



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

TECHNICAL SPECIFICATIONS FOR INSTRUMENTATION WORKS



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

SPECIFICATION FOR INSTALLATION OF INSTRUMENTS

CONTENTS

1) SCOPE



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

- 2) STANDARDS OF MATERIALS
- 3) INSTALLATION OF INSTRUMENTS
- 4) TESTING
- 5) CALIBRATION OF INSTRUMENTS

INSTALLATION, TESTING AND CALIBRATION OF INSTRUMENTATION AND CONTROL SYSTEM

1.0 SCOPE



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

1.1 The purpose of this specification is to define the general requirements for the installation, installation materials, testing and calibration of instruments and control system.

1.2 The work shall be carried out in accordance with the codes, standards and recommended practice listed in this specification and in accordance with local 'Statutory regulations'.

1.3 For installation of instruments and control system, of the new material where quality is of the prescribed standards and which is in every way fit for its intended purpose shall be used.

1.4 Unless otherwise specified all the materials shall be indicated in this specification except where it is not compatible with fluids being handled. In such cases the selection of the material shall be approved by Employer.

1.5 Only the best trade practices shall be used. All the work shall be carried out in a neat, workman like manner and to the satisfaction of Employer.

2.0 STANDARDS OF MATERIALS

2.1 Instrument process piping / tubing upto and including the first block valve and 'in-line' instrument equipment shall conform to the line class or vessel rating concerned instrument piping or tubing after the first lock valve may use alternate materials consistent with service conditions. In general they shall conform to the following specification as a minimum.

2.1.1 Stainless tubes shall be fully annealed and cold drawn seam less as per ASTM A 269 TP316 with size 1/2"OD x 0.65" WT (wall thickness).

2.1.2 Monel tubing shall be fully annealed seamless as per ASTM B165 with size 1/2" OD x 0.35"WT.

2.1.3 Carbon steel pipe shall be 1/2" seamless and shall be as per ASTM A106 Gr B min of sch 80 & dimensions as per ANSI B36.10.

2.1.4 Seamless stainless steel pipes shall be as per ASTM A 312 Gr TP 316L Sch 80S, dimensions as per ANSI B 36.19.

2.1.5 Instrument air supply piping from the main instrument air header shall be galvanised heavy class pipes to IS 1239.

2.2 Individual pneumatic signal and air supply tubing shall conform to the following specifications:

2.2.1 Stainless tubes shall be used in general and shall be fully annealed and cold drawn seamless as per ASTM A269 TP 316 with 6mmOD x 1mmWT.

2.2.2 Copper tubing where specified shall be seamless 6mmOD x 1.0mmWT soft annealed as per ASTM 868.74a cd No. 122 (DHP) sheathed with PVC 1.0mm thick coloured Black.

2.3 All fittings shall be as a minimum of 100 rating except for tube fittings. The fittings shall have threading as per B2.1 and socket weld connections as per B 16.11. These shall conform to the following specifications in general.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

2.3.1 Tube fittings shall be flare type compression fittings Swagelok or equivalents make double ferrule and pressure seat type.

All tube fittings in impulse lines shall be rated to 5000 PSIG at 380C.

2.3.2 Carbon steel pipe fittings shall be forged as per ASTM A105 stainless steel pipe fittings shall be as per ASTM –182 Grf 316L

2.4 Valve shall have normally Globe body and shall be fabricated out of Bar-stock and rated to min. of 1500. These shall be screwed bonnet type with 13% GSS trim and plug shall be integral with the stem. Face to face dimensions shall be approx. 80mm. End connections shall be socket weld to ANSI 16.11 and threaded to B2.1

2.5 Multibore tubing shall have a maximum 19 single polyethylene tubes, 6mmOD x 1mm numbered for easy identification. The bundle shall be marked with inner and outer fire resistance PVC sheath. They shall carry a pair of telephone wire 0.6mm diameter flexible.

2.6 Single pair and multi pair extension cables for Thermocouples shall be matched and calibrated in accordance with ISA MC 96.1. Conductor size shall be AWG for single pair and 20 A for Multipair.

The cable shall be armoured, each twisted pair shall be individually shielded with aluminium Mylar tape and a tinned copper drain wire. The wires and the cable shall be colour coded as per ISA recommended practices.

2.7 Instrument Electrical cables shall conform to the following specifications: 2.7.1 Instrument electronic signal cables single pair/ Multipair shall have copper conductor, twisted in pair and individually shielded with Aluminium Mylar tape with drain wire. In multipair cables, each pair shall be armoured with inner and cut PVC sheath. Minimum conductor size shall be 1.5 mm².

2.7.2 Control Cables for control signal, alarms actuating devices and solenoid valves of the interlock and shutdown valves shall generally be 1.5 mm² copper conductors armoured with inner and cut PVC sheath.

2.7.3 All power supply cables shall have copper/Aluminium conductor depending upon the conductor size. The cables shall be armoured with inner and cut PVC sheath. The cables shall be sized adequately. Minimum conductor size shall be 2.5 mm².

2.7.4 2-core armoured cable shall be used for illuminator on level gauges.

2.7.5 The material and construction of all electrical cables shall conform to IS- 1554 Part I or appropriate equivalent code and standard.

3.0 INSTALLATION OF INSTRUMENTS

3.1 Instrument Mounting

3.1.1 No instrument shall be installed in such a way that it bends for support on the impulse piping or electrical connection on it.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

3.1.2 Pressure gauges and temperature indicator shall normally be mounted directly on line. However direct on line mounting shall be avoided where vibrations are likely to be present.

3.1.3 Local mounted instruments shall be mounted on brackets, panels or placed on a suitable pedestal. Transmitters shall be mounted on 2" pipe supports where practical. Instruments to be mounted on steel columns, masonry structure etc. These shall not be mounted on heating equipments, pipelines and structures.

3.1.4 Blind transmitters shall be mounted at 130mm above graded platform. Local controllers, indicating transmitters and indicating instruments shall be mounted at approximately 1500 mm.

3.1.5 All the instruments shall be accessible from grade, ladder or platform etc. Pressures gauges and other local indicating instruments shall be readable from grade or operating level and if used for manual control shall be visible from the related valve.

All the instruments shall be located such that they don't impede the process operation.

3.1.6 Local mounted instruments which are not available in weather proof housing shall be mounted inside a weather proof case.

3.1.7 Items such as pilot valves, solenoid valves etc. shall be located local to its point of application or near to the device being actuated by them.

3.1.8 For blind transmitters output meters shall be mounted on instrument supports.

3.1.9 Filter regulators shall be mounted on the instrument supports below pneumatic transmitter or on the control valve yoke.

3.1.10 Instruments or instrument lines shall not be supported on hand rails, in general.

3.1.11 The use of process piping to support instrument lines shall be avoided as far as possible.

3.1.12 The instrument impulse piping shall be kept as short as possible.

3.1.13 Instruments and impulse lines shall be protected against mechanical damage.

3.1.14 In case of capillary tube instruments, capillary tube is to be supported and protected against mechanical damage.

3.1.15 Orifice meters shall not be installed on the top of orifice fittings. On horizontal lines orifice pressure taps shall be located as follows:

a) On top for air and gas service b) Horizontal for liquid and condensable vapour service.

3.2 Instrument Piping & Tubing.

3.2.1 Impulse Piping/tubing

3.2.1.1 The primary instrument block valves for all instruments shall be as per piping specifications.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

3.2.1.2 3-Valve manifold in general shall be integral type. For pressure gauges, 2-valve manifolds shall also be acceptable instead of isolation valve, drain valve and pipe fittings.

3.2.1.3 Differential or static pressure sensing lines shall not exceed 6 mtrs. (20 feet) in general for direct connected or locally mounted instruments

3.2.1.4 All impulse lines shall be run with a slope not less than 1 in 12 except where otherwise specified. Direction of slope is to be downward from the process for liquid service and upward from the process for gas service.

3.2.1.5 Tubing shall be joined by compression fittings.

3.2.1.6 Piping shall be joined by pipe fittings/flanges as per the piping specifications.

3.2.1.7 All instruments pipes and tubes shall run in horizontal and vertical planes only and shall run with minimum number of changes in direction, consistent with good engineering practices and neat appearance.

3.2.1.8 Tubing shall be bent with correct size tube bender as far as possible to avoid use of fittings. Hot bending shall be totally avoided.

Tube cutter shall always be used to cut tubing. The use of short lengths of tubing in long runs shall be avoided in order to avoid the fittings.

3.2.1.9 All tubing shall run in such a manner as to give the maximum protection against mechanical damage. Tubing runs shall be grouped together and clamped.

3.2.1.10 Tubing shall be arranged so that the unions can be tightened without distorting lines.

3.2.1.11 Instrument tubing or piping shall not run on trays intended for cables and shall not share the same transit.

3.2.1.12 No pipe or tube shall be left with mechanical strain on them.

3.2.1.13 A mechanical ferrule seater shall be used on tubing for 140 kg/cm² (2000 psi) or more.

3.2.1.14 Pipe bushings shall not be used.

3.2.1.15 Pipe plugs shall be fabricated out of bar stock and shall have hex-head.

3.2.2 Air/Signal Tubing

3.2.2.1 Signal Transmission tubes shall be laid on perforated trays prefabricated out of min 2.5 mm. thick steel plates. The width of the tray shall be selected as per the number of tubes to be laid.

3.2.2.2 Where tubing is run in permanent enclosures, it should be ensured that entry and exit of such enclosures is clean and smooth.

3.2.2.3 Tubing run in permanent enclosures shall not have joints, except at special junctions boxes provided for this purpose.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

3.2.2.4 Where permanent enclosures are left with space for instrument tubing to be laid at some later date, a galvanised pull wire of adequate size shall be left in the tray.

3.2.2.5 Where the length of transmission tubing exceeds 60 mtrs (200ft) necessity of installing signal booster relays shall be considered.

3.2.2.6 In case of 'Skidded' equipment or vessels with instrumentation, where off-skid alarms shutdown or control functions are provided the signal tubes shall be terminated on the control bulk head near the skid boundary.

3.2.3 All threaded pipe joints shall be joined after applying Teflon tape. It should be applied in a manner to ensure that the tape does not spill over the end of the male fitting. No other pipe joining compound shall be used except on high temperature service where graphite sealing compounds shall be used.

3.2.4 All reasonable precautions shall be taken to prevent foreign materials entering pipe lines or tubing before and during erection.

3.2.5 Pipes and tubes installed but not connected, shall have the ends clad in approved fashion to prevent the entry of foreign material. For a period upto one week adhesive tape may be used, for longer periods, caps or plugs shall be used.

3.2.6 Piping/Tubing supports

3.2.6.1 Piping and tubing shall be adequately supported and fixed at a distance not exceeding that in the following table:

Single tubing/Piping	Max. distance between supports
3/8" OD or less	Continuous
1/2" to 3/4" Nom. Size	2 meters (6ft.)
3/4" to 1" Nom. size	3 meters (9ft.)
Multitube bundle	3 meters (9ft)

3.2.6.2 All field mounted instrument air tubing shall be supported with galvanized steel angles or channels of minimum 1/8" thickness fabricated to present neat appearance.

3.2.6.3 All instruments tubing supports shall be galvanised prior to installation

3.2.6.4 Trays shall be properly supported either from any rigid steel structure or concrete member. In case of non-availability of above, a suitable support shall be fabricated.

3.3 Instrument Air Supply Distribution

3.3.1 Piping material for instrument main and branched air headers upto the isolation valve at each take-off from main or branch header shall conform to piping specification.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

3.3.2 The air header size shall be established in accordance with the table below, unless otherwise specified, for a header pressure of 4 to 8.5 kg/cm²

Maximum number of users	Nominal pipe size
Upto 5	1/2"
Upto 10	3/4"
Upto 25	1"
Upto 80	1-1/2"
Upto 150	2"
Upto 500	3"

3.2.3 All take off for branch lines are to be from the top of the main header with block valves equal in size to the branch line. All low point shall have a 1/2" valve installed as a drain and blow down point.

3.3.4 A minimum size of 1/2" pipe shall be run to the instrument with a 1/2" valve for each ser. Tubing from the isolation valve to the instrument shall be 6.0 mm.

3.2.5 Union shall be provided at convenient location in the air header.

3.3.6 Filter regulator shall be provided for individual field mounted consumer and shall be complete with an output gauge.

3.3.7 In case of skid mounted equipments or vessels which incorporate instrumentation requiring pneumatic supply, on skid supply piping shall terminate at the skid boundary location and size of the supply connections shall be noted on the vendor approval drawings.

3.4 Installation of multitude and Multicore cables.

3.4.1 Multicore/ Multitube cables shall generally be installed on trays or ducts and properly clamped. At bends minimum radius shall be maintained as per cable manufacturer's standards.

3.4.2 All cables shall be rigidly supported on structural steel and masonry. Drilling of steel member should normally be avoided. However, if the drilling of steel must be resorted to, it must be drilled where minimum of weakening of structure will result cables shall be support at every 500 mm. At every vertical drop these shall be lamped at more frequent intervals max of 300 mm.

3.4.3 Directly buried cables shall be laid underground in excavated cable trenches. Trenches shall have sufficient depth and width to accommodate all cables correctly spaced and arranged with a view of heat dissipation and economy of design construction of trenches laying of cables and filling up of trenches shall be as per relevant standard.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

3.4.4 Each underground cable shall be provided with identifying tag of load securely fastened every 30 M of its underground length with at least one tag at each end before the cable enters the ground.

Before cables are placed, the trench bottom shall be filled with a layer of sand. The cables shall be covered with 150 mm of sand on the top of the largest dia. Cable tube and sand shall be lightly pressed. A protective covering of 75 mm thick second class red bricks shall be laid flat and the balance portion of the trench shall be filled with soil, compacted and levelled.

3.4.5 At each road crossing and other places where cables enter pipe sleeves, adequate bed of sand shall be given so that the cables don't slack and get damaged by pipe ends after back filling.

3.4.6 At the entry into concrete blocks loops shall be provided at either end to prevent any damage to cable.

3.4.7 The cable entry to control room shall be suitably filled and sealed after laying of cables so as to achieve a positive sealing against the entry of gas/water.

3.4.8 All wiring, tubing, cables, Junctions boxes and auxiliary equivalent shall be suitably identified as per applicable codes and practices. All piping and tubing shall be tagged with slip-on or clip on wire marker at both ends.

3.4.9 Jointing of cables is generally not permitted. Cables shall be cut after the exact site measurements at the cable drums shall be so selected before cutting the lengths as to avoid any unnecessary wastage.

3.4.10 Low signal cables like alarms, analysers cables, special cables for turbine meter, thermocouple compensating cables etc. shall be layed separated from power supply cables in ducts/trenches/trays.

3.4.11 Electric signal lines for electronic transmitters to receive and to final control element shall be continuously shielded with the shield grounded at the same point as the signal circuit generally at the control instrument.

3.4.12 Separate junction boxes shall be used for intrinsically safe cables.

3.4.13 Different intrinsically safe system e.g., systems having different rounds shall not be run in the same multicore cable, in general.

Recommended minimum separation distance between twisted pair signal leads and AC Power Lines.

AC Power Cable		Minimum Distance to Signal Lead
Voltage (Volts)	Current (Am)	in (cm)
0 to 125	0 to 10	12" (30)
125 to 250	0 to 50	15" (38)



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

250 to 440

0 to 200

18" (46)

5KV & Up

200 Amp. & Up

24" (61)

Different intrinsically safe circuits e.g., circuits having different voltage levels, of the same intrinsically safe system shall not be run in the same cable unless each conductor insulation is at least 0.25mm or no hazard can result from interconnection.

3.4.14 The physical separation of power and signal cables shall be as per API 550 Part I Section VII. Cable in intrinsically safe circuits shall preferably be not run in the same tray where-- on intrinsically safe circuits cables are being run. If these are being run in the same tray, a metallic earthed separately shall be provided.

3.4.15 For temperature controllers, single pair thermocouple extension cable or cable for resistance thermometer, shall be layed directly from the element to the transducer in the control room without intermediate terminal blocks.

3.4.16 In case of skid mounted equipment or equipment which incorporate skid instrumentation like alarms, shutdown or control function shall terminate signals or control junction box near skid boundary for connection of off skid equipment.

3.4.17 No wire shall be terminated or left with mechanical strain within any conductor.

3.4.18 Splices shall be made only at terminals, in instruments or approval equipment/ junction boxes using lugs and screwed connections. No intermediate splices shall be made in cable trays or in conduct. Number of junction boxes in any cable path shall be limited to only one.

3.5 Installation of Zener barriers

3.5.1 Zener barriers shall be installed in the circuit to make the system intrinsically safe provided:

a) There is no energy storage system in excess to the minimum permitted by the barrier design on the hazardous side of the barrier. The same shall be met by taking intrinsically safe transmitters and selecting the cable electrical parameters like inductance L/R ratio & capacitance in accordance with the maximum parameters given in barrier specifications.

b) No power source exceeding the voltage rating of Zener barrier shall be connected on safe side of the Zener barrier.

c) No outside power source including other intrinsically safe circuits shall be connected to the hazardous side of the barrier.

3.5.2 Zener barriers shall be located as close as possible to the field wiring entry point in the control room.

3.5.3 Single barrier are bolted directly to copper bus bar and multiple barriers on the barrier mounting plates. Copper bus or barriers mounting plates shall be isolated from the panel frame.

3.5.4 The signal ground system for intrinsically safe system shall be separate from power ground system and shall be connected to the signal ground reference point. The maximum



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

resistance allocable between the farthest point on intrinsically safe barrier ground bus and signal ground reference point shall be less than 1 ohm.

3.5.5 Field wires shall directly terminate at the barriers and not through intermediate terminals.

3.6 Installation of Analyser / Gas Chromatograph

3.6.1 Installation of all analyser shall be in general, as per APIP 550 Part II.

3.6.2 The analyser housing at its installation shall meet all safety requirements as per classifications.

3.6.3 Sampled process fluid, if not returned to the process shall be disposed to a safe location. Piping shall be provided so that vapours can be vented to a safe location and liquids shall be drained in a clean and orderly fashion to a safe place. Toxic vapours shall not be vented to atmosphere.

3.6.4 Analyser shall be located as near to the sampling point as possible.

3.6.5 Analyser equipment must be protected from the following:

- a) Hot equipment
- b) Severe ambient temperature changes
- c) Shock
- d) Mechanical damage
- e) Vibration

3.6.6 If a separate vent for the analyser is used, the location of that vent shall be in area of minimum air Turbulence. If the vents of different analysers are vented into a common vent, a back pressure regulator shall be used.

3.6.7 Vent piping shall be designed to prevent condensate from accumulation in low point and obstruct a free vent flow.

3.7 Ducts, Trays and Supports

3.7.1 Main cable duct shall be of bottom open type with flat/angle --- construction with side sheet and top cover of 3.2 mm thickness.

3.7.2 The ducts and trays shall be properly supported at regular intervals. Wherever insert plates are not available, support on concrete structure or ceiling shall be fixed with a minimum of 10 mm expansion bolts Angle supports for ducts shall be fabricated from minimum of 40 mm angle.

3.7.3 All supports shall be neatly cut with hacksaw only and not with gas cutting. Free ends of angle supports shall not have sharp ends and shall be properly rounded off.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

3.7.4 Ducts and supports shall be painted with one coat of Red oxide Zinc chromate primer conforming to IS-2074 after cleaning to remove scale and then painted with

2 coats of final enamel paint as given below:

- a) Duct - Dark admirately Grey as per IS0632.
- b) Supports - Black.

3.8 Instrument Steam Tracing

3.8.1 Steam for Tracking of instruments shall be taken from main steam header take of valve through carbon steel pipes supported at regular intervals.

3.8.2 Steam tracing around individual instrument shall be by copper tube of 1/8" diameter.

3.8.3 Piping or tubing for steam tracing shall be installed in such a way as to avoid condensate pockets.

3.8.4 After steam tracing, the line is connected to drain funnel through steam trap.

3.9 Identification of Lines and Instruments

3.9.1 All site mounted instruments, junction boxes, air headers, tubing and wiring terminations shall be labeled or tagged.

3.9.2 Instruments shall be furnished with stainless steel name tags containing Tag no., manufacturer's name, and model no. serial number. This tag number shall be approximately 3"x1" size and shall be attached to the instruments with -- gauge stainless steel wire. 3.9.3 Unused cable entries in junction boxes and field instruments are to be plugged.

4.0 TESTING

4.1 Instrument Impulse piping/Tubing

4.1.1 All process impulse lines shall be disconnected both from the instrument and vessel/piping end and flushed with water.

4.1.2 After thorough flushing the impulse lines shall be isolated from the instruments and pressurised hydraulically to 1.5 times the maximum working pressure corrected for ambient temperature. They shall then be isolated from the pressure source and the pressure reading on a test pressure gauge shall not fall at a rate exceeding one psig/hour.

In case no isolation valve is provided near the instrument, impulse piping/tubing shall be pressurised along with the instrument to the maximum pressure of scale in case of pressure transmitter and max. Operating pressure in case of differential pressure instrument with equalizing valve open

4.1.3 In special conditions where hydro- testing is not permissible due to service requirements, testing shall be carried out by using compressed air/nitrogen.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

4.1.4 The external displacer type instruments and cage type level switches shall be tested to 1.5 times the operating pressure using air/nitrogen after thorough flushing.

4.2 Instrument Air lines/signal tubing.

4.2.1 Instrument air lines/signal tubing shall not be hydrostatically tested.

4.2.2 Instrument air tubing shall be disconnected upstream of all filter regulators and blown down to remove water, slag and mill scale, from lines at 7.0 kg/cm² G for fifteen minutes.

Air filter shall be taken in line and tubing shall be disconnected at instrument end, and blown for 3 minutes to remove traces of dirt.

4.2.3 Testing of instrument air shall be carried out with instrument air at 7 kg/cm²G upto the upstream of the filter regulator after thorough flushing. All lines shall be checked with soap solution and bubbler unit for possible leak at joints.

4.2.4 All signal tubing shall be checked with 1.5 kg/cm² after proper flushing. After pressuring, source shall be cut off and rate of fall in pressure shall be less than IPSL for each 100 feet of tubing for a test period of 2 minutes as per instrument society of American RP 7.1 'Pneumatic Control Circuit Pressure Test'

4.3 Cables

4.3.1 All wiring shall be checked to ensure that it is correctly connected and properly grounded.

4.3.2 All cables shall be checked for continuity proper connection and insulation testing.

Insulation test shall be carried out on all wiring with a certified magger after disconnecting the cables at both ends.

4.4 All the results of the above mentioned testing shall be recorded and submitted for check.

4.5 All the in line instruments like orifice plates, turbine meters, Rota meters, Target meters, vortex meters, control valves, safety valves etc. shall be removed and spool pieces shall be provided prior to the flushing of the lines.

5.0 CALIBRATION OF INSTRUMENTS

5.1 All instruments shall be calibrated strictly as per manufacturer's instructions prior to the installation. In addition to calibration of instruments, setting of safety devices like process switches, safety valves etc. and simulation testing of all interlock and shutdown system shall be carried out.

5.2 In general, all tests shall simulate, as closely as possible, design process condition by the use of manometers, potentiometers, deadweight testers, test pressure gauges etc. Pour point calibration shall refer to the input signal to an instrument equivalent to 0, 25, 50, 75, 100% of instrument range upscale (rising) and 75, 50, 25, 0% of instrument (downscale) (falling).



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

All instruments unless otherwise noted shall be calibrated in upscale and downscale direction and if necessary, adjusted until their accuracies conform to those limits state by the manufacturer.

Upon completion of these tests, the instruments shall be drained, completely.

5.3 Temperature Instruments

5.3.1 Temperature Gauges Filled type and Bi metallic dial type Thermometers shall be four point bench checked for proper operation and calibration using a temperature bath prior to installation.

5.3.2 Temperature Elements and Temperature Transmitters.

Temperature Elements and Transmitter shall be four point bench calibrated using a temperature bath precision meter or precision gauge prior to installation.

5.4 Pressure Instruments

5.4.1 Pressure Gauges

5.4.1.1 Direct connected bourdon type pressure gauges shall be dead weight tested or tested against a test gauges prior to installation.

5.4.1.2 Receiver type pressure gauges shall be four points calibrated using a precision gauge and precision air regulator.

5.4.1.3 Pressure and Differential Pressure Transmitters.

Pressure and differential pressure transmitters shall be four points calibrated using a hydraulic or dead weight tester or a precision pneumatic calibrator prior to the installation. A precision output meter or gauge shall be used to monitor the output.

5.5.1 Orifice plates shall be checked visually for the name plate and for an upstream sharp edge. Bore dia. shall be checked for compliance with the specification.

5.5.2 Differential pressure type of flow instruments shall be four points calibrated using precision pneumatic calibrator or a manometer and precision regulator. A precision output meter or gauge shall be used to monitor the output of the transmitter.

5.5.3 a) Rotameters shall be installed as received. A check shall be made to confirm that shipping stops have been removed and float has been installed.

b) Where rotameters have transmitting mechanism, the float shall be raised and lowered mechanically and output shall be checked. Vendor calibration data/ curve shall be checked.

C) A check shall be conducted with plumb for a vertical installation

5.5.4 Turbine meters, Annubar, positive displacement meters, vortex meter, ultrasonic flow meter, etc. shall be installed as received.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

5.5.5 Target meters shall be checked for calibration using calibration weights. Output shall be monitored using precision output meter.

5.6 Level Instruments

5.6.1 Level Gauge Glasses

Gauge glasses shall be installed as received installation of illuminators, frost protectors and other accessories shall be checked.

5.6.2 Displacer Type, Level Transmitter

- Displacer type level transmitter shall be checked by raising and lowering mechanically the displacement and checking the pilot or transmitter action. Check transmitter with out put gauge or meter for smooth and full output change.

- A check shall be conducted with plumb for a vertical installation.

5.6.3 Differential pressure type level transmitter Differential pressure type level transmitter shall be calibrated with pneumatic calibrator at four points prior to installation. A precision meter or gauge shall be used to monitor the output of the transmitter.

5.6.4 Tank level gauges

a) Tank level gauges shall be checked by raising and lowering mechanically the displacer and checking the indicator on the gauge board.

b) Check for proper liquid seal prior to installation in case of liquid seal tank gauges.

c) In case of servo type gauges, the displacer is hoisted from the tank into the calibration chamber.

5.7 Control Valves, shutdown valves and self actuated valves

5.7.1 All diaphragm and piston operated control valve shall be stroked pneumatically using a pressure regulator and pressure gauge against the spring range specified on the name plate of the valve.

5.7.2 Mechanical seating and travel of the valve stem shall be checked against the side indicator and the name plate

5.7.3 Valve positioner shall be calibrated with the control valve in accordance with the name plate data and specifications with the help of pneumatic calibrator or gauge with precision regulator. Zero position or fully close position of the valve shall be a live zero i.e., the plug shall be just off the seat at the minimum setting.

5.7.4 Volume bottles, where used shall be checked for proper filling. The signal line shall be bled to zero pressure and failure action shall be confirmed.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

5.7.5 Control valve accessories such as handwheels, boosters, relays etc. shall be checked operationally. Declutch able handwheel shall be operable both with and without an air signal to the diaphragm.

5.7.6 Self actuated control valves shall be installed as received, checking inlet and outlet points and name plate data. Regulators with external pressure connections shall be inspected for proper installation.

5.7.7 Butterfly shall be checked carefully to see that the vane moves freely into the upstream and down stream piping. Proper vane movement to stroke shall be confirmed.

5.7.8 All control valves and regulators shall be removed from the line prior to flushing and during hydro testing.

5.8 Safety Relief Valves

5.8.1 Safety relief valves shall be installed as received after carefully checking the name plate data. Pilots, if used, shall be checked carefully for installation on the proper safety valve.

5.8.2 Valves, which are installed in such a manner as to permit on line testing, shall be pressure tested after installation to determine proper operation and setting. Compressed air or nitrogen shall be used for testing of safety relief valves.

5.9 Switches

5.9.1 Level Switches shall be actuated mechanically for switch operation but shall not be calibrated for level setting.

5.9.2 Pressure switches shall be calibrated using hydorlic or dead weight tester or precision air regulator and gauge. The setting/trip point shall be checked using a continuity tester.

5.9.3 Temperature switches shall be calibrated using a temperature both prior to installation and set to the required alarm/ trip point using a continuity tester.

5.10 Receiver Instruments

5.10.1 Receiver Indicator/Recorders

5.10.1.1 Pneumatic indicators/ Recorders shall be calibrated using pneumatic calibrator/ precision pressure regulator and gauge.

5.10.1.2 Electronics indicators/ Recorders shall be calibrated using a current generator and a precision meter.

5.10.1.3 Chart drive assembly shall be checked for proper operation.

5.10.2 Controllers

5.10.2.1 Proper balancing of the controller shall be checked as per the manufacturers catalogues.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

5.10.2.2 Controllers shall be checked for manual and Auto operation and Transfer. The transfer from manual to Auto and vice versa shall be bumpless and smooth.

5.10.3.1 Manual loader station Output of the manual loader shall be checked with a precision meter.

5.10.4.1 Multipoint Temperature Recorders

Each point shall be calibrated using a temperature simulator/ decade box for RTD / voltage generator and precision meter for the thermocouples.

5.10.4.2 Point synchronisation shall be checked.

5.10.5 Pneumatic receiver switches shall be calibrated using precision air regulator and gauge. The setting/alarm/trip point shall be checked using continuity tester.

5.10.6 Trip Amplifiers Trip amplifiers shall be calibrated using a temperature simulators or voltage generator and precision meter for thermocouple or Resistance box for RTD's. The required setting/ alarm point/ trip point shall be checked using a continuity tester.

5.10.7 Receiver Switch module Receiver switch modules shall be calibrated using a current source and a precision meter. The required setting/alarm/trip point shall be checked using a continuity tester.

5.10.8 Alarm and Annunciator system

5.10.8.1 Alarm and annunciator system shall be checked for visual and audio alarm operation using dummy signals. Full alarm sequence of each alarm point shall be checked.

5.10.8.2 Each point shall be checked for proper engraving.

5.10.9 Shutdown System

5.10.9.1 Operation of final actuating elements shall be checked for proper operation using dummy signals.

5.10.9.2 All timers, push buttons and switches shall also be checked for their proper operation.

5.11 Analytical Instruments

5.11.1 Check the full analyser system including sample handling system for leakage.

5.11.2 Check the full sample handling system for its proper operation. Calibrate and check completely all analyzers using zero and span samples as per vendor catalogues.

5.12 Flow computer / Volume corrector

5.12.1 Corrected flow values shall be checked for various D.C. inputs and pressure and temperature variations for upscale and downscale ranges.

5.13 The list of test and calibration instruments with traceability certificates shall be submitted to Employer for approval before carrying out the tests / calibration of instruments at site.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

5.14 The formats / description of tests / calibration of all instruments shall be submitted to Employer for approval.

5.15 Daily / weekly reports shall be submitted during execution of work at site.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

SPECIFICATION FOR INSTRUMENT TUBING

CONTENTS

1.0 GENERAL

2.0 CONSTRUCTION



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

3.0 TESTING

4.0 SHIPPING

5.0 REJECTION

1.0 GENERAL

1.1 Scope



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

1.1 This standard specifications covers the requirements for the design, materials, testing and shipping of Instrument Tubing which includes the following types:-

a) SS tubes

b) Copper tubes

1.1.2 The related standards referred to herein and mentioned below shall be of the latest edition prior to the date of Purchaser's enquiry:

- | | | |
|-------------|---|---|
| ASTM A 269 | - | Specification for seamless and welded ferritic stainless steel tubing for general services. |
| ASTM B 251 | - | Specification for general requirements for wrought seamless copper and copper alloy tube. |
| ASTM B 251M | - | Specification for general requirements for wrought seamless copper and copper alloy tube (Metric) |
| ASTM B 68 | - | Specification for seamless copper tube, bright annealed |
| ASTM B 68M | - | Specification for seamless copper tube, bright annealed. (Metric) |

1.1.3 In the event of any conflict between these specifications, data sheets, related standards, codes, etc., the vendor shall refer the matter to the purchaser for clarifications and only after obtaining the same shall proceed with the manufacture of the items in question.

1.2 Bids

1.2.1 Vendor's quotation shall include a detailed specification sheet for each type of tube which shall provide the following information:

a) All the details regarding the type, construction, materials etc. of the items.

b) Overall the dimensions in mm.

1.2.2 All the units of measurement and material specifications for various parts in the vendor's specification sheets shall be to same standards as in purchaser's data sheets.

1.2.3 Vendor shall attach a list of items, type wise, summing up all the deviations from this specification and purchaser's data sheets if there are any. Also vendor shall provide reasons for these deviations.

1.2.4 Vendor shall enclose catalogues giving detailed technical specifications and other information for each type of tube in the bid.

1.2.5 Vendor's quotation, catalogues, drawings etc. shall be in English language.

1.3 Drawings, Data and Certification



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

Detailed drawings, data, catalogues and manuals etc. required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number of reproducible and prints shall be despatched to the address mentioned, adhering to the time limits indicated.

2.0 CONSTRUCTION

2.1 Stainless Steel Tubes

2.1.1 SS tubes of the tubes shall be Rockwell RB 70-70. Tubes shall be free from scratches and to be suitable for bending.

2.1.3 Tube wall thickness shall be 0.049" for 1/2" OD and 1mm for 6 mm unless otherwise specified.

2.1.4 Maximum working pressure shall be 153.0 kg/cm² at 38oC for 1/2" OD Tube, unless otherwise specified and 80.0 kg/cm² at 38o for 6mm OD tube.

2.1.5 Tubes shall be supplied in minimum length of 6 metres without brazing in between.

2.1.6 Dimensional tolerances shall be as per ASTM A 269.

2.1.7 The following shall be marked on the tube:

- a) Name of manufacturer
- b) Type and material grade of tube
- c) Tube O.D. and wall thickness

2.2 Copper Tubes

2.2.1 Copper Tubes (PVC Jacket)

2.2.1.1 The tube shall be soft annealed copper with 6mm OD and a wall thickness of 1.0 mm as per ASTM B 68M Copper No.C12200.

2.2.1.2 The tube shall be jacketed with black PVC. The jacket thickness shall be 1.6mm. The PVC jacket shall confirm to ASTM D-1047.

2.2.1.3 The tube ends shall be plugged prior to transportation.

2.2.1.4 The tube shall be of continuous length without any brazing in between for 100 metres length.

2.2.1.5 Minimum length of single tube shall be 100 meters.

2.2.1.6 The dimensional tolerances shall be as per ASTM B 251M.

2.2.2 Bare Copper Tubes (For Steam Tracing)

2.2.2.1 The tube shall be soft annealed copper with 3/8" OD or 6mm OD with a wall thickness of 1.0 mm as per ASTM B68 copper No.C12200.

2.2.2.2 The tube ends shall be plugged prior to transportation.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

2.2.2.3 The tube shall be of continuous length without any brazing in between for 100 metres length.

2.2.2.4 Minimum length of tube shall be 100 metres.

2.2.2.5 The dimensional tolerances shall be as per ASTM B 251.

3.0 TESTING

3.1 The following tests shall be done for SS tubes.

a) Hardness test

b) Hydrostatic test at 153.0 kg/cm² at 38o C for 1/2" tube and at 80.0 kg/cm² at 38oC for 6mm tube, unless otherwise specified.

3.2 PVC jacketed copper tubes shall be tested at 7.0kg/cm²g with dry air for leak check.

3.3 Bare copper tubes shall be hydrostatically tested at 80.0 kg/cm²g at 38oC.

3.4 Final test before delivery shall include ball test to ensure clear opening of the tube for copper tubes. The O.D of the ball shall be minimum 1mm for 6mm O.D tube and 2mm for 3/8" tube.

4.0 SHIPPING

4.1 The tubes shall be plugged at both ends to avoid entry of foreign matter. The tubes shall be packed carefully so as to avoid damage during transport.

5.0 REJECTION

Vendor shall make his offer in detail, with respect to every item of the purchaser's specifications. Any offer not conforming to this shall be summarily rejected.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

SPECIFICATION FOR INSTRUMENT TUBE FITTINGS

CONTENTS

- 1.0 GENERAL
- 2.0 CONSTRUCTION



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

3.0 TESTING

4.0 SHIPPING

5.0 REJECTION

‘

1.0 GENERAL

1.1 Scope

1.1.1 This standard specifications covers the requirements for the design, materials, testing and shipping of instrument tube fittings which includes the following types:-



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

a) SS compression fittings (SS tube)

b) Brass compression fittings (copper tube)

1.1.2 The related standards referred to herein and mentioned below shall be of the latest edition prior to the date of Purchase's enquiry:

ANSI B 2.1 - Pipe Threads

B16.11 - Forged steel fittings-socket welding and threaded.

IS:319 - Specification for free cutting brass bars, rods and sections.

ISA RP 42.1 - Nomenclature for instrument tubing - fittings.

1.1.3 In the event of any conflict between these specifications, data sheets, related standards, codes etc., the vendor shall refer the matter to the purchaser for clarifications and only after obtaining the same shall proceed with the manufacture of the items in question.

1.2 Bids

1.2.1 Vendor's quotation shall include a detailed specification sheet for each type of tube fittings which shall provide the following information:

a) All the details regarding the type, construction, materials, etc. of the items.

b) Overall dimensions in mm.

1.2.2 All the units of measurement and material specifications for various parts in the vendor's specification sheets shall be to same standards as in purchaser's data sheets.

1.2.3 Vendor shall attach a list of items, typewise, summing up all the deviations from this specification and purchaser's data sheets if there are any. Also vendor shall provide reasons for these deviations.

1.2.4 Vendor shall enclose catalogues giving detailed technical specifications and other information for each type of fitting in the bid.

1.2.5 Vendor's quotation, catalogues, drawings, etc. shall be in English language.

1.3 Drawings, Data and Certification

Detailed drawings, data, catalogues and manuals etc., required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number of reproducibles and points shall be despatched to the address mentioned, adhering to the time limits indicated.

2.0 CONSTRUCTION

2.1 SS Tube fittings:

2.1.1 Nomenclature of all tube fittings shall be as per ISA RP 42.1.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

2.1.2 Fittings shall be flareless compression type and of three piece construction with ferrule, nut and body suitable for use on SS tubes conforming to ASTM A 269 TP316, hardness not exceeding RB80.

2.1.3 All parts shall be of SS 316.

2.1.4 Hardness of the ferrules shall be in the range of RB 85-90 so as to ensure a minimum hardness difference of 5 to 10 between tube and fittings, for better sealing.

2.1.5 Nuts and ferrules of particular size shall be interchangeable for each type.

2.1.6 Spanner hold shall be metric.

2.1.7 Threaded ends of fittings shall be NPT as per ANSI B 2.1.

2.1.8 Copper Tube Fittings

2.2.1 Nomenclature of all tube fittings shall be as per ISA 42.1.

2.2.2 Fittings shall be of flare less compression type and of three-piece construction consisting of ferrule, nut and body suitable for use on copper tubes conforming to ASTM B 68/B 68M hardness not exceeding RB 50.

2.2.3 All parts shall be manufactured from Brass as per IS 319 bar stock and Nickel plated.

2.2.4 For better grip, vendor shall maintain hardness difference between tube & ferrule and indicate the same along with the offer.

2.2.5 Nuts & ferrules of particular size shall be interchangeable for each type.

2.2.6 Threaded ends of fittings shall be NPT as per ANSI B 2.1.

2.2.7 Spanner hold shall be metric.

2.2.8 Vendor shall ensure that the ferrules and nuts supplied for fittings shall be suitable for sample tube which shall be supplied during manufacture.

3.0 TESTING

3.1 Random samples of SS tube fittings shall be hydrostatically tested as follows:-

For 6 mm fittings at 80.0 kg/cm², 1/2" fittings at 153.0 kg/cm² at 38°C unless otherwise specified.

3.2 Random samples of brass compression fittings shall be hydrostatically tested as follows:-

For 1/4" fittings, at 10 kg./cm², 3/8" at 80.0 Kg/cm² and all at 38°C.

4.0 SHIPPING

4.1 All thread/ends shall be protected with plastic caps to prevent damage/entry of foreign matter.

5.0 REJECTION



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

Vendor shall make his offer in detail, with respect to every item of the purchaser's specifications. Any offer not conforming to this shall be summarily rejected.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

SPECIFICATION FOR INSTRUMENT VALVES AND MANIFOLDS

CONTENTS

- 1.0 GENERAL
- 2.0 CONSTRUCTION



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

3.0 TESTING

4.0 SHIPPING

5.0 REJECTION

1.0 GENERAL

1.1 Scope

1.1.1 This standard specifications covers the requirements for the design, materials, testing and shipping of Instrument Valves & Manifolds which includes the following types:-

a) Miniature instrument valves



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

b) Instrument valve manifolds

c) Instrument air valves

1.1.2 The related standards referred to herein and mentioned below shall be of the latest edition prior to the date of Purchaser's enquiry:

ANSI B 2.1 - Pipe threads

ANSI B 16.11 - Forged steel fittings-socket welding and threaded.

1.1.3 In the event of any conflict between these specifications, data sheets, related standards, codes etc, the vendor shall refer the matter to the purchaser for clarifications and only after obtaining the same shall proceed with the manufacture of the items in question.

1.2 Bids

1.2.1 Vendor's quotation shall include a detailed specification sheet for each type of Valves & Manifolds which shall provide the following information:

a) All the details regarding the type, construction, materials etc. of the items.

b) Overall dimensions in mm.

1.2.2 All the units of measurement and material specifications for various parts in the vendor's specification sheets shall be to same standards as in purchaser's data sheets.

1.2.3 Vendor shall attach a list of items, typewise, summing up all the deviations from this specification and purchaser's data sheets if there are any. Also vendor shall provide reasons for these in the bid.

1.2.5 Vendor's quotation, catalogues, drawings etc. shall be in English language.

1.3 Drawings, Data and Certification

Detailed drawings, data, catalogues and manual etc. required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number of reproducible and prints shall be dispatched to the address mentioned, adhering to the time limits indicated.

2.0 CONSTRUCTION

2.1 Instrument Valves (Miniature)

2.1.1 The instrument valves shall be globe pattern-needle valves forged/ barstock with inside screwed bonnet.

2.1.2 Body and trim material shall be 316 SS unless otherwise specified.

2.1.3 The valve body rating shall be 3000 lbs unless specified in piping material specification which shall govern in case it is specified.

2.1.4 The end connection shall be 1/2" NPTF to ANSI B2.1.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

2.1.5 The packing material shall be teflon unless otherwise specified.

2.1.6 The hand wheel material shall be carbon steel zinc plated.

2.1.7 Flow direction shall be marked on the body.

2.1.8 The valve dimension shall be as follows:

a) End to end dimensions 76 mm (approximately).

b) Height in fully open condition - 135mm maximum.

2.2 VALVE MANIFOLDS

2.2.1 3-Valve & 5-Valve manifolds:

2.2.1.1 3 Valve manifold shall be designed for direct coupling to differential pressure transmitters having 2 bolt flanges with 54 mm (2-1/8") centre to centre connections and 41.3 mm (1-5/8") bolt to bolt distance. The manifold shall contain two main block valves and an equalizing by-pass valve. The valves shall be needle valves. They shall use self aligning 316SS ball seats.

2.2.1.2 5 Valve manifold shall contain two main line block valves and a combination double block and bleed for the bypass line.

2.2.1.3 The manifold shall be suitably for mounting directly on the stanchion (2" pipe).

2.2.1.4 All bonnets shall have teflon packing unless otherwise specified.

2.2.1.5 The material of construction shall be 316 SS unless otherwise specified.

2.2.1.5 The material of construction shall be 316SS unless otherwise specified.

2.2.1.6 The flanges shall be integral part of the block.

2.2.1.7 The process connection shall be 1/2" NPTF to ANSI B2.1.

2.2.1.8 The manifolds shall be supplied alongwith mounting accessories. The bolts and nuts shall be alloy steel as per ASTM A 193 Gr B ASTM A 194 GR 2H respectively. Rings shall be teflon and other accessories shall be cadmium plated.

2.2.1.9 Vendor shall furnish the material certificate for body.

2.2.2 3 Way 2 Valve Manifold for pressure gauges.

2.2.2.1 The manifold shall be designed for use with pressure gauges.

2.2.2.2 The valve shall be a ball valve.

2.2.2.3 The body shall be either straight or angle

2.2.2.4 The body and trim material shall be 316SS, packing material shall be teflon unless otherwise specified.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

2.2.2.5 The inlet connection shall be 3/4" plain end (female) for socket weld as per ANSI B 16.11.

2.2.2.6 The gauge connections shall be with union nut & tail piece threaded 1/2" NPT (F).

2.2.2.7 The drain connection shall 1/2"NPTF.

2.3 Instrument Air Isolation Valves

2.3.1 The valves shall be full bore ball valves.

2.3.2 Body material shall be Nickel or Cadmium plated carbon steel.

2.3.3 Trim material shall be 316SS.

2.3.4 The end connection shall be 1/2" NPTF to ANSI B2.1 unless otherwise specified

2.3.5 The packing material shall be teflon.

2.3.6 The handle/wrench material shall be cadmium or nickel plated carbon steel.

2.3.7 The valve body rating shall be ANSI 800 lb.

2.3.8 End to end dimensions shall be 70mm (approximately).

3.0 TESTING

3.1 The instrument valves (miniature) shall be hydrostatically tested at 200kg/cm² g at 38oC.

3.2 All manifolds (3 valves, 5 valves and 3 ways, 2 valves) shall be hydrostatically tested at 200 kg/cm² at 38C.

3.3 The instrument air valves shall be hydrostatically tested at 15.0 kg/cm²g at 38oC and at 10.5 kg/cm²g with dry air.

4.0 SHIPPING

4.1 All threads/ends shall be protected with plastic caps to prevent damage/entry of foreign matter.

5.0 REJECTION

Vendor shall make his offer in detail, with respect to every item of the purchaser's specifications. Any offer not conforming to this shall be summarily rejected.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

SPECIFICATIONS FOR JUNCTION BOXES AND CABLE GLANDS

CONTENTS

- 1.0 GENERAL
- 2.0 JUNCTION BOXES
- 3.0 CABLE GLANDS & PLUGS, REDUCERS/ ADAPTORS
- 4.0 NAME PLATE
- 5.0 SHIPPING
- 6.0 REJECTION



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

1.0 General

1.1 Scope

1.1.1 This standard specifications covers the requirements for the design, materials, nameplate marking, testing and shifting of junction boxes & cable glands which include the following types:

- a) Electrical junction boxes.
- b) Pneumatic junction boxes
- c) Cable glands (whenever specified)



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

1.1.2 The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the purchaser's enquiry:

1.1.3 In the event of any conflict between specifications, data sheets, related standards, codes etc., the vendor shall refer the matter to the purchaser for clarifications and only after obtaining the same should proceed with the manufacture of the items in questions.

- ANSI B 2.1 : Pipe threads
- IS-5 : Colors for ready mixed paints and enamels
- IS-2147 : Degrees of protection provided by enclosures for Low voltage switchgear and control gear.
- IS-2148 : Flame proof enclosure of electrical apparatus.

1.2 Bids

1.2.1 Vendor's quotation shall include a detailed specification sheet for each type of junction box and cable gland which shall provide the following information:

- a) All the details regarding the type, construction, materials, housing, entries, etc.
- b) All dimensions in millimeter.
- c) Sketch for each type of JB with dimensional details showing the terminal and entries arrangement.
- d) Mounting details.
- e) Vendor shall furnish certificate from statutory body for explosion proof enclosure, indicating the gas group and temperature class.

1.2.2 All the material specifications for various parts in the vendor's specification sheets shall be to the same standards as those in purchaser's data sheets (e.g. BS IS, etc.)

1.2.3 Vendor shall attach a list of items, tag number wise, summing up all the deviations from the purchaser's data sheets, if there are any. Also vendor shall furnish reasons for these deviations.

1.2.4 Vendor shall enclose catalogues giving detailed technical specifications and other information for each type of JB/cable glands and its accessories covered in the bid.

1.2.5 Vendor's quotation, catalogues, drawings, etc. shall be in English language.

1.3 Drawings, Data and Certification

1.3.1 Detailed drawings, data, catalogues required from the vendor are indicated in vendor data requirements sheets. The required number of reproducible and prints shall be dispatched to the address mentioned, adhering to the time limits indicated.

1.3.2 After placement of purchaser order, vendor shall submit certified drawings and specifications sheets for each type of JB/cable gland which shall include the following:

- a) Detailed dimensional drawings



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

b) Weight of each in grams/Kg.

c) Certificate from statutory body suitable for installation in specified hazardous area.

2.0 Junction Boxes

2.1 Junction boxes shall be either of the following type as specified in data sheets.

I. Weather proof junction boxes.

II. Weather proof & Explosion proof junction boxes.

2.2 The enclosure shall be as per IS-2147 for weather proof junction boxes and for Explosion proof it shall be as per IS-2148 suitable for the area classification specified.

2.3 Number of entries and locations shall be as per data sheets.

2.4 Junction boxes shall be provided with telephone sockets and plugs for connection of hand powered telephone set.

2.5 Electrical Junction boxes

2.5.1 Material shall be die-cast aluminium of minimum 5 mm thick (LM-6 alloy)

2.5.2 Explosion proof junction boxes shall have detachable cover which is fixed to the box by means of cadmium plated triangular head/hexagonal head screws.

2.5.3 Weather proof junction boxes shall have doors which shall be hinged type and these shall be fixed with cadmium plated countersunk screws. 2.5.4 Explosion proof junction boxes shall have a warning engraved/integrally cast on the cover as given below:

"Isolate power supply elsewhere before opening"

2.5.5 Terminals shall be spring loaded, vibration proof, clip-on type, mounted on nickel plated steel rails complete with end cover and clamps for each row.

2.5.6 All terminals shall be suitable for accepting minimum 2.5 sq. mm copper conductor, in general. However for power supply distribution boxes, terminal detail shall be as per job specification/Data sheets.

2.5.7 Sizing shall be done with due consideration for accessibility and maintenance in accordance with the following guidelines.

i) 50 to 60 mm between terminals and sides of box parallel to terminal strip for upto 50 terminals and additional 25mm for each additional 25 terminals.

ii) 100 to 120mm between terminals for up to 50 terminals and additional 25mm for each additional 25 terminals.

iii) Bottom/top of terminal shall not be less than 100 mm from bottom/top of the junction box.

2.5.8 Terminals shall be marked as per the various types indicated in data sheets.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

2.5.9 Shall be provided with external earthing lugs.

2.6 Pneumatic junction boxes

2.6.1 Pneumatic junction boxes shall be made of 3mm thick hot rolled steel. They shall have necessary neoprene gasket between door and body. Door shall be flush with the box and shall be hinged type and provided with wing nuts.

2.6.2 Single tube entries shall be suitable for 6mm O.D. copper tube with bulk head fittings. Multi tube bundle entry shall be suitable for the data furnished in data sheets

2.7 Painting

2.7.1 Surface shall be prepared for painting. It shall be smooth and devoid of rust and scale.

2.7.2 Two coats of lead-free base primer and two final coats of lead free epoxy based paint shall be applied both for interior and exterior surfaces.

3.0 Cable glands & plugs, Reducers/Adaptors

3.1 Cable glands shall be supplied by vendor whenever specified.

3.2 Cable glands shall be double compression type for use with armoured cables.

3.3 The cable glands shall be of Nickel plated brass.

3.4 The cable gland shall be weather proof. Whenever specified they shall be explosion proof and certificate from statutory body shall be furnished.

3.5 Cable glands shall be supplied to suit the cable dimensions indicated along with tolerance indicated in data sheets. Various components like rubber ring, metallic ring, metallic cone and the outer/inner nuts etc. shall be capable of adjusting to the above tolerances of cable dimensions.

3.6 Reducers/Adaptors shall be supplied as per details indicated in data sheets. They shall be nickel plated brass. These shall be weather proof in general. These shall also be explosion proof wherever specified and certificate from statutory body for explosion shall be furnished.

3.7 Plugs shall be provided wherever specified. They shall be of Nickel plated brass.

3.8 Plugs shall be certified explosion proof when used with explosion and junction boxes.

4.0 Name Plate

4.1 Each junction box shall have an anodized aluminum name plate permanently fixed to it at a visible place bearing the tag no. & enclosure. The name plate shall also bear the stamp of certifying agency with certificate number.

5.0 Shipping

5.1 All threaded openings shall be suitably protected to prevent entry of foreign material.

5.2 All threaded components shall be protected with plastic caps to prevent damage of threads.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

6.0 Rejection

Vendor shall furnish his offer in detail, with respect to every item of the purchaser's specifications. Any offer not conforming to this shall be summararily rejected.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

SPECIFICATAION FOR SIGNAL CABLE

CONTENTS

- 1.0 GENERAL
- 2.0 CONSTRUCTION
- 3.0 ELECTRICAL CHARACTERISTICS
- 4.0 TESTING



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

1.0 GENERAL

1.1 Scope:

This specification together with the job Specifications attached herewith forms the requirements for design, materials manufacturing, testing and shipping of PVC insulated signal cables.

1.2 Standards:

The cables shall conform to the latest editions of the various standards mentioned in the specification.

In case of any conflict between any standard and this - specifications the matter shall be referred to the purchaser before proceeding with the manufacture of the cables.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

1.3 Bids:

1.3.1 Vendor's quotation shall include the following as a minimum.

Completed job spec. Pair identification method, type test certificates, technical literatures, various testing methods and cross sectional dimensional drawings. All information/data shall be in English language.

1.3.2 Vendor's quotation shall include a list of deviations if any from purchaser's specifications and shall also indicate the reasons for such deviations for consideration to arrive at mutually agreed deviations. However vendor shall note that no deviation shall be accepted in respect of the permissible limits of resistance capacitance and L/R ratio of cables.

1.3.3 Vendor shall quote unit price per metre for each type of cable.

1.4 Instructions to Bidder:

1.4.1 The quantity indicated against each type of cable in the job specification may vary by $\pm 25\%$ at the time of placement of order. Vendor shall confirm that there shall be no price implication on this account in unit prices typewise.

1.4.2 Drum length for each type of cable shall be 500 to 1000 metres. Vendor shall indicate the maximum drum length possible for each type of cable in his bid. Exact requirements of drum length will be specified after purchase order during detailed engineering and vendor shall confirm that the same shall not affect the price or delivery schedule. The actual produced drum length shall not vary by more than $\pm 5\%$ from the value indicated in the purchase order.

1.4.3 Tolerance over the total ordered length shall be as follows: $\pm 5\%$ for total length less than 5 km $\pm 2\%$ for total length 5 km or more

1.4.4 Cable dimensions furnished by vendor in his bid shall be firm. Vendor shall comply with all the values during execution.

1.5 All cables shall be suitable for laying in open air, corrosive hydrocarbon plant atmosphere, direct sun and in trenches. The cable shall also be designed for prolonged use in tropical atmosphere.

1.6 On demand vendor shall furnish documents such as invoice and test certificates to prove the quality and composition of the materials used for manufacturing the cable to the satisfaction of client/ consultant or authorised representative during various stages of expediting and inspection.

2.0 Construction:

2.1 Type 1

(Single pair/triad shielded cable)

2.1.1 Each core shall be 1.5 sq. mm made of 7 stranded annealed electrolytic copper conductors. Each strand shall be 0.53 mm dia.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

2.1.2 Primary insulation shall be 85oC polyvinyl chloride (PVC) as per IS-5831 Type C. Thickness shall be 0.5 mm minimum.

2.1.3 Each wire shall have twisted cores and No. of twists shall be not less than 10 per meter. Color of cores insulation shall be black blue in a pair and black, blue and brown in a triad.

2.1.4 Individual pair and triad shall be shielded. Shield shall be Aluminium backed by Mylar/polyester tape bonded together with the metallic side down helically applied with either side - 25% overlap and 100% coverage. Minimum shielded thickness shall be 0.05mm. Drain wire shall be 0.5 sq.mm multistrand bare tinned annealed copy conductor. The drain wire shall be in continuous contact with Aluminium side of the shield.

2.1.5 Inner and outer jacket shall be made of extruded flame retardant 90oC PVC to IS 5831-Type ST2 Oxygen index of PVC shall be 30. Temp. Index shall be over 250o C.

Inner jacket color shall be black. Outer jacket color shall be black except for cable to be used in intrinsically safe systems it shall be light blue

2.1.6 Armour over inner jacket shall be of galvanised steel wire/flat as per IS-1554 part-I. 2.1.7 A pair or triad identification shall be with numbers at interval of not more than 250 mm as per vendor's standard.

2.1.8 Tolerance in overall diameter of cable shall be within ± 2 mm over offered value for cables with OD less than 30mm and ± 3 mm for cables with OD more than 30mm.

2.2 Type-II

(Multipair / Multitraid cable with individual pair shield and overall shield)

The cable shall be same as single pair shielded cable except conductor size shall be 0.5 sq.mm made of 16 strands of annealed electrolytic copper conductor. Each strand shall be of 0.2mm dia.

Additional feature shall be as follows:

2.2.1 Overall shield shall be of Aluminum backed up by Mylar/polyester tape helically applied with the metallic side down either side - 25% overlap and 100% coverage. Minimum shield thickness shall be 0.075mm Drain wire shall be similar to individual pair drain wire and shall be in continuous contact with the Aluminum side of the overall shield.

2.2.2 Overall twist of all pair/triads shall be as per vendor's standard.

2.2.3 A pair of communication wire shall be provided for multipair/multitriad cables. Each wire shall be 0.5 sq. mm of plain annealed single or multistrand copper conductor with 0.4 mm thick 85oC PVC insulation. Insulation shall be green and red colour coded.

2.3 Type-III

(Multipair/Multitriad cable with only overall shield)



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

These cables shall be same as type-II cables except that the individual pair/triad shall not have shielding.

2.4 Type-IV

(Multipair/ multitriad cable with individual pair shield and overall shield)

The cable shall be same as Type II except conductor size shall be 1.5 sq.mm made of 7 stranded annealed electrolytic copper conductor. Each strand shall be 0.53 mm dia.

2.5 Type-V

(Multipair/ Multitriad cable with overall shield only) The cable shall be same as type IV except that the individual pair/triad shall not have the shielding.

3.0 Electrical Characteristics

3.1 Maximum d.c. resistance of the conductor of the completed cable shall not exceed 12.3 ohms/km at 20°C for cables with 1.5 sq.mm conductor and 39.7 ohms/km at 20°C for cables with 0.5 sq.mm conductor.

3.2 Capacitance

3.2.1 Mutual Capacitance

The mutual capacitance of the pairs or adjacent cores shall not exceed a maximum of 250 pF/Meter at a frequency of 1 KHz.

3.2.2 Capacitance between any core or screen.

The capacitance between any core or screen shall not exceed a maximum of PF/Meter at a frequency of 1KHz.

3.3 L/R ratio of adjacent core shall not exceed 40 micro henry/ohm for cables with 0.5 sq. mm conductor.

3.4 The drain wire resistance including shield shall not exceed 30 ohms/km.

3.5 Electrostatic noise rejection ratio shall be over 76 dB.

4.0 Testing

4.1 Type test: Cable shall be flame retardant to IEC 332 Part III Cat. A. For qualification certificates from third party or client /consultants authorised representative for this test shall be furnished by vendor for cables similar to those being offered.

4.2 Routine tests: (To be carried out by vendor during various stages of manufacture. Purchaser shall review the related documentation).

4.2.1 Insulation and jackets: All tests as per IS-5831 except insulation resistance, voltage and spark test shall be as per BS-5308. Part-II(1986)

4.2.2 Armour test as per IS-3975.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

4.2.3 Conductor resistance.

4.2.4 Cable capacitance and L/R ratio.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

SPECIFICATION FOR INSTRUMENTATIONS

CONTENTS

- 1.0 GENERAL
- 2.0 DEFINITIONS
- 3.0 SCOPE OF WORK
- 4.0 DESCRIPTION OF WORK
- 5.0 DRAWINGS AND DOCUMENTS TO BE PROVIDED BY OWNER
- 6.0 DRAWINGS AND DOCUMENTS TO BE PROVIDED BY CONTRACTOR
- 7.0 SCRAP AND EXCESS MATERIAL
- 8.0 SPECIAL INSTRUCTIONS TO CONTRACTOR



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

1.0 GENERAL

1.1 INTRODUCTION

1.1.1 This part of the technical specifications covers in general, definitions, standards, scope of works, specifications of work, documentation, scope of supply of materials and scrap and excess materials and different requirements to be adhered to during the course of execution of instrumentation works.

1.1.2 Instrumentation works shall be performed in accordance with this technical specification and various other drawings and schedules supplied during the execution and time to time instructions from Engineer-in-Charge or his authorised representative(s) during the progress of the work.

2.0 DEFINITIONS

2.1 MANIFOLDS



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

2.1.1 For close coupled instruments "Manifold" shall mean complete piping of instruments from first block valve upto the instruments, if the distance of the Instrument is within 2 feet (0.6m), from the Instrument tapping. If the distance of instrument is more than 2 feet (0.6m) from primary tapping such as orifice, then the installation is to be considered under remote installation.

2.1.2 For remote mounted instrument, "Manifold" shall mean the assembly of nipples, valves and fittings around the instrument to form a block and bleed or by pass manifold or drain manifold as the case may be. These shall be generally according to the hook up drawings enclosed with tender. Wherever the instruments are with 3--way-valve manifold, this definition shall not be applicable as 3-way manifold forms part of instrument.

2.2 FIRST BLOCK VALVE

First block valve shall mean the valve/valves that are mounted directly on equipment, columns, pipe, standpipe etc. and shall be operated to isolate the instrument and connected instrument piping from the above items.

2.3 SUPPORTS

Supports shall mean the MS angles, flats, channels that are generally provided to support the main cable ways, cable ducts, junction boxes, angle trays, perforated trays, instrument piping, signal tubing, instrument air supply lines etc., at specified intervals from the structures, concrete columns etc. to keep all items firmly secured against vibration, warping, bending etc.

2.4 SCRAP

2.4.1 Salvageable scraps

Salvage scrap shall mean lengths of tubes, pipes, multicables, other cables etc. that can be used one time or other at later date and normally they are recovered from the cut-pieces of tubes, pipes, multicables, cables, etc.

2.4.2 Non Salvageable Scrap

Non salvageable scrap shall mean the lengths of tubes, pipes, multicables, cables, etc. that cannot be used at all one time or other.

2.5 Standards

The instrumentation erection and calibration works shall be carried out generally in accordance with various international and Indian standards in instrumentation listed below but not limited to the following:

2.5.1 API -RP-550 Manual on Practices for instrumentation.

2.5.2 ISA standards and Practices for instrumentation

2.5.3 Instrumentation hook-up standards enclosed.

2.5.4 Instrumentation supports standard enclosed.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

2.5.5 Manufacturer's standards and Practices.

3.0 SCOPE OF WORK

3.1.0 The Scope of work shall consist of supply of instrument items (as per schedule of quantities/rates and SCC), instruments, their erection, testing, calibration and commissioning and making it ready for commercial operation. The scope covers various jobs listed under the schedule of quantities/rates. However to ensure proper execution and completeness of instrument--work any or all of the following shall also form the part of the scope and shall be covered in the quoted rates.

3.1.1 Fabrication of pipe nipples, including threading whenever required.

3.1.2 Fabrication of seal pot/syphon/drain pot as per standards. Filling of seal pots with filling liquids as per instructions from Engineer-in-charge.

3.1.3 Back/seal welding of screwed fittings as required by standards.

3.1.4 Laying of cable underground including excavation, sand filling, brick laying and back filling.

3.1.5 Connection of purging devices for instruments to the systems provide as per drawings.

3.1.6 Civil works including the casting of foundation as per requirements for instruments supports where paved surface do not exist.

3.1.7 Minor civil works like chipping of pavement and grouting on the pavements the instrument panels/supports/stanchions, and chipping and refilling of the pavement for conduits.

3.1.8 Sealing of cables/ tube entries into the control room after laying and testing of all tubes, cables etc.

3.1.9 Degreasing of handwheels of control valves, stud bolts, nuts of side and bottom flange of control valves, orifice plates, other primary elements flanges, oxygen service impulse lines, instruments as per manufacturers instructions and other items as required by Engineer-in-charge.

3.1.10 Rotation of control valve bonnet wherever required.

3.1.11 Reversing the action of control valves either the replacement of springs, accessories or in positioner wherever required.

3.1.12 Minor modification/repairs required to be done on the instruments namely, changing the dial, glasses for pressure gauges, temperature gauges and other instruments, replacement of rotameter tubes, level gauge glasses, replacement of damaged signal tubes, threads, couplings etc.

3.1.13 Painting of all structural supports for trays, pipes, junction boxes, instruments, etc, as per painting specification.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

3.1.14 Identification with approved colour of paint the instruments/impulse, lines manifold connected with alarm/trap circuit. Also, punching of tag numbers on items shall be carried out as per instructions of Engineer-in-charge.

3.1.15 Coordination with mechanical and other sub-contractors for proper installation of line/ vessels/ equipment mounted instruments like control valves, orifice assemblies, turbine meters, PD meters, level transmitters, level gauges, level switches etc. which involves removal of instruments, disconnection of tubes/cables, reconnection for alignment proper installation etc.

3.1.16 Drilling holes on all panels, shut down cabinets, power supply cabinets, control panels pneumatic enclosures etc., for cables/ multitubes/ glands/ groomats

3.1.17 Grounding of shield of all shielded cables to respective instruments earth bus provided in the control room/local panel/thermocouple head.

3.1.18 Laying and termination at both ends between instrument earth buses provided in control room/ local panel to instrument earth pit provided by others.

3.1.19 Supply of all types of consumables required for the execution of the job.

3.1.20 Submission of monthly material appropriation statements for cables, piping materials fittings, including the quantity issued and expended in standard Performa.

3.1.21 Completion of owners drawings/documents, as per the execution of work at site.

3.1.22 Preparation and submission of as built drawings as required.

3.1.23 Start-up and commissioning.

3.1.24 Submission of final material appropriation statements for all the materials issued by the owner.

3.1.25 Any other work not mentioned above, but required for the proper execution of the works.

3.1.26 Where requested by owner/Engineer-in-charge or his authorized representatives, all or any of the works detailed above and schedule quantities shall also be performed on package units, local panels/cabinets/gauge board installed by owner or by others.

3.1.27 Sealing of safety valves/switches with standard lead seals after final setting in the presence of Engineer- in-charge.

4.0 DESCRIPTION OF WORK

4.1.0 INSTRUMENT PIPING

4.1.1 All primary piping shall be installed in the best workman like manner and shall follow installation standards in each case. Where there is no installation standard, the instruction of the Engineer-in-charge shall be followed.

4.1.2.1 Horizontal and vertical lines shall be installed using levels and plumo bobs.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

4.1.3 Unless otherwise specified in the drawings pipelines shall have a slope of 8% on the horizontal runs.

4.1.4 All welding shall be carried out as per welding procedures and codes with electrodes approved by Engineer-in-charge. Only qualified welders approved by Engineer-in-charge shall carry out welding. Charges for non-destructive testing like radiography, Dye penetration tests, post heat treatment tests and stress relieving shall be carried out on the basis of actual man hours spent towards these works and man-hour charges with cost of all materials, test equipments, etc. shall be used. However, any materials like electrode, equipments, testing charges for various tests, etc., required for the initial qualification of the welder/welders shall be or the scope of the contractor.

4.1.3.1 Pipe shall be bent using pipe benders only and any bending will be totally rejected. Pipes shall be cut using pipe cutting device. Hot cutting will not be allowed.

4.1.6 Piping for steam tracing shall be installed according to the standards and avoiding condensate pockets.

4.1.7 All threaded joints shall be jointed with Teflon tape and no other pipe jointing compound shall be used except on high temperature service where graphited sealing compounds shall be used.

4.1.8 All primary piping shall be properly supported at regular intervals of 1.0 meters. Angle supports shall be fabricated from 40mmx40mmx5mm MS angles as minimum.

4.2.0 PVC COVERED/BARE TUBE (COPPER/SS/ALUMINIUM)

4.2.1 Single copper/SS/Aluminium tubes shall be laid as per standards on trays. Fabricated out of 2.5 mm thick perforated steel plate. The width of the trays shall be selected as per the number of tubes laid. Tubes shall be clamped to the trays at every 300 mm using clamps made of galvanized steel/Aluminium strips. The practice of flattening tubes for clamping purposes shall be avoided. In case of PVC covered tubes, any exposed portion at ends and connection shall be neatly taped to appropriate thickness.

4.2.2 Trays shall be properly supported either from any rigid steel structure or concrete member as detailed under trays and supports below.

4.2.3 All male/female tube connectors shall be installed with Teflon tape only. Identification tag plates/ferrules shall be provided on either side of copper tubing as per tubing/junction box schedules. Ferrules shall be single sleeve type with letters and numbers neatly printed.

4.3.0 INSTALLATION OF MULTITUBES AND MULTICORE CABLES

4.3.1 Multiple cables/ multitubes shall always be installed on ducts/trays and properly clamped. At every vertical drop to junction boxes, they shall be clamped at more frequency intervals (Maximum of 300mm). They shall be connected inside junction boxes strictly according to the number system as mentioned in cable schedule. At bends minimum radius



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

shall be maintained as per manufacturer's standard. The angle tray supports shall be fabricated from 40mmx40mmx5mm angles minimum size.

4.3.2 Identification tags shall be provided on either end of multitubes, multicore cables as per cable/tubing/cable schedules. Engraved tag plates or PVC ferrules shall be used for identification of tubes/cables. 4.3.3 All Multitubes and Multicables shall be cut after the exact site measurements are taken between ends and the cable/tube drums shall be selected before cutting the lengths so as to avoid any wastage.

4.3.4 In the field, the cables shall be laid in perforated trays as per layout drawings. Cables shall also be buried or laid in concrete trenches. Inside control room, these shall be laid in concrete trenches or under false floorings.

4.3.5 In the field, the cables shall be laid in perforated trays as per layout drawings. Cables shall also be buried or laid in concrete trenches. Inside control room, these shall be laid in concrete trenches or under false floorings.

4.4.0 INSTALLATION OF INSTRUMENTS

4.4.1 All instruments shall be generally installed on supports as per installation standards in each case, and shall be accessible.

4.4.2 Receiver gauges shall be mounted on instrument support itself as per tubing hook up standards.

4.4.3 Filter regulators shall be mounted on the instruments support itself below the instruments or on the control yoke.

4.5.0 INSTRUMENT AIR SUPPLY

4.5.1 The main instrument air header in each area is laid by other contractor. Air supply from the main air header take off valve to individual instrument shall be through either galvanized steel pipe or 1/4" OD PVC covered copper tube or SS tubes.

4.5.2 Individual takes off valves shall always be located on top of the main air header. Unions shall be provided at convenient locations. There shall be one isolation valve at each instrument end. The galvanised pipe shall be supported at a minimum interval of 1000 mm with 40mmx40mmx5mm MS angles. Final connection to be instrument shall be copper/SS tubing as per tubing hook up standards.

4.5.3 Teflon tapes shall be used on all threaded joints.

4.6.0 INSTRUMENT STEAM TRACING

4.6.1 The mainstream header in each area is laid by the other contractor. From the main steam header take off valve, steam to individual instrument shall be taken through carbon steel pipes supported at regular intervals. Steam tracing around individual instruments shall be to copper tubes. After steam tracing, the line is connected to the drain funnel through individual steam trap/condensate return header/tapper point as the case may be.

4.6.2 Electrical tracing shall be done by others.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

4.7.0 PERFORATED TRAYS AND SUPPORTS

4.7.1 The perforated trays / angle trays shall be properly supported at a regular interval of max. 1000mm from insert plates or steel structures. Wherever insert plates are not available supports on concrete structures on ceiling shall be fixed with a minimum 10mm diameter expansion bolts. Angle supports for perforated trays/angle trays shall be fabricated from 40mmx40mmx5mm M.S. angles minimum size.

4.7.2 All supports shall be cut with hacksaw and any work executed by gas cutting for cutting and drilling holes will be totally rejected. Free ends of angle support shall not have sharp edges and shall be properly rounded off.

4.7.3 Perforated trays/angle trays shall be used for branching cables and tubes from main trays. Perforated trays shall be used for branching cables and tubes from main trays. Perforated trays shall be fabricated out of 2.5 mm perforated steel sheet. Width of trays shall be selected according to number of tubes and cables. Trays shall be laid generally as per site conditions with the approval of Engineer-in-charge.

4.8.0 LAYING OF CABLES

4.8.1 All cables shall be laid in accordance with installation drawings and cable schedules. Before laying, cable/multicable on drums shall be meggered and tested to ascertain the transit damages.

4.8.2 All cables routes shall be carefully measured and cables cut to the required lengths, leaving sufficient amount for the final connection of the cable to the terminals on either end. The various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables. Sufficient extra length of cable shall be kept at the terminal on points.

4.8.3 Cables shall have complete uncut lengths from one terminal to the other.

4.8.4 All cables shall be identified close to their termination point by cables number as per cable schedules/junction boxes schedules. PVC ferrule/tag plate shall be used and these identification tags shall be securely fastened to the cables.

4.8.5 All cores of electrical cables shall be identified by their wire numbers by means of the PVC ferrules. Wire numbers shall be as per schedules. All temporary ends of cables shall be protected against dirt and moisture. For this purpose, ends of all PVC insulation cables shall be taped with an approved PVC or rubber insulating tape. Use of function type or other fabric type is not permitted.

4.8.6 The cable shall be bent in a large radius. Cables installed above ground shall be run exposed on walls, ceilings, structures and shall run parallel or at right angles with beams, walls or columns.

4.8.7 Cables shall be rigidly supported on structural steel and masonry individually or in groups as required using galvanised clips, multiple cable supports or cable trays. If drilling of steel must be resorted to, approval must be obtained and steel must be drilled where the minimum of weakening of the structure will result. Cable shall be supported at every 500 mm.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

4.8.8 All special cables and power supply cables will be laid directly to the field instrument without any junction boxes, unless otherwise specified.

4.8.9 While laying cable in trenches or burying them care shall be taken to ensure that low signal cables like alarm, analyser cables, special cables, special cables from turbine meters, compensating cable etc. are separated from other power supply cables.

4.8.10 Each underground cable (either in concrete trenches or buried) shall be provided with identifying tag of lead securely fastened every 30m of its underground length with at least one tag at each end before the cable leaves/enters the ground.

4.8.11 Directly buried cables shall be laid underground in excavated cable trench wherever specified in layout drawings. Trenches shall have sufficient depth and width to accommodate all cables correctly spaced. Before cables are placed the trench bottom shall be filled with 100 mm layer of sand and leveled. Each layer of cables shall be covered with 150 mm of sand on top and sand shall be lightly pressed. A protective covering of 75 mm thick second-class red bricks shall be placed flat on the final layer of sand and cable. The remaining portion of the trench shall be then back filled with soil compacted and leveled. On complete of every group of cable laying and before sand filling, every cable shall be given insulation test in the presence of Engineer-in-charge. Any cable proved to be defective should be replaced before the next groups of cables are laid. Cable route markers indicating number of cables, depth and direction will be placed enroute, on crossovers/turnings, etc. to mark the cable route.

4.8.12 At each road crossings and other places, where cables enter pipe sleeves, adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends after pack filling.

4.8.13 At the entry into concrete blocks at road crossings cable loops shall be provided at either end to prevent any damage to cables. Each cable shall have one tag at each end before the cable enters/leaves conduct pipes

4.8.14 After laying of all the cables and multitubings, cables, the cable entry to control room shall be suitably filled and sealed so as to achieve a positive seal against the entry of gas/water.

4.8.15 All cables and tubes shall be laid in accordance with the layout drawings with sand and precast concrete slabs shall be placed on the trench.

4.8.16 On completion of cable laying in concrete trenches, the trenches shall be filled with sand and precast.

4.9.0 EARTHING

4.9.1 Earthing of junction boxes, local cabinets as per the documents and instruction from Engineer-in-charge.

4.10.0 PAINTING

4.10.1 This part of the specification is applicable to cable ducts, MS cable ways, angle trays, instrument supports, perforated trays, all structural supports for the above items, etc.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

4.10.2 The surface to be painted shall be thoroughly cleaned with wire brush, sand paper to remove all scales. After cleaning, the surface is painted with one coat of red oxide zinc chromate primer conforming to IS- 207 and allowed to dry completely.

4.10.3 Primer coated surface is painted with one coat of paint to the colour nearest to the final paint and allowed to dry. The colour number shall be specified from IS-5.

4.10.4 Final second coating shall be with the paint of desired colours and shall be selected from IS-5.

4.10.5 It shall be noted that final second coating of external surfaces not covered by cables, copper tubes etc. shall be applied just before handling over the plant or commissioning of the plant whichever is earlier.

4.10.6 The name of manufacturer, color and quality of all types of primer paint shall be subject to approval of Engineer-in-charge.

4.11.0 TESTING

4.11.1 Electrical cables for signal power supply alarms, and compensating cables for thermocouples; resistance thermometer cables shall be checked for megger values and continuity before proper termination and ferruling.

4.11.2 Testing shall be carried out after the installation of instrument with primary piping complete in all respects and approved by Engineer-in-charge.

4.11.3 Primary piping shall be tested hydraulically pneumatically to 1.5 times the operating pressure after isolating the instruments. Flushing of piping shall be carried out as per instructions of Engineer-in-charge. Lines shall be blown after hydro-testing. All external displacement /float type level instrument level gauges shall also be tested as per instructions of Engineer- in-charge.

4.11.4 Tubes and air line shall be tested with compressed air to 7 kg/cm² upto the filter regulator. The down stream side of the filter regulator shall be tested for 1.5kg/cm². The lines shall be blown with the instrument air upto the regulator for 15 minutes to remove any traces of oil, dust & moisture. All lines shall be checked with soap solution and bubbler unit for possible leak at joints. After pressurizing, source shall be cut off and rate of fall in pressure shall be less than 1 p.s.i. for each 100 ft. of copper tubing for a test period of 2 minutes as per I.S.A.R.P.7-1 "Pneumatic control circuit pressure test".

4.11.5 All test results shall be recorded in the approved format.

4.12.0 CALIBRATION

4.12.1 All instruments shall be calibrated strictly as per manufacturer's instructions prior to installation. The scope of calibration includes all field and control rooms of all types namely, pneumatic, electronic, electrical etc.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

4.12.2 Contractor shall use his own oil free instruments, air compressor for calibration purposes.

4.12.3 The level switches (external cage type) shall be set by filling the cage with water to the desired alarm/trip level, while setting the switches, it shall be ensured that the micro switches do not reset for full rated travel of the float.

4.12.4 Control valves and positioners shall be checked for hysteresis and linearity and calibration for rated strokes. Prior to calibration, valves shall be cleaned externally. The stem is then lubricated if required, and stroked few times to extreme positions of plug to ensure that movement is free from friction. The valve shall then be calibrated for rated stroke and linearity also. Subsequently the valves shall be checked for hysteresis to the accuracy of 1% FS with positioners and 5% FS without positioners.

Stroke speed has to be evaluated for all trip/shutdown valves.

4.12.5 All calibrations reading shall be recorded in the enclosed format and submitted to Engineer-in-Charge for approval. Where significant deviations from specifications are obtained, the matter shall be brought to the immediate notice of the Engineer-in- Charge for corrective actions.

4.12.6 Finished hereunder is a list of recommended calibration and test equipments required as a minimum for calibration work. The contractor shall clearly state in his offers the complete list of calibration and test equipments along with the range, accuracy and quantity, which he proposes to use for this job. Contractor should also ensure that any equipment not listed below but required at the time of calibration shall be made available at his own cost.

4.12.7 All test equipments/kits shall be approved by NPL authorities.

4.12.7.1 Controller test stands Mft. Standard

4.12.7.2 Indicator/recorder test stands -do-

4.12.7.3 Squeeze bulb (Flow calibrator) -

Range: 0-770, 10,000 mm wg.

4.12.7.4 Dead weight testers
(Budenberg or equivalent) - +/- 0.1%
For ranges upto 350 kg/cm²

4.12.7.5 Gauge comparator for
pressure gauges Rating : upto 350 kg/cm² -

4.12.7.6 Oil bath for temperature calibrations Mfr's Std .
max. Temp ^{3500C}



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

4.12.8.7 Standard Mercury in glass thermometers Range -50 to + 50 ⁰ C. 0 to 1000 ⁰ C (NPL certified) 0-250 ⁰ C, 0-350 ⁰ c	± 0.25%
4.12.7.8 Standard gauges for Ranges upto 350kg/cm ²	±0.25%
4.12.7.9 U-tube differential manometers/inclined tube manometer Static pr. rating 7 kg/cm ²	±1mm
4.12.7.10 Single leg manometers Scale :-1500 mm water and 1500 mm hg. Static pr. Rating : 7 kg/cm ² .	± 1mm
4.12.7.11 Decade resistance box	MFR' std.
4. 12.7.12 Millimeters	±0.05Mv
4.12.7.13 Potentiometer (Cable of generating and measuring mV)	-
4.12.7.14 Meggers 500V/1000V	-
4.12.7.15 Air hydro pump/hydraulic pump	-
4.12.7.16 Vaccum Pump	-
4.12.7.17 Instrument air compressor with filters and Regulators and deoilers.	-
4.12.7.18 Current generator (instrument checker) 4-20mA dc(YEW make or equivalent)	-

4.13.0 LOOP TEST

4.13.1 Loop test shall be performed after calibration of all instruments and leak test of signal lines. Loop tests are conducted to check the functional performance of all elements comprising the loop, thereby ensuring proper connections and operations.

4.13.2 Before proceeding for loop tests the calibration results of individual elements shall be recorded on the enclosed proforma and shall get it approved by Engineer-in-Charge for correctness of installation, measurements and calibration results.

4.13.3 Loop testing for all control loops shall be generally by simulation of process

conditions and shall fix points namely 0%, 25%, 50%, 75% and 100% of fullscale inputs. Detailed procedure shall be submitted to Engineer-in-charge for approval before proceeding with the loop testing.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

In case of shutdown system field/receiver pressure switches are simulated for abnormality by disconnecting the wires at terminal and function of all associated systems are checked.

4.13.5 Performance of individual loops may be accepted for an overall accuracy of $\pm 1.5\%$ where deviations exist, contractor shall recalibrate the instruments, which form part of loop testing wherever required, at no extra cost.

4.13.5.1 After the loop test is complete, the contractor shall connect back any terminations and connections removed for loop test.

4.13.7 A loop shall be considered as handed over only after measurements in that particular loop are complete and certified by Engineer-in-Charge, in addition to loop sheets being duly filled in all respects and approved and accepted by Engineer-in-Charge and client.

4.13.8 In case of loops in which certain instruments of the loops are calibrated by other agency, loop testing shall be performed in coordination with the agency involved. Any defect in the calibration of the instrument in contractor's scope is observed, it shall be rectified to the satisfaction of the Engineer-in-Charge. However, defect in calibration of the instruments in the scope of other agency, same shall be rectified by the agency involved. After the calibration has been rechecked by the other agency/agencies the loop checking would be performed to the satisfaction of Engineer-in-Charge, and this part covers under the scope of the contract.

4.13.9 Final certified loop sheets shall be submitted in 4 copies and one transparency.

5.0.0 DRAWINGS AND DOCUMENTS TO BE SUPPLIED FOR EXECUTION BY OWNER/ENGINEER IN CHARGE

5.1.1 Piping and Instrumentation diagrams.

5.1.2 General layout plan for all units, showing all information like position of field instruments junction boxes indicative routes of cables, main ducts/cable trays. 5.1.3 Cable schedules for alarm, signal, shutdown, power supply and pneumatic cables, earthing guide lines.

5.1.4 Termination details/drawings for connecting at control room end

5.1.5 Individual Instrument specifications

5.1.6 Bill of materials

5.1.7 Installation standards/ Hook-up

5.1.8 Manufacturers hand book with instructions for installation and calibration wherever necessary for reference.

6.0 DRAWINGS AND DOCUMENTS TO BE PROVIDED BY CONTRACTOR

6.1.1 The drawings for materials that are included on their supply and erection scope namely local control panel, junction boxes and local cabinets.

6.1.2 The detailed engineering drawing wherever such drawing is assigned.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

6.1.3 Two sets of layout drawings, standards bill of materials cable schedules etc., duly incorporating the changes/modification carried out during the course of execution of works.

6.1.4 Final material appropriation statement for all free issue materials indicating shortages of any in the proforma duly approved by Engineer-in-Charge.

7.1.0 SCRAP AND EXCESS MATERIAL

7.1.1 Every month, the contractor shall submit an account for all the materials issued by the Owner in the standard proforma prescribed for this purpose by the Engineer- in-Charge.

7.1.2 On completion of the work, the contractor shall submit 'Material appropriation' statements for all materials issued by the Owner in the Performa prescribed by the Engineer-in-Charge.

7.1.3 The following scrap allowances are permissible.

Length below 0.5 mm	Non-salvageable	Unaccountable
Steel pipes, SS 2% 0.5% Tubes single pair/ Two core / Three Core cables.	2%	0.5%
Multi-tube, Multi-cables	2%	0.5%

8.0 SPECIAL INSTRUCTIONS TO CONTRACTOR:

8.1.4 All excess materials and scrap shall be returned after duly accounting for, to the storage points designated by the Owner. Where materials are to be weighed before return, the contractor shall be responsible for making the necessary section obtained during the course of construction for fabricating temporary supports or other items, without prior permission of the Engineer - in -Charge.

8.1.5 If the contractor fails to return the surplus material as aforesaid, the owner will charge the contractor for such unreturned materials at panel rates, which will deducted from whatever amount is due to the contractor. In case any material issued by the Owner deteriorates during storage by the contractor, new materials will be issued to him at penal rates, but the delay in procuring such materials will be at the contractor's account only.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

STANDARD SPECIFICATION FOR CABLING



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

CONTENTS

- 1.0 SCOPE
- 2.0 STANDARD
- 3.0 CABLE SPECIFICATIONS
- 4.0 MISCELLANEOUS MATERIALS SPECIFICATIONS
- 5.0 CABLE LAYING
- 6.0 TERMINATION
- 7.0 TESTING



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

1.0 SCOPE

This is to define the requirements for supply, wherever applicable, the installation, testing and commissioning of the cabling system.

2.0 STANDARDS

The work shall be carried out in the best workman like manner in conformity with this specification, the relevant specifications, codes of practice of Indian Standards Institution, approved drawings and instructions of Engineer-in-Charge or his authorized representative issued from time to time. In case of any conflict between the standards, the instruction of Engineer-in-Charge shall be binding.

3.0 CABLE SPECIFICATIONS

3.1 Power Cables

Power cables for use on 415 V systems shall be of 1100 Volts grade, aluminium stranded conductor, PVC insulated, PVC sheathed, armoured and overall PVC sheathed. Power cables for 3.3 KV 6.6 KV and 11 KV system shall be aluminium conductor, XLPL insulated, screened, PVC bedded galvanized steel flat armoured and PVC sheathed cable. All L.T. Cables conform to standard specification and relevant sections of IS: 1554 Part-I and H.T. Cables shall conform to IS: 7098 (Part II). Unarmoured cables will be used wherever specified on the cable schedule.

3.2 Control Cables:

Control cables shall be 1100 Volt Grade, 2.5 mm² copper conductor PVC insulated PVC sheathed, single wire armoured with an overall PVC sheath, as per IS: 1554 Pt. Unarmoured cables shall be used wherever specified on the cable schedule.

3.3 Communication cables:



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

Communication cables shall comprise 1 pair unarmoured, 2-pair, 5-pair and multipair armoured cables of sizes as specified in the cable schedule. Minimum conductor size shall be 0.5 mm telephone system and 0.71 for plant communication system.

4.0 MISCELLANEOUS MATERIALS SPECIFICATIONS

4.1 Connectors:

Cable terminations shall be made with aluminium / tinned copper crimped type solder less lugs of M/s. Dowell's make or approved equivalent for all aluminium conductors and stud type terminals.

4.2 Cable Identification

Cable tags shall be of 2 mm thick, 20 mm wide aluminium strap of suitable length to contain cable number, equipment no., etc.

4.3 Ferrules

Ferrules shall be of approved type size to suit core size mentioned and shall be employed to designate the various cores of control cable by the terminal numbers to which the cores are connected for ease in identification and maintenance.

4.4 Cable Glands:

Cable glands to be supplied shall be nickel-plated Brass double compression type of approved/reputed make. Glands for classified hazardous areas shall be certified by CMRS.

4.5 Multi Cable transit

Multi Cable Transit shall be used for cable entry to all type of control room walls, Decks, Firewall etc. The MCT Block system should have only few components for facilitating simple, easy and quick assembly. The Multidiameter based cable transits shall be repeatedly re-openable and reusable without the need of special tools and discarding the modules in normal operation.

Frame shall be G type galvanized or stainless steel. Block should be multi diameter blocks with center core in all the blocks / add blocks with plug / galvanized or stainless steel stay-plates / single piece compression wedge with galvanized or stainless steel bolts. Solid blocks and insert blocks should not be used. MCT should have 100% spare for each cable size / O.D. Spare blocks should be available on the frame as usable Multidiameter blocks / add blocks with center plug, so that these spare blocks in future can be used for wide range of cables also, solid blocks should not be used at all on frame. Apart from spare if there is any additional uncovered space left on frame then this uncovered space should also be filled only with usable Multidiameter blocks with center plug only.

The Multi Cable & Pipe Transit penetrations should have been tested for Gas Tightness / water tightness & fire tests.

4.6 Cable Trays:



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

This shall be either prefabricated hot dip galvanized sheet steel trays or site fabricated angle iron trays as specified elsewhere. Prefabricated hot dip galvanized sheet steel cable trays shall be used for maximum support span of 2000 mm unless design is approved for larger span. For requirements of larger than 750 mm width two trays shall be run side by side. Cable trays shall be suitable for a cable weight of 50 kg/meter running length of tray. Minimum thickness of sheet steel/galvanizing shall be 2mm/86 microns respectively.

Cable trays fabricated from standard rolled sections shall use 50x50x6 /ISMC 100 Sections for runners for supporting spans limited to 2000 mm/more than 2000 mm respectively. Cross support shall be 32 x 6 mm flat/ 25x25x6 angle for width upto 500 mm/ more than 500 mm respectively. Vertical supports for both the above type of trays shall be fabricated out of ISMC 100 and horizontal supports with 75 x 50 x 6 angle iron/ ISMC 75 as approved by Engineer-in-Charge. If unit rate is not included in schedule of rates, then cable trays if required, shall be fabricated and installed at site as per tone rate for electrical structural supports etc.

5.0 CABLE LAYING

5.1 Cable network shall include power, control, lighting and communication cables, which shall be laid in trenches, cable trays or conduits as detailed in the relevant drawings and cable schedules. Erection of cable trays as required shall be checked after erection and marked in as built drawings. Cable routing given on the layout drawings shall be checked in the field to avoid interference with structures, heat sources, drains, piping, air-conditioning duct etc. and minor adjustments shall be done to suit the field conditions wherever deemed necessary without any extra cost.

5.2 High voltage, medium voltage and other control cables shall be separated from each other by adequate spacing or running through independent pipes, trenches or cables trays, as applicable.

All communication cables (telephones, P.A.S.) RTD Cables shall run on instrument trays/ducts/trenches. Wherever these are not available, cables shall be taken in a separate trench with a minimum clearance of 300 mm away from electrical trench as per the direction of Engineer-in-Charge and Communication cables shall cross power cables at right angles.

All cable routes shall be carefully measured and cables cut to the required lengths, leaving sufficient lengths for the final connection of the cable to the terminal of the equipment. The various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables. The quantity indicated in the cable schedule is only approximate. The contractor shall ascertain the exact requirement of cable for a particular feeder by measuring at site and avoiding interference with structure, foundation, pipelines or any other works. Before the start of cable laying, cable drum schedule; shall be prepared by electrician contractor and get that approved by Engineer-in-Charge to minimize/avoid straight through joints required. Contractor shall work out the actual number of straight through joints required.

5.4 Cables as far as possible shall be laid in complete, uncut lengths from one termination to the other.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

5.5 Cables shall be neatly arranged in the trenches/trays in such a manner so that criss-crossing is avoided and final take off to the motor/switchgear is facilitated. Arrangement of cables within the trenches/trays shall be the responsibility of the Contractor. Cable routing between lined cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 45° to the trench wall. In case of larger dia cables, i.e., 50 mm and above, adequately sized pipe with larger bend radius shall be provided for ease of drawing of cable or for replacement. In places where it is not possible, a smaller trench may be provided if approved by Engineer-in-Charge.

5.6 All cables will be identified close to their termination point by cable numbers as per cable schedule. Cable numbers will be punched on aluminium straps (2 mm thick) securely fastened to the cable and wrapped around it. Alternatively cable tags shall be circular in construction to which cable numbers can be conveniently punched.

Each underground cable shall be provided with identity tags of lead securely fastened every 30 m of its underground length with at least one tag at each end before the cable enters the ground. In unpaved areas, cable trenches shall be identified by means of markers as per standard drawing. These posts shall be placed at location of changes in the direction of cables and at intervals of not more than 30 M and at cable joint locations.

5.7 All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all PVC insulated cables shall be taped with an approved PVC or rubber insulating tape. Use of friction type or other fabric type tape is not permitted. Lead sheathed cables shall be plumbed with lead alloy.

5.8 RCC cable trenches shall be with removable covers. Cables shall be laid in 3 or 4 tiers in these trenches as indicated on the sectional drawings. Concrete cable trenches shall be filled with sand where specified to avoid accumulation of hazardous gases, RCC covers of trenches in process area shall be effectively sealed to avoid ingress of chemicals etc. The electrical Contractor at no extra cost shall do removal of concrete covers for purpose of cable laying and reinstating them in their proper positions after the cables are laid.

Cables shall be handled carefully during installation to prevent mechanical injury to the cables. Ends of cables leaving trenches shall be coiled and provided with a protective pipe or cover, until such times the final termination to the equipment is connected.

5.9 Directly buried cables shall be laid underground in excavated cable trenches where specified in layout drawings. Trenches shall be of sufficient depth and width for accommodation of all cables correctly spaced and arranged with a view of heat dissipation and economy of design.

Minimum depth of buried cable trench shall be 750 mm for low voltage and 900 mm for H.V. Cables, the depth and the width of the trench shall vary depending upon the number of layers of cables.

Cables shall be laid in trenches at depth as shown in the drawing. Before cables are placed, the trenches bottom shall be filled with a layer of sand. This sand shall be levelled and cables laid over it. These cables shall be covered with 150 mm of sand on top of the largest diameter



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

cable and sand shall be lightly pressed. A protective covering of 75 mm thick second class red bricks shall then be laid flat. The remainder of the trench shall then be back-filled with soil, rammed and levelled.

5.10 As each row of cables is laid in place and before covering with sand every cable shall be given an insulation test in the presence of Engineer-in-Charge / Owner. Any cable, which proves defective, shall be replaced before the next group of cables is laid.

All wall openings / pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building/-lined trench. purpose. Where cable enters conduit the cable should be bent in large radius. Radius shall not be less than the recommended bending radius of the cables specified by the manufacturer.

Following grade of the pipe fill shall be used for sizing the pipe size:

- a) 1 cable in pipe - 53% full
- b) 2 cables in pipe - 31% full
- c) 3 or more cables - 43% full
- d) Multiple cables - 40% full

After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound/ 'PUTTI' for sealing purpose. Alternatively G.I. Lidsor PVC bushes shall be employed for sealing purposes. The cost for the same shall be deemed to have been included in the installation of G.I. Pipe and no separate payment shall be allowed.

5.11 Where cables pass through foundation walls or other underground structures, the necessary ducts or openings will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures, the electrical contractor shall determine their location and obtain approval of the Engineer-in-Charge before cutting is done.

5.12 At road crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends.

5.13 Drum number of each cable from which it is taken shall be recorded against the cable number in the cable schedule.

5.14 Cables installed above grade shall be run in trays, exposed on walls, ceilings or structures and shall be run parallel or at right angles to beams, walls or columns.

Cables shall be so routed that they will not be subjected to heat from adjacent hot piping or vessels.

5.15 Individual cables or small groups which run along structures/walls etc. will be clamped by means of 10 SWG GI saddles on 25x6 mm saddle bars. The cost of saddle and saddle bars shall be deemed to have been included in the installation of cables and no separate payment shall be made on this account. Alternatively small group of cables can be taken through 100



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

mm slotted channel/ISMC 100. They shall be rightly supported on structural steel and masonry, individual or in groups as required, if drilling of steel must be resorted to, approval must be secured and steel must be drilled where the minimum weakening of the structure will result.

Where cables rise from trenches to motor, control station, lighting panels etc., they shall be taken in G.I. Pipes for mechanical protection upto a minimum of 300 mm above finished ground level.

Cable ends shall be carefully pulled through the conduits, to prevent damage to the cable. Where required, approved cable lubricant shall be used for this Cables shall be supported so as to prevent unsightly sagging. In general distance between supports shall be approximately 300 mm for cables up to 25 mm diameter and maximum 450 mm for cables larger than 25 mm dia.

5.16 All G.I. Pipes shall be laid as per layout drawings and site requirements. Before fabrication of various profiles of pipe by hydraulically operated bending machine (which is to be arranged by the contractor), all the burrs from the pipes shall be removed. GI Pipes with bends shall be buried in soil/concrete in such way that the bends shall be totally concealed. For G.I. Pipes buried in soil, bitumen coating shall be applied on the buried lengths. Installation of G.I. Pipes shall be undertaken well before paving is completed and necessary co-ordination with paving agency shall be the responsibility of Electrical Contractor. The open ends of pipes shall be suitably plugged with G.I. Plugs after they are laid in final position. The Contractor at no extra cost shall supply G.I. Plugs.

5.17 Cable laid on supporting angle in cable trenches, structures, columns and vertical run of cable trays shall be suitably clamped by means of G.I. Saddles/Clamps, whereas cable in horizontal run of cable trays shall be tied by means of nylon cords.

5.18 Supporting steel shall be painted before laying of cables. The painting shall be done with one coat of red lead paint and two coats of approved bituminous aluminium paint unless otherwise specified.

6.0 TERMINATION

6.1 All PVC cables up to 1.1 KV grade shall be terminated at the equipments by means of double compression type cable glands. They shall have a screwed nipple with conduit electrical threads and check nut.

All Cable entries shall be through bottom only and top entry terminations are made only after getting approval of Engineer-in-Charge.

6.2 Power cables wherever colour coding is not available shall be identified with red, yellow and blue PVC tapes. Where copper to aluminium connections is made, necessary bimetallic washers shall be used. For trip circuit identification additional red ferrules shall be used only in the particular cores of control cables at the termination points in the Switchgear/Control panels and Control Switches.

6.3 In case of control cables all cables shall be identified at both ends by their terminal numbers by means of PVC ferrules or Self-sticking cable markers. Wire numbers shall be as per schematic/ wiring /inter- connection diagram. Bidders shall have the samples of PVC



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

ferrules/cable markers approved before starting the work. All unused spare cores of control cables shall be neatly bunched and ferruled with cable tag at both ends.

6.4 Where threaded cable gland is screwed into threaded opening of different size, suitable galvanized threaded reducing bushing shall be used of approved type, at no extra cost. All switchgear and control panels shall have undrilled gland plate.

Contractor shall drill holes for fixing glands wherever necessary at no extra cost. Gland plate shall be of non-magnetic material/aluminium sheet in case of single core cables.

6.5 The cable shall be taken through glands inside the panels or any other electrical equipment such as motors. The individual cores shall then be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Only control cables of single strand and lighting cables may be directly terminated on to the terminals. In case of termination of cables at the bottom of a panel over a cable trench having no access from the bottom close fit hole should be drilled in the bottom plate for all the cables in one line, then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables it should be sealed with cold setting compound. Cables shall be clamped over the open armouring to connect it to earth bus.

6.6 Cable leads shall be terminated at the equipment terminals, by means of crimped type solder less connector as manufactured by M/s. Dowell Electro works or approved equivalent.

Crimping shall be done by hand crimping hydraulically operated tool and conducting jelly shall be applied on the conductor. Insulation of the leads should be removed immediately before the crimping. Conductor surface shall be cleaned and shall not be left open.

6.7 Cable accessories for H.V. Systems

6.7.1 The 11, skilled and experienced jointers duly approved by the Engineer-in-Charge shall do 6.6 and 3.3 KV cables terminations joints. Termination including supplying of jointing kit shall be threaded in Contractor scope unless specified otherwise.

6.7.2 The termination and straight thro' joint kit. For use on high voltage system shall be suitable for the type of cables red by the contractor or the type of cables issued by owner for installation. The materials required for termination and straight through joints shall be supplied in kit form. The kit shall include all insulating and sealing materials apart from conductor fitting and consumables items. An installation instruction shall be included in each sheet.

6.7.3 The termination kits shall be suitable for termination of the cables to indoor switchgear or to a weatherproof cable box of an outdoor mounted transformer motor. The terminating kits shall preferably be of the following types:

- a) TAPLEX' of M-seal make using non-linear resistance material fortress grading.
- b) 'PUSH-ON' type of CCI make using factory - moulded silicone rubber insulators.
- c) 'TROPOLINK' type of CCI makes.
- d) Heat-shrinkable sleeve type of M/s. Raychem.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

For outdoor installations, weather shields/sealing ends and any other accessories required shall also form part of the kit.

6.7.4 The straight thro jointing kits shall be suitable for underground-buried installation with uncontrolled backfill and possibility of flooding by water. The jointing kit shall be one of the following types.

- a) 'TAPLEX' of M-seal make
- b) 'TROPOLINK' type of CCI make
- c) Heat-shrinkable sleeve type of M/s. Raychem.

6.7.5 Makes of kits other than those specified in 6.7.3 and 6.7.4 may be considered provided the Contractor furnishes type test certificates, along with the offer.

6.7.6 Type tests are to be carried out at manufacturer's works to prove the general qualities and design of a given type of termination/jointing system. The type tests shall include the following tests conforming to the latest IEC 502.2, 466 and VDE 0278 specifications. The Contractor along with the offer for the jointing system considered shall submit the type test certificates.

- a) A.C. Voltage withstand dry test for 1 minute
- b) Partial discharge test - Discharge magnitude shall be less than 20 p.c.
- c) Impulse voltage withstand test with 10 impulses of each polarity.
- d) A.C. high voltage test following load cycling test with conductor temperature at 95°C.
- e) Thermal short circuit test of 250°C for 1 second.
- f) DC Voltage withstand test for 30 minutes.
- g) Humidity test.
- h) Dynamic short circuit test.
- i) Salt fog test
- j) Impact test

7.0 TESTING:

7.1 Before energizing, the insulation resistance of every circuit shall be measured from phase to phase and from phase to ground.

7.2 Where splices or termination are required in circuits rated above 600 volts, measure insulation resistance of each length of cable before splicing and or/ terminating. Repeat measurement after splices and/or terminations are completed.

7.3 Measure the insulation resistance of directly buried cable circuits before cable trenches are back-filled. Repeat measurement after back-filling.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

For cables up to 1.1 KV grade, 1KV Megger and for H.V. Cables 2.5 KV/5 KV, 2.4 KV/4.9 KV Megger shall be used

7.4 D.C. High Voltage Test shall be conducted after installation on the following and test results are recorded.

- a) All 1000volts grade cables in which straight through joints have been made.
- b) All cables above 1100 V grade.

For record purposes test data shall include the measure values of leakage current versus time.

The D.C. High Voltage test shall be performed as detailed below in the presence of the Engineer-in- Charge or his authorized representative only.

Cables shall be installed in final position with the entire straight through joints complete. Terminations shall be kept unfinished so that motors, switchgears transformers etc. are not subjected to test voltage.

The test voltage shall be as under: -

- i) For cables 3.3 KV grade 5.4 KV DC
- ii) For cables 6.6 KV grade 10.8 KV DC
- iii) For cables 11 KV grade 18 KV DC

7.5 All cables shall be tested as per standard test Performa available with site engineer.

7.6 Cable schedule and layout drawings must be marked for AS BUILT conditions during the installation work and shall be approved by Site Engineer.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

SPECIFICATION FOR EARTHING AND LIGHTING PROTECTION



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

CONTENTS

- 1.0 SCOPE
- 2.0 STANDARDS
- 3.0 EARTHING CONDUCTOR/ELECTRODE
- 4.0 EARTHING NET WORK
- 5.0 INSTALLATION OF EARTH ELECTRODE
- 6.0 CONNECTION
- 7.0 TESTING
- 8.0 TEST PROFORMA



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

1.0 SCOPE:

The intent of this specification is to define the requirements for the supply, installation, testing, and commissioning of the Earthing System.

2.0 STANDARDS:

The work shall be carried out in the best workmanlike manner in conformity with this specification, the relevant specifications/codes of practice of Indian Standard Institution, approved drawings and instructions of the Engineer-in-Charge or his authorized representative issued from time to time. In case of any conflict between the standards, the instructions of Engineer-in-Charge shall be binding.

3.0 CONDUCTOR ELECTRODE:

The main grid conductor shall be hot dip galvanized G.I. Flat or PVC insulated aluminum conductor/copper conductor. Sizes for main conductors shall be marked on the drawings. Thickness of hot dip galvanizing shall not be less than 75 microns.

4.0 EARTHING NETWORK:

4.1 The earthing installation shall be done in accordance with the earthing drawings, specifications and the standard drawings of reference attached with this document. The entire earthing system shall fully comply with the Indian Electricity Act and Rules framed thereunder. The contractor shall carry out any changes desired by the Electrical Inspector or the owner, in order to make the installation conform to the Indian Electricity Rules at no extra cost. The exact location on the equipment shall be determined in field, in consultation with the Engineer-in-Charge or his authorized representative. Any changes in the methods, routing, size of conductors etc. shall be subject to approval of the Owner/Engineer-in-Charge before execution.

Excavation and refilling of earth, necessary for laying underground earth bus loops shall be the responsibility of the contractor.

4.3 The earth loop impedance to any point in the electrical system shall have a value which will ensure satisfactory operation of protective devices.

4.4 The main earth loop shall be laid at a depth of 500 mm below grade level. Wherever cable trenches are available, the earth lead shall be laid in the trenches and shall be firmly cleared to the walls of concrete lined trenches. The earthing strip shall be protected against mechanical damage.

4.5 In process unit areas, the earthing cable shall be run along cable trays wherever specified in the layout drawings. The earthing cable shall be suitably cleated and electrically bonded to the cable tray at regular intervals.

4.6 Joints and tapping in the main earth loop shall be made in such a way that reliable and good electrical connections are permanently ensured. All joints below grade shall be welded and suitably protected by giving two coats of bitumen and covering with Hessian tape. All joints above ground shall be by means of connectors/lugs as far as practicable. Tee connectors shall be used for tapping, earth leads from the main earth loop wherever it is installed above ground.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

Earthing plates shall be provided for earthing of two or more equipment at a place from earth grid. Where aluminum cable risers are to be connected to the underground GI earth bus, the aluminum cable riser shall be taken to the nearest earth pit and terminated through a bolted joint. If this is not practicable, then a G.I. risers shall be brought above grade and a bolted joint shall be made between this GI riser and the aluminum cable termination. This G.I. Riser shall be protected applying two coats of bituminous paint/bitumen on the exposed portion.

4.7 Conduits in which cables have been installed, shall be effectively bonded and earthed. Cable arm ours shall be earthed at both ends.

5.0 EARTH ELECTRODES:

5.1 Earth pipe electrodes shall be installed as shown in the earthing layout drawings and in accordance with the standard drawings of reference and IS:3043. Their location shall be marked to enable accurate location by permanent markers.

5.2 All earth electrodes shall preferably be driven to sufficient depth to reach permanently moist soil. Electrodes shall preferably be situated in a soil which has a fine texture and which is packed by watering and ramming as tightly as possible. Wherever practicable, the soil shall be dug up, all lumps broken and stones removed from the immediate vicinity of the electrodes.

5.3 All earth electrodes shall be tested for earth resistance by means of standard earth test meter. The tests shall take place in dry months, preferably after a protracted dry spell. If necessary, a number of electrodes shall be connected in parallel to reduce the earth resistance. The distance between two electrodes shall not be less than twice the length of electrode.

5.4 The electrodes shall have a clean surface, not covered by paint, enamel, grease or other materials of poor conductivity.

5.5 The exact location and number of earth electrodes required at each location shall be determined in the field in consultation with the owner/Engineer-in- Charge, depending on the soil strata and resistivity, to meet the ohmic values prescribed in clause 5.3. Earth Electrodes shall be located avoiding interference with road, building foundation, column etc. Individual earth electrode shall be provided for each lightning arrestor and lightning mast. The electrodes shall be so placed that all lightning protective earths may be brought to earth electrode by a short and straight a path as possible to minimize surge impedance.

5.6 The disconnect facility shall be provided for the individual earth pits to check their earth resistance periodically. All the earth electrodes shall be suitably numbered and this should be indicated in as built drawings.

6.0 CONNECTION:

6.1 All electrical equipment is to be doubly earthed by connecting two points on equipment to a main earthing ring. The earthing ring will be connected via links to several earth electrodes. The earth grid formed shall be a closed loop as shown in the drawing with earth electrodes connected to the grid with double strip connection. The cable armour will be earthed through the cable glands.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

6.2 In hazardous areas all major process equipments shall be connected to the earthing ring by means of anti-loosening connections and all pipelines will be bonded and earthed on entering the battery limit of the process area.

6.3 The following shall be earthed.

1. Transformer neutrals, CT/PT neutrals.
2. Neutral Grounding Resistors.
3. Transformer Housing.
4. Lightning Arrestors.
5. All switchgear and their earth buses, bus duct.
6. Motor Frames.
7. Non-current carrying metallic parts of electrical equipment such as switchgear, switch racks, panel boards, motor control centers, lighting, power and instrument panels, push button stations, cable trays, pipes, conduits, terminal boxes, etc.
8. All fences, gates/enclosures, housing electrical equipment
9. All steel structures, rails etc. including bonding between sections.
10. Shield Wire
11. Structural steel and Columns.
12. Loading racks.
13. Lighting Mast, poles.
14. Lighting rods (Mast).
15. Tanks and vessels containing flammable materials.
16. Rotating parts of the agitators, pumps etc. through spring loaded brushes of suitable grade.
17. Earth continuity conductor shall be provided for flanges.

Conductor size for connection to various equipments shall be as indicated on Earthing Layout Drawings.

6.4 Two distinct conductors directly connected to independent earth electrodes, which in turn, shall be connected to the earth too, shall earth system.

The earth connection shall be properly made. A small flexible aluminum cable loops to bridge the top cover of the transformer and the tank shall be provided to avoid earth fault current passing through fastening bolts when there is a lightning surge, high voltage surge or failure of the bushings.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

6.5 Each Lightning Arrestor shall be connected to a separate electrode located as close as possible to it and within the fenced area for each set of arrestors. The three nos. electrodes for each set of arrestors shall be spaced about 5 meters apart so that they are all within the enclosing fence. Each of these electrodes shall be connected to the main earth grid.

6.6 The shield wire shall be connected with the main grid solidly and not through supporting steel structures.

6.7 All paint, scale and enamel shall be removed from the contact surface before the earthing connections are made.

6.8 All earthing connections for equipment earthing shall be preferably from the earth plate mounted above ground. In case of G.I. Earth Loop all underground "T" connections shall be of the same size as main loop however in case of PVC insulated aluminum conductor loops underground joints shall be completely avoided. Connections to motors from earth plate or main loop conductor brought above ground shall not be less than following:

i) No.8 SWG G.I. Wire upto 3.7 KW motors.

ii) 3/8" DIA G.I. FINE WIRE ROPE for all motors above 3.7 KW upto 30 KW with tinned copper lug at both ends or 35 mm² PVC insulated stranded aluminum conductor with crimped lug.

iii) 5/8" DIA G.I. FINE WIRE ROPE OR 70 mm² PVC insulated aluminum stranded conductor for motors above 30 KW upto 75 KW terminated as described above.

iv) For all motors above 75 KW conductor size shall be same as that of loop conductor with equivalent size flexible, if required.

Anchor bolts or fixing bolts shall not be used for earthing connection.

6.9 All hardware used for earthing installations shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections of equipment.

6.10 Lighting fixtures shall be earthed through the extra core provided in the lighting cable for this purpose.

7.0 TESTING:

Earthing systems/connections shall be tested as follows:

7.1 Resistance of individual electrodes shall be measured after disconnecting it from the grid.

7.2 Earthing resistance of the grid shall be measured after connecting all the electrodes to the grid. The resistance between any point on the metallic earth grid and the general mass of earth shall not exceed 1 ohm.

7.3 The resistance to earth shall be measured at the following:

a) At each electrical system earth or system neutral earth.

b) At each earth provided for structure lightning protections.



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

- c) At one point on each earthing system used to earth electrical equipment enclosures.
- d) At one point on each earthing system used to earth wiring system enclosures such as metal conduits and cable sheaths or armor.
- e) At one point on each fence enclosing electrical equipment.

Measurement shall be made before connection is made between the ground and the object to be grounded.

8.0 LIGHTNING PROTECTION

8.1 Lightning protection system shall generally comprise lightning finials (air terminals), roof conductors, down conductors, test links, and earth electrodes. the number, types, materials and sizes shall be in accordance with the drawings.

8.2 Air terminals shall be mounted on top of buildings or structure as required. All air terminals shall be inter-connected with roof conductors, pipes, hand rails or any other metallic projection above the roofs shall also be bonded to the roof conductors.

8.3 Down conductors from air terminals or from roof conductors shall be routed as directly as possible to the test links on earth buses, with minimum bends.

8.4 All provisions regarding connections of conductors for equipment earthing system shall also apply to lightning protection system. 8.5 In corrosive atmospheres, plumbing metal for corrosion protection shall cover lightning finials or air terminals.

9.0 TEST PROFORMA

(INSTALLATION TESTING REPORT EARTHING INSTALLATIONS)

1.	Earth system data	
	Type of electrode	
	Total number of electrodes	
	Main grid size	
	Material	
2.	General checks Put Tick \checkmark if O.K.; otherwise give details	
	Construction of earth electrodes as per Standard	
	Size of earth conductor for various equipment O.K. as per Standard.	



Project Title: Design, Supply, Installation, Testing & Commissioning of Fire-fighting system and associated facilities including Operation & Maintenance for a period of five years as per OISD-156 at Oil Jetty No. 08, Kandla, of Deendayal Port Authority

Document Title: Vol III of III Technical Specifications

	Cleanliness and tightness of connectors. Inspect bolted & clamped connectors.	
3	TESTS	
3.1	Measured earth resistance of each electrode in ohms	
No.	1	
	2	
	3	
	4	
	5	
3.2	Measurement of earth grid resistance (with all electrodes connected to grid)	
a)	At each electrical system earth or system neutral earth.	
b)	At each point provided for structure lightning protection	
c)	At one point on each earthing systems used to earth electrical equipment enclosure	
d)	At one point on each earthing systems used to earth wiring systems such as metal conduits etc.	
e)	At one point on each fence enclosing electrical equipment.	
4.	Remarks:	
PROJECT:		UNIT:
TESTED BY		WITNESSED
CONTRACTOR		OWNER
		DATE