

EMPLOYER'S REQUIREMENT FOR MECHANICAL & ELECTRICAL WORKS

CHAPTER 02 MATERIALS & WORKMANSHIP MECHANICAL & ELECTRICAL PLANT

CHAPTER 2

MATERIALS & WORKMANSHIP

MECHANICAL & ELECTRICAL PLANT

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CHAPTER 2

MATERIALS & WORKMANSHIP

MECHANICAL & ELECTRICAL PLANT

2.1. Introduction

This Chapter of the Specification sets out the minimum standards of materials, workmanship and design to be used by the Contractor for mechanical works. Reference to any specific material or equipment does not necessarily imply that such material or equipment is included in the Work.

All components/parts of the Work shall, unless otherwise specified, comply with the provisions of this Chapter unless overridden by the Employer's Requirements or be subject to the approval of the Employer.

2.2. Reference of Standards

All goods, materials and workmanship shall comply with the requirements of the latest issue (with up to date amendments) of the appropriate standard or standards of the British Standards Institution or, if none is applicable, with the standards of best practice.

Where standards other than British Standards are proposed by the Contractor in his tender, the acceptance of the tender based on such standards shall only signify the approval to the use of such standards, but shall not make the Employer liable to accept any standard subsequently found inferior to the corresponding British Standard. The Employer shall be empowered to reject any material components and workmanship found to be inferior to the appropriate British Standard and the Contractor shall make good the deficiency at his own expense.

The Contractor may propose at no extra cost to the Employer the use of any alternative relevantly authoritative and internationally recognized reference of standard which shall be no less exacting than the corresponding standard quoted in the Specification. The Contractor shall demonstrate to the Employer that the alternative standard is suitable and equivalent to the specified standard as well as provide proof of previous successful use.

2.3. Abbreviations for references of standard

The following abbreviations where used in the specification refer to standard; codes of practice and other publications published by the organizations listed below:

ACI	American Concrete Institute
ANSI	American National Standard Institute
API	American Petroleum Institute
ASA	American Standard Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
BS	British Standard Institute
CP	British Standard Institution (Code of Practice)
DIN	German Industrial Standard
HMSO	Her Majesty's Stationary Office
IEE	The Institute of Electrical Engineers
IEC	International Electro-technical Commission
IME	The Institute of Mechanical Engineers
ISO	International Organization for Standardization
JIS	Japanese Industrial Standard
NEMA	National Electrical Manufacturers Association
SI	International System of Units
SIS	Swedish Standard Commission

2.4. Plant design and life

The plant as a whole shall be new, of sound workmanship, robustly designed for a long reliable operating life and shall be capable of 24 hours per day continuous operation for prolonged periods and with minimum maintenance required. Particular attention shall be given to temperature changes, the stability of paint finish for high temperatures, the rating, electrical machinery, thermal overload services, cooling systems and the choice of lubricants for possible high and prolonged operation at high ambient temperature.

The plant shall be designed to provide easy and safe access and replacement of component parts which are subject to wear, without the need to replace whole units except for consumable items. No part subject to wear shall have a life of less than five years from new to replacement or repair. Where major dismantling is unavoidable to replace a part, the life of such part shall not be less than ten years.

Component parts shall be designed to be manufactured to strict limits of accuracy and to be interchangeable with parts of similar plant.

Design features shall include the protection of Plant against damage caused by vermin, dirt, dust and dampness and to reduce risk of fire. Plant shall operate without undue vibration and parts shall be designed to withstand the maximum stresses under the most severe conditions of normal service. Materials shall have a high resistance to change in their properties due to the passage of time, exposure to light, temperature and any other cause which may have a detrimental effect upon the performance

or life of the Work. All materials in contact with water shall be impervious to it and not impart taste, odor and toxicity or otherwise be harmful to health or adversely affect the quality of water conveyed.

Manually operated plant located outside a building or structure shall be vandal-proof in addition to any other requirement in the Specification in respect of security.

Outdoor equipment shall be weatherproof and designed to exclude dust and to prevent the collection of water at any point. Metal-to-metal joints will not be permitted and all external bolts or screw shall be provided with blind tapped holes where a through hole would permit the ingress of moisture.

Mechanisms shall be constructed of materials which will not corrode due to rust, corrosion, brine or dust. Bearings of exposed operating shafts shall be designed to prevent moisture seeping along the shaft into the interior of the equipment.

Equipment and instruments shall not be located in positions where they are vulnerable to falling objects or water drips. Weather shields shall be provided where necessary to protect equipment and instruments from the sun.

2.5. Workmanship

Workmanship and the general finish of Plant installations shall be of first class commercial quality and in accordance with the best workshop practice and shall be performed by persons skilled in their respective trades.

Pipe work, fittings, cables, cable trays, etc., shall be fitted in a neat, straight and symmetrical manner so as to present a pleasing appearance.

Indicating gauges fitted to machine assemblies or to control panels shall generally be of similar style and grouped in a neat manner.

External welds and flame cuts shall have a smooth finish by means of careful grinding. Floor plate covering shall be fixed squarely in their frames and with their patterns lined-up. Hand railings shall be free from burrs.

2.6. Welding

All welding electrodes, wire and fluxes shall be stored in a clean dry place and protected from all forms of deterioration. All welding consumables shall be properly identified and shall retain their identification up to the time of use. Each batch of electrodes and wire shall be identifiable with the respective manufacturer's test certificate and advice note and shall be used in strict delivery rotation.

Gas cylinders shall be supplied to the site marked in accordance with the requirements of ISO 8448. They shall be stored under a suitable sunshade.

All welding equipment shall be of sufficient capacity and be maintained in such a condition as to ensure welds of acceptable quality throughout the range of electrode sizes to be used on the work.

Welding machine earth or ground leads shall be firmly fixed to the workplace. Welding cables shall be maintained in good condition and shall be free from kinks and loose connections.

Welders and welding shall be protected by suitable equipment from wind, airborne sand and moisture. Work shall not be performed when weather conditions do not permit satisfactory workmanship or adequate inspection.

Weld preparation profiles may be prepared by machine, shear, flame or plasma cutting followed by grinding and shall be performed carefully and accurately. Whenever possible, a mechanically guided tool shall be used for flame or plasma cutting. All edges shall be left free of slag, burs, fins, oxides and foreign matter and the finished profile shall conform to the design tolerances for the weld preparation.

Tack welding of weld preparations may be permitted but all tacks must be ground to a feather edge prior to completing the next pass.

Where spacer strip or bridging pieces are used, due care shall be taken when tack welds are removed.

All scars and blemishes shall be grounded prior to submitting the weld for inspection.

Where preheating is required, preheat and inter-pass temperatures shall be checked by temperature recorders on indicating crayons at a distance of not less than 75 mm from the weld groove. The use of hand held torches for heating will not be permitted.

Work which is subjected to heat treatment by use of electrically heated elements shall be monitored by suitable thermocouples connected to a chart recorder. A minimum of two thermocouples shall be used.

All slag, excess filler metal and surface irregularities shall be removed between weld inter-pass runs. Flame gouging is prohibited.

Welding on attachments such as lugs, cleats, supports etc shall be positioned well clear of all pressure retaining welds carrying principal stresses. If it is found essential to bridge or span a principal weld, then the attachments shall be designed so as to ensure that no further weld is positioned within 40 mm of the principal weld.

All tube butt welds shall have full penetration with a maximum of 3 mm excess penetration in the root run. The surface of the finished weld shall not be concave.

Unless otherwise specified, welds subject to radiographic, ultrasonic or other forms of non-destructive test shall be dressed to a smooth contour. Care shall be taken to blend weld and parent metal without under flushing.

All weld dressings shall be carried except where otherwise specified or ordered by

the Employer.

Mechanical and other non-radiographic test, if required, shall be carried out in the presence of the Employer. Welder shall be qualified in accordance with the requirements of the appropriate section of BS 4872 or BS 4871 whichever is applicable.

2.7. Castings

The structure of castings shall be homogeneous and free from non-metallic inclusions and other defects. Surfaces of casting which are not machined shall be carefully fettled to remove all foundry irregularities.

Minor defects not exceeding 10 mm in depth or 10% of total metal thickness whichever is less and which will not ultimately affect the strength and serviceability of the casting may be repaired by approved welding techniques.

If the removal of metal from repair reduces the stress-resisting cross-section of the casting by more than 25% or to such an extent that the computed stress in the remaining metal exceeds the allowable stress by more than 25% then the casting shall be rejected.

Castings repaired by welding for major defects shall be stress-relieved.

Non-destructive tests may be required for any casting containing defects whose effect can otherwise be established, or to determine that repair welds have been properly made.

Unless otherwise specified, casting shall be produced to the following standards or equal:

Grey-Iron	BS 1452	Grade 220
Carbon Steel	BS 3100	Steel alloy
Stainless Steel	BS3100	Steel 316 C16

2.8. Forgings

Major stress-bearing forgings shall be made to a standard specification. They shall be subjected to internal examination and non-destructive tests for the detection of flaws and shall be heat-treated for the relief of residual stress.

2.9. Nuts, bolts, studs and washers

Nuts and bolts for pressure fittings as a minimum shall be of zinc plated high quality steel machined on the shank and under the head and the nut. Bolts shall be of such a length that only one to three-threads shall show through the nut when in the fully tightened condition.

Fitted bolts shall be a tight driving fit in the reamed holes they occupy, they shall have the screwed portion of such a diameter that it will not be damaged in driving and shall be marked in a conspicuous position to ensure correct assembly at site.

Washers, locking devices and anti-vibration fittings shall be provided where necessary to ensure that no bending stress is caused in the bolt.

When there is a risk of corrosion, bolts and studs shall be designed so that the maximum stress in the bolt does not exceed half the yield stress of the material under all conditions. All bolts, nuts and screws which are subject to frequent adjustment or removal in the course of maintenance and repair shall be made of nickel-bearing stainless steel or brass.

The Contractor shall supply all holding down, aligning and leveling bolts complete with anchorages, nuts, washers and packing required to attach the plant to foundations.

Unless otherwise necessary to meet special requirement all threads shall be have preferred metric sizes with standard coarse thread.

ISO metric black hexagon bolts, nuts and screws shall comply with S11 0585-81, or ISO 885, ISO 888, ISO 898-1 and ISO 898-2 and BS 4190 strength Grade 4.6.

ISO metric precision hexagon bolts, nuts and screw shall comply with ISO 272. ISO 4759-1, ISO 885, ISO888 898-1 and 2 or ASTM F-593, ASTM F-468M, strength Grade 8.8 and BS 3692 strength Grade 8.8.

The dimensions of metric countersunk head bolts, screws and hexagon nuts shall comply with ISO 225 or ISO 888 or ISO 898-1.

Plain steel washer for use with ISO metric bolts shall comply with ISO 887 or ASTM F-884.

Taper steel washer shall comply with ASTM F-844 and ASTM F-436.

2.10. Non-metallic materials

Fabrics, cork, paper and similar materials which are not subsequently to be protected by impregnation shall be treated with an approved fungicide. Sleeves and fabrics treated with linseed oil varnish shall not be used.

The use of organic materials shall be avoided as far as possible, but where these have to be used, they shall be treated to make them fire resistant and non-flame propagating.

The use of wood shall be avoided as far as possible. If used, woodwork shall be seasoned teak or similar hardwood which is resistant to fungal decay and free from distortion and faults.

Woodwork shall be treated to protect it against damage by fire, moisture, fungus, vermin, insect, bacteria or chemical attack, unless it is naturally resistant to all these. Joints in woodwork shall be dovetailed or tongued and pinned. Metal fitting on wood shall be of nonferrous material. Adhesives shall be impervious to moisture and fungus growth. Synthetic resin cement only shall be used for joining wood. The use of casein cement will not be permitted.

2.11. Guards for moving parts

All moving parts shall be protected by safety guards. Guards shall be rigid, securely fixed and designed to allow normal operation, running, maintenance and routine inspection to be carried out on equipment without the need to remove the guard. Where this is impractical, guards shall be designed for easy fixing, dismantling and re-assembly.

2.12. Safeguarding of Plant

The Contractor shall ensure that the whole of the Work as installed is safe for use by the operating and maintenance staff, and by any other persons having access thereto. Guards, electrical safety devices, thermal insulation, noise suppression devices, written notices, safety colours and the like shall be provided where necessary during erection and as a permanent feature.

Plant layout shall be designed to provide easy and safe access to valves hand wheels, electrical equipment, instruments and any other operating devices, free from hazardous obstructions.

Nothing in the Specification shall remove the Contractor's obligation from drawing the attention of the Employer to any feature of the Work which is not consistent with safety or prevents him from making proposals for incorporating equipments of design which would increase the safety of the Plant.

2.13. Rating plates, name plates and labels

The Contractor shall supply a Plant identification system showing the name and number of each item of the Plant and its respective arrangement drawing number and add any additional items necessary to fully identify it.

The Contractor shall supply all labels, nameplates, instruction and warning plates necessary for the identification and safe operation of the Plant.

All such labeling shall be securely fixed to items of plant and equipment with stainless steel rivets, plated self-tapping screws or other approved means. The use of adhesives will not be permitted.

Nameplates for plant, and equipment identification and record purposes shall be manufactured from stainless steel with a matt or satin finish and engraved with black lettering of a size which is legible from the working position.

Warning plates/labels shall be manufactured from stainless steel engraved with white lettering on a red background and sited in the position where they afford maximum safety of personnel.

All equipment within panels and desk shall be individually identified by satin or matt finish stainless steel labels or laminated plastic labels where approved.

Pipe work systems shall be color coded in accordance with the requirements of BS 1710.

Each valve shall be fitted with a stainless steel nameplate indicating the valve service and reference where nameplates shall be circular and fitted under the hand wheels captive nut. They have to be of such a diameter that there is no

danger for persons operating the valve or that they do not prevent lock-off of the valve. For check valves and small valves, the Contractor may provide rectangular nameplates fitted to brackets on the valves or attached to a wall or steel work in convenient positions adjacent to the valves.

2.14. Lubrication:

2.14.1. General

Items of Plant shall be lubricated as necessary to ensure operation, heat removal and freedom from undue wear. Lubricated items shall be designed so that they do not require more than monthly lubrication attendance, unless otherwise required.

All grease nipples, oil cups and dip sticks shall be readily accessible, being piped where necessary to convenient positions.

The Contractor shall supply first fill of oil and grease for both Plant and maintenance equipment. In addition, the Contractor shall provide adequate supplies of lubricants for all equipment sufficient for 12 months of normal operation from the date of the Taking Over.

A complete schedule of recommended oils and other lubricants shall be provided by the Contractor as part of the Operating and Maintenance Manuals. The number of different types of lubricants shall be kept to a minimum. In the case of grease lubricated ball and roller bearing, a lithium based grease is preferred.

2.14.2. Oil lubrication

Oil reservoirs shall be fitted with oil-level indicators of the sight glass type, or where this is not practicable, with dipsticks. The normal, maximum and minimum levels shall be clearly visible to an operator standing on the normal access floor to the particular item of plant. The sight glasses shall be made from toughened glass, easily dismantled for cleaning and in exposed situations, fitted with the guards.

Drain points shall be located or piped to such a position that an adequately sized container can be placed beneath them.

For forced oil lubrication systems, the pressure shall be monitored during operation with automatic shutdown of the machine and alarm on low oil pressure.

All oil lubricated machinery shall utilize a common grade of oil which is readily available in Pakistan. High temperature high performance lubricates shall be avoided as far as possible.

2.14.3. Grease Lubrication

Grease lubrication shall be for steel lubrication nipples manufactured in accordance with BS 1486.

A separate nipple shall be provided to secure each lubrication point. Where a number of nipples supply remote lubricating points, they shall be grouped

together on a conveniently placed batter plate, with spacing in accordance with BS 1486.

The Contractor shall provide a grease gun for each size and type of nipple installed. Where different types of greases are involved, separate grease guns shall be provided for each type. They shall be suitably labeled and if possible of different style to prevent incorrect greasing.

2.15. Joint Rings & Gaskets

Joint rings shall be manufactured to conform to BS 2194 and shall be of chloroprene rubber or other approved synthetic material suitable for temperatures up to 80° C or greater to suit the application.

Joints shall be made in accordance with manufacturer's instructions or as specified herein. Until immediately required for incorporation in a joint, each rubber ring or gasket shall be stored in the dark, free from the deleterious effects of heat or cold and kept flat so as to prevent any part of the rubber being in tension.

Only lubricants recommended by the manufacturer shall be used in connection with rubber rings and these lubricants shall not contain any constituents soluble in water. They shall be suitable for the climatic conditions at site and shall contain an approved bactericide.

Graphite grease or similar shall be applied to the threads of bolts before joints are made.

2.16. Electroplating, galvanizing and sherardizing

Parts to be galvanized, other than nuts, bolts and fasteners, shall be hot dip galvanized to BS 729 to give a minimum average coating of 610 g/m² area covered and a zinc thickness of not less than 85 microns.

Where specified, nuts, bolts and fasteners to be galvanized shall be hot dip galvanized to BS 729 to give a minimum average coating of 305 g/m² and a zinc thickness of not less than 43 microns. Where hot dip galvanizing is not practicable, nuts, bolts and fasteners shall be sherardized. Sherardizing shall be in accordance with BS 4291, the thickness of zinc coating being not less than 30 microns.

Where chromium plating is used, it shall comply with the requirements of BS 1224 including the provision that no blistering of any surfaces will be accepted. For all base metals, the service condition number 2 shall be used.

2.17. Noise

The Plant shall be designed and constructed to reduce the operating noise level as much as possible. During periods of short duration or abnormal operation (e.g. during startup) higher noise level up to an additional 20 dB (A) may be acceptable at the discretion of the Employer.

Except as provided for below, the noise emitted by any single item of the Plant shall not exceed a sound pressure level of 85 dB (A) when measured at a

distance of 1 m from the reference surface of that item in a horizontal direction and under the environmental conditions appropriate to the test requirements of ISO 3746 "Acoustic Determination of Sound Power Levels of Noise – Survey Methods" or the equipment ANSI S1 36.

The Contractor shall carry out noise tests on Site if in the opinion of the Employer, the Plant is excessively noisy. Sound pressure levels shall be measured in dB (A) using a calibrated sound meter meeting the requirements of BS 4197 with a response speed set to "Slow". The background noise level shall be at least 10 dB (A) below the operating noise level of the machine or other item of the Plant.

For major items of the Plant, the Contractor shall provide workshop certificates from the manufacturer covering noise level tests carried out on the items or type test certificates for similar items of the Plant.

If any item of Plant in its standard built, does not comply with the above requirement, the Contractor shall be required to reduce the sound pressure level by providing improved or additional silencers or fitting sound insulating materials to the item, until the requirement is met.

Noise levels in control rooms and offices shall not exceed 45 dB (A) with equipment such as printers in operation and in local plant control rooms it shall not exceed 70 dB (A).

The background noise level at any point along the boundary of the Site, arising from operation of the Plant shall not exceed 65 dB (A).

2.18. Vibration

All rotating elements shall be dynamically balanced so that the level of vibration at any point on a machine when operating at Site, either singly or with other machines, and at any speed throughout the operating range shall be within the limits of Class IV, Grade B as defined in BS 4675 Part 1. "Machine" shall mean a complete assembly including its drive shafting, motor and bedplate, generator, and compressor etc.

Pipe work, valves and other equipment connected to the machine or forming part of the operating system, shall be with provided adequate supports, brackets and fixtures, as necessary to restrict any induced vibration to a minimum under any operating condition.

Vibration measurements shall be taken on Site by the Contractor at various points on each complete machine as defined above.

Measurements shall also be taken on connecting Plant. If any item is found to be vibrating beyond the level considered by the Employer to be reasonably minimum for the particular Item, the Contractor shall take further steps to bring vibration to the required level. Equipment with unacceptable vibration levels may be rejected if the Contractor is unable to achieve satisfactory operation of the equipment involved.

2.19. Corrosion and erosion

The Contractor shall make proper provision for the prevention of corrosion and erosion in any part of his Plant. Such provision shall include the use of suitable materials, choice of operating speeds, design of components and type of protective coating and finishes. Particular attention shall be given to the Plant that may be exposed to water from different sources with varying characteristics and possible galvanic reaction with dissimilar metals.

2.20. Precautions against dampness

Special precautions shall be taken to prevent corrosion due to humidity, rainfall and moisture.

All wall-mounted equipment shall be fitted with spacers to provide a minimum gap of 5 mm.

All holes in the equipment shall be effectively sealed against the ingress of water. All items exposed to weather or water shall be free of water traps. Where necessary drain holes shall be provided to prevent the accumulation of water.

All fixings, fastenings and spacers which may be submerged in a corrosive liquid shall be galvanized or sherardized, unless otherwise specified.

All electrical equipment which is not sealed against free movement of air shall be protected from condensation with anti-condensation heaters. In general these heaters shall be thermostatically controlled and switched off when heat is generated by the operation of the Plant.

In choosing materials and their finishes due regard is to be given to the conditions under which the equipment is to Work. Tropical duty materials should be used throughout the Plant. Iron and steel are to be painted or galvanized in accordance with the Specification. Small iron and steel parts (other than stainless steel) of all instruments and electrical equipment, the cores of electromagnets and the metal parts of relays and mechanisms are to be treated in an approved manner to prevent rusting, Cores etc. which are built up of laminations or cannot for any other reason be antirust treated are to have all exposed parts cleaned and heavily enameled or lacquered.

When it is necessary to use dissimilar metals in contact these should be so selected so that the electrochemical potential difference is not greater than 250 milli-volts and if practicable the two metals are to be insulated from each other by an approved insulating material or by a coating of approved varnished compound.

The use of iron and steel is to be avoided in instruments and electrical relays wherever possible. Steel screws when used are to be zinc, cadmium or chromium plated or when plating is not possible owing to tolerance limitations, are to be of corrosion resisting steel. Springs are to be of brass, bronze or non-rusting material. Pivots for which non-ferrous material is unsuitable are to be of approved rustless steel where possible.

The use of wood within electrical and mechanical equipment is to be avoided as far as possible and, if used shall be of a type resistant to termite attack and fungal decay.

The use of hygroscopic insulating materials is not permitted except immersed in oil or otherwise suitably sealed to prevent ingress of moisture.

In choosing materials and their finishes due regard is to be given to the conditions under which the equipment is to Work. Typical duty materials should be used throughout the Plant.

Springs are to be of brass, bronze or non-rusting material. Pivots for which non-ferrous material is unsuitable are to be of approved rustless steel where possible.

2.21. Protective finishes

The surfaces of Plant shall be fully protected against corrosion and erosion with the exception of steel or similar corrosion resistant material or where the surface is required to be clear for operational purpose, e.g at glands, bearing, etc.

Parts to be galvanized shall be designed to avoid overlapping surfaces and narrow gaps and pockets which may trap pickling acid. Thermal distortion or the creation of unacceptable residual stresses should not occur.

Nuts, bolts and fasteners shall be of stainless steel Grade 316 S312 or shall have corrosion, resistant finish. Galvanizing, sherardizing, or electroplating of fasteners shall be to BS 3353. Cadmium plating shall not be used.

The paint protection system shall be obtained from the same manufacturer and applied strictly in accordance with the manufacturer's instructions and requirements and in accordance with BS 5493 and 6160. The Contractor shall be responsible for cleaning surfaces and preparing them for protective treatment and protective coatings applied at the place of manufacture and at Site. Coatings shall not be applied to external surfaces at Site during rain, fog, mist or condensation or when wind borne dirt and dust are present or likely to be present before the coating is dry enough to be undamaged.

All items of plant shall be delivered to Site with their protective finish fully applied. Site painting shall be limited to the making good of damaged protective finish and the application of further decorative coats to provide a clean and uniform finish to the whole of the Work. Site painting shall not be carried out unless the surface to be painted is dry and has undergone surface preparation as instructed by the paint manufacturer. In general Site painting shall be applied only when ambient temperatures are above 16 degrees and relative humidity is less than 55%. If these conditions cannot be achieved, a special painting system may be applied with the approval of the Employer.

Mating surfaces shall have primary coats applied before assembly. The mating surfaces of structural steel shall be sealed during erection.

Care shall be taken not to paint over any nameplates, rating plates, labels etc. All bearing and gland surfaces shall be protected during final painting.

The protective treatment system shall enable any necessary repairs, whether during the Contract period or subsequently to be made simply, without need for special skills or equipment. "Two pack" product shall not be used on any of the Plant Item.

All coatings used for any part of the Plant in contact with water for potable use shall be non-toxic, non-carcinogenic, not impart taste, odor, color or turbidity to the water. Only materials included in the approved list of the UK water fittings and by-laws scheme (operated by WRc) or in the "Current Statement of the Committee" on chemicals and materials of the construction for use in public water supply and swimming pools (issued by DOE) shall be used in places where they may come into contact with water to be used for potable purposes.

The following table gives the minimal acceptable finish system for different types of plant. Further detailed requirements for specific items of plant if given in the Specification shall take precedence over any requirement stated here:

Hand-railing, walkways and steel structure installed inside and outside buildings.	Hot dip galvanized/stainless steel where specifically mentioned.
Steel pipe work 100 mm dia. and larger.	Fusion bounded epoxy.
Steel pipe work under 100 mm dia. and smaller.	Hot dip galvanized.
Ductile iron pipe work.	Bitumen coating.
Steel surfaces other than pipe work in damp or wet environment.	Zinc rich epoxy or zinc spray followed by epoxy top coat.
Electrical switchgear in dry uncontrolled atmosphere.	Stove dried enamel or manufacturer's standard finish.
Electrical switchgear in damp uncontrolled atmosphere.	Stainless steel or GRP enclosure self-colored.

Table 2 -1: Minimal Acceptable Finish System

Paint finished shall include color coding taping (BS 1710) of pipes for chemicals, treated and raw water to the approval of the Employer.

2.22. Water Compliance of Materials in Contact with Water

Any materials that come or may come in contact with water which is to become potable shall comply with one of the following.

- a) The UK Secretary of State for the Environment under Section 25 of the water supply (Water Quality Regulation 1989).
- b) The 15th Statement of the UK Department of Environment Committee on Chemical and Materials for use in public water supply.
- c) The American Food and Drug Association.
- d) Other internationally recognized and approved body.

Where a material does not comply with the above it shall be subject to the approval of Employer. Certificates confirming compliance with the above shall be submitted to the Employer and these shall form part of the approval/acceptance of the Plant.

Construction of New 65 MGD Pump House(Equipped with M&E Pumping Machineries)
at Gharo, Karachi. Package # 2