SECTION 7200 METAL WORKS

7201 General

(1) General

- All Sub-Sections under Section 8000 General Technical Specification shall be applied to this Section 7200.
- This section covers the metal works for handrails, steel ladders, ladder rungs, plate covers, steel doors and other miscellaneous metal works installed in and around the El Salaam No. 7 Pumping Station.

(2) Scope of Works

a. The works shall include services and furnishing of design, labor, materials, equipment, consumables required for the execution of metal works.
b. The Contractor shall prepare the shop drawings showing the size, welding details, thickness and gauge of all materials and installation details.
c. The Contractor shall take all precautions to not damage or alter strength or other characteristics of adjoining works.
d. The Works include, but are not limited to, the following.
   - Handrails
   - Steel Ladders and Ladder Rung
   - Checkered Plate Covers, Steel Plate Covers and Grating Cover
   - Steel Doors
   - Steel Pipe and Duct

7202 Applicable Codes and Standards

The metal works shall conform to the following codes, standards and specifications or other equivalent codes and standards of Egypt subject to approval of the Engineer, except as may be amended in this Specification. The following standards and other publications are referred to in this section:

ASTM	A	27	Standard Specification for Steel Castings, Carbon, for General Application
ASTM	A	36	Standard Specification for Structural Steel
ASTM	A	48	Standard Specification for Gray Iron Castings
ASTM	A	53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM	A	269	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM	A	276	Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
ASTM	A	283	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plate

ASTM A 307 Standard Specification for Carbon Steel Bolts and Studs, 60000 PSI Tensile Strength

ASTM A 480 Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

ASTM B 221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

7203 Materials and Workmanship

(1) Materials

The metal materials to be used in the works shall be free from harmful defects and rust, and cut to the correct shapes. The metal materials shall conform to the following specifications:

Structural steel bars and shape	ASTM A 36 "Structural Steel"
Mild steel for railing, posts, flanges and sleeves	ASTM A 53 "Welded and Seamless Steel Pipe"
Steel pipe (medium weight)	ASTM A 53 "Welded and Seamless Steel Pipe"
Cast iron	ASTM A 48 "Gray Iron Castings"
Bolt and nut	ASTM A 307 "Carbon Steel Bolts and Studs
Cast steel	ASTM A 27 "Steel Castings, Carbon, for General Application"
Stainless steel pipe and nut	ASTM A269 "Seamless and Welded Austenitic Stainless Steel Tubing for general Service"
Stainless steel plate and sheet	ASTM A 480 "General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip"
Stainless bar and shape	ASTM A 276 "Stainless and Heat-Resisting Steel Bars and Shapes"
Aluminum for structural shape	ASTM B 221 "Aluminum, Aluminum-Alloy Extruded Bars, Rods, Wires, Shapes, and Tubes
Architectural aluminum	ASTM B 221 "Aluminum, Aluminum-Alloy Extruded Bars, Rods, Wires, Shapes, and Tubes
Rolled steel	ASTM A283 "Low and Intermediate Tensile Strength Carbon Steel Plates"

(2) Workmanship

Material shall be thoroughly straightened by methods that will not result in injury, except that sharp kinks or bends in members to be straightened will be cause for rejection. Finished members shall be free from kinks or bends. Shearing shall be accurately done, and all portions of the works neatly finished. Corners shall be square and true, unless otherwise shown on the drawings. Where re-entrant cuts made by shearing shall not be approved, a rectangular punch shall be used. Re-entrant cuts shall be filled, unless otherwise approved by the Engineer.

Bends, except for minor details, shall be made by approved dies or bending rolls. Where

heating is required, precautions shall be taken to avoid overheating the metal and it shall be allowed to cool in such a manner as not to destroy the original properties of the metal. Steel with welds will not be accepted, except where welding is definitely specified, called for on the drawings, or otherwise approved. All bolts, nuts, and screws shall be tight. The ends of pipes, except for handrails, shall be reamed.

7204 Welding

Welding of parts shall be in accordance with the Standard Code for Arc and Gas Welding in Building Construction of the AWS and shall only be done where shown on the drawings, specified, or permitted by the Engineer. All welding shall be done only by welders certified as to their ability to perform welding in accordance with locally accepted testing requirements. The AWS Code will be used as guide.

Damage to galvanized areas shall be thoroughly cleaned by wire crushing and all traces of welding flux and loose or crocked zinc coating removed prior to painting. The cleaned area shall be painted with two coats of zinc oxide-zinc dust paint. The paint shall be properly compounded with a suitable vehicle in the ratio of one part zinc oxide to four parts zinc dust by weight. As an alternate to the above, the Contractor may submit for approval the use of a galvanizing rod or galvanizing solder to repair damaged areas.

7205 Field Assembly

All parts to be installed shall be cleaned thoroughly; all packing compounds, rust, dirt, grit and other foreign matter removed; all holes and grooves for lubrication cleaned; and all enclosed chambers or passages examined to make sure that they are free from injurious materials. Where units or items are shipped as assemblies they will inspected by the Engineer, prior to installation. Disassembly, cleaning and lubrication will not be required except where there is indication that such work is necessary to place the assembly in a clean and properly lubricated condition.

The top of all steel floor plating and gratings, shall be installed flush with abutting curb surfaces. Stillson wrenches, cold chisels, or other tools, likely to cause injury to the surfaces of rods, nuts, or other parts, shall not be used for the work of assembling and tightening parts. Bolts and screws shall be tightened firmly and uniformly, but care shall be taken not to overstress the threads by using excessive force or wrenches of excessive length. When a half nut is used for the purpose of locking a full nut, the half nut shall be placed first and followed by the full nut. Threads of all bolts, nuts, and screws shall be lubricated by lead and oil before assembly. Driving and drifting bolts or keys will not be permitted.

7206 Painting

(1) Shop Priming

All structural steel, miscellaneous ferrous metal and metal castings, shall be shop primed

before delivery to the site. This prime coat is to be applied after fabrication and before exposure to the weather.

(2) Field Priming

Any structural steel, miscellaneous metal and other metals, which arrive at the site unpainted, shall be cleaned and field primed. Surfaces that have been shop primed and have been damage in shipment and/or in installation or where shop prime has deteriorated shall be promptly cleaned and retouched before any successive painting is done in the field. Shop primed surfaces damaged by field welding shall be cleaned and field primed.

(3) Field painting

Successive cost of paint shall be tinted so as to make each coat easily distinguishable from each other with the final undercoat tinted to the appropriate shade of the finished coat. Finish surfaces shall not show brush marks or other irregularities. Under coats of metal surfaces shall be sanded to remove defects and provide a smooth surface.

Painting shall be continuous and shall be accomplished in an orderly manner so as to facilitate inspection. Surfaces of exposed members that will be inaccessible after erection shall be cleaned painted before erection. Any defective paint changes in color or incompatible paint with undercoat shall be scraped off and repainted.

Any pipe or other metal surfaces to be painted a color other than black that have a coating of tar or asphalt-compound shall be painted with a paint specifically designed to isolate the finish paint from the tar surface.

7207 Handrails

The Contractor shall furnish all steel pipes and other accessories required for the handrails. Handrails shall be welded assemblies of the steel pipes, and shall be installed by the Contractor in the manner and at the locations shown on the drawings.

All shop and field connections shall be welded unless otherwise indicated on the drawings. All welds shall be ground smooth. All handrails shall be galvanized or painted as indicated on the drawings after fabrication. Galvanized coatings damaged in the field shall be repaired or replaced as directed by the Engineer.

Handrails shall be carefully adjusted prior to fixing in place to insure proper matching at abutting joints and correct alignment and camber throughout their length. Handrails to be set in concrete shall be assembled and installed when concrete is placed, or recesses shall be left or holes shall be drilled in the concrete for anchorage, and the handrails shall be assembled and grouted in position at some later time.

7208 Steel Ladder and Ladder Rung

The Contractor shall furnish all structural steels, steel pipes, anchor bolts and other accessories required for the steel ladders and ladder rungs. Steel ladders and ladder rungs shall be welded assemblies of the structural steels and steel pipes, and of the dimensions shown on the drawings. Steel ladders shall be galvanized or painted after fabrication and fastened to walls in accordance with the details indicated on the drawings. Steel ladders and ladder rungs shall be installed as shown on the drawings or as directed by the Engineer. Safety cages shall be provided if directed by the Engineer.

Steel ladders and ladder rungs shall be completely fabricated in sections convenient for handling and transporting. Field anchors and anchor bolts shall be assembled by bolting or welding. Anchors and anchor bolts shall be embedded in the concrete at the proper positions while the concrete is placed, or recesses shall be left in the concrete and the anchors and anchor bolts shall be thoroughly grouted or concrete in place.

Anchor bolts, fasteners, washers and all parts of devices necessary for proper installation, whether or not fully detailed on the drawings, shall be furnished and installed by the Contractor. All nuts, screw and other fastening devices shall be tight.

7209 Checkered Plate Cover, Steel Plate Cover and Grating Cover

The Contractor shall furnish all structural steels, checkered plates, round steel bars, anchor bolts and other accessories required for the checkered plate covers, steel plate covers and grating covers. Checkered plate covers, steel plate covers and grating covers shall be welded assemblies of the structural steels, checkered plates, round steel bars and anchor bolts, and of the dimensions shown on the drawings. Checkered plate covers, steel plate covers and grating covers shall be galvanized or painted after fabrication in accordance with the details indicated on the drawings. Checkered plate covers, steel plate covers and grating covers shall be installed as shown on the drawings or as directed by the Engineer.

Checkered plate covers, steel plate covers and grating covers shall be completely fabricated in sections convenient for handling and transporting. Field anchors and anchor bolts shall be assembled in the manner of bolting or welding. Anchors and anchor bolts shall be embedded in the concrete at the proper positions while the concrete is placed, or recesses shall be left in the concrete and the anchors and anchor bolts shall be thoroughly grouted or concrete in place.

Anchor bolts, fasteners, washers and all parts of devices necessary for proper installation, whether or not fully detailed on the drawings, shall be furnished and installed by the Contractor. All nuts, screw and other fastening devices shall be tight.

7210 Steel Pipe and Duct

The Contractor shall furnish all structural steels, steel pipes, anchor bolts and other accessories required for the steel pipes and ducts. Steel pipes and ducts shall be welded assemblies of the

structural steels and steel pipes, and of the dimensions shown on the drawings. Steel pipes and ducts shall be galvanized or painted after fabrication and fastened to walls in accordance with the details indicated on the drawings. Steel pipes and ducts shall be installed as shown on the drawings or as directed by the Engineer.

Steel pipe and ducts shall be completely fabricated in sections convenient for handling and transporting. Field anchors and anchor bolts shall be assembled in the manner of bolting or welding. Anchors and anchor bolts shall be embedded in the concrete at the proper positions while the concrete is placed, or recesses shall be left in the concrete and the anchors and anchor bolts shall be thoroughly grouted or concrete in place. Anchor bolts, fasteners, washers and all parts of devices necessary for proper installation, whether or not fully detailed on the drawings, shall be furnished and installed by the Contractor. All nuts, screw and other fastening devices shall be tight.

7211 Steel Door

The steel door in the pump room shall be referred to the Clause 6504 "Doors" of the Division 6 "Building Works", Section 6500 "Architectural Finishing".

7212 Measurement and Payment

(1) Handrails

a. Measurement for payment of handrail shall be made by length in meters.
b. Payment for handrail will be made at the unit price per meter, which unite price shall include the cost for design, assembly, welding, painting or galvanized coating, supply and storage of all necessary materials, installing and testing, and all other costs necessary to complete the works.

(2) Steel Ladder and Ladder Rung

a. Measurement for payment of steel ladders and ladder rungs shall be made by weight in tones of steel ladders and ladder rungs installed as computed from the dimensions shown on the Shop Drawings.
b. Payment for steel ladders and ladder rungs will be made at the unit price per ton, which unite price shall include the cost for design, supply and storage of all necessary materials, assembly, welding, painting or galvanized coating, installing and testing, and all other costs necessary to complete the works.

(3) Checkered Plate Cover, Steel Plate Cover and Grating Cover

a. Measurement for payment of checkered plate covers, steel plate covers and grating covers shall be made by weight in tones of checkered plate covers, steel plate covers and grating covers installed as computed from the dimensions shown on the Shop Drawings.
b. Payment for checkered plate covers, steel plate covers and grating covers shall be made at

the unit price per ton, which shall include the cost for design, supply and storage of all necessary materials, assembly, welding, painting or galvanized coating, installing and testing, and all other costs necessary to complete the works.

(4) Steel Pipe and Duct

a. Measurement for payment of steel pipes shall be made by length in meters of steel pipes. And measurement for payment of ducts shall be made by weight in kilograms of ducts installed as computed from the dimensions shown on the Shop Drawings.
b. Payment for steel pipes and ducts will be made at the unit price per meter or kilogram, which shall include the cost for design, supply and storage of all necessary materials, assembly, welding, painting or galvanized coating, installing and testing, and all other costs necessary to complete the works.

CONTENTS OF DIVISION 8

DIVISION 8 MECHANICAL WORKS

SECTION 8000 GENERAL TECHNICAL SPECIFICATION

8001 General Requirements

This specification covers the general and specific requirements for the design, manufacture, supply of equipment, installation, testing, site work and construction work for Mechanical works for the El Salaam No. 7 (Bir El Abd) Pumping Station. The Contractor shall supply the required engineering, equipment, materials, installation and construction works, which are necessary to complete the mechanical and electrical systems in accordance with all Contract Documents. Any items not described herein shall also be considered part of the work if they are shown on the drawings or are considered necessary for the proper operation of the pumping station or the described equipment.

The General Technical Specifications included shall cover the general design, manufacture, supply, installation and testing for all equipment supplied by the Contractor. The indicated ratings and features shall govern the specific ratings and requirements for all equipment. The particular specifications and associated drawings shall govern in case of any conflict with this Specification. Any deviations from this specification or the particular specifications shall be clearly state with reasons for the deviations.

All equipment shall be installed in strict accordance with manufacturer's recommendations. The Contractor shall purchase, receive, unload, transport (as necessary), store (as necessary), install and commission all material required for complete the electrical and mechanical systems.

8002 Design Works

The Contractor shall furnish a complete design for mechanical and related system in accordance with this specification, particular specification and drawings. The design work shall include, but is not limited to, technical calculations, preparation of drawings and bills of materials, and specifying equipment not specified in this specification, particular specification and drawings but necessary to provide a complete operable pumping station. The technical calculations, design drawings, etc shall be submitted to the Engineer for approval.

8003 Equipment and Material Supply

Equipment and material supplied under this contract shall meet all requirements as specified in the particular specifications and attached drawings and as specified herein. The actual equipment and materials to be supplied is described in the section on the particular specification, drawings and bill of quantities.

8004 Scope of Works

The work required comprises the following.

a. Design, manufacture, testing, supply CIF insurance from FOB till running against all kinds of risks, clearing the goods at customs, inland transportation to site, storing and guarding at site.
b. Erection works including supervising, testing at site, maintenance during the guarantee period of two years.
c. Handing over to the Engineer the machinery, equipment, material, tools and spare parts for the El Salaam No. 7 Pumping Station.

In the paragraphs of the specifications when references to the pumping units, motors etc. is in singular form, they shall apply equally to all pumping units, motors etc., to be supplied except where specifically stated otherwise.

8005 Works by Others

(1) Site Preparation

The Civil Works as shown on the attached drawings has executed grading and filling works by the joint contractors.

(2) Soil Investigation for Foundations

The detailed information on the foundation of pumping station shall be provided by the joint contractors.

(3) Building Works

The pumping station building have been executed by the building works as shown on the attached drawings.

8006 Materials

All materials furnished by the Contractor shall be new and of the most suitable grade for the purpose intended considering strength, ductility, durability, and best engineering practice. Furnished materials and manufacturing procedures shall be in accordance with pertinent provisions of the applicable standards herein specified unless otherwise specified.

Material	Applicable Standard	Equivalents
Structural steel for general use	ISO 630 E 235A, E 275A	JIS G 3101 SS400 ASTM A36
Steel plate for pressure vessels and principal stress carrying member of welded structure	ISO 630 E 275A to C	JIS G 3106 SM400 ASTM A 516 Gr.60
Steel plate for other than principal carrying member	ISO 630 E 235A E 275A to C	JIS G 3106 SM400 or JIS G 3101 SS400 ASTM A 516 Gr.60
Steel piping for pressure service	ISO 2604-2 ISO 2604-3	JIS G 3454 STPG 370, 410 ASTM A53 E(A,B) S(A,B)
Steel piping for ordinary piping	ISO 559 ST 320	JIS G 3452 SGP ASTM A53 Type F
Forging	ISO 9327	JIS G 3201 SF 440A min. ASTM A 668, class C min.
Steel casting	ISO 3755 200 – 400 min.	JIS G 5101 SC410 min ASTM A 27 U-60-30 min
Iron casting	ISO 185	JIS G 5501 FC250 ASTM A 48 No. 25
Spheroidal graphite iron casting	ISO 1083 400 – 18 min.	JIS G 5502 FCD 400 min. ASTM A 536 60-40-18 min.
Stainless steel (martensitic)	ISO TR 15510 L-No 48	JIS G4303~4305 SUS403 AISI 403, 410
Stainless steel (austenitic)	ISO TR 15510 L-No 6	JIS G 4303~4305 SUS304. AISI 304

8007 Workmanship

All work shall be performed and completed in a thorough workmanlike manner and shall follow the best modern practice in the manufacture of high-grade machinery, notwithstanding any omissions from these specifications. All works shall be performed by mechanics skilled in their various trades.

All bolts, nuts, screws, rivets, threads, pipe, gauges, gears, and measurements or dimensions shown on the drawings shall conform to ISO standards. For internal connections only, the Contractor will be permitted to deviate from the ISO standards.

8008 Applicable Codes and Standards

The pumps and related materials shall be manufactured in accordance with ISO codes and standards. When the Contractor requires apply the codes and standards, which have been adopted by various associations of manufacturer and engineering societies of his country, he shall submit copies of the codes and standard of the English version. The Engineer will accept the codes and standards, which are applied for materials or working method.

Materials, contractor design, construction work, and other requirements which are specified by reference to ISO codes, ISO standard specifications or other accepted standard

specifications or codes shall be in compliance with the latest editions or revisions thereof in effect on the date bids are received, including any amendments or supplements

In the event of conflicting requirements between a referenced specification, standard, or code and ISO specifications, ISO specifications shall govern. Unless otherwise specified, all materials that will become a part of the completed work shall be new and shall conform to the ISO or other specifications and standards approved by the Engineer.

In the event that ISO or other specifications do not cover the materials, the materials furnished shall be of standard commercial quality. Where types, grades, or other options offered in the reference specifications are not specified in these specifications, the material furnished will be acceptable if it is in accordance with any one of the types, grades, or options offered.

8009 Safety Factors and Working Stresses

Except where specifically stated otherwise, liberal factors of safety shall be used throughout the designs, and especially in the design of all parts subject to alternating stresses or shocks.

(1) Allowable Unit Stresses under Normal Operating Conditions

All pressurized parts of the pump shall be designed for the greater to withstand the pressure of shutoff head plus maximum suction head or maximum head plus head rise due to water-hammer. Maximum suction head on the pumps shall be determined by using EL 10.70 m as the maximum suction sump water surface elevation. The total of maximum head plus head rise due to water hammer is expected approx. 127 m.

However, the Contractor shall confirm maximum pressure based on the performance of the pump offered by him. Other parts shall be designed for the most severe operating conditions. Under the conditions specified above, the unit stresses shall conform to the following requirements:

a. For materials specified by ASME Boiler and Pressure Vessel Code, SectionVIII Unfired Pressure Vessel Code or Codes / Standards the unit stresses shall not exceed the value of specified.
b. For other materials, the unit stresses shall not exceed one-third of the yield point or one-fifth of the tensile strength of the material.

(2) Allowable Unit Stresses under Abnormal Operating Conditions

Unit stresses higher the specified by Clause (a) above, but not to exceed two-third of the yield point, shall be permitted for the following parts under the given conditions.

a. For all affected parts of the pump when subjected to maximum reverse (runaway) speed at maximum head.
b. For parts subjected to temporary localized stress where jack pads or tie rod lug pads are attached.

8010 Service Conditions

(1) Climatic Conditions

All equipment shall be installed under tropical climate conditions and shall operate in an environment with a maximum ambient temperature of 45℃ and relative humidity of 90% for indoor equipment and 100% for outdoor equipment. Elevations shall be less than 1000 meters above mean sea level. Rain is rather scarce and occurs during winter. Max. Wind velocity is about 120 km/h and may blow from any direction. The storms may occur in a few days in the year. Average water temperature for pump design is about 30 °C.

(2) Operation Time

All parts of the plant and machinery shall be rated for 24 hours continuous running with intermittent operation (eight to ten times successive starting during 24 hours).

(3) Quality of Water to be pumped

(a) Water Analysis

Chemical and physical analysis of the water flown into the pumps is as follows

Sample No.	Location	Sampling date
1.	Before the Suez Siphon	March 1999
2.	After the Suez Siphon	March 1999
3.	After the Suez Siphon	March 1999

Substance or Characteristics	Intern. Units	Sample Analysis 1	Sample Analysis 2	Sample Analysis 3
1. Color	Haze	non	cloudy	cloudy
2. Turbidity	NTU	45	85	> 100
3. Odor	—	+	+ +	+ +
4. pH - Value	Unit	6.8	6.7	6.7
5. Conductivity	micro rnhos	1950	2300	3650
6. T.D.S.	mg / 1	1351	1544	2472
7. Sodium ion	mg / 1	302	409	735
8. Potassium ion	mg / 1	11	14	21
9. Calcium ion	mg / 1	83	83	88
10. Magnesium ion	mg / 1	56	69	97
11. Chloride	mg / 1	591	631	1152
12. Bicarbonate	mg / 1	153	156	159
13. Carbonate	mg / 1	nil	nil	nil
14. Hydroxyl	mg / 1	nil	nil	nil
15. Sulphate	mg / 1	146	162	198
16. Silica	mg / 1	8	8.9	12.8
17. Iron	mg / 1	0.23	0.26	0.45
18. Manganese	mg / 1	< 0.01	< 0.01	< 0.01
19. Hardness as (CaCO3)	mg / 1	348	380	463
20. Total Hardness	mg / 1	502	551	674

Source: NSDO 1999

The Contractor shall pay attention to the equipment for designing as to galvanic corrosion, which may be occurred based above analysis.

(b) Sand Particle

Grain size of the sand blown into conveyance canal from sand dune is ranged 0.3 to 1.0 mm and settling basin has been designed to deposit 0.3 mm or more of grain size. The Contractor shall carefully select materials and design coating for pumps, valves and pipelines taking into account water quality and sand particle.

(3) Auxiliary Electricity supplies

The power for auxiliary equipment shall be supplied in the manner of.

- AC 380 V, 3-Phase, 50 Hz or AC 220 V, Single Phase, 50 Hz
- Frequency variation shall be less than ± 5%
- Neutral point of the distribution system shall be solidly grounded

8011 Unit of Measurements

Units of measurements shall be in the metric system and Celsius for temperature.

8012 General Requirements to Equipment

All equipment shall be new, shall be capable of withstanding long time use and shall satisfy all requirements of this specification, all applicable standards, and all requirements which a complete product should generally meet, even if such requirements are not expressly provided in the particular specifications.

All equipment shall be of a construction convenient for disassembly, inspection, erection, maintenance and operation. All equipment shall have markings, such as the center line mark, march mark, etc., in order to facilitate the installation works at the site. All materials used in supplied equipment shall be selected to give high quality performance shall be that normally accepted by the industry for the intended service.

8013 Welding

All welding shall be performed by the electric arc method, by a process that excludes the atmosphere from the molten metal, and where practicable, by automatic machines. Machined surfaces of parts affected by welding shall be machined to final dimensions after welding. Machined surfaces of parts requiring stress relief shall be machined to final dimensions after the parts have been stress relieved.

The design and fabrication of all major components which are to be welded shall be in accordance with ASME Boiler and Pressure Vessel Code, Section VIII Unfired Pressure Vessel Code or Codes / Standards of the Contractor's country which accepted by the Engineer. For welding of principal stress carrying parts, the qualification of welding

procedures, welders, and welding operators shall conform to the requirements of Section IX of the ASME Boiler and Pressure Vessel Code or the Code accepted by the Engineer.

The Contractor shall prepare the complete schedule of welding procedure which shall consist of the detailed procedure and specifications for each structure to be welded, the tables or diagrams showing the welding procedure to be used for each required joint, filler metal requirements, preheat and inter-pass temperature requirements, and stress relief heat treatment etc.

The schedule shall be submitted for approval to the Engineer. Welding will be subjected to inspection to determine conformance with approved welding procedures. The welding, which showing any degree of incomplete fusion shall be not acceptable inadequate penetration, or undercutting.

8014 Protective Coating

(1) General

All equipment shall be cleaned and to be coated in the manner of specified hereinafter, except galvanized metal and nonferrous metal parts will not be required unless otherwise specified. Where, Stainless steel, austenitic grey iron, and high nickel cast iron shall be considered as nonferrous in this section.

Surfaces not required to be coated, but which are adjacent to surfaces to be cleaned and coated, shall be protected from contamination and damage during the cleaning and coating operations. Cleaning and coating shall be performed only on thoroughly dry surfaces and during periods of favorable weather. Application of coating materials will not be permitted when the ambient temperature is below 18 degrees C or when the metal surface temperature is less than 3 degrees C above the dew point of ambient air. Surfaces, except those exposed to concrete, shall receive a prime coat to the specified dry film thickness within six hours after being cleaned unless otherwise specified. Surfaces exposed to concrete shall not coated and be thoroughly cleaned, de-greased and de-rusted.

(2) Coating Schedule

Coatings, minimum thickness, minimum number of coats, and surface preparation for the various items shall conform to the following schedule.

a. All machined and finished surfaces of ferrous metals to be exposed to the atmosphere during shipment shall be solvent cleaned and coated with one heavy coat of rust preventive compound.
b. All interior ferrous surfaces of the guide bearing reservoirs and valve hydraulic unit oil reservoirs shall be cleaned to white metal by sand-blasting and be coated with the manufacturer's standard coating system at the shop.
c. All water passage surfaces of the pumps, valves, pipes, and ferrous surfaces normally

in contact with water except stainless steel, shall be cleaned by sand-blasting and coated with not less than three coats of coal tar epoxy coating, black, to a minimum total dry film thickness of 400 microns at the shop and touch up as required at the site except site weld portion of pipelines.

d. All exterior surfaces which will be exposed to the atmosphere indoor, including those of the pump shall be cleaned by white metal sand-blasting and receive first and second coating of red lead paint of 20 microns respectively, intermediate and finish coats on alkyd resin basis of 40 microns respectively shall be applied with a total minimum dry film thickness of 120 microns at the shop and touch up at the site. Surfaces subject to condensation shall be coated with an approved anti-condensation paint. For these surfaces alternative based on chlorinated rubber basis may be offered.

   Painting of shafts of main pumps made of plain steels and not covered by protective sleeves and only for that portion which runs along with water shall be coated with epoxy lining of 850 microns at shop and touch up as required at the site.

e. All exterior surfaces which will be exposed under sunlight at the outdoor, including those of the weed screen cleaning machine and gantry crane shall be cleaned by white metal sand-blasting and receive a coating of organic zinc-rich primer of 20 microns, epoxy resin paint of 60 microns as under coat, epoxy resin paint of 60 microns as intermediate coat respectively and polyurethane resin intermediate paint of 40 microns, and polyurethane resin top paint of 30 microns respectively shall be applied with a total minimum dry film thickness of 190 microns (except zinc-rich primer) at the shop and touch up as required at the site.

f. All exterior surfaces of pipeline normally in contact with water and /or soil shall be protected according to Sub-Section 4011 "External Coating".

g. The Contractor's standard painting system will be acceptable for practical and economical reason for standardized pumps, motors, instruments, cranes and equipment used in all station as far as possible.

h. The color of paints applied in the painting and coating shall be from those offered as coating schedule of the plant by the Contractor and approved by the Engineer.

(3) Preparation of Surfaces

All surfaces to be coated shall be cleaned with approved equipment before application of coating materials. Any grit or dust remaining on the surface after the cleaning operations shall be removed before proceeding with the application of coating materials. Surfaces upon which rust forms, or which otherwise becomes contaminated in the interval between cleaning and coating or between coats of material, shall be re-cleaned. Surface preparation for each specific item shall be in accordance with the following methods.

a. Solvent Cleaning

   All oil, grease, and wax shall be removed by wiping or scrubbing the surface with clean rags or brushes wetted with solvent. A final wiping shall be performed with clean solvent and rags or brushes to avoid leaving a thin film of greasy residue on the surfaces being cleaned. Mineral spirits or other approved low toxicity solvent having

a minimum flash point of 38 degrees C shall be used as general purpose cleaning solvent during normal weather conditions. In hot weather, heavy mineral spirits, Grade 2, with a minimum flash point of 52 degrees C shall be used. Surfaces to be coated with coal tar epoxy shall be cleaned with xylol.

b. White Metal Sand-blasting
All welds shall be ground smooth and weld splatter shall be removed. The surfaces to be coated shall be blast cleaned to white metal using hard, sharp, dry sand or steel grit, to produce a surface with a gray-white uniform metallic color. The compressed air used for blasting shall be free of oil and condensed moisture.

(4) Application of Materials

Application of Materials shall conform to the following schedule:

a. All materials shall be thoroughly mixed at the time of application as recommended by the paint manufacturer. Any dust remaining on prepared metal surfaces from the cleaning operation shall be removed before proceeding with the application of coating materials.
b. Effective means shall be provided for removing free oil and moisture from the air supply lines of all spraying equipment. Nozzle pressure consistent with acceptable finish results shall be employed when spray painting. Each coat shall be free from runs, pinholes, holidays, and sags, and shall be allowed to dry or harden before applying the succeeding coat.
c. Zinc-rich primer shall be applied by spray or brush in conformance with the paint manufacturer's printed instructions.
d. Spare containers of coating materials shall be furnished in sufficient quantities to make field touch-up repairs to all coating systems.

8015 Quality Assurance

(1) General

The Contractor shall perform all material, mechanical and electrical assembly, dimensional and operational tests as required to confirm that the equipment meets all requirements of the specifications and of applicable codes, standards, and regulations. The Contractor shall be qualified for ISO 9001 and ISO 14001.

All defects revealed, as a result of tests shall be rectified by the Contractor to meet the all requirement of the specifications. The waiver of any test, or the witnessing thereof by the Engineer, shall not constitute a release of the Contractor's responsibility to meet fully the requirements of the specifications.

(2) Witnessing of Tests

The Engineer shall have free entry at all times while tests are being conducted. The Contractor shall notify the Engineer 30 days in advance of the performance of each test so that the Engineer may, at his option, witness the test.

(3) Material Tests

Copies certifies by manufacturer of all specified material tests for chemical analysis and mechanical properties shall be retained on file by the Contractor and shall be available for inspection by the Engineer.

(4) Nondestructive Tests

Nondestructive inspection shall be performed on the major components such as pressure vessels and principal stress carrying parts by qualified inspector accepted by the Engineer. All surface examinations shall be made after final machining or finishing of the surface. Examination of welds shall be made after final stress relieving of the component.

Inspection and repair of cast parts and those fabricated by welding shall be performed in accordance with ASME Boiler and Pressure Vessel Code, SectionⅧ Unfired Pressure Vessel or Codes / Standards of the Contractor's country which accepted by the Engineer.

When the Contractor propose to use test methods or acceptance criteria alternated from those stated above, he shall submit to the Engineer for review a schedule of the nondestructive methods he proposes to use for each of the major components. The Contractor shall submit a schedule of, which shall include the areas to be subjected to the required nondestructive test and the required acceptance level associated with each test.

8016 Drawings and Data

(1) Contract Drawings

The contract drawings shall consist of the Tender drawings and contractor's shop drawings submitted to the Engineer for his approval. These contract drawings show the works to be done under this contract together with the technical descriptions in the Contract Documents. If there are any discrepancy between the specification and drawings, this specification shall supersede.

(2) The Drawings for Manufacturing

The Contractor shall submit for approval the detail drawings for assemble, installation, wiring diagrams, wiring plan etc. and descriptions to demonstrate that the equipment to be furnished will conform to the requirements and intent of the specification. These drawings shall be submitted within the specified times. Within 90 days after notice of award, the

Contractor shall submit a detailed production schedule to the Engineer and the Engineer.

The Contractor shall submit four copies of each drawing to the Engineer for approval. One print of each drawing will be returned to the Contractor stamped "Approved", " Approved with noted", or "Returned for Correction". The Contractor may proceed with manufacture of equipment on drawings stamped "Approved" and "Approved with noted". Drawings stamped "Returned for Correction" shall be revised and re-submitted for approval as soon as possible.

The Engineer will require 60 calendar days from Contractor's submitted date to answer correspondence and to review each submittal of approval data or approval drawings. Any manufacturing done by the Contractor before approval of the drawings will be at the Contractor's risk. The Contractor shall furnish two (2) sets of reproducible to Engineer and two (2) sets of copies to the Engineer of all final approved drawings.

8017 Severity of Vibration

The vibration severity of the machinery offered shall correspond to quality judgement "Good" or better in ISO 3945.

8018 Sound Pressure Level

As for auxiliary pumps, the sound pressure level measured at no load shall be less than 80-dB (A) at a measuring distance of 1 meter, unless otherwise specified.

8019 Supporting Structures

The support structures except in case of the particularly specified shall be galvanized after fabrication, all necessary galvanized bolts, nuts, and washers to complete the erection shall be furnished.

8020 Name Plates

Nameplates or rating plates shall be corrosion resistant and shall be engraved in the English language. Instruction plates, warning signs and all markings on the equipment, parts and accessories thereof shall also be in the English language. Details of the data to be shown on the nameplate or rating plate shall be indicated on drawings and submitted to the Engineer for approval.

8021 Packing

All the equipment and spare parts shall be carefully packaged so as to withstand long time transport by sea and land. The mechanical equipment shall be completely protected against rust, corrosion and moisture during transport and storage in a high temperature climate. The spare parts shall be packaged separately from other articles. Packages of spare parts shall be

labeled in the English language clearly indicating that the contents are spare parts and giving directions for proper storage.

Each crate or package shall contain a packing list in waterproof envelope and copies in triplicate shall be forwarded to the Engineer prior to dispatch. All items of material shall be clearly marked for easy identification against the packing list. All cases, packages etc., shall be clearly marked on the outside to indicate the total weight, to show where the weight is bearing and the correct position of the slings and shall bear an identification mark relating to the appropriate shipping documents.

8022 Transportation

The Contractor shall observe any regulations, which limit loads on road and bridges over which materials may be conveyed.

8023 Arrangement and Access of Equipment

The general arrangement of equipment within the pumping station is shown on the contract drawings. Minor changes in the arrangement shown on these drawings may be accepted provided that the overall dimensions, the location of incoming and outgoing of accompanying system and the bay spacing are not varied.

The Contractor shall provide and submit to the Engineer for approval a complete set of drawings showing all details of equipment arrangement, structure designs and foundation requirements for actual equipment being furnished in accordance with related specifications. The Contractor's arrangement of equipment shall permit safe access for operating personnel on foot in any part of the pumping station. The Contractor's arrangement of equipment shall make provision for maintenance access to equipment with small trucks, forklift or cranes as required.

8024 Installation Supervision

The Contractor shall install, test and commit the equipment by skilled workers under supervision of qualified and experienced staffs. The Contractor shall be responsible for the installing, starting, and operating of the equipment until the field tests are completed. The Contractor shall be coordinated with the program of construction at the job site under cooperation the Engineer.

The Contractor shall, at his expense, provide the services of experienced and qualified personnel to supervise the installation of equipment herein defined and of equipment for which the manufacturer recommends installation supervision. Each installation supervisor shall have the following qualifications:

a. Be a representative of the manufacturer of the equipment for which the installation supervision shall be provided.

b. Have a minimum of 3 years experience in the installation of the manufacturer's equipment similar to that being installed.
c. Be reasonably proficient in the use, both oral and written, of the English language.

Each installation supervisor shall supervise and be responsible for the installation, erection, adjustment, and site testing and commissioning of the equipment for which his services are engaged. Each installation supervisor shall be present at the job site at all times during the performance of work for which he has supervision responsibility. Absence of the installation supervisor from the job site during such periods shall not be permitted except with the express authorization of the engineer.

8025 Equipment for which Supervision is required

The installation supervision shall be required, but is not limited to, for the following equipment.

- Main pump units
- Main pump motors
- Valves and all auxiliary equipment for main pump unit
- Discharge header
- Overhead traveling crane
- Gantry crane
- Bulkhead gates
- Trash screen and trash cars
- Auxiliary substation
- All control panels for main pump
- Remote control console and auxiliary equipment
- Emergency generator unit

8026 Equipment Problems

When the Contractor encounters a problem in the installation, erection, adjusting, which he is unable to solve to the satisfaction of the engineer, he shall, at his expense, provide at the job site, within a reasonable time, the services of a qualified and experienced representative of the manufacturer of the equipment to arrive at a solution to the problem that is acceptable by the Engineer.

8027 Unloading and Storage

The Contractor shall thoroughly check and provide list all equipment received. The list shall show any damaged or missing parts or equipment. The memorandum accompanying each item shall be furnished in an external weatherproof packet.

The Contractor is responsible for finding proper storage facilities, which shall be approved by the Engineer for all equipment and material. Equipment shall be unloaded and suitably stored as soon as possible after arrival. The Contractor shall store, protect and maintain

materials and equipment after receipt until when the Engineer accepting installation of the equipment.

Such storage and maintenance shall be in strict accordance with recommendation of the manufacturer and the requirements of this Specification. The Contractor shall provide all materials, equipment, storage areas and labor required for such storage and maintenance. The Contractor shall be responsible for any damage and deterioration of materials or equipment resulting from improper storage, maintenance or handling. The Contractor shall at his expense subject to the Engineer for approval to recondition, repair or replace to the satisfaction of the Engineer, all materials and equipment so damaged or deteriorated.

All proposed methods of reconditioning or repair shall be submitted to and approved by the Engineer prior to commencing reconditioning or repair work. The Contractor assumes all risks for reconditioning or repair work performed without approval by the Engineer. Equipment stored outdoors shall be supported at least 20 centimeters above the ground. All internal parts shall be kept free of dust, dirt, moisture and contamination of any kind. All spare parts shall be stored at a location and under conditions to be specified by the Engineer.

8028 Installation Requirements

The Contractor shall install all equipment as indicated on the tender/shop drawings and as approved by the Engineer. The Contractor shall provide all tools required for installation, including any special tools, and all the tools specified. All special tools and appliances, as defined in the Specifications, shall be furnished also, and become the property of the Employer after installation. Where it is specified that the equipment shall be erected on walls or columns, the Contractor shall install adequate structural steel supports and adequate expansion bolts for anchorage.

The steel supports to be installed on foundations shall be leveled with precision to avoid distortion and misalignment among sections or adjacent compartments of equipment. The quantity, size, arrangement and other details of the equipment erected on the supports shall be subject to the Engineer for approval.

The equipment shall be leveled to ensure that the vertical sides are perfectly vertical and aligned, and that doors, panels and sliding frames operate freely. All electrical equipment and associated accessories shall be assembled, installed, connected and tested as required to make the equipment installation complete and ready for operation.

The Contractor shall be responsible for all assembly and disassembly required in the handling and erection of the equipment. Before assembly or erection, equipment shall be thoroughly cleaned of all protective coatings and foreign material. After the erection of equipment, all external surfaces shall be cleaned of oil, grease, dirt and other foreign material. All marred or damaged spots on equipment and material shall be refinished to match the original finish.

8029 Testing and Trial

(1) Condition and Procedure for Testing

The basic condition and procedure for testing shall be described in the Sub-Section 8104 of this Specification. The factory tests for the equipment specified hereinafter shall be carried out in the presence and subject to the control of Employer's Representatives or the Engineer. They have to be informed of the dates when the materials shall be ready for inspection at least 30 days before any materials is ready for inspection to avoid the possibility of delay. The equipment required the above mentioned inspection test be as follows.

- Main Pump units
- Main Pump Operating Equipment

In case, the observers fail to attend the inspection test the Contractor may be given discretion either grant a reasonable extension to carry out such tests in the presence of them or the Engineer waive inspection against submission of test certificates and guarantee certificates by the Contractor, that the equipment are tested in accordance with the specifications.

Inspection tests shall be carried out in conforming to prevailing international standards or standards of a competent Engineer in the country of manufacture. Such tests shall be stated briefly in the offer supported by brief abstract in English for it and will be given by the Contractor in full details after concluding the Contract. The Engineer will issue the certificate of the test results for every test carried out with his comments as to whether tests are successful or rejected.

The decision of the Engineer will be final and binding to the Contractor, however test and acceptance certificates issued by the Engineer do not relieve the Contractor from his obligations under this contract. All tests at site shall be carried out under the control of the Engineer and in the presence of the Contractor (or his representative), or in his absence if he fail to attend at the fixed times, after having been duly notified in that behalf.

The Contractor shall not be entitled to any payment whatsoever or to any extension for the time of completion by reason of, or in respect of such tests, or the failure of any tests, or the rejection of any part of material or equipment as result of any test. All the apparatus and equipment supplied under this contract shall pass their specified tests to the satisfaction of the Engineer both at factory and at site.

(2) Expenses of Tests

All tests shall be carried out by and at the expense of the Contractor who shall supply all test pieces and specimens as well as all apparatus, instruments and equipment (even if they are not mentioned in the Contract), staff and labor required for effective carrying out the prescribed tests.

All site tests shall be carried out by and at the expense of the Contractor including in case the Contractor requires repeat the tests before settling any penalties, in which case these tests will be at the Contractor expense. Any repeated tests for the penalty purposes shall be final and binding to all parties.

(3) Calibration of Instruments

The instruments used for the testing shall be of calibrated by the official laboratory recognized by the Engineer. Particulars of the calibration shall be given on test certificates. The Engineer before or after testing shall check the calibration of all instruments, even if it has been previously approved.

(4) Penalties and Rejections

All equipment and materials are rejected, if they do not satisfactory pass the specified tests at factory or any additional tests of current practice, which the Engineer may consider necessary in order to satisfy himself regarding workmanship and quality of material.

Besides, if results obtained by the tests made on any equipment or materials, with consideration of the tolerances given in the specifications do not correspond to the specified figures, thus proving that the equipment or material supplied is of a standard lower than that required or guaranteed, the equipment or material shall be reject. Due penalties shall be applied on completion of each corresponding test result, and will be subjected to settlement if decided later by the Engineer.

8030 Training

(1) Factory Training

The Contractor shall provide training for MED personnel in the country of the equipment manufacture as follows.

	Number of Personnel	Period of Training
Senior Mechanical Engineer	2	2 weeks
Junior Mechanical Engineer	2	2 month
Mechanical Technician	5	2 month

If possible part of the training should take place at sites in the Contractor's country where equipment similar to that supplied under the contract is being installed. All expenses (Cost of training, accommodations, food, medical treatment, local travel in the country) shall be included in the contract prices.

(2) On the Job Training

The Contractor shall dispatch specialists of operation and maintenance of the mechanical

systems for train MED personnel in the No. 7 Pumping Station as follows.

- Personnel of the Specialist: by the recommendation of the Contractor
- Period of the training: 3 month.

All expenses (Cost of training, accommodations, medical treatment, international and local travelling etc.) shall be included in the prices.