under the Contract shall be provided by the Contractor for the Employer's design and construction, where applicable.

(3) Grouting to structural steelwork, machine bases, electrical and mechanical plant and equipment / Plant and Materials shall be provided and constructed by the Contractor and shall comply with the requirements as follows:

(a) The permission of the Engineer's Representative shall be obtained before any plant or equipment / Plant or Materials is grouted. The Contractor shall inform the Engineer's Representative before grouting starts and shall allow the Engineer's Representative sufficient time to inspect the work which is to be grouted.

(b) The voids to be grouted shall be cleaned and thoroughly wetted immediately before grouting.

(c) The machine bases shall be properly and accurately levelled and aligned before any grout is poured.

(d) The wedges and packing pieces shall provide at least 25 mm clearance for grouting. After correct alignment and levelling, the foundation bolts shall be nipped up to hold the machine firmly in position.

(e) Grouting materials shall be of non-shrink type and shall be mixed and placed following strictly the methods recommended by the manufacturer. Manufacturer's technical literature on application of the grouting material shall be submitted.

(f) After the grouting mixture has set, the foundation bolts shall be pulled up hard and the alignment and level rechecked. The Engineer's

Representative shall be informed when any check on alignment and level is to be carried out so that he may witness the checks.

(g) Exposed grout surfaces shall have a uniform, dense and smooth surface free from trowel marks and which is produced by steel trowelling the surface under firm pressure.

(h) Sharp edges of grouting shall be chamfered.

(4) Locations with tripping hazards shall be painted with yellow and black warning strips.

4.3 Holes and Recesses for Installations

(1) The Contractor shall be responsible for the building-in of any items of plant / Plant or for the boxing out or cutting out and the subsequent back-filling of all openings, box-outs, rebates, etc. required in the concrete structure and indicated on the Contractor's approved drawings.

(2) Holes and recesses shall be left in structures for electrical and mechanical installations. Unless approved by the Engineer, holes and recesses shall not be cut in existing structures for mechanical and electrical installations.

(3) Holes and recesses in internal floors, stairways and platforms shall be protected with temporary covers or by other methods agreed by the Engineer until installation work starts; holes and recesses in roofs, external walls and external floors shall be sealed with watertight temporary covers until the installation work starts.

(4) Holes in structures shall be filled and made good after installations; holes left in structural elements designated as fire barriers shall be sealed to at least the same degree of fire resistance as the structural element.

4.4 Removal and Replacement of Trench Covers

(1) Where installation of new equipment / Materials or cables in the service trenches, pipe ducts and draw-pits are required, the Contractor shall be responsible, at his own cost, for the breaking of sealing materials, removal and reinstatement of the trench covers, manhole covers, etc., where necessary, for the execution of the Works.

(2) The foreign materials such as building debris, surplus installation materials and other combustible items shall be prevented from entering or being left in the service trenches and pipe ducts which are left open during installation work. The precautionary measures shall be taken to prevent flooding the trenches and ducts when covers have been removed for execution of the Works. Sand bags or other suitable kerbing materials shall be placed around all openings of

outdoor trenches, which shall then be covered with planking and plastic sheeting to stop surface water and rain water from getting into the trenches.

(3) In case of rainstorms, the Contractor shall also make available and operate temporary pumping facilities at any opened trenches to avoid ingress of rain water to the plant / Plant rooms.

(4) Temporary sealant shall be applied as necessary to openings leading into plant / Plant rooms to avoid the possible flooding in case of rainstorms.

(5) All the surplus installation materials and building debris left in service trenches, pipe ducts and draw-pits shall be removed after installation.

(6) Upon completion of work inside service ducts, pipe trenches, draw-pits, etc., and completion of back filling of structural openings with fire resistant and water sealing materials, the Contractor shall serve notice to the Engineer's Representatives for inspection before covering up of the ducts, trenches, draw-pits. The Contractor shall be responsible for the reinstatement of all concrete trench covers, service duct and manhole covers. The gaps between covers shall be sealed up with bitumen or other suitable materials as may be approved by the Engineer.

(7) The cutting or welding work shall be carried out in situ as necessary to modify the layout or dimensions of the covers so as to provide openings or access to cater for the mechanical and electrical plant or equipment / Plant or Materials installed. Any such cut, opening and weld shall be made good by dressing and / or painting to the satisfaction of the Engineer's Representative.

4.5 Initial Charges of Lubricants and Consumables

The initial charges of oil, grease and any consumables necessary for the correct setting to work and operation of the plant / Plant throughout the period of site testing shall be provided.

4.6 Fire Barrier

Internal fire barriers shall be constructed in service channels, service shafts and service ducts for electrical and mechanical installations at termination points and open ends.

4.7 Framed Drawings

The Contractor shall provide the as-fitted drawing showing the schematic block diagrams of all circuits, fire services layout plan and other operation instructions as instructed by the Engineer on the framed glazed adjacent to the switchboard.

4.8 Lubrication

(1) 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 readily accessible for routine maintenance and if necessary suitable extension pipes shall be installed.

(2) If continual grease or oil feed is required, the capacity of the lubricant reservoir shall be sufficient for not less than seven days continuous operation.

(3) Lubrication grease points shall comprise hexagon headed nipples. Where the lubrication required is of a special nature, the lubrication points shall be fitted with metal labels to indicate the characteristics of the special lubricant required.

(4) Where grease nipples are provided they shall be grouped on a common plate mounted in an accessible position. The plate and grease nipples shall be designated 'Multiple Greasing Unit'. Each grease pipes shall be 6 mm nominal bore flexible stainless steel of not more than 3 m overall length. If necessary, several Multiple Greasing Units shall be provided on each machine.

(5) Where oil is used as a lubricant, drain, filter and level points shall be easily accessible. Where necessary, suitable stainless steel extension tubes shall be fitted to facilitate access. Lubrication pipes shall have continuous downward gradients.

4.9 Guarding of Machinery

(1) All rotating parts such as shafts, couplings, gears, flywheels, belt drives, and moving parts such as counter weight levers of reflux valve, etc. shall be fully guarded to comply with PD 5304 (formerly BS 5304) and Cap. 59Q Factories and Industrial Undertakings (Guarding and Operation of Machinery) Regulations.

(2) Guards shall be designed to provide ready access to bearings, greasing points, thermometer pockets and other check points to allow routine observations to be made by the operating staff without danger or the need to dismantle any part of the guard. Hinged doors let into the guards with adequate fastenings shall be provided where necessary to facilitate access to the check points.

(3) Guards shall be made of galvanised mild steel. Brackets and securing arrangements for guards shall be of rigid construction.

(4) Drawings of guards shall form part of the plant or equipment / Plant or Materials drawing to be submitted to the Engineer for approval before manufacture.

4.10 Painting and Protection of Steel and Ironwork

4.10.1 General

(1) All metalwork, including structural steelwork, fabricated steel supports, steel pipe, fittings and weld joints shall be protected by an approved system.

(2) Threaded portion of bolts and nuts, joint surfaces, etc. in general shall not be painted.

(3) Surface preparation and protective coatings shall be complying with relevant standards and conforming to the following schedules:

1 - Surface Preparation
2 - Materials and Application
3 - Coating System

(4) Proprietary items shall have all surface protection applied at the place of manufacture.

(5) Tints and shades of final coats shall be in accordance with the colour schedule covered in the Standard Specification EM-00-03. Colours of undercoats shall be of slightly different shades to adjoining coats.

4.10.2 Surface Preparation

(1) All surface defects in metals to be coated including cracks, surface laminations, shelling and deep pitting shall be made good. All fins at saw cuts, burrs and sharp edges shall be similarly removed. Where the specified coating system is preceded by blast cleaning and extensive grinding has been necessary, the dressed areas shall be re-blasted to restore the surface to the required standard of cleanliness and roughness.

(2) Where steelwork is to be zinc-dip coated all cutting and drilling shall be completed before surface preparation and coating.

4.10.3 Paints

(1) Copy of manufacturer's data sheets shall be furnished for the paints proposed to use.

(2) Protective and decorative paints including primers and undercoats with guarantees of coating compatibility shall be obtained from a single manufacturer. All containers of paints and other coating systems shall show date of manufacture, shelf life and pot life where applicable.

(3) Only the paints which are delivered ready mixed for use, in sealed cans or drums bearing the manufacturer's name, properly labelled as to quality shall be

used. In so far as it is possible, the paints shall be come from a single manufacturer.

(4) Two pack or any similar chemically cured type paint shall not be used after expiration of the 'shelf life' stipulated by the manufacturer and such paints shall not be mixed with fresh paint.

(5) Colouring pigments shall not contain lead compounds which may be affected by hydrogen sulphide or other gas likely to be found in waterworks premises.

(6) The Volatile Organic Compound (VOC) content of all paint products shall comply with the VOC limits stipulated in the Air Pollution Control (Volatile Organic Compounds) Regulation.

(7) For corrosive environment, suitable chemical resistant coating shall be proposed for the Engineer's approval and applied accordingly.

(8) Suitable epoxy paints shall be proposed for the Engineer's approval and applied to all steel and ironwork structures from concrete surface to a height of at least 150 mm to provide extra protection against corrosion.

4.10.4 Application of Paints

(1) All paints shall be applied strictly in accordance with the directions of the manufacturer by skilled and experienced painters under constant supervision by qualified staff.

(2) All surfaces to be painted shall be cleaned with white spirit or other appropriate cleaner immediately before painting.

(3) All shop coatings shall be carried out under controlled conditions. The atmosphere shall be dust free and kept at a temperature of between 10 ℃ and 20 ℃. The relative humidity should not exceed 80 per cent.

(4) Items which are to be bolted or riveted together at the manufacturer's works shall have the priming coat applied before the parts are assembled. The mating surfaces of structural steel work shall be sealed with litharge and glycerine or an approved putty during erection. The mating surfaces of aluminium shall be sealed with an approved sealer.

4.10.5 Conditions when Painting shall not Proceed

Paints shall not be applied under the following conditions:

(1) When the ambient temperature falls below 4°C or the relative humidity rises above 80 per cent.

(2) For outdoor work during the periods of inclement weather, e.g. rain, fog or mist, when condensation has occurred or is likely to occur on the surfaces to be painted.

(3) When the surface temperature of the metal to be painted is less than 3℃ above the dew point of the ambient air.

(4) When in the opinion of the Engineer or his representatives, the amount of dust in the atmosphere and/or on the surface of the materials is such that the application of the paint would be unsatisfactory.

(5) Two pack paints of epoxide resin type shall not be applied when the temperature is below 5ºC or as stated in the paint manufacturer's instructions, nor shall such paints be applied when the temperature is likely to fall below the specified minimum during the curing period.

4.10.6 Dissimilar Metal Surfaces

Where dissimilar metals are mated, such as aluminium and steel, the mating surfaces shall be insulated to provide protection against galvanic or similar corrosion. Bolts, nuts washers and rivets shall be similarly insulated. The means of providing this protection shall be submitted for approval.

4.10.7 Repair to Damaged Surfaces

(1) On delivery of items to the Site, any damage made to the shop-applied protective coatings shall be made good. The coated surfaces on Site shall be protected from damage by weather or by subsequent operation and shall make good any defects / Defects as soon as they are discovered.

(2) Immediately after erection, any damage to the shop-coating shall be made good in a manner acceptable to the Engineer and compatible with the paint system. Damage to coatings occurring at any time shall be made good within 7 days.

(3) Damage to galvanised or metal sprayed coatings shall be made good by wire brushing followed by phosphate wash, followed by two coats of zinc or aluminium suspension paint.

(4) Prior to repairs to coatings, the damaged and surrounding areas shall be degreased and abraded, and the edges of the original coating 'feathered'. Where the complete coating system has been damaged the damaged area shall be returned to a bright finish.

4.10.8 Other Surfaces

All machined, polished, or bright surfaces, both internal and external, shall be afforded adequate protection against corrosion, mechanical damage, etc., until the plant / Plant is taken over.

4.10.9 Schedules

(1) Schedule No. 1 - Surface Preparation

Notes:
(a) All cutting and drilling shall be completed before surface preparation.
(b) Application of Systems SP1 and SP2 applies to all coats detailed in Schedule No. 3.

System	Surface Preparation	Description
SP1	Degreasing	Shop cleaning to remove contaminants in accordance with the approved standard.
SP2	Blast cleaning	Abrasive grit blast cleaning to remove rust and millscale, first quality finish for steel, second quality finish for cast iron. Blasting materials shall be free of deleterious substances. The maximum grade of abrasive permitted shall be in accordance with BS 7079. The maximum amplitude of the blast cleaned surfaces shall not exceed 0.1 mm. Surfaces shall except as otherwise specified be protected within 4 hours of having been blast cleaned.
SP3	Pickling	Chemical cleaning after blast cleaning by the Duplex or Footner process.
SP4	Shop treatment for aluminium	Shop treatment prior to anodising.
SP5	Pre-coat cleaning	Immediately before priming and before painting is commenced, all dirt, oil or grease shall be removed from the surface with white spirit or an approved emulsion cleaner thoroughly and scrubbed in a continuous flow of clean fresh water and dried before coating.
SP6	Wire wool, abrasive cloth or sand paper	On-site preparation to remove high spots and to provide key for primers and undercoats and finishing coats.
SP7	Powered wire brush	On-site preparation of welds in steel.

(2) Schedule No. 2 - Materials and Application

Notes:

(a) Bracketed references are from BS 5493, Table 4A to 4M.

(b) All cutting and drilling shall be completed before application of the specified materials.

(c) Primer and first undercoats shall be brushed. Roller application for these coats will not be permitted.

(d) DFT means minimum dry film thickness in microns as determined by non-destructive magnetic flux and eddy current test methods covered in BS 5493 and BS EN ISO 12944 as appropriate.

(e) For coatings containing micaceous iron oxide (MIO), pigments shall contain at least 80% MIO and have a lamellar particle shape, the pigment volume concentration shall be between 35% and 45%, solids volume not less than 64% and not more than 5% of anti-settling agent.

(f) Select pretreatment primer and sealer P2(b) below to suit subsequent coatings as detailed in Section 11.2.2 of BS 5493 or appropriate section of BS EN ISO 12944.

(g) For use of scheduled materials, see Schedule No. 3.

(h) Delete MIO content if finished colour to be other than self colour.

(i) The surface shall be sprayed with a zinc metal coating immediately after blast cleaning.

Reference	Material
P1	Zinc Metallisation : (a) Zinc-dip coating (SB2), Table 4B nominal thickness 140 microns. (b) Zinc-spray coating (SC6Z), note subsequent pretreatment and sealing times in P2(b), Table 4C, Part 1, nominal thickness 150 microns.
P2	Pretreatment primers and sealers : (a) Etch primer (T-wash) for zinc-dip coatings, Section 11.3.2(c).
	(b) Pretreatment primers and sealers for zinc-spray coatings (CP2 and CP3 to CP6). Primer and sealer to be applied within 4 hours and 24 hours of zinc spraying

Reference	Material
	respectively.
P3	Zinc phosphate primer (FP2A or FP3A), DFT 35.
P4	(a) Zinc phosphate/epoxy primer (KP1A), DFT 35. (b) Terephthalic or isophthalic polyester resin primer, DFT 35.
P5	Drying oil under coat (FUL1A or FU2A), DFT 35.
P6	Drying oil/MIO (see Note v) undercoat (FU1B), DFT 40.
P7	Drying oil finishing coat (FF5B), DFT 35.

(3) Schedule No. 3 - Coating System

System No.	Material	Surface Preparation[1]	Coatings from Schedule No. 2									
			Shop Coating					Site Coating				
			1st	2nd	3rd	4th	5th	1st	2nd	3rd	4th	5th
(1)	Cast Iron[2]	SP1 and SP2	P3	P5	-	-	-	P5	P7	-	-	-
(2)	Ductile Iron	SP1 and SP2	P1(a)	-	-	-	-	P2(a)	P3	P5	P7	-
	Steel[3]		P1(b)	P2(b)	P3	P5	-	P5	P7	-	-	-
(3)	Steel	SP1 and SP2	P1(b)	P2(b)	Approved systems		-	-	-	-	-	-

Notes:

1 Surface preparation from Schedule No. 1
2 Apply to an environment of non-exposure to weather and dry atmosphere with decorative finish (other than items in System No. 3).
3 Refer to System No. 4 for surface preparation of electrical switchboard and motor control panels

5. REQUIREMENTS FOR SITE TEST AND COMMISSIONING

5.1 General

(1) After completing the installation of the plant or equipment / Plant or Materials and prior to any operation, individual plant or equipment / Plant or Materials shall be inspected and witness tested in the presence of the Engineer Representatives of his appointed staff.

(2) Each individual item of the plant / Plant shall be checked and tested to ensure that it performs in accordance with the specified requirements and is in working conditions to the satisfaction of the Engineer.

(3) The Contractor shall notify the Employer and other contractors on the Site prior to performing site testing, and shall ensure safety of personnel at the Site and the plant or equipment / Plant or Materials undergoing tests.

(4) Requirements for inspection and testing of the plant / Plant on the Site are stipulated in the relevant WSD Standard Specifications and the Particular Specification, which shall include, but not limited to, the following:

(a) The installation is completed in accordance with all relevant drawings, circuit diagrams and the specified requirements.

(b) All items of plant / Plant are adequately and correctly labelled and identified.

(c) All cables and individual conductors are labelled and ferruled as per the relevant drawings.

(d) All pipelines shall be tested to ensure tightness of joints and connections to the pressure specified.

(e) The internal surfaces of all new equipment are properly cleaned prior to installation. Adequate flushing is completed and no foreign matters are left inside piping system (in particular lubricating lines), pumps, pressure vessels, sumps and tanks, etc. prior to box-up or final connection in the presence of the Engineer's Representative.

(g) The insulation resistance and continuity of all conductors of cables, windings, coils, busbars, etc. are tested acceptable in the presence of the Engineer's Representative before the service ducts are covered or before the cables are energised.

(g) The earthing arrangements are complete and a satisfactory value of earth loop impedance has been achieved in the presence of the Engineer's Representative.

(i) All protection devices such as temperature detectors, no-flow switch, relays, thermostats etc. have been individually checked, tested and properly adjusted.

(i) Every circuit component such as relay contact, switch, circuit breaker, thermostat etc. is properly connected and operates in accordance with the relevant circuit diagram.

(j) The necessary on-load adjustments have been made to ensure that the plant and equipment / Plant and Materials operates as intended.

(k) An independent trip test has been carried out to prove that all tripping and safety devices operate as designed.

(l) All errors, omissions, alterations and changes found during tests are rectified and details marked up on the relevant record drawings.

(m) All settings of the plant and equipment / Plant and Materials are properly adjusted, tested and recorded.

(5) Where necessary or when required by the Engineer's Representative, the testing and commissioning of a particular item of plant or equipment / Plant or Materials shall be carried out jointly in the presence of the respective plant or equipment / Plant or Materials supplier or manufacturer and the Contractor.

(6) Inspection/test results shall be recorded, verified and submitted immediately after the test. Individual items of plant / Plant shall not be released for commissioning with the whole system until it is proven as free from any defects / Defects and deficiencies and the Engineer has accepted the test results.

(7) During the process of site installation or testing and commissioning, the Engineer's Representative will inspect the Works to ensure that the standards of workmanship are to his satisfaction and to the requirements of the Specifications. In the event of any part of the Works failing to meet the requirements of the Specifications or the standards of workmanship be defective, the Contractor's supervisor or foreman will be informed and the Contractor shall take immediate steps to remedy the deficiency to the satisfaction of the Engineer's Representative.

(8) When the above tests have been satisfactorily completed, the Contractor shall inform the Engineer in writing that the plant / Plant is ready for commissioning.

(9) The Engineer shall have the right to put any item of the plant / Plant into continuous running once it is satisfactorily tested for commissioning.

5.2 Test Procedures and Reports

(1) A test schedule showing details of the proposed inspection complete with test procedures and format of test records for readings to be taken shall be submitted to Engineer's Representative for acceptance at least one (1) month prior to the scheduled commencement of testing and commissioning.

(2) A Request for Inspection (RFI) Form shall be submitted by the Contractor using the standard RFI form in the Appendix for agreement of the test / inspection dates by the Engineer's Representative before the tests. The deadline for submission is stated in the table below:

	Time for inspection		
	Monday to Friday (except General Holiday)	Saturday or Sunday	General Holiday (except Sunday)
Deadline for submission	24 hours before inspection	Noon of the preceding Thursday	48 hours before inspection

Note: if the deadline for submission falls on Saturday or a General Holiday, the deadline shall automatically be advanced by 24 hours.

(3) When the RFI forms could not be submitted prior to the time for inspection due to exceptional circumstances with prior agreement by the Engineer, the Contractor shall submit the RFI forms no later than 3 calendar days following the inspection.

(4) If any items of Works are not completed by the time for inspection shown on the RFI form, then, at the discretion of the Engineer or Engineer's Representative either a revised time for inspection shall be agreed or a new form giving a revised time for inspection shall be submitted by the Contractor, of which the deadline for submission shall nevertheless comply with this sub-clause. The Engineer or Engineer's Representative shall at his discretion refuse to inspect any item of Works without proper and timely submission of the RFI form in advance as required and any extra time or delay so caused shall not constitute any ground for claim.

(5) The Contractor may propose changes to the standard RFI form for the Engineer's acceptance to suit the nature and scope of the Works. The RFI form shall be complete, numbered and printed as required by the Engineer or Engineer's Representative, with clear description of the Works to be inspected accompanied by the relevant drawings.

(6) For any item of Works that requires inspections of various construction activities, stages, elements and particular aspects or details, a separate RFI form shall be submitted for each of the inspections of the relevant item. The various construction activities, stages elements and particular aspects or details appropriate to each item of Works shall be defined by the Contractor and agreed with the Engineer or Engineer's Representative. Unless with the agreement of the Engineer or Engineer's Representative, the Contractor shall only proceed to the next construction activity, stage, element and particular aspect or detail of any item of Works after inspection and acceptance of same by the Engineer or Engineer's Representative.

(7) In addition to the above, the Contractor shall submit to the Engineer before noon of each day (other than Saturday or General Holiday), a detailed list of the Works to be carried out on the next working day. This shall include the exact location and the nature of each construction activity, stage, element and particular aspect or detail, and the time when the Works are to be carried out to enable the Engineer or his staff to attend for the purpose of inspecting such Works.

(8) Under no circumstances should any item of Works be covered up or put out of view unless with the agreement of the Engineer. Should any item of Works not be inspected as result of the Contractor's failure to take action in accordance with sub-clauses (2) to (7) of this Clause, then such item of Works will be treated as having been covered up without the agreement of Engineer or Engineer's Representative. Such item of Works may be classified as a defect / Defect.

(9) To enable the Engineer to plan his inspections on a weekly basis, the Contractor shall submit to the Engineer or Engineer's Representative before noon of each Friday, a short programme showing the Works that he proposes to carry out in the following week. If that Friday is a General Holiday, the Contractor shall submit the short programme before noon of the preceding date which is not a General Holiday.

(10) To enhance the monitoring of the completeness and timeliness of inspections, the Contractor shall maintain a register summary to keep track of the status of the RFI forms and submit the register summary to the Engineer for record before noon of each Friday. If that Friday is a General Holiday, the Contractor shall submit the register summary before noon of the preceding date which is not a General Holiday.

(11) The Engineer or Engineer's Representative may notify the Contractor from time to time the names of his staff who may receive the RFI forms or are assigned to carry out inspection.

(12) The submission of the RFI form shall not relieve the Contractor of any of the duties, responsibilities, obligations or liabilities imposed upon him by any of the provisions of this Contractor nor restrict the Engineer or his staff from carrying out any other inspection. The Contractor shall make due allowance in his programme of the Works for the use of this RFI system. Notwithstanding other provisions of this Contract, compliance with the requirements of this Clause shall not constitute any ground for claim.

(13) All site tests recommended by the manufacturers shall be carried out.

(14) In the event that any item of the plant / Plant fails to meet any specified requirements, immediate steps shall be taken to rectify the deficiencies.

(15) One (1) copy of the inspection and test report giving details of the test readings, deficiencies encountered and rectified etc. shall be submitted for records within seven (7) days upon completion of the tests on an item of the plant / Plant.

(16) All items of the plant and equipment / Plant and Materials shall be adequately and properly labelled, thoroughly cleaned and dried out where necessary prior to testing. The labels, model and rating shall be checked for consistency with approved drawings and manuals during the inspection. After completion of the tests, the plant and equipment / Plant and Materials access covers, switches, operating devices, etc. shall be bolted or locked to prevent interference by unauthorised persons.

5.3 Testing Instruments and Equipment

(1) Calibrated instruments and equipment / Equipment shall be provided for carrying out tests on the Site. The Engineer may require any instrument / Equipment for rechecking and recalibration if he considers that such instruments / Equipment are not in conditions to produce sound and accurate measurements.

(2) Test instruments / Equipment shall have been calibrated and certified by a HKAS accredited laboratory not more than 12 months before the tests. The instruments / Equipment shall be sealed by the testing laboratory showing the date of calibration. Calibration certificates shall be submitted when requested.

(3) Provision shall be made on the plant and equipment / Plant and Materials for fitting test instruments / Equipment for carrying out appropriate tests.

(4) When performing hydraulic pressure test, in addition to the testing instruments / Equipment provided by the Contractor, a pressure gauge provided by the Employer shall also be fitted in parallel with the Contractor's gauge. The readings of both gauges shall be recorded in the test report.

6. TEST ON COMPLETION

6.1 General

(1) The Test on Completion (TOC) shall be the tests for the completed system or whole plant / Plant. TOC shall only be performed when all testing and commissioning of individual items of plant or equipment / Plant or Materials have been carried out and their results accepted by the Engineer.

(2) During the TOC, the Contractor shall operate the plant / Plant continuously to prove its satisfactory performance under specified conditions. All modes of operation, control and monitoring of the process and electrical and mechanical

functions shall be demonstrated to verify its performance. The Contractor shall provide attendance throughout the TOC to ensure that any plant, equipment or materials / Plant, Equipment or Materials, or workmanship found not in compliance with the Contract are immediately rectified or, if necessary, removed and replaced. The Contractor shall provide round-the-clock fault attendance within reasonable time throughout the TOC.

(3) To determine the plant / Plant performance, measurements and readings shall be recorded by the Contractor and verified by the Engineer's Representative at times and frequencies to be determined by the Engineer.

(4) At least one month prior to the commencement of TOC, the Contractor shall submit a detailed proposal covering the intended schedule, test procedures, format of test records, testing equipment, etc. for the Engineer's comment.

(5) If the TOC fails, the Contractor shall investigate the cause, rectify any defects / Defects, replace any faulty plant, materials or equipment / Plant, Materials or Equipment and repeat tests. Upon request, the Contractor shall submit a proposal for rectification of the defects / Defects for the Engineer’s approval. The Contractor shall restart the TOC upon agreement of the Engineer’s Representative.

(6) The Engineer shall have the full discretion of rejecting the plant or equipment / Plant or Materials if the plant or equipment / Plant or Materials fails to meet the performance requirements as specified in the Contract. The Contractor shall rectify all defects / Defects and deficiencies to the satisfaction of the Engineer.

- End of Specification -

Appendix

Standard Request for Inspection and/or Survey Check Form

Standard Request for Inspection and/or Survey Check Form

Contract No. _____ Request No. _____ Rev. _____[#]

To the Engineer,

(1) Works to be inspected and/or surveyed:	Date & time for inspection and/or survey check:
(2) Location of works:	
(3) Works proposed after acceptance of (1):	
(4) Drawings, sketches, specifications, record forms for specific works (e.g. pile driving) enclosed:	
(5) Remarks (if this is a re-submission, rectification works carried out since last inspection and/or survey check shall be stated):	

Submitted on behalf of the Contractor:

Full name: _____ Signed: _____

Designation: _____ Date and time: _____

Received and filled by the Engineer's Representative:

Full name: _____ Signed: _____

Designation: _____ Date and time: _____

Inspection and/or survey check assigned to inspection and/or surveying officer with details below:

Full name: _____ Designation: _____

Received and filled in by the inspection and/or surveying officer:

Works outlined in (1) above [have / have not]* been inspected and/or surveyed [on _____ at][@]. Permission to carry out the works proposed in (3) above is [given / not given]* for the following reason(s):

_____

Non-conformities recorded: _____

Recurrence of non-conformities: [Yes / No / NA]*

Rectification works required: _____

This in no way limits or alters the Contractor's obligations under the Contract. Form is returned to the Contractor at time stated below.

Full name: _____ Signed: _____

Designation: _____ Date and time: _____

Countersigned by the supervisor of the inspection and/or surveying officer. For critical items, hold points, witness points, interfacing works or works to be covered-up, countersigned by the resident engineer or above rank:

Full name: _____ Signed: _____

Designation: _____ Date and time: _____

Received on behalf of the Contractor by:

Full name: _____ Signed: _____

Designation: _____ Date and time: _____

Remarks: [ ][#] Insert one character from A to Z, for re-submission.
[ ]* Delete where inappropriate.
[ ][@] Fill in the date and time or delete if not inspected and/or surveyed.

c.c. with enclosures: interfacing parties (if applicable)