

## I.6.2 Measurement and Payment

Measurement for payment for each work item shall be made by the following methods, and payment for these shall be made at the unit prices tendered in the Bill of Quantities so established according to the measurement, which unit prices shall include the cost for all incidental works specified and as required.

Works Item	Basis of Measurement	Incidental Works included
<b>(1) Concrete Works</b>		
(a) Concrete	: Volume of concrete placed in cubic meters.	/Casting, compaction and initial floating to level surface.
(b) Formwork	: Area of formwork measured in square meters.	/Shoring and removal.
(c) Reinforcing bars	: Weight of steel reinforcement measured in tons.	/Bending, lapping and securing.
<b>(2) Masonry Works</b>		
(a) Concrete block wall	: Area of concrete block wall measured in square meters.	/Bonding and filling cement mortar, reinforcing bars and concrete lintels.
<b>(3) Plastering Works</b>		
(a) Cement mortar plaster to floor, wall and ceiling	: Area of plastered surface measured in square meters.	/Expanding grouting and corner beads.
(b) Cement mortar plaster to skirting	: Length of plastered surface measured in linear meters.	
(c) Waterproof cement mortar plaster to roof, top of eaves, parapet and roof gutter	: Area of plastered surface measured in square meters.	/Waterproofing admixture, cover beads and required wire lath.
(d) Colored cement spray	: Area of surface sprayed with colored cement spray measured in square meters.	/Surface preparation.
(e) Concrete trowel finish to floor	: Area of concrete floor surface troweled.	

Works Item	Basis of Measurement	Incidental Works included
(4) Bituminous Waterproofing Works		
(a) 3-ply built-up asphalt roofing, 2-ply built-up asphalt roofing	:	Area of surface covered with asphalt roofing measured in square meters. /Joint filler, asphalt compound and required caulking.
(5) Carpentry and Joiner Works		
(a) Wooden blind box, Wooden casing for aluminium windows, Wooden ceiling trimming	:	Length of blind box, casing and trimming measured in linear meters. /Wooden blocks and required fixing devices.
(6) Terrazzo Works		
(a) Terrazzo tile to floor	:	Area of surface of terrazzo tile floor measured in square meters. /Joint filler and required polishing
(b) Terrazzo tile skirting, Terrazzo block door sill, Terrazzo block shelf, Terrazzo block border	:	Length of skirting, door sill, border and shelf measured in linear meters. /Base cement mortar.
(7) Tile Works		
(a) Porcelain floor tile, Asphalt block tile, Mosaic tile, Ceramic tile	:	Area of surface covered with porcelain tiles, asphalt block tiles, mosaic tiles and ceramic tiles measured in square meters. /Base cement mortar.
(8) Wooden Doors		
(a) Wooden doors	:	Area of door leaves measured in square meters. /Wooden frames, required wooden louvers, hardware, wooden blocks and cement mortar grouting.
(9) Metal Doors, Windows and Louvers		
(a) Steel doors	:	Area of door leaves measured in square meters. /Steel frames, hardware, cement mortar grouting and caulking

Works Item	Basis of Measurement	Incidental Works included
(b) Steel louvers	:	Area of louvers measured in square meters./Steel frames, required insect screen, cement mortar grouting and caulking.
(c) Aluminium doors	:	Area of door leaves measured in square meters. /Aluminium frames, hardware, cement mortar grouting and caulking.
(d) Aluminium windows	:	Area of windows measured in square meters. /Aluminium frames, required insect screen, hardware, cement mortar grouting and caulking.
(e) Aluminium louvers	:	Area of louvers measured in square meters./Aluminium frames, cement mortar grouting and caulking.
(10) Glazing Works		
(a) Float glass, Wired glass, Sheet glass, Figured glass	:	Area of surface covered with glass measured in square meters. /Glazing beads.
(11) Painting Works		
(a) Vinyl emulsion paint, Oil Paint, Clear lacquer paint, Acid-proof paint	:	Area of painted surface measured in square meters. /Surface preparation.
(12) Spray Tile		
(a) Spray tile	:	Area of surface sprayed with spray tile measured in square meters. /Surface preparation.
(13) Interior Finishing Works		
(a) Rockwool acoustic tile	:	Area of ceiling finished with acoustic tiles measured in square meters. /Gypsum boards, ceiling suspension frames, ceiling inspection holes and required accessories.

Works Item	Basis of Measurement	Incidental Works included
(b) Asbestos cement sheet	:	Area of ceiling finished with cement sheets measured in square meters. /Suspension frames, ceiling inspection holes and required accessories.
(c) Vinyl floor tile	:	Area of floor finished with floor tiles measured in square meters. /Adhesive.
(d) Vinyl soft skirting	:	Length of soft skirting finished in linear meters. /Adhesive.
<b>(14) Miscellaneous Metal Woks</b>		
(a) Steel unloading hatch cover on roof parapet	:	Number of unit installed with hatch cover measured in set. /Steel frames, lifting devices, anchor bars, glass wool with punching metal sheets and required accessories.
(b) Steel floor hatch cover	:	Number of unit installed with hatch covers measured in set. /Rib angles, base angles or plates, required reinforced beams, anchors and accessories.
(c) Cable trench cover	:	Area of hatch covers measured in square meters. /Base angles, anchors and accessories.
(d) Steel hoist beam	:	Total weight of hoist beams measured in kilograms. /Base plates, anchor bolts and grouting mortar.
(e) Steel hoist hook bar	:	Number of hook bars measured in numbers.
(f) Steel pipe ladder, Steel angle ladder with safety cage	:	Length of ladder measured in linear meters./Supporters, anchors, required safety cage, accessories and mortar grouting.
(g) Roof drain, Floor drain	:	Number of drains measured in numbers. /Mortar grouting and caulking.

Works Item	Basis of Measurement	Incidental Works included
(h) Steel pipe handrail	:	Length of handrails measured in linear meters. /Balusters, intermediate rails, wooden rails, anchors and mortar grouting.
(i) Cover of expansion joint	:	Length of joint cover measured in linear meters. /Fixing metal, anchors and accessories.
(j) Aluminium non-slip, Steel angles non-slip, Stainless steel door sill, Brass floor divider	:	Length of non-slips, door sills and floor dividers installed with those measured in linear meters. /Anchors and mortar grouting.
(k) Stainless steel door mat	:	Number of door mats measured in numbers./Fixing border angles.
(l) Steel channel frame suspension system on steel light gauge ceiling bed	:	Total weight of suspension system suspended with channel frames measured in kilograms. /Suspension angles and accessories.
<b>(15) Miscellaneous Works</b>		
(a) Polyvinyl chloride downspout, Drainage clay pipe	:	Length of downspouts and clay pipes measured in linear meters. /Supporters and required steel fittings.
(b) Foamed plastic board for expansion joint filler	:	Area of plastic boards measured in square meters.
(c) Polysulfide caulking to expansion joint filler	:	Length of caulking measured in linear meters.
(d) Wooden partition in toilet	:	Area of partition measured in square meters. /Doors with hardware and required accessories.
(e) Kitchenette unit	:	Number of kitchenette unit measured in set. /Sink unit, cupboard with wooden shelf, flashing plate and accessories.
(f) Mirror in toilet	:	Number of mirrors measured in numbers. /Fixing metals.

Works Item	Basis of Measurement	Incidental Works included
(g) Venetian blind	:	Area of blind measured in square meters. /Fixing metals and required accessories.
(h) Room name plate	:	Number of name plates measured in numbers. /Inscriptions and fixing metals.
(i) Skylights	:	Number of skylights measured in sets. /Fixing metals and required accessories.
(j) Elevator	:	Lump sum for 1 unit./Installation, testing and required accessories.

## **I.7 PLUMBING AND FIRE PROTECTION WORKS**

### **I.7.1 General**

The works under this Sub-paragraph shall comprise water supply system, waste water, sewage system and fire protection system for the Pump house.

The Contractor shall carefully investigate the structural and finish conditions in Architectural Works affecting all his work and shall arrange such work accordingly, at no additional cost to the CRM.

The general arrangement of the plumbing and fire protection shall be as indicated on the Drawings. Materials and equipment installed in the plumbing system shall be suitable for the pressures and temperatures encountered. Installation shall be as required by applicable international plumbing code and local regulations and as specified herein. The installation shall be accomplished by workmen skilled in this type of work.

#### **(1) Shop Drawings**

At least 60 days prior to starting installation of any plumbing materials or equipment, the Contractor shall submit for approval of the Supervision the followings shop drawings:

- (a) Layout drawings of equipment including list of equipment and materials to be incorporated.
- (b) Details of piping and valve connections.
- (c) Details of supports, hangers, attachments, anchoring and sleeves.
- (d) Details of foundation for equipment.
- (e) Detailed layout of electric wiring and conducting.
- (f) Other drawings as required by the Supervision.

## **(2) Data and Samples**

The Contractor shall submit for approval of the Supervision a complete list of materials and equipment to be incorporated in the works under this Paragraph including sufficient descriptive materials such as catalogs, diagrams, performance curves, charts, layout drawings and other data published by the manufacturer to demonstrate conformance to the Specifications and Drawings.

## **(3) Operation and Maintenance Manuals**

Operation and maintenance manuals for the domestic water supply system, sewage system and fire protection system shall be furnished as specified hereafter. The manuals shall be furnished at the time of performance tests of the system.

The manuals shall include but not limited to the following:

### **Explanation of system:**

- General description of system including function, design conditions, system design, equipment incorporated.
- Schematic diagrams of piping including equipment, valves and controls.
- Schematic diagram of electric power supply and controls.
- Layout plan of equipment.

### **Operation and maintenance instructions:**

- Method of operation including procedures for safe starting and stopping of equipment, preventive procedures and checking methods.
- Manufacturer's instructions on each piece of equipment including lubrication instructions.
- Daily, weekly, monthly and yearly inspection items on each piece of equipment and systems.
- Method of finding causes of breakdown of each piece of equipment and systems and countermeasures to be taken.

### **Manufacturer's bulletins:**

- Manufacturer's specifications, shop drawings and catalogues of each piece of equipment.
- Manufacturer's certifications:
- Any guarantee, test data and engineering data furnished by the manufacturers.
- Spare parts list:
- List of spare parts and consumables furnished with the equipment and standard appurtenances as required by the Specifications.
- Service and maintenance organizations:
- Name and address of nearest recommended service and maintenance agent who can practically be addressed by the CRM at the time of breakdown of an equipment.

#### **(4) Attachments and Spare Parts**

The Contractor shall furnish each piece of equipment, standard attachments and spare parts which the manufacturer supplies under normal commercial transactions. In addition to these, the Contractor shall furnish spare parts, consumables or stand-by equipment as specified hereinafter. The Contractor shall also furnish a complete list of spare parts as recommended for operation of each piece of equipment for a period of one year with current prices and source of supply.

#### **(5) Tools**

The Contractor shall provide sufficient special tools as recommended by the manufacturers for field maintenance of the system. One complete set shall be provided at no extra cost to the CRM.

#### **(6) Field Instructions**

Upon completion of the work, the services of one or more instructors shall be provided by the Contractor for a total period of not less than 5 days to instruct the representative of the CRM in operation and maintenance of the equipment and the systems. These field instructions shall cover all the items contained in the bound instructions as specified for operation and maintenance manuals, and all costs for the services shall be born by the Contractor.

### **1.7.2 Plumbing Works**

#### **(1) General Requirements for Piping**

All pipes shall be jointed with fittings compatible with the pipe and of the suitable type for the intended service.

The joints shall be properly provided in piping to allow disassembly of the piping into reasonable length of handling.

Flanges shall be provided for pipes more than 75 mm in diameter. The flanges shall be compatible with and shall have the same rating as the companion flange of the valve or the fittings. Full face rubber gasket shall be provided to all flanged joints.

All piping shall be fitted and assembled to introduce minimum stress to the pipe and fittings. All pipe shall be supported where shown on the Drawings and as required. P.V.C. pipe shall be supported at the spacing recommended by the pipe manufacturer.

The same standard of thread shall be used throughout the works.



All piping to be embedded shall be tested and approved by the Supervision prior to being embedded.

Sleeves or blockouts shall be provided where pipe passes through concrete structure or concrete block. The space shall be filled or caulked with suitable materials. Where pipe passes through a wall or floor where watertightness is required, the space shall be filled with yarn tarred or with approved expanding grout.

Cleanout and manhole shall be provided as shown on the Drawings or as directed by the Supervision.

All pipes embedded in the ground shall be at the pipe top minimum 30 cm below the grade of the ground where no heavy traffic is expected and minimum 90 cm below the grade crossing the road and where heavy traffic is expected. Pitch of the pipe line shall comply with the applicable code or regulations or as directed by the Supervision.

Change in direction shall be made with fittings except that bending of galvanized steel pipe 100 mm and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center line radius of bends shall not be less than 6 times of the pipe diameter. Bent pipe showing kinks, wrinkles, flattening or other malformations will not be accepted.

Exposed piping shall be run parallel with the lines of the building unless otherwise indicated.

## (2) Pipes

### (a) Galvanized Steel Pipes

Domestic water service, drainage and vent pipe shall be of standard weight galvanized, screwed, and socketed pipe conforming to JIS G 3422 and G 3452 or approved equivalent. Threaded joints shall be sealed with an approved graphite compound or with anti-corrosive tape applied to the male threads only.

### (b) PVC Pipes

Polyvinyl chloride pipes shall be used for storm drain, waste water, sewage, vent pipes and drainage pipes for outdoor piping. The PVC pipes shall conform to JIS K 6741 or approved equivalent. The pipes shall be laid and jointed in accordance with the manufacturer's instructions and to the Supervision's satisfaction.

## (3) Valves

Gate valves and check valves in 50 mm diameter and smaller pipe shall be of brass or bronze construction. Valves 65 mm in diameter and larger in the pipe line shall have cast iron body and brass trim.

Gate valves shall be of solid wedge disc type and shall have rising stem or non-rising stem. Check valves shall be horizontal swing type having a light weight brass disc. Globe valves shall have replaceable resilient plugs and shall have rising stem.

Air vent valves shall be either float type, ball type or combined float and heat sensing or diaphragm type to be selected according to the service intended.

All valves throughout this Sub-paragraph shall be of the same manufacture in principle.

#### (4) Unions and Hose Faucets

Unions on ferrous pipe 50 mm in diameter and smaller shall be malleable iron zinc-coated. Unions shall not be concealed in walls, ceilings or partitions. Hose faucets shall be brass or bronze with male inlet threads, hexagon shoulder and hose connection.

#### (5) Flexible Joints

The flexible joint shall be either of the followings:

A rubber tube type formed with a flexible reinforced, rubber tube with bolted flanges and split backing flanges for attachment to the pipe, or

A bellows type formed with copper or stainless steel, activated by internal pressure and retained by flange rings and tension lug bolts.

#### (6) Plumbing Fixtures

Plumbing fixture shall be obtained from a reputable supplier and the Contractor shall submit catalogues for approval of the Supervision.

Generally, all fixtures except toilets shall have the water supply above the rim. Angle stops, straight stops, stop integral with the faucets, or concealed type loose-key pattern stops for supplies shall be furnished and installed with fixtures. Exposed fixture trimmings and fittings shall be chromium-plated or nickel-plated brass with polished, bright surfaces.

Where space conditions will not permit standard fittings special fittings shall be provided. Connections between earthenware fixtures and pipes shall be made absolutely watertight with a closet-setting compound or with a gasket and seal.

Wall-hung fixtures shall be fastened to the wall by through bolts where practicable. For solid concrete or masonry and where through bolting is not practical, fixtures shall be fastened with machine-bolt expansion shields or stud-type expansion bolts. For concrete masonry unit construction, fixtures shall be fastened with through bolts or toggle bolts as required. Exposed nuts in finished areas shall be chromium-plated hexagonal cap nuts.

The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with an integral stop, shall be equipped with a cutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixture.

**(7) Traps**

Each fixture, floor drain and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on steel pipe or copper tube shall be recess-drainage pattern or tube type.

**(8) Pipe Cleanouts**

Pipe cleanout shall be the same size as the pipe. Cleanouts in connection with other pipe shall be T-pattern, 90 degree branch drainage fittings with screw plugs. Cleanouts on pipe where installed in finished floors or walls shall be provided with chromium plated cast brass covers secured to plugs.

**(9) Floor and Shower Drains**

Floor and shower drains shall be integral with a trap, provided with water cut-off flange with threaded or caulked pipe connection. Grate shall be of chromium plated cast brass.

**(10) Pipe Insulation and Coating**

Exposed water supply and drainage pipes shall be insulated as specified in Paragraph I.8 Air Conditioning and Ventilation Works hereafter.

When steel pipes and fittings are buried in the ground, they shall be insulated with either of the following with approval of the Supervision:

Asphalt with jute

Glass wool cloth impregnated with waterproof insulation compound

Vinyl tape with adhesive

**(11) Pipe Hangers, Inserts and Supports**

The Contractor shall submit for approval of the Supervision detailed drawings of the type of inserts, hangers and supports for the piping he proposes to provide.

The location of hangers and supports shall be coordinated with the structural work to assure that structural members will support the intended load. For steel construction, joints shall be bridged where required to support the expected load.

Hangers and supports shall be provided at intervals specified below, at locations not more than 1.0 m from the ends of each runout and not over 30 cm from each change in direction of piping. Hangers shall be adjustable. Vertical steel pipe shall be supported at each floor, or at intervals of not more than 4.5 m and at not more than 2.5 m from end of riser.

Horizontal steel pipe shall be supported at not more than the following intervals:

<u>Pipe dia.</u>	<u>Interval</u>
20 - 25 mm	1.8 mm
32 - 40 mm	2.0 mm
50 - 80 mm	3.0 mm
90 - 150 mm	4.0 mm
over 200 mm	5.0 mm

#### (12) Painting

All hangers, supports and other iron works shall be painted with one coat of red lead primer and with two coats of oil point. All galvanized steel pipes exposed to view shall be painted with two coats of oil paint. Color code shall be as directed by the Supervision.

#### I.7.3 Testing of Pipe Lines

The Contractor shall test all pipe lines as directed by and in the presence of the Supervision. If the pipe fails in test, the Contractor shall repair, replace and pretest the piping until accepted by the Supervision. All piping system shall be flushed clean before testing.

The Contractor shall provide all personal, water and equipment for testing. The cost for the test shall be included in the Contract price.

##### (1) Pressure Testing of Water Service Pipe

Pipes of each part shall be subject to a hydraulic pressure test of 7 kgf/cm<sup>2</sup>.

If piping is tested in sections, temporary cap shall be fitted. Each section shall be slowly filled with water and air inside the pipe shall be carefully expelled.

For acceptance, the test pressure shall remain constant for one hour without additional water.

##### (2) Testing of Sewage and Waste Water Pipe

No pipe shall be covered or concealed before it is tested. In any sections of pipe lines are tested, the Contractor shall obtain approval of the Supervision.

All openings and pipe ends shall be securely plugged and filled up with water up to the top of the highest opening. The water shall remain at the same level for 2 hours.

All pipes shall also be inspected visually to ensure that there is no projections in the pipe and the pipe line is straight and void of abrupt kinds. At least three-quarters of the pipe opening of any sections between manholes shall be visible when viewed from opposite end of the pipe section.

Exposed pipes shall further be subject to a leakage test. Leakage tests shall be made only after a minimum of 24 hours after the pipe has been filled with water. No leakage shall be found for duration on another 2 hours on the pipe line.

#### **I.7.4 Domestic Water Supply System**

Raw water for domestic use in the pump house shall be obtained from the cooling water supply system for the pumping units which will be constructed by the other contractor. A raw water delivery pipe shall be connected to the said cooling water supply pipe at the point shown on the Drawings. Tapping and stub of pipe with bell will be provided by the other contractor.

The raw water shall be received in a raw water storage tank, filtered by a filtering unit, sterilized by a chlorinator and then stored in a treated water storage tank. The treated water (pure water) shall be delivered to each requirement through a pressure tank, automatically.

##### **(1) Water Filter Unit**

The filter unit shall be of factory assembled, rapid force feed type unit with back-washable sand filtering medium contained in a hermetic steel tank.

The unit shall be a complete unit equipped with piping assembly, valves, flow meter, pressure gauges, manholes, inspection windows and mounting base.

The tank shall be hydraulic pressure-tested at the shop, inside surface painted with a synthetic resin paint and outside with a silver paint.

The filtering medium shall be of suitably graded, durable, back-washable processed silica sand and anthracite, which shall remove from the raw water of fine particles, protozoan and colloidal substance to a level of an applicable standard.

The water feed pump shall be of centrifugal volute pump. Operation of the unit shall be controlled by a manual 4-way valve for filtering, back-washing and rinsing. For back-washing and rinsing water in the treated water storage tank shall be used.

The unit shall be so designed that back-washing operation is needed only once a day under the normal service conditions.

The filtering operation shall further be electrically controlled by a water level sensing switch to be installed in the treated water storage tank.

## **(2) Chlorinator**

Chlorinator shall be of a type which dispenses hypochlorite solution automatically into the filtered water pipe when there is a flow. The chlorinator shall have a field adjustable discharge capacity suitably rated in coordination with the filter unit.

The chlorinator shall consist of a hypochlorite solution retention tank and a chemical feed pump with feed pipe and valves. The chemical feed pump shall be of diaphragm pump.

The retention tank shall have a capacity of not less than 50 liters.

All components of the chlorinator which get in contact with chlorine shall be made of PVC or other chemical resistant materials.

## **(3) Water Storage Tank**

The raw water and treated water storage tanks shall be of prefabricated type, made of pressed steel and shall have a capacity as shown on the Drawings. The tank shall be provided with a cover, a manhole, ladders, pipe connections, a water level sensing switch (for treated water storage tank), a ball cock tap (for raw water storage tank), vent pipe and base frame.

The tank shall be assembled at site. The assembled tank shall withstand the water pressure inside and shall be completely watertight. All components of tank which get in contact with water shall be corrosion-proof and shall not exude harmful substance into the water.

As treated water is used for back-washing of the filtering medium in the filter unit as specified hereto, capacity of the treated water storage tank shall be checked in the light of the required water quantity for this operation. The Contractor shall enlarge the capacity as the case may require in conformity with his filter unit at not extra cost to the CRM.

## **(4) Water Supply Unit**

The water supply unit shall be of automatic and pneumatic pressure type.

The unit shall be completely factory-assembled, consisting of horizontal axle centrifugal volute pumps, pressure tank, suction water filling mechanism, air charging devices, pressure switch, local control panel with complete wiring, controls and alarm, piping assembly, valves and mounting base.

Supply capacity, starting and stopping pressures shall be as indicated.

## **(5) Performance Tests**

Functional check-out of all controls shall be made prior to the operational testing of the system. After the check-out, the entire domestic water supply system shall be performance tested to demonstrate the capacity specified and general operating characteristics of the equipment.

Testing of individual pumps will not be needed if the Contractor presents to the Supervision evidences to certify that the pump are manufactured by a reputable manufacturer in accordance with an applicable standard.

Filtered water shall be tested by a test kit set to check the following items:

- |                       |                |
|-----------------------|----------------|
| (a) Iron ion          | (e) pH         |
| (b) Ammonia           | (f) Total iron |
| (c) Manganese         | (g) Arsenic    |
| (d) Residual chlorine | (h) Hardness   |

The test kit for the above items (a) through (g) shall be of color comparison type.

For item (h) one complete set of reagents, beaker, pipe, burette etc., shall be provided.

After the performance test, the Contractor shall hand over the test kit set to the CRM free of cost.

### **I.7.5 Waste Water and Sewage**

All sewage from the toilets shall be treated in septic tank before being discharged. Treated sewage shall be pumped to sewage drainage system and discharged to drain ditch.

The waste water will be connected and drained into the septic tank and pumped out into site drainage system after treatment.

Storm water from downspout shall be discharged to drainage ditch or disposed in a subsoil drainage system as shown on the Drawings.

Septic tank, 20 persons capacity for pump house, shall be of factory-assembled aeration type with aeration blower in concrete tank and shall have the rating as shown on the Drawings.

### **I.7.6 Fire Extinguishers**

Fire extinguishers shall be of dry chemical, portable, 6.0 kg in capacity, CO<sub>2</sub> pressure operated type.

A three meter length of 6 mm inside diameter air hose rated for a working pressure of 21 kgf/cm<sup>2</sup> with air charging valve and threaded adaptor coupling shall be provided for pressurizing the extinguishers.

Each fire extinguishers shall be supplied with a free flowing, moisture repellent fire extinguishing chemical powder. The chemical powder shall extinguish fires in paper, wood, rags, gasoline, petroleum products, gas and chemical and electrical fires. Suitable chrome finished hooks or hangers with attachment screws shall be supplied and installed where shown or as directed by the Supervision.

#### **I.7.7 Spare Parts and Consumables**

The Contractor shall furnish the following spare parts with the equipment and hand over to the CRM at the time of field instruction services.

- (1) For raw water tank : one set of ball tap
- (2) For filter unit : one complete set of filtering medium, one set of 4-way valve
- (3) For treated water storage tank : one set of water level sensing switch
- (4) For water supply unit : one set of pressure switch
- (5) For chlorinator : chemical powder for one year use
- (6) For septic tank : one set of blower, hypochlorite solution (for one year use)

### **I.8 AIR CONDITIONING AND VENTILATION WORKS**

#### **I.8.1 General**

The works shall comprise air conditioning system by packaged airconditioners and ventilation system by outside air supply fans and exhaust fans for the pump house and appurtenant buildings.

##### **(1) Code and Standards**

All equipment, material and installation shall comply with the following standards where applicable in so far as they do not conflict with what specified herein.

- (a) Japan Industrial Standard (JIS)
- (b) Heating, Air Conditioning and Sanitary Standard in Japan (HASS)
- (c) Other approved standards or codes

The Contractor shall obtain the approval of the Supervision if he proposes to deviate from the above codes or standards.



## **(2) Shop Drawings and Working Drawings**

The Contractor shall submit for approval of the Supervision the following working drawings:

- Layout drawings of equipment including list of equipment and materials to be incorporated,
- Details of piping and valving,
- Fabrication details of duct and detailed layout,
- Details of sleeves and opening for piping and ducting,
- Details of supports, hangers, attachments, anchoring,
- Details of vibration isolation,
- Details of foundation for equipment,
- Detailed layout of electric wiring and conducting
- Complete electrical connection diagrams,
- Other drawings as required by the Supervision.

## **(3) Data and Samples**

The Contractor shall submit for approval of the Supervision a complete list of materials and equipment which he intends to incorporate in the works under this Paragraph including sufficient descriptive materials such as catalogs, cuts, diagrams, performance curves, charts, layout drawings and other data published by the manufacturer to demonstrate conformance to the Specifications and Drawings.

### **1.8.2 Packaged Air Conditioner and Split Type Air Conditioner**

#### **(1) Cabinet**

Cabinet shall be fabricated of heavy gauge steel properly formed for close fit and structural rigidity. All access panels shall be so constructed as to be quickly and easily removable. Cabinet shall be fully insulated.

#### **(2) Cooling Coil**

Cooling coil shall be fabricated of copper tubes mechanically bonded to aluminium or copper plate fins and fitted with equalizing distributors to ensure each coil circuit receives equal amounts of refrigerant. Cooling coil shall be thoroughly dehydrated and pressure tested.

#### **(3) Refrigerant Circuit**

Unit shall be completely factory piped, tested and shipped with an operating charge of R-22 refrigerant and oil. Circuits shall include preset nonadjustable thermal expansion valve, filter drier, fusible plug on condensers and liquid line shutoff valve with a high-low pressure start to protect the system.

#### (4) Expansion Valves

Expansion valves shall be designed for use with the type of refrigerant used with a pressure rating suitable for pressure encountered. The valves shall be of the thermostatic type, diaphragm or bellows operated, with an adjustable external superheat adjustment. Power elements and valve size shall be as recommended by the manufacturer for the service intended.

#### (5) Fan and Drive

Fans shall be statically and dynamically balanced, double inlet centrifugal type designed for maximum efficiency and quiet operation. Fan wheels shall be constructed of aluminum-coated steel or equivalent and rotate on a solid steel shaft in lubricated ball bearing mounted in vibration absorbing rubber mounts. Fans shall be driven through an adjustable pitch pulley, permitting the air quantity to be varied by adjusting the fan speed.

#### (6) Fan Motors

Fan motors shall be mounted within the cabinet and shall be of the inherently protected type not requiring external overload protectors. Motor base shall be of the vibration absorbing type and shall be adjustable to assure proper alignment and belt tension.

### I.8.3 Air-Cooled Condensing Unit

#### (1) Air-Cooled Condensing Unit

Air-cooled condensing unit shall be suitable for remote installation in a weather-proof casing. The air-cooled condensing unit shall be a complete factory-fabricated and assembled unit consisting of compressor, coils, fans, and electric-motor drive. The entering dry bulb outside design air temperature shall be based on 33°C. For those periods when the refrigeration system will operate over design conditions, the equipment shall be capable of operating continuously at 6°C above stated outside design air temperature without damage or shutdown of the compressor motor or shutdown of the refrigeration system by safety devices. The condenser shall be provided with a start-up control package which permits start-up of compressor regardless of low ambient temperatures.

#### (2) Compressor

Compressor shall be of accessible hermetic type fitted with suction and discharge valves permitting field servicing. Motors shall be suction gas-cooled, sealed against dirt and moisture and protected by either inherent or external protectors against thermal over-load. Oil pressure shall be force fed by automatically reversible oil pump.

### (3) Condenser Coil

Condenser coil shall be of the extended-surface fin-and-tube type and shall be constructed by seamless copper or aluminium tubes with copper or aluminium fins. The fins shall be soldered or mechanically bonded to the tubes and installed in a metal casing. The coil shall be tested after assembly at pressures specified hereinafter for the refrigerant employed in the system.

After testing, the coil shall be dried to remove moisture and capped to prevent entrance of foreign matter. The coil shall be evacuated as hereinafter specified.

### (4) Fan

Fans shall be propeller fan driven as best suited for the application. Fans shall be directly connected to the motor shaft or indirectly connected to the motor by means of a V-belt drive. Belt drives shall be completely closed within the unit casing or equipped with a guard. Fans shall be statically and dynamically balanced.

### (5) Fan Motor

Electric motor shall be totally enclosed type. Motor starter shall be magnetic across-the-line type with weather-proof enclosure. Thermal protection shall be of a manual type.

## 1.8.4 Refrigerant Piping and Accessories

### (1) Copper Tubing

Copper tubing shall be soft annealed where bending is required and hard drawn where no bending is required. Soft annealed copper tubing shall not be used in sizes larger than 35 mm. Joints shall be brazed except that joints on lines 20 mm and smaller may be flared.

### (2) Fitting for Copper Tubing

Fitting for flare joints shall be standard forged-brass flare type with short-shank flare units. Fittings for brazed joints shall be wrought-copper or forged-brass sweat fittings. Cast sweat-type fittings shall not be allowed for brazed joints.

### (3) Vibration Dampeners

Vibration dampeners of the all-metallic bellows and woven-wire type shall be provided on suction and discharge lines where connections to compressor are made.

#### **(4) Refrigerant Stop Valves**

Refrigerant stop valves shall be designed for use with the refrigerant used and shall have pressure ratings compatible with system working pressure encountered. Gate valves shall not be acceptable.

Valves for copper tubing shall be all brass, hand-wheel operated, diaphragm packless type globe or angle valves in sizes up to and including 16 mm. In sizes over 16 mm the valves shall be brass or bronze globe or angle type, wrench operated with ground-finish stems, packed especially for fluorocarbon refrigerant service, back-seated, and provided with seal caps.

#### **(5) Installation**

The provisions provided in Paragraph I.7 Plumbing and Fire Protection Works shall be applied here wherever applicable.

#### **(6) Joints**

Joints in copper tubing shall be brazed with silver solder as hereinbefore specified. Surplus brazing material shall be removed at all joints in lines not insulated. Tubing shall be protected against oxidation during brazing.

Flanged joints shall be faced true, provided with gaskets suitable for use with fluorocarbon refrigerants and made square and tight.

### **I.8.5 Thermostats and Fans**

#### **(1) Thermostats**

Thermostats shall be two position action type and shall control within plus or minus 1.5°C of the temperature setting at the thermostat location, unless otherwise specified. Thermostats shall be manufactured of factory modified to a minimum of 1°C for cooling.

#### **(2) Propeller Fans**

Propeller fans and motors shall be supported on heavy metal frames designed for wall opening and mounting. Motors shall have totally enclosed enclosures. Gravity dampers and rainhood shall be provided on the exterior side of wall. Remote manual switch with pilot indicating light shall be provided where indicated.

#### **(3) Ceiling Mounted Duct Type Fans**

Fans shall be of turbo type or axial flow type against static pressure and complete with totally-sealed motor. All parts shall be protected by application of high quality enamel paint.

#### (4) Multiblade Fans

Air supply and exhaust fans for substructure shall be floor mounted, V-belt driven, multi-blade type centrifugal fans with compete vibration isolating base and accessories having the capacities as shown on the Drawings.

### I.8.6 Pipe Insulation and Vapor Barrier

#### (1) Insulation

Refrigerant piping and air-conditioner drain lines shall not be insulated until after the pipes have been groven tight under the required test pressures. The insulation material shall be fibrous glass or mineral fiber. The insulation thickness shall be as indicated in Table I-1 for mineral fiber and fibrous glass. Exposed insulated piping in traffic area shall be fitted with a metal jacket to protect the insulation.

Table I-1 Mineral Fiber and Fibrous Glass,  
Minimum Thickness in mm

Range of Temperature degree C	6 thru 32	40 thru 75	80 thru 125	150 thru 250
Above 10	18	18	25	25
10 to 0	25	25	38	38
0 to -15	38	50	50	50
-15 to -10	38	50	65	65

#### (2) Vapor-Barrier Jacket

The insulation shall be provided with field-applied or factory-applied non combustible vapor-barrier jacket. The jacket shall consists of lamination of aluminum foil, glass fiber reinforcement and kraft paper where exposed to view, and where concealed the kraft paper may be omitted. The kraft paper shall be enamel painted.

#### (3) Application

After pressure tests have been completed in the piping system, insulation shall be applied to the pipe with end joints tightly butted and the vapor-barrier jacket lapped not less than 38 mm at longitudinal joint and adhered with adhesive. At circumferetial laps, a 75 mm wide strip of jacking material shall be applied and adhered with the adhesive.

The insulation shall be continuous through pipe hangers and pipe sleeves.

Unless otherwise indicated, all flanges, unions, valves, anchors and fittings shall be insulated with prefabricated or field-fabricated segments of insulation of the similar material and thickness as the adjoining pipe insulation.

The Contractor may use alternative insulation vapor barrier upon approval of the Supervision.

#### (4) Piping Exposed to Weather

Piping exposed to weather shall be insulated as specified above for applicable service except thickness required shall be double that specified. The exposed piping shall be finished with approximate 0.4 mm thick corrugated, smooth or embossed aluminum sheet with factory fabricated "z" type longitudinal joints or field applied seam joints, lapped not less than 50 mm at butt joints. The joints shall be properly constructed to shed water or otherwise sealed with adhesive compound.

### I.8.7 Duct Work

#### (1) General

Duct work shall be constructed of galvanized steel sheets. Ducts, unless otherwise approved, shall conform to the dimension indicated and shall be straight and smooth on the inside with joints neatly finished. Ducts shall be made substantially airtight at all joints connections, grilles, register, or diffusers.

#### (2) Duct Construction

Curved elbows shall have a centerline radius not less than 1-1/2 times the width or diameter of the duct.

Laps at the joints shall be made in the direction of air flow. Button punch or bolt connections in standing seams shall be spaced at fixed centers not greater than 150 mm. Horizontal locks or seams of the type known as "Button Punch Snap Lock" may be used in lieu of "Pittsburgh Lock".

Transformations shall be made with side pitches not to exceed a maximum of 20 degrees, 40 degrees included angle for diverging air flow and 30 degrees, 60 degrees included angle for converging air flow, or as indicated.

Duct and stiffeners shall be constructed of steels of thickness and fabrication indicated in Table I-2 for rectangular ducts.

Air deflector shall be provided in all square elbows, duct-mounted supply outlets, takeoff or extension collars to supply outlets, and tap-in branch-takeoff connections. Air deflectors shall be factory-turning vanes or louver blades for uniform air distribution and change of direction with minimum turbulence and pressure loss.

### (3) Duct Access Doors

Hinged doors shall be provided at all air control dampers, fire dampers and other apparatus requiring service and inspection in the duct system. Doors shall be 35 cm x 45 cm unless otherwise indicated. Where size of duct will not accommodate this size, the doors shall be made as large as practical.

Table I-2 Sheet Metal Thickness for Rectangular Duct Construction (Low Velocity System)

Galvanized Sheet Gage and Thickness mm	Longer Side of Duct in cm	Bracing
26 0.5	15-45	None
24 0.6	46-75	25 x 25 x 3 girth angle reinforcing spaced on 180 cm max. centers
22 0.8	75-150	30 x 30 x 3 girth angle reinforcing spaced on 90 cm max. centers
20 1.0	151-225	40 x 40 x 3 girth angle reinforcing spaced on 90 cm max. centers
18	226 & over	40 x 40 x 5 girth angle reinforcing spaced on 90 cm max. centers

Notes: Ducts with longer sides of 1500 mm and over shall have angle flanged joint.

All fittings shall be continuous weld constructions.

### (4) Duct Insulation

The insulation material shall be fibrous glass or mineral fiber, specific weight of 50 kg/cm<sup>3</sup>. The insulation shall be provided with field applied or factory applied non-combustible vapor barrier jackets. Jackets shall consist of lamination of aluminum foil of 0.50 mm thick, glass fiber reinforcement and kraft paper where exposed to view, and where concealed the kraft paper may be omitted.

The insulation material shall be jointed to the ducts with a non-flammable glue.

## **1.8.8 Miscellaneous Units**

### **(1) Goosenecks and Rainhoods**

Goosenecks and rainhoods shall be fabricated from galvanized steel sheets, and shall be provided with frames and steel structural shapes. Bird insect screens shall be provided where indicated. Sheet metal fabrications shall conform to Sub-paragraph 1.8.7. Duct Work specified hereinbefore. Thickness of sheet metal shall be as indicated.

### **(2) Dampers**

#### **(a) General**

All damper frames shall be constructed of 16 gage galvanized sheet metal, and shall have flanges for duct mounting. The blades shall be parallel or opposed, as required, and suitable for the air velocities to be encountered in the system. Replaceable edge seals shall be provided with the damper, installed along the top, bottom and sides of the frame and each blade.

#### **(b) Manual Dampers and Splitters**

Manual dampers with locking quadrants shall be installed where indicated or necessary for proper control and balancing of air distribution. All dampers shall have an accessible operating mechanism. Splitter dampers shall be operated by quadrant operators or steel rod brought through the side of the duct with locking set-screw and bushing. Manual volume control dampers shall be operated by locking-type quadrant operators. Dampers and splitters shall be two gages heavier than duct in which installed. Unless otherwise indicated, multileaf dampers shall be opposed-blade type with maximum blade width of 300 mm. Splitter dampers shall be of sufficient length to close off either branch duct.

#### **(c) Fire Dampers**

Fire dampers shall be provided in the ducts as shown on the Drawings. Dampers shall be installed with sufficient tension to prevent ratting or vibration. Fire dampers shall conform to the requirements of applicable codes.

### **(3) Diffusers, Register and Grilles**

#### **(a) General**

Diffusers, register, and grilles shall be the approved products of a manufacturer regularly engaged in the manufacture of such products and shall be factory-fabricated of steel or aluminum and shall distribute the specified quantity of air evenly over space intended, without causing noticeable drafts, air movement faster than 0.5 m/sec. in occupied zone, or dead spots anywhere in the conditioned area. The Contractor shall



be responsible for diffusion, spread, drop, and throw. Diffusers and registers shall be provided with opposed-blade volume controller with accessible key operator unless otherwise indicated.

**(b) Diffusers**

Diffusers shall be round, square, rectangular, slop strip-shape or perforated-face type with fixed or adjustable air discharge pattern as indicated. Ceiling mounted units shall minimize ceiling smudging through design features.

**(c) Register**

Registers shall be four-way directional-control type except that return and exhaust registers may be fixed horizontal or vertical louver type similar in appearance to the supply-register face.

**(d) Grilles**

Grilles shall be as specified herein for registers, without volume-control damper.

**(e) Louvers**

Louvers blades shall be fabricated from aluminum or steel sheets, and shall be provided with frame or structural shapes. Blades shall be accurately fitted and firmly secured to frames. Edges of louver blades shall be folded or beaded for rigidity and baffled to exclude driving rain. Louver shall be provided with bird screen where shown on the Drawing. Sheet metal thickness shall be as indicated.

**(4) Apparatus Connections**

Where sheet-metal connections are made to fan, plenum chamber or the like, a noncombustible flexible connection of woven inorganic or other approved noncombustible material approximately 150 mm in width, shall be installed. For rectangular ducts the flexible connections locked to metal collars shall be installed using normal duct construction methods.

**(5) Duct Supports**

Duct supports shall not be less than two steel hangers spaced in accordance with Table I-3. Supports on the risers shall allow free vertical movement of the duct.

**Table I-3 Duct Supports for Rectangular Duct**

Galvanized Sheet Gage and Thickness mm	Angle Support mm	Max. Spacing cm
26 0.5	25 x 25 x 3	300
24 0.6	25 x 25 x 3	300
22 0.8	30 x 30 x 3	300
20 1.0	40 x 40 x 3	300
18 1.2	40 x 40 x 5	300

Notes: Hangers shall be steel rod 9 mm in diameter.

**I.8.9 Tests**

**(1) General**

Upon completion of the air-conditioning and ventilation system, and at a time designated by the Supervision, the entire system shall be performance-tested as hereinafter specified. The tests shall be conducted in the presence of the Supervision. Procedures for conducting of the tests shall conform to the applicable standard. The Contractor shall furnish all instruments, test equipment, water, electricity and personnel that are required for the tests at no extra cost to the CRM.

**(2) Refrigerant Piping**

After all components of the refrigerant system have been installed and the piping connected, the system shall be subjected to a pneumatic test. The pneumatic testing shall be done with anhydrous carbon dioxide or dry nitrogen before any refrigerant pipe is covered. The high and low side of the refrigerant systems shall be tested for the minimum refrigerant-leak field-test pressure of 20 kgf/cm<sup>2</sup>. The system shall be proved tight under the test pressure by first checking each joint with soap solution and second, with a halide torch or by electronic leak detection. The leak-test pressure shall remain on the system for 24 hours with no drop in pressure. After the foregoing tests have been satisfactorily completed and the pressure relieved, the entire system shall be evacuated to an absolute pressure of 1,000 microns, 1 mm of Hg. The vacuum line shall be closed, and the system shall stand for 12 hours.

After this period the increase in absolute pressure shall not exceed 100 microns. During this test, pressures shall be recorded by a thermocouple-type, electronic-type, or a calibrated micron gage. Upon completion of the test, the vacuum shall be broken by charging the system with dry refrigerant for which the system is designed.

### (3) Performance

After the foregoing tests have been completed, tests to demonstrate the capacity specified and general operating characteristics of all equipment shall be conducted by a competent experienced expert in the presence of the Supervision. The tests shall cover a period of not less than 3 days for each system and shall demonstrate that the entire system is functioning in accordance with the Drawings and Specifications. Corrections and adjustments shall be made as necessary to produce specified conditions.

- Packaged airconditioners : Air temperature in door.  
Electric power output of fan and compressor
- Controls : Setting and performance of automatic or safety controls
- Multi-blade Fans : Electric power output of fan motor  
Air quantity  
Air speed

### 1.8.10 Spare Parts

The Contractor shall furnish the following spare parts with the equipment and hand over to the CRM at the time of field instruction services.

- (1) For packaged airconditioners and air-cooled condensing units (for each) : One set of V-belt, one set of air filter, two sets of fuse and pilot lamp, one set of crank case heater, two sets of auxiliary relay, two sets of magnetic contactor for fan and compressor and one set of fusible plug. Two sets of magnetic contactor for fan.
- (2) For multi-blade fans (for each) : One set of V-belt
- (3) For ceiling mounted fans (for each in the kitchen) : One set of air filter

## I.9 Measurement and Payment for Building Service Facilities

Measurement for payment for each work item shall be made by the following methods, and payment for these shall be made at the unit prices tendered in the Bill of Quantities so established according to the measurement, which unit prices shall include the cost for all incidental works specified and as required.

Works Item	Basis of Measurement	Incidental Works included
(1) Raw water storage tank	: Number of tank measured in numbers.	All accessories specified and concrete foundation.
(2) Filter pump	: Number of pump measured in numbers.	Integral accessories and concrete foundation.
(3) Filter unit	: Number of filter unit measured in numbers.	Integral accessories and concrete foundation.
(4) Chlorinator	: Number of chlorinator measured in numbers.	Chlorine feed pipe and concrete foundation.
(5) Domestic water tank	: Number of tank measured in numbers.	All accessories specified and concrete foundation.
(6) Automatic water supply unit	: Number of water supply unit measured in numbers.	Integral accessories and concrete foundation.
(7) Control panel and wiring for domestic water supply unit	: Total cost measured in lump sum.	The works shall include local control panel and all conducting and cabling for equipment and tanks from the safety switch box.
(8) Electric water heater	: Number of water heater measured in numbers.	All accessories required.
(9) Galvanized steel pipe for water supply	: Length of pipe measured in linear meters.	All fittings, supports, hangers, painting and sleeves.

Works Item	Basis of Measurement	Incidental Works included
(10) Copper pipes for hot water	:	Length of pipe measured in linear meters. /All fittings, supports, hangers, painting, insulations and sleeves.
(11) Gate valves, check valves	:	Number of valves measured in numbers.
(12) Flexible joints	:	Number of flexible joint measured in numbers.
(13) Automatic relief valve	:	Number of valve measured in numbers./ All accessories required.
(14) Flow meter	:	Number of meter measured in numbers.
(15) Ball cock tap	:	Number of ball cock tap measured in numbers.
(16) Insulation for galvanized steel pipes	:	Length of pipe to be insulated measured in linear meters. /Cotton tapes and painting.
(17) Painting for galvanized steel pipes	:	Length of pipe to be painted measured in linear meters.
(18) Cast iron pipes for sewage	:	Length of pipe measured in linear meters. /All fittings, supports, hangers, insulations, painting and sleeves.
(19) Galvanized steel pipes for waste water	:	Length of pipe measured in linear meters. /All fittings, supports, hangers, insulations, painting and sleeves.
(20) Galvanized steel pipes for vent pipes	:	Length of pipe measured in linear meters. /All fittings, supports, hangers, painting and sleeves.
(21) Lead pipes	:	Length of pipe measured in linear meters. /All fittings, supports, hangers, insulations, painting and sleeves.
(22) P.V.C. pipes	:	Length of pipe measured in linear meters. /All fittings, supports, hangers and earth works.

Works Item	Basis of Measurement	Incidental Works included
(23) Floor drains	:	Number of floor drain measured in numbers.
(24) Floor cleanouts	:	Number of cleanout measured in numbers.
(25) Vent caps	:	Number of vent cap measured in numbers.
(26) Cess pits	:	Number of cess pit measured in numbers. /Cast iron manhole cover, bottom inverting and earth works.
(27) Catch basin	:	Number of catch basin measured in numbers. /Concrete cover and earth works.
(28) Septic tank	:	Number of tank measured in numbers. /All accessories specified, concrete and earth works shown on the Drawings.
(29) Seepage pit	:	Number of seepage pit measured in numbers. /Cast iron manhole cover, concrete, masonry and earth works shown on the Drawings.
(30) Plumbing fixtures	:	Number of plumbing fixture measured in set. /All accessories specified, shelves, paper holders, soap dispensers and faucets.
(31) Swing faucet	:	Number of faucet measured in numbers.
(32) Hose faucet	:	Number of hose faucet measured in numbers. /Cast iron faucet boxes and earth works.
(33) Shower set	:	Number of shower set measured in set. /Shower head, hoses and required accessories.
(34) Fire extinguishers	:	Number of fire extinguishers measured in numbers. /All accessories specified.
(35) Packaged airconditioners, split type air conditioners	:	Number of airconditioner measured in set./Outdoor condensing units, concrete foundations.

Works Item	Basis of Measurement	Incidental Works included
(36) Refrigerant pipes for air conditioners	:	Length of pipe measured in linear meters. /All fittings, soldering, insulations, hangers, supports and sleeves.
(37) Galvanized steel pipes for drain	:	Length of drain pipe measured in linear meters. /All fittings, supports, hangers, insulations, painting and sleeves.
(38) Multi-blade type air supply fan and exhaust fan	:	Number of fan measured in numbers. /Concrete foundation, vibration isolating base and required accessories.
(39) Wall mounted propeller type air supply and exhaust fans	:	Number of fan measured in numbers. /Wooden frame, gravity shutter, rainhood and painting.
(40) Ceiling mounted duct type fans	:	Number of fans measured in numbers. /Hangers, supports, intake grille, air filter and required accessories.
(41) Galvanized steel sheets	:	Area of steel sheet measured in square meters. Seams and bends at joints shall not be counted in the measurement. Openings for air diffusers, grilles or the like shall not be deducted from the area of steel sheets. /All supports, hangers, sleeves, painting, reinforcement metals and inspection doors.
(42) Grilles	:	Number of grille measured in numbers.
(43) Volume damper, fire damper	:	Number of damper measured in numbers.
(44) Air filter for multi-blade Air filter for multi-blade	:	Number of air filter measured in numbers. /Aluminium casing and metal wire lath.
(45) Spiral duct	:	Length of duct measured in linear meters. /All fittings, hangers and supports.
(46) Vent caps	:	Number of vent cap measured in numbers.
(47) Spare parts and consumables	:	Total cost measured in lump sums. /Spare parts, stand-by equipment and consumable as specified.

## **I.10 DIESEL ENGINE GENERATOR HOUSE**

### **I.10.1 General**

The Contractor shall furnish and construct a diesel engine generator house in the pumping station courtyard, as shown on the Drawings and as specified herein or as directed by the Supervision.

- (1) Building structure : Foundations, beam and columns, floor, wall and roof slabs shall be of reinforced concrete construction.
- (2) Roofing : 3-ply built-up asphalt waterproofing covered with 60 mm thick light weight concrete. The thermal expansion joint shall be provided in the roof covering as shown on the Drawings.
- (3) Exterior wall finish : Spray tile on exposed concrete.
- (4) Interior wall and ceiling finish : Cement mortar plastering for walls and exposed concrete for ceilings.
- (5) Floor finish : Cement mortar finish.
- (6) Door and window : Steel door glazed aluminium window and louver for the wall.

Before beginning construction of building, the Contractor shall level and thoroughly compact the foundation of the building.

### **I.10.2 Measurement and Payment**

Measurement and payment will be made in accordance with the provisions stipulated in Sub-paragraph I.6.2.



CONSTRUCTION OF CIVIL WORKS

PACKAGE 2

LA ESPERANZA~POZA HONDA TRANSBASIN  
AND  
POZA HONDA~MANCHA GRANDE TRANSBASIN

VOLUME III - GENERAL AND TECHNICAL SPECIFICATIONS

SECTION J

ELECTRICAL WORKS

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## SECTION J ELECTRICAL WORKS

### J.1 GENERAL

The lighting and ancillary electrical equipment shall be provided for the pumping station and the Poza Honda inlet structure as shown on the Drawings or as directed by the Supervision. The following apparatus and materials shall be furnished and installed to complete the lighting and ancillary electrical equipment in the above-mentioned facilities;

#### J.1.1 Pumping Station

##### (1) Panel Boards

- (a) Lighting Panels : For lighting and convenience outlet circuits as shown on the Drawings

##### (2) Lighting Fixtures

- (a) Type A : Pipe pendant fluorescent light
  - A-1 : 40 W x 2
  - A-2 : 40 W x 1
- (b) Type B : Ceiling or wall surface mounted fluorescent light with acrylic cover
  - B-1 : 40 W x 2
  - B-2 : 40 W x 1
- (c) Type C : Ceiling or wall surface mounted fluorescent light, 40 W x 1
- (d) Type D : Ceiling flush mounted fluorescent light with acrylic cover
  - D-1 : 40 W x 2
  - D-2 : 40 W x 1
- (e) Type E : Ceiling flush mounted incandescent downlight with plastic or glass lens, 60 W x 1
- (f) Type F : Wall mounted incandescent light with opal glass or plastic globe, 60 W x 1
- (g) Type G : Pipe pendant mercury light with open industrial dome reflector, 400 W x 1

(h) Type H : Pole mounted mercury light with plastic lens, weather-proof type, 400 W x 1

(3) Switches and Outlet

(a) Convenience Outlets : Wall mounted, duplex outlet, 127 V and 20 A

(b) Tumbler Switches : 127 V and 10 A

(c) Safety Switches : Knife switch with enclosed fuse, 3-phase, 4 wire, 3 pole, 220 V/127 V, 50 A

(d) Three-way switch : 10 A - 127 V

(4) Conduits

(a) Rigid Steel Conduits : f 16 mm, f 22 mm, and f 28 mm (or f 1/2", f 3/4" or f 1")

(5) Wires and Cables

(a) IV Wires : 600 V grade, PVC insulated single core wire, 2.0 mm<sup>2</sup>, 3.5 mm<sup>2</sup> and 5.5 mm<sup>2</sup> (or 14 AWG, 12 AWG and 10 AWG)

(b) CV Cables : 600 V grade, thermoplastic polyethylene insulated and PVC sheathed, multi-core cable, 4C x 3.5 mm<sup>2</sup>, 2C x 5.5 mm<sup>2</sup>, 4C x 5.5 mm<sup>2</sup> and 4C x 22 mm<sup>2</sup> (or 4 x 12 AWG, 2 x 10 AWG, 4 x 10 AWG and 4 x 4 AWG)

(6) Telephone Facilities

(a) PABX Set : Private automatic branch exchange, cross-bar type  
Subscriber circuit  
Capacity : 60 lines  
Equipped : 40 lines  
Outgoing exchange lines  
Track lines for public exchange : 2 lines  
Intra-office trunk lines : 7 lines

(b) Battery and Charger : DC power supply unit for the PABX consisting of storage type batteries and battery charger

- (c) Main Distribution Frame : Wall mounted, 40 P
- (d) Telephone Set : Dial type
- (e) Telephone Wires : PVC insulated 2-core copper cable of 0.8 mm in diameter for indoor use, and 600 V core code polyethylene-plane (CCP-P) cable of 0.65 mm in diameter for outdoor use.

**(7) Grounding System**

The grounding system of the pumping station shall be installed referring to the general plan shown on the Drawings.

The grounding system shall comprise copper conductor mesh covering the pump house, main transformer yard and 138 KV switchgear yard, and grounding rods/plates as required. The lead conductor to connect the equipment to the mesh shall also be provided.

The Contractor shall design and submit drawings for approval to the Supervision. The target grounding resistance shall be less than 1.0 ohm.

**J.1.2 Poza Honda Inlet Structure**

**(1) Panel Boards**

- (a) Lighting Panel : For lighting and convenience outlet circuits, as shown on the Drawings.

**(2) Lighting Fixtures**

- (a) Type A : Pipe pendant fluorescent light, 40 W x 2  
B-2: 40 W x 1
- (c) Type P : Wall mounted incandescent light with opal glass or plastic globe, 60 W x 1

**(3) Switches and Outlet**

- (a) Convenience Outlet : Wall mounted, duplex outlet, 127 V and 20 A
- (b) Tumbler Switches : 127 V and 10 A

**(4) Conduits**

- (a) Rigid Steel Conduits : f 16 mm and f 22 mm (or f 1/2" and f 3/4")

**(5) Wires and Cables**

**(a) IV Wires**

: 600 V grade, PVC insulated single core wire, 2.0 mm<sup>2</sup> and 3.5 mm<sup>2</sup> (or 14AWG and 12 AWG)

**(b) CV Cables**

: 600 V grade, thermoplastic polyethylene insulated and PVC sheathed, multi-core cable, 4C x 3.5 mm<sup>2</sup> (or 4 x 12 AWG)

**(6) Grounding System**

The grounding system of the Poza Honda inlet structure shall be installed referring to the general plan shown on the Drawings.

The grounding system shall comprise copper conductor mesh covering the inlet structure and grounding rods/plates as required. The lead conductor to connect the equipment to the mesh shall also be provided.

The Contractor shall design and submit drawings for approval to the Supervision. The target grounding resistance shall be less than 5 ohm.

The Contractor shall supply all materials and equipment include in and necessary to complete the building electrical system.

**J.2 ELECTRICITY SUPPLY**

For the pumping station, the power supply for lighting and auxiliary power supplies shall be 3 phase, 4-wire, 220 V or single phase, 127 V, 60 Hz. Each supply circuit shall be protected with a molded case circuit breaker (MCB) installed in the A.C. panel-2 provided in the low tension switchgear floor under the other contract.

For the Poza Honda inlet structure, the power supply shall be of 3-phase, 4-wire, 220/127 V, 60 Hz. The power will be supplied from the diesel engine generator installed by the other contractor.

**J.3 REQUIREMENTS FOR MATERIALS AND EQUIPMENT**

**(1) Standard and Approval**

Unless otherwise specifically provided herein, all electric materials and equipment shall comply with the requirements of the latest revisions of Japanese Standards and any other standards authorized by the Supervision. The Contractor shall obtain approval of the Supervision if he proposes to deviate from the said standards.

The equipment and materials shall be subjected to tests at the manufacturer's factory before shipment and test records shall be submitted to the Supervision as instructed to do so.

As far as practicable all similar equipment shall be interchangeable.

**(2) Electric Power Source**

The power source shall be A.C. 220/127 V, 3-phase, 4-wire, 60 Hz and D.C. 125 V system for the pumping station and A.C. 220/127 V, 3-phase, 4-wire, 60 Hz for the Poza Honda inlet structure.

**(3) Panel Boards**

Electric circuits for panels shall conform to the Drawings. The panels shall be dead-front, no-fuse circuit breaker type, sheet steel made with locks and ventilators. Phasing marks shall be indicated.

Circuit cards shall be provided in card holders in the panel. No-fuse circuit breakers shall have sufficient interrupting capacity to protect the circuits on an electrical fault.

Each lighting panel shall be furnished with the apparatus shown on the Drawings.

**(4) Wires and Cables**

Insulated wires shall be of 600 V, PVC insulated single-core copper wire. Insulated wires shall have a minimum size of 2.0 mm<sup>2</sup> or 14 AWG, stranded conductor.

Low tension cables shall be 600 V cross-linked polyethylene insulated and PVC sheathed cable (CV cable) and conductors shall be stranded and larger than 2.0 mm<sup>2</sup>.

**(5) Conduits**

Conduits shall be of rigid steel, galvanized inside and outside and enamelled inside, or of galvanized rigid steel coated with epoxy resin inside. They shall have a minimum inside diameter of 16 mm or 1/2 inch.

**(6) Safety Switches**

Safety switches shall be knife switches with enclosed fuses, 50 A, enclosed in a sheet steel box suitable for surface mounting. The surface mounted enclosures shall be provided with external operation handles lockable in "on" position. Ratings and quantities shall conform to the Drawings. Phasing marks shall be indicated.

**(7) Outlet, Switch and Junction Boxes and Fittings**

The boxes to be concealed in concrete shall be of galvanized sheet steel and shall be fitted with appropriate covers where necessary to set flush with the finished surfaces of the structures. The boxes in the exposed work shall be of galvanized, cast steel or alloy fitted with appropriate covers.

**(8) Convenience Outlets**

Convenience outlets shall be of duplex outlet type suitable for 2-blade plug for single-phase, 127 V, 20 A, and provided with suitable outlet box cover and stainless cover plates.

**(9) Tumbler Switches**

Wall switches shall be of enclosed flush or surface mounting tumbler type, single pole, 127 V, 10 A, and shall be fully recessed within the box fitted with suitable plates for covering them.

**(10) Lighting Fixtures**

Lighting fixtures shall be complete with lamps, and shall comply with the following:

Fluorescent lighting fixtures for A.C. 127 V shall be equipped with ballasts of high power factor and of rapid-start type for 40 W.

Mercury lighting fixtures for A.C. 127 V shall be equipped with screwed base lamp holders, ballasts of high power factor for stable operation.

Incandescent lighting fixtures shall be equipped with complete fittings for D.C. 125 V for emergency.

The lighting fixtures for the valve room shall be of moisture-proof type and for outdoor use shall be of weather-proof type. Fixtures for battery room shall be of acid-proof type. Special care shall be exercised on selection of fixtures to prevent accumulation of insects and dust.

**(11) Lighting Supports**

Lighting supports shall be steel poles galvanized outside and inside. The shape and size of poles shall be as shown on the Drawings. Ballasts, cut out switch and terminal shall be equipped in the pole and other attachments necessary for wiring and fixing of the lighting fixtures shall also be supplied.

**(12) PABX (Private Automatic Branch Exchange)**

One (1) set of crossbar type PABX shall be supplied. The PABX shall be housed in a steel cabinet of self standing type and be made dust-proof and sound deadening.

Circuit arrangement of the PABX shall be as follows:

**Subscriber circuit**

- Capacity : 60 lines
- Equipped : 40 lines

**Outgoing exchange lines**

- Trunk lines for public exchange : 2 lines

The outgoing exchange lines shall be of both way traffic. Right transfer switches shall be provided for outgoing exchange lines.

- Intra-office trunk line : 7 lines

**(13) Power Supply Unit for PABX**

One set of D.C. 48 V power supply unit shall be supplied for the PABX. The unit shall consist of storage batteries and a battery charger normally operated in floating.

Storage batteries shall be of alkaline enclosed type and shall have a sufficient capacity to operate the equipment for a period of not less than five (5) hours at full load without charging. The battery voltage shall not drop more than ten (10) per cent of the rated voltage. The batteries shall be housed in a steel cabinet.

The battery charger shall consist of an automatic voltage controller, silicon rectifier, protective and alarm circuits. The charging equipment shall be housed in a ventilated steel cabinet with auxiliary devices and shall be equipped with flush mounted A.C. voltmeter, D.C. voltmeter and ammeter.

**(14) Accessories for Telephone Facilities**

For PABX

- Cordless type manual attendance board, desk top type : 1 set
- Dial telephone set : 30 sets
- Maintenance tools : 1 set
- A recommended accessories by the manufacturer : 1 lot



For power supply unit

- Voltmeter, -3 ~ 0 ~ +3 V : 1 set
- Thermometer : 1 set
- Suction type hydrometer, 1,100 ~ 1,300 : 2 sets
- Funnel : 1 set
- Spring : 1 set
- A recommended accessories by the manufacturer : 1 lot

#### (15) Grounding System

The Contractor shall provide and install the following materials but not limited to;

- Bare annealed copper conductor of 100 mm<sup>2</sup> or 4/0 AWG for the grounding mesh and for lead wire to the high voltage equipment and 38 mm<sup>2</sup> or 2 AWG for lead wire to the low voltage equipment.
- Copper plates of 1.0 m x 1.0 m with a thickness of 3 mm, provided with lead wire, copper plated steel rods of 1.5 m or over in length and with a diameter of 14 mm or over may also be used for lessening the grounding resistance.
- Connectors of compression type suitable for connecting the above conductors.

#### J.4 SPARE PARTS

- (1) Cables and conduits : 5 % for each size
- (2) Lighting fixtures : 5 % or min. 1 set for each type
- (3) Bulbs and tubes : 300 %
- (4) Lighting supports : 1 no. for each type
- (5) Fuses : 300 %
- (6) Dial type telephone set : 5 sets
- (7) Relays in telephone facilities : 1 set
- (8) Pilot lamps : 300 %
- (9) Others : As recommended by the manufacturers

#### J.5 INSTALLATION WORKS

All installation works shall be carried out in accordance with the requirements of these Specifications or as directed by the Supervision.

##### (1) Conduits

Conduits shall be concealed within the walls, ceilings and floors where possible. Exposed runs of conduit shall have supports spaced at not more than 150 cm. Conduit shall be securely fastened to all sheet outlets, junction and pull boxes with galvanized lock nuts

bushings. Exposed conduits shall be finished with the same color of the wall or ceiling against which the conduits are placed.

**(2) Wiring**

Where an underground cable crosses a roadway, it shall be suitably protected against damage from heavy traffic. Suitable cable route markers shall be provided at 10 m spacing for short runs and at 20 m spacing for long runs.

**(3) Switches**

The height of switches above floors shall be 120 cm.

**(4) Lighting Fixtures**

Electric tubes and bulbs shall be installed when directed by the Supervision.

**(5) Grounding System**

The mesh conductors shall be directly buried in the ground at least 0.8 m below ground surface. The grounding plates shall be placed horizontally in the ground at least 1 m below ground surface. The grounding rods shall be driven into the ground a minimum of 2.5 m. Grounding lead conductor for electrical equipment and other facilities shall be provided at the location close to the respective equipment. Connection for the electrical equipment and other facilities will be carried out by the other contractor.

The resistance of the grounding system for the pumping station shall be test-measured by the Contractor by means of the alternating current fall-of-potential method from time to time as the progress of installation. Necessary auxiliary grounding poles for voltage circuit and current circuit with wiring and measurement devices shall be provided by the Contractor, as approved by the Supervision. The distribution line and the cable for telephone facilities may be used for this purpose.

**J.6 TEST**

The following tests shall be carried out by the Contractor after completion of the installation works.

- (1) Test such as specified in applicable standards**
- (2) Continuity test**
- (3) Measurement of insulation resistance**
- (4) Switching and operation test**

## J.7 MEASUREMENT AND PAYMENT

Measurement for payment for each work item shall be made by the following methods, and payment for these shall be made at the unit prices in the Bill of Quantities so established according to the measurement, which unit prices shall include the cost for all incidental works specified and tests as required.

Measurement and payment for grounding systems shall be made for the length of copper conductors (100 mm<sup>2</sup>, 50 mm<sup>2</sup> or 38 mm<sup>2</sup>) measured in meters and numbers of copper plates (or rods and clamps) at the unit prices per meter or number stated in the Bill of Quantities, which the unit prices shall constitute full compensation for the cost of all labor, tools, equipment and materials, including those for the measurement of grounding resistance and any other items necessary to complete the works.

Work Item	Basis of Measurement	Incidental Works Included
(1) Panels	: Number of panels measured in set.	/All mounting devices, support, frames, bonding, installation and cable connection.
(2) Lighting fixtures	: Number of fixtures measured in sets.	/All lamps, fittings, bonding, supports, hangers, penetration and repair ceiling, reinforcement of ceiling suspension and installation.
(3) Switches and outlets	: Number of switches and outlets measured in sets.	/All fittings, boxes, bonding, support and installation.
(4) Conduit pipes	: Length of conduit pipes measured in linear meters.	/All fittings, bonding, supports, paint finish, sleeves and installation.
(5) Wires and cables	: Length of wires or cables measured in linear meters.	/All joint materials and installation.
(6) PABX set	: Number of PABX set measured in set.	/All mounting devices, supports, frames and installation.
(7) Battery and charger	: Same as item (6) above.	
(8) Main distribution frame	: Same as item (6) above.	
(9) Telephone sets	: Number of telephone sets measured in sets.	/All fitting and installation.

**CONSTRUCTION OF CIVIL WORKS**

**PACKAGE 2**

**LA ESPERANZA-POZA HONDA TRANSBASIN  
AND  
POZA HONDA-MANCHA GRANDE TRANSBASIN**

**VOLUME III - GENERAL AND TECHNICAL SPECIFICATIONS**

**SECTION K**

**MEASURING APPARATUS**

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## **SECTION K MEASURING APPARATUS**

### **K.1 GENERAL**

The Contractor shall furnish, install, maintain and take readings of instruments for the detection of ground movements and the detection of deformations in underground excavations.

The instruments to be supplied, installed and maintained shall be convergence bolts for measuring horizontal and diagonal convergence, roof settlement and invert upheaval; stress measuring anchors and strain gauges for measuring stress of rock bolts; disk load cells for measuring stress of steel supports; hydraulic pressure cells for measuring stress of shotcrete; together with all required measuring equipment, such as leveling survey equipment, steel tape, dial gauge, transducer, etc., for reading.

All readings and measurements shall be taken by the Contractor to monitor deformations of the underground excavations and surrounding ground in order to evaluate ground stability. The data shall be submitted, in an approved form, to the Supervision on a daily basis. The Supervision may direct adjustments of support elements or modifications to the excavation plan on the basis of the observed data.

Damaged or missing instruments shall be repaired or replaced by the Contractor as soon as possible at no additional cost to the CRM.

### **K.2 CONVERGENCE MEASUREMENTS**

Convergence bolts shall be securely attached to exposed rock or shotcrete surface within the underground excavation, and located such that pairs of bolts are at directly opposite sides of the opening and as shown on the Drawings or as directed in other underground excavations. A tape extensometer with dial gauge shall be used to connect between convergence bolts in tunnels and other underground structures to monitor the change in size of the opening, if any, occurring during the period between excavation and construction of the final lining.

The Contractor shall supply and install convergence bolts in the pattern indicated above or as directed. The convergence bolts shall be installed as soon as practicable after the tunnel, shaft or underground structure has been excavated and supported, and generally within 5 m of the working face.

Convergence bolts shall be approved non-corrosive bolts compatible with the approved convergence measuring devices, and shall be installed in accordance with the manufacturer's instructions. The chainage, offset and elevation of each convergence bolt shall be established to within 25 mm by the Contractor.

The measuring device shall be an "OYO type" tape extensometer in Japan or approved equivalent. Two (2) tape type extensometers shall be provided by the Contractor.

Measuring shall be made twice daily until the heading has advanced five (5) times the tunnel width, or as directed by the Supervision, and weekly thereafter until the final underground excavation lining is constructed.

### **K.3 ROOF SETTLEMENT AND INVERT UPHEAVAL MEASUREMENTS**

The roof settlement and invert upheaval measurements will be used to monitor the changes in size of the opening of underground structures and the effectiveness of primary support. The measurements shall be made by means of leveling.

The Contractor shall supply and install 12 mm diameter x 200 mm long grouted stainless steel bolts in crown or invert portions as shown on the Drawings or as directed by the Supervision, and take survey leveling measurement.

Measurements shall be made twice daily until the heading has advanced five (5) times the tunnel width and weekly thereafter until the final underground excavation lining is constructed.

### **K.4 STRESS MEASURING ANCHORS FOR ROCK BOLT LOADS**

Stress measuring anchors shall be installed at specified locations and used to monitor the rock bolt loads. Readings shall be taken weekly or as directed by the Supervision.

The Contractor shall supply, install and test stress measuring anchors as shown on the Drawings or directed by the Supervision, and take readings. The anchors shall be installed and tested in accordance with the manufacturer's recommendations. Measurement of the elongation of anchors shall be done using a dial gauge or a strain gauge, and load determined from an anchor load versus dial gauge reading calibration curve.

The stress measuring anchors shall be MMA or EMA type (mechanical or electrical type) average stress measuring anchors produced by "SHINGIJUTSU KEIKAKU CO., LTD.," in Japan, or approved equivalent, and with a 14 ton design capacity.

### **K.5 DISK LOAD CELLS FOR STEEL SUPPORT LOADS**

Disk load cells shall be installed at the crown portion of steel supports at specified locations in the underground excavations, and used to monitor the steel support loads. The Contractor shall supply, install and test disk load cells as shown on the Drawings or as directed by the Supervision. Readings shall be taken daily from installation of the steel supports until completion of the shotcrete lining, and weekly thereafter until completion of the concrete lining. Readings of the disk load cells shall be done by means of a strain/stress transducer unit. Two (2) transducer units shall be provided by the Contractor.

The disk load cells for steel support shall be ME 960 type load cells produced by "INTERFELS GMB/H", or approved equivalent, with a nominal load of 20 ton and a maximum load of 24 ton.

## **K.6 HYDRAULIC PRESSURE CELLS FOR MEASUREMENT OF STRESS OF SHOTCRETE**

The Contractor shall supply, install, measure and test hydraulic pressure cell assemblies at the specified locations in the underground excavations, as shown on the Drawings or as directed by the Supervision. The hydraulic pressure cell assemblies shall be installed and tested in accordance with the manufacturer's recommendations, at the interface between rock and shotcrete and inside the shotcrete in order to measure radial pressure and tangential pressures.

The hydraulic pressure cells shall be of two types:

- Contact pressure cell for interface between the rock and shotcrete or concrete lining (50 kgf/cm<sup>2</sup> capacity)
- Stress cell unit for embedment in shotcrete or concrete lining ( 200 kgf/cm<sup>2</sup> capacity)

The cells to be used shall be proposed by the Contractor and approved by the Supervision.

The cells shall be installed in accordance with the manufacturer's instructions. Readings shall be taken daily initially then weekly thereafter or as directed by the Supervision.

A portable manual hydraulic readout unit shall be provided complete with a hand-operated hydraulic pump, flow controller, pressure gauge, valves, etc., all mounted in a carrying frame.

## **K.7 MEASUREMENT AND PAYMENT**

Measurement and payment for supplying and installing instruments, and the measurement and recording of the convergences, roof settlement and invert upheaval, stress measuring anchors, disk load cells, and hydraulic pressure cells, will be made of the actual numbers of measurements as directed and approved by the Supervision at the respective unit prices per number tendered therefor in the Bill of Quantities. Provided that the actual numbers of measurements for horizontal and diagonal convergences shall mean the number of sections of which the convergence bolts are installed for measurements.

No separate payment will be made for taking measurements and reading instruments, for providing access (including staging, etc.) to obtain measurements and readings, for recording and submitting data, or for any other work required to meet the requirements of this Section.





**CONSTRUCTION OF CIVIL WORKS**

**PACKAGE 2**

**LA ESPERANZA~POZA HONDA TRANSBASIN  
AND  
POZA HONDA~MANCHA GRANDE TRANSBASIN**

**VOLUME III - GENERAL AND TECHNICAL SPECIFICATIONS**

**SECTION L**

**MISCELLANEOUS**

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## SECTION L MISCELLANEOUS

### L.1 TRASH BOOMS FOR RESERVOIR

#### L.1.1 General

The Contractor shall furnish, install and float the trash booms on the reservoir as shown on the Drawings or as directed by the Supervision.

The trash booms shall consist of drums as floats, wire ropes, wire clips, chains, shackles, angles welded on the drums, concrete anchor blocks, and embedded steel metals in the blocks.

The drums shall conform to JIS, ASTM or approved local standard, having dimension of 58 cm in diameter, 88 cm in length and 2 mm in thickness. The drums and other steel surface shall be painted with one coat of anticorrosive primer and two coats of oil paint. Sand and gravel shall be filled in the drums as balance weight.

The wire rope shall be galvanized, flexible, improved plough steel wire type with grease impregnated fiber core.

The drums shall be connected with the drums by the clips, chains, shackles and angles welded on the drums. All materials to be incorporated in the metalwork required in this Paragraph shall be approved by the Supervision and shall conform to the JIS standards or approved equivalent.

The construction of anchor blocks shall conform to the Section E, Concrete Works.

#### L.1.2 Measurement and Payment

Measurement, for payment, of trash boom will be made of the length in linear meters along the centerline from end to end of trash boom in place. Payment will be made at the unit price per linear meter tendered therefor in the Bill of Quantities, which the unit price shall include all cost of labour, materials and equipment for furnishing and installing the trash boom with connecting materials and other work specified in this Paragraph. Provided that payment for trench excavation, backfilling, concrete works and embedded steel metals will be made separately under the appropriate work items in the Bill of Quantities.

## **L.2 WATER LEVEL STAFF GAUGE**

### **L.2.1 Material and Installation**

#### **(1) Staff Gauges at Severino**

The Contractor shall furnish and install water level staff gauges at the Severino pumping station and head tank as shown on the Drawings or as directed by the Supervision. The staff gauges, 200 mm wide, shall be of enameled iron-ware with melamine resin coating and shall be subject to the approval of the Supervision. Total lengths of the staff gauges shall be 25 m for the pumping station and 11.8 m x 2 sets for the head tank.

The Contractor shall set the staff gauges vertically by accurate levelling from the designated bench marks.

#### **(2) Staff Gauges at Poza Honda**

The Contractor shall furnish and install water level staff gauges at the Poza Honda inlet as shown on the Drawings or as directed by the Supervision. The staff gauge shall consist of steel pipes, 100 mm in diameter and 22 m in total length, and concrete foundations.

The steel pipes shall conform to JIS, ASTM or approved local standard stipulated in Section H, Miscellaneous Metal Works. The surface of steel pipes shall be painted with one coat of anticorrosive primer and two coats of oil paint as shown on the Drawings or as directed by the Supervision.

The Contractor shall set the staff gauges vertically by accurate levelling from the designated bench marks. Excavation and backfilling, and concrete foundation shall conform to the applicable provisions stipulated in Section C, Earth Works and Section E, Concrete Works.

### **L.2.2 Measurement and Payment**

#### **(1) Staff Gauges at Severino**

Measurement and payment of the water level staff gauges will be made on the lump sum basis.

Payment will be made upon completion of the water level gauges based on the lump sum price tendered therefor in the Bill of Quantities, which the lump sum price shall include the cost of all labor, tools, equipment and materials including supplying and setting the gauge staff and other costs necessary to complete the work.

**(2) Staff Gauges at Poza Honda**

Measurement and payment of the water level staff gauges will be made on the lump sum basis.

Payment will be made upon completion of the water level gauges based on the lump sum price tendered therefor in the Bill of Quantities, which the lump sum price shall include the cost of all labor, tools, equipment and materials including supplying and setting the gauge staff pipes, painting, excavation and backfilling, and foundation concrete and other costs necessary to complete the work.











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