



**Project Title:** Design, 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

**VOLUME-III of III**

**TECHNICAL SPECIFICATIONS**

Sl.No	Description
1.	Technical Specifications for Fire Fighting Works
2.	Technical Specifications for Civil Works
3.	Technical Specifications for Structural Works
4.	Technical Specifications for Electrical Works
5.	Technical Specifications for Instrumentation Works



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# TECHNICAL SPECIFICATIONS FOR FIRE PROTECTION SYSTEM



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# TECHNICAL SPECIFICATION FOR FIRE FIGHTING WORKS



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# STANDARD SPECIFICATION FOR FIREMAN'S AXE

## 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

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The specification covers the general requirement regarding the material, shape, dimensions and construction of fireman's axe.

## **2 Material**

2.1 Axe head shall be of steel made by forging. The chemical composition and requirements of steel shall be as per IS: 926.

2.2 Axe handle shall be of steel confirming to IS: 1977.

2.3 The axe handle shall be insulated. The insulated handle shall be of vulcanized rubber.

## **3 Shape, Dimensions and Construction**

1. The shape and dimensions of the axe shall be as per latest edition, amendments, and substitutions of IS: 926.

2. The axe head shall be soundly forged to shape and the steel handle shall be welded to the head.

3. The pick and the blade shall be well and evenly hardened and tempered.

4. The handle grip shall be of knurled surface to make it non-slippery.

## **4 Performance Test**

4.1 The cutting edge of the axe shall not show any sign of damage when tested for single heavy blow as per the procedure mentioned in IS: 926.

4.2 The cutting edge of the axe shall receive no damage when tested for load and buckling as per IS: 926.

4.3 The insulated handle shall be capable of withstanding 20,000 volts for 60 seconds.

## **5 Workmanship and Finish**

5.1 All parts shall be of good finish, clear of burrs.

5.2 All forgings shall be clean and sound and shall be free from porosity, blow-holes, scales and cracks.

## **6 Marking**

1. Each axe shall be clearly and permanently marked with the following information:

- a) Manufacturers name or trade-mark,
- b) Year of manufacture,
- c) Tested to 20,000 volts and d) ISI certification mark.



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# STANDARD SPECIFICATION FOR FIRE BUCKETS

## 1.0 Scope



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The specification covers the general requirement regarding the material, shape, design, dimensions, manufacture, finish and tests of galvanized mild steel fire bucket.

## **2.0 Material**

2.1 Buckets shall be of mild steel black sheets confirming to grade ST42 of IS: 1079.

2.2 Rod used for top & bottom handles shall be of mild steel confirming to IS: 226.

2.3 Wires used for stiffening of top rim shall be of mild steel, confirming to IS: 280.

2.4 Painting of fire bucket shall be as follows:

- a) Inside - Two coats of white paints (enamel finish), as per IS: 2932.
- b) Outside - Two coats of fire red paints, confirming to Shade No. 536 of IS: 5 (enamel finish), as per IS: 2932.
- c) Ears, Handles & Letters - Two coats of black paints, as per IS: 2932.

## **3.0 Shape, Dimensions and Construction**

3.1 The shape and dimensions of the fire bucket shall be as per IS: 2546.

3.2 The body of fire bucket shall be in two halves and to be joined together by butt welding. Top rim of the body shall be wired and uniformly beaded without gaps. Thickness of body shall be 1.0 mm & dia of beading wire 3.55 mm.

3.3 Bottom sheet of fire bucket shall be 1.0 mm thick and dished. It shall be joined to the body by butt welding to avoid raw edge on the inside of the bucket.

3.4 Thickness of mild steel sheet for ears shall be 2.8 mm and shall be fitted to the body at the top by welding with the flat head on the side.

3.5 Top & bottom handle shall be of mild steel rod of 10.0 mm dia. The grip shall have no sharp edges.

## **4.0 Performance Test**

4.1 The bucket shall be fully filled with water and kept for 15 minutes, there shall not be any leakage for the period.

4.2 The dry empty bucket with its top facing upward shall be pressed down the water in a water tank of suitable size vertically. In such a way that top of the bucket shall be minimum 6.0 mm above the water level. Water shall not enter inside the bucket.

4.3 After taking out the bucket, the bucket shall be reversed and pressed inside the water tank vertically. There shall not be any air bubble seen escaping through the water.

## **5.0 Workmanship and Finish**

5.1 All parts shall be of good finish, clear of burrs.



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5.2 All gas welds shall clean and sound and shall be free from porosity, blow-holes, scales and brittleness.

5.3 The bucket shall be galvanized after manufacturing with thickness of zinc coating on any portion not less than 0.06 gm./cm<sup>2</sup> (both sides inclusive), as per IS: 2629.

### **6.0 Marking**

Each fire bucket shall be clearly and permanently marked with the following information:

- a) Manufacturers name or trade-mark,
- b) Year of manufacture & capacity,
- c) Word "FIRE" shall be painted in black centrally on outside with letters 75 mm high & 12 mm thick.





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# STANDARD SPECIFICATION FOR FIRE DETECTION AND ALARM SYSTEM

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## **1.0 SCOPE**

1.1 This specification covers the design, engineering, manufacture, testing, packing and supply of automatic and manual Fire Alarm System incorporating manual call points (break glass



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boxes), automatic detectors, release and inhibit switches for fire suppressant clean agent, data gathering, fire alarm and central fire alarm panels, conventional or computer aided (microprocessor based) mimic panels and associated equipments as specified under scope of work.

## **2.0 CODES AND STANDARDS**

2.1 The fire alarm system and the components used shall confirm to the latest edition of the following and also the other Indian and international Standards as applicable.

2.1.1 IS-5 Colours for ready mixed paints and enamels

2.1.2 IS-513 Specification for cold rolled low carbon steel sheets and trips.

2.1.3 IS-2175 Specification for heat sensitive fire detectors for use in automatic fire alarm system.

2.1.4 IS-2189 Code of practice for selection, installation and maintenance of automatic fire detection and alarm system.

2.1.5 IS-3700 Essential ratings and characteristics of semiconducting devices.

2.1.6 IS-3826 Part-I Connectors for frequencies below 3 MHz General requirements and tests.

2.1.7 IS-5469 Code of practice for the use of semi-conductor junction devices

2.1.8 IS-5780 Intrinsically safe electrical apparatus and circuits

2.1.9 IS-11360 Specification for smoke detectors for use in automatic electrical fire alarm system.

2.1.10 BS-5839 Specification for manual call points Part-2

2.1.11 NFPA 72 National Fire Protection Association

2.1.12 LPC Loss Prevention Council Recommendation

2.2 Wherever the requirements of this specification are in conflict with any of the standards mentioned above, the requirements of this specification shall be binding.

2.3 In addition to the above, all equipment shall confirm to the provisions of Indian Electricity rules, Tariff Advisory Committee and other statutory regulations in force from time to time.

## **3.0 SITE CONDITIONS**

3.1 All the equipments shall be suitable for the site conditions specified in the Scope of work. If not specifically mentioned therein, a design ambient of 40°C and an altitude not exceeding 1000m above mean sea level shall be considered with a minimum temperature of 10°C for battery sizing.

## **4.0 GENERAL REQUIREMENTS**



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4.1 Unless otherwise specified in the enquiry documents, all the equipments shall be suitable for installation in safe, non-hazardous area and shall confirm to the recommendations of Tariff Advisory Committee.

Equipments to be located in hazardous areas shall have certification for use in such areas by the recognized testing and certification authorities, such as 'CMRI', Dhanbad, BASEEFA (UK), UL (USA) etc., or the relevant authorities of the country of origin. Equipment for hazardous areas shall be approved by CCE / DGMS / DGFASLI, as applicable, and all indigenous flameproof equipment shall be covered under a valid BIS license.

#### **4.2 Power Supply**

The Fire Alarm System shall be suitable to receive the power supply as given below:

- a) Voltage : 110V / 240V  $\pm$  6% (field selectable),
- b) Frequency : 50Hz  $\pm$  3%, 1 phase

Further distribution shall be vendor's responsibility. Any voltage, other than the above shall be internally derived by the vendor within the system.

4.2.1 The battery back-up shall be capable of maintaining the system in normal operation for a period of not less than 48 hours after the failure of normal mains supply, after which sufficient capacity shall remain to provide full load operation for at least 30 minutes.

The full load shall be considered as the load caused by the operation of all alarm sounders operating simultaneously, operation of detectors in at least 25 percent of the zones and the operation of fault indicators.

The switch over from mains to batteries shall be automatic, in the event of a mains failure.

Ni-Cd / Lead Acid / Sealed maintenance free batteries, as per site requirement and suitable battery charger shall be provided for each system.

#### **5.0 FIRE MONITORING AND ALARM PANEL**

5.1 Fire sensed by the field equipments shall be monitored by Fire Alarm Panels located in plant control rooms. Fire Alarm panels can be either conventional type using digital electronic techniques or computer aided microprocessor based analogue addressable type, as per site requirement.

5.1.1 The conventional system shall generally comprise of the following equipments used in conjunction with conventional automatic fire alarm detectors and manual call points.

- a) Central Fire Alarm Panel with Mimic
- b) Zonal Fire Alarm Panel
- c) Repeat Alarm Panel / Annunciation Panel

5.1.2 Microprocessor based system shall generally comprise of the following equipments used in conjunction with analogue addressable automatic fire alarm detectors and manual call points.



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- a) Central Fire Alarm Panel / Central Processing Unit
- b) Data Gathering cum Fire Alarm Panel (DGFAP)
- c) Repeat Alarm Panel

## **5.2.2 Addressable Fire Alarm System (PLC Based)**

### **5.2.2.1 Central Fire Alarm Panel**

5.2.2.1 Central fire alarm panel shall gather information from various Zonal Alarm panels regarding the status of activation of detectors / manual call points etc. on an overall basis.

5.2.2.2 Central fire alarm panel shall house starter control(s) for siren(s), in order to generate an alarm audible in the entire plant in the event of fire.

5.2.2.3 If specified in the scope of work, the central fire alarm panel shall have provision for signals, alarms etc. as specified under clauses 5.2.5.1.

5.2.2.4 A mimic, unless otherwise specified in the enquiry document shall form an integral part of the central fire alarm panel and shall be located at the top of the panel. If separate, mimic panel shall either be wall mounting or free standing floor mounted type. Two nos. LEDs shall be provided for each zone on mimic panel. It shall derive the power supply from Fire Alarm panel. Mimic panel shall be illuminated through potential free contacts available in fire alarm panel.

LEDs on the mimic panel shall be arranged on a graphic mimic of the plant/area covered by the mimic panel. The LEDs shall be arranged on the basis of zones, unit wise, building wise, detector / manual call point wise or a combination of the above as described in the scope of work.

### **5.2.3 Circuit Description and Operational Requirements**

5.2.3.1 The system shall be modular in construction to facilitate future extension/modification and shall include fire monitoring PCB, output relays, annunciators, indicating lamps, switches, push buttons etc.

5.2.3.2 Static components shall be mounted on plug-in type printed circuit boards (PCBs). PCBs for identical logic circuits shall be interchangeable. Connections to and from the PCBs shall be taken through gold plated edge connectors only. Plug and sockets of heavy duty type shall be used for PCBs. Card edge connecting pins shall not be acceptable. PCBs shall be coated with the antifungus chemicals on both sides and shall be suitable for tropical climate.

5.2.3.3 "Fail Safe" feature to signal the failure in the circuitry shall be incorporated in the logic circuit and operation of the alarm system shall be on opening normally closed field contact.

5.2.3.4 Test facility through common "Test" push button shall be provided for complete functional test of each group of logic circuits, audio and visual flasher circuit, lamps etc.

5.2.3.5 The annunciation circuit design shall ensure that momentary short circuit in the lamp circuit does not adversely affect the performance of the system. Visual and audible alarm circuits shall be independent i.e. the failure of one will not affect the other.



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5.2.3.6 The circuit shall be so designed that silencing of the current alarm by ACCEPT push button shall not prevent initiation of fire alarm in case of subsequent 'FIRE' signal received from any other location.

5.2.3.7 The field contact wiring will be carried out by using multicore, copper conductor, PVC insulated and armoured cable which may be running close to power cables. Hence the logic circuitry shall be designed with sufficiently high signal-to noise ratio to avoid spurious actuation due to noise induced in the field wiring because of proximity with power cables. Adequate noise filters and time delay shall be incorporated at the input stages to reduce the effect of the noise.

5.2.3.8 A minimum of two lamps shall be provided in parallel for each fire loop to increase the reliability of the visual alarm.

5.2.3.9 Fire alarm loop card shall be capable to receive the signal from break glass box, Heat, UV, IR, ionization, optical type detector, heat sensing cable, linear beam detector and any combination thereof.

5.2.3.10 Whenever the fire is detected in any zone, both audible and visual (flashing) alarm shall be raised in the fire alarm panel indicating the corresponding location of fire zone. On pressing the 'ACCEPT' push button, the audible alarm shall stop and the lamp shall glow steadily. The panel shall be brought to normal condition by pressing 'RESET' push button (only after the field conditions are normalized). It shall be possible to manually initiate the audio alarm in addition to automatic operation.

If specified in the material requisition the system shall be provided with a siren to be located at a suitable location in the plant. The controls for the siren shall form an integral part of the Fire Alarm Panel. The starter for the siren shall be direct-on-line type, weather proof shall be in an IP-55 enclosure, suitable for outdoor installation. The enclosure shall be epoxy painted fire red, to shade 536 of IS-5.

#### **5.2.4 Zonal Fire Alarm Panel**

5.2.4.1 Zonal Fire Alarm Panel shall gather information from various detectors / manual call points connected to its loop. It shall monitor the status of detectors, cable faults etc. Zonal Fire Alarm Panel shall have provision to annunciate the fire/fault signals received from the detector/manual call points connected to its loops. LEDs shall be provided for visual annunciation and electronic hooters as audible alarm.

5.2.4.2 Additionally LEDs shall be provided for power ON, fault, fire, multiple alarm indication etc. Push buttons shall be provided for alarm accept, hooter reset, LED test etc. Power ON switch shall be provided.

5.2.4.3 Zonal Fire Alarm Panel shall generate output contacts for signals to repeat alarm panels, central fire alarm panel etc. It shall generate potential free contacts for energisation of hooters, exit signs, tripping of owner's AHU and pressurization system etc.

5.2.4.4 As specified in the scope of work, the zonal fire alarm panel shall have provision for the signals, alarms etc. as specified under clause 5.2.5.1



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### 5.2.5 Repeat Alarm Panel

5.2.5.1 Repeat alarm panels shall generally be constructed as specified in clause 5.4 and shall be wall mounting type.

Repeat alarm panel shall receive signals from Central Fire Alarm Panel or Zonal Fire Alarm Panel shall have provision to annunciate the same using audio-visual annunciation. LEDs shall be provided for visual annunciation and electronic hooters as audible annunciation. Additionally LEDs shall be provided for power ON, fault, fire, multiple alarm indication etc. Push buttons shall be provided for alarm accepts and hooter reset, as well as, for LEDs test. Switch shall be provided for power ON.

5.2.5.2 Repeat alarm panels may either have

a) LEDs arranged in a matrix (rows and columns) along with text engraved alongside each LED indicating the zone where the fault/fire has occurred.

OR

b) LEDs arranged on a graphic mimic of the zones/areas covered by the repeat alarm panel.

5.2.5.3 Repeat alarm panels shall derive power from the associated fire alarm panel.

### 5.2.6 Alarm, Signal and Control Requirements

5.2.6.1 In addition to the initiation of fire alarm, zonal, central fire alarm panels shall have the facility for following status signals, status alarms and shutdown signals as specified in Scope of work / drawings.

- i. Automatic signal for release of clean agent/CO2 release for protected area and release alarm in control room.
- ii. Selector switches for primary or secondary clean agent/CO2 supply for each skid / protected area.
- iii. Manual push button for discharge of clean agent/CO2 in each protected area (after alarm and 30 seconds time delay).
- iv. Clean agent/CO2 discharge inhibit push button for each protected area.
- v. Deluge valve activation push buttons, deluge valve test push buttons and deluge valve activated status lamps.
- vi. Shutdown signals to various air handling units relative to the zone of fire.
- vii. Fire water pumps running indications.
- viii. Fire water pumps start push buttons.
- ix. Controls of sirens.
- x. Repeat alarm signal to various control rooms.





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xi. Repeat alarm signal to mimic panel.

xii. Repeat alarm signal to repeat alarm panel. xiii. Status of Battery Conditions.

### **5.3 Computer Aided Fire Alarm System**

The microprocessor based analogue addressable fire detection and alarm system shall be computer aided utilizing distributed processing techniques. The system shall include the following as a minimum.

#### **5.3.1 Central Fire Alarm Panel (CFAP)**

5.3.1.1 The CFAP or central processing unit shall be a special purpose microprocessor operating under software program which shall provide central control and monitoring functions of the entire fire alarm system.

5.3.1.2 CFAP shall communicate with various Input / output devices, DGFAPs, repeat alarm panels, I/O multiplexer, mimic panels, industrial grade PCs, Visual Display Units (VDU), key boards, printers etc. located at central / various locations in the plant.

5.3.1.3 CFAP shall have the facility to scan the data received from the DGFAPs and shall send necessary information to the respective DGFAPs, repeat alarm panels, VDUs etc. through bi-directional communication network.

5.3.1.4 CFAP shall be modular in design and shall contain 100% redundant microprocessor based master unit, processing units, signaling module and power supply unit. The CFAP shall serve as an interface and controller for connected PCs having graphics/text facility, located at central location and DGFAP panel(s) distributed in various control rooms.

5.3.1.5 CFAP shall be designed specifically for fire alarm and protection system applications and shall provide status, alarm, shutdown signals in predefined manners, initiate alarms, synchronize all activities, provide repeat alarms and other signals as specified.

5.3.1.6 The CFAP shall have non-volatile memory for reliability and shall permit reprogramming by authorized personnel.

5.3.1.7 The CFAP shall provide various event initiated programmes (EIP). EIP shall be initiated by any of the following user defined parameters; day, time, alarm, return to normal, change of status and hardware failure. The system shall provide multi levels of command priority to assure that high level commands are not overridden by lower level commands.

5.3.1.8 CFAP shall have the facility to display the affected area on the VDU and provide the instructions to suppress the cause. High resolution graphic software shall be provided for display. The graphics shall have many layers of penetration. The VDU shall either be touch screen type or menu driven using mouse/keyboard. However, instead of graphic display, VDU with only text display shall be provided, as specified in the Scope of work.

5.3.1.9 Unless otherwise specified in the Scope of work CFAP shall be designed to provide multicolor display on the VDU.





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5.3.1.10 Suitable communication interface cards shall be provided in CFAP to interface with DGFAPs, repeat alarm panels etc.

5.3.1.11 PC shall be with a Pentium or higher processor with a minimum 100MHZ clock rate, with 8GB hard disk, 3.5" floppy drive, CD drive, 512MB RAM, 64 KB cache memory, serial and parallel ports suitable for the devices connected. PC shall be complete with 101 key key-board with English language characters, 17" colour monitor with SVGA compatibility, nonglare screen with front mounted power switch, brightness/contrast control, horizontal/vertical position and size control etc. The monitor shall be on a swivel base.

5.3.1.12 Monitor screen shall have dedicated areas for the following functions:

- Alarms and returns to normal
- Menus, commands, reports and programming
- Time, day and date

5.3.1.13 Alarms and all other changes of status shall be displayed on the screen area reserved for this information. The following information shall be provided as a minimum:

- Condition of detector (Alarm / Trouble)
- Type of detector
- Location of detector and numerical system address
- Emergency instructions.

On receipt of alarm, an audible alarm shall sound and the condition and detector type shall flash until acknowledged by the operator. Return to normal shall also be annunciated and shall require operator acknowledgement.

5.3.1.14 The system shall have multiple levels of priority for displaying alarms. Should multiple alarms occur, the first received, highest priority alarm shall be displayed on the screen until acknowledged by the operator. Then the next highest priority alarm shall be displayed until acknowledged etc. Should a higher priority alarm occur, the higher priority alarm shall replace the lower priority alarm on the screen and the lower priority alarm shall be retained in memory and re-displayed after the higher priority alarm is acknowledged.

5.3.1.15 The system shall provide sufficient memory so that no alarm shall be lost. A message highlighted in reverse video, shall advise the operator when other unacknowledged alarms are present in the system.

5.3.1.16 The VDU keyboard shall use function keys with English descriptions to initiate all system functions. Typing abbreviations or using unlabeled or numerical function buttons is unacceptable. When a function key is pressed, the monitor shall lead the operator through the function by asking him to choose one of several clearly defined options (menu penetration). When a specific detector must be addressed, a distinct numerical keypad shall be used to speed up and simplify the operation. On command from the operator, system reports either shall be displayed on the VDU screen or output on the printer, as desired by the operator.



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5.3.1.17 Multiple levels of access to the system shall be provided for operators and supervisors via user defined passwords. The following functions shall be provided for each levels:

a) Operator level access functions

- Display system directory, definable by detector type
- Display status of an individual detector
- Manual command (alarm with an associated command i.e. secure / accesses / alarm – shall use the same system address for both functions)
- Report generation, definable by detector type. Reports shall be output on either the monitor or printer, as desired by the operator.

b) Supervisor Level Access Functions

- Reset time and date
- Holiday scheduling
- Enable / disable event initiated programmes, printouts, initiators.
- Enable / disable individual hardware points and system components.

5.3.1.18 Printer used in the system shall provide real time records of the system events and provide system reports on demand.

5.3.1.19 Printer shall be microprocessor controlled, high speed, read only (RO) type.

5.3.1.20 The system printer (PTR) shall be a letter quality dot-matrix printer, 132 character wide and shall have a 96 character set. The printer shall have a microprocessor controlled bi-directional logic seeking head. The printing speed shall not be less than 300 cps in draft mode.

5.3.1.21 The printer shall automatically record in English all alarms, troubles, acknowledgements, return to normal, manual commands, plus those automatic commands selected by the user.

5.3.1.22 Alarms shall be highlighted differently than other traffic and shall be recorded in English, including type, location, time, date and numerical address of alarm detector. Multiple alarms shall be recorded in the order received, regardless of alarm priority. If an alarm is received during the preparation of reports, the printer shall interrupt the report to record the alarm and afterwards resume the report automatically.

5.3.1.23 Automatic (EIP) commands shall be recorded automatically. All changes to system programming shall be recorded automatically.

5.3.1.24 Printer shall use fanfold paper and shall accommodate an original and two copies. Paper shall be tractor fed. Each page shall be automatically timed, dated and page numbered to detect unauthorized removal.

5.3.1.25 Printer shall be desk top unit and shall be styled to match the VDU.



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5.3.1.26 The printer shall have an indicator to alert the operator that paper has run out.

5.3.1.27 The printer shall have a self-test feature to verify printer operability even when off line.

5.3.1.28 To achieve 100% redundancy, 2PCs, VDUs, keyboards and printers shall be provided for communication with the 100% redundant central processing unit of the CFAP, as specified in the material Scope of work

5.3.1.29 The central processing unit, along with PCs and their peripherals shall be housed in a console type enclosure made out of minimum 16 gauge CRCA sheets.

5.3.1.30 All cabling between the central processing unit, PCs and their peripherals shall be in the vendor's scope. Arrangements shall be made within the console enclosure for distribution of power supply to various equipments.

### **5.3.2 Data Gathering Cum Fire Alarm Panel (DGFAP)**

5.3.2.1 The DGFAP shall act as a control and interface point between manual/automatic fire detectors and the CFAP.

The DGFAP shall be UL listed and FM approved, suitable for application in fire detection and alarm systems. Approvals from agencies other than UL/FM shall be subject to DPT's review.

5.3.2.2 All manual/automatic fire detectors shall be connected to DGFAP. Input signals shall be processed by the DGFAP. It shall also have the facility to control all the input data received from different field devices. Field devices can be automatic fire detectors, break glass boxes, switches and process parameters.

5.3.2.3 The DGFAP shall have its own microprocessor and non-volatile memory.

5.3.2.4 The DGFAP shall have the facility to transfer all data to CFAP. It shall be possible to re-programme the operations at site. The DGFAP shall have the capability of stand alone operation in case of communication failure with the CFAP/other DGFAPs.

5.3.2.5 The DGFAP shall have at least the following facilities:

- External power supply with standby backup (Integral charger and battery may be accepted in case SMF batteries are specified under Scope of work).
- Alarm and trouble / fault indications, through 2x40 character fluorescent alphanumeric display.
- Self diagnostic facility.
- Interface for data communication to other DGFAPs, CFAP, remote text or graphics displays, repeat alarm panels etc.
- Detector or loop disablement and restoration.
- Message, data storage in non-volatile memory.
- Change/examination of sensitivity of various detectors.



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- Hooter with reset facility
- Battery low indication
- Hardwired potential free contacts for shutdown signals etc. as defined in clause 5.2.5.1

5.3.2.6 Simultaneous display of Fire and Fault indication on DGFAP shall be provided on the alpha-numeric display (LED type) with the action message that is to be taken by the operator.

5.3.2.7 All the data gathering panels shall have alarm verification capability.

5.3.2.8 DGFAP shall have repeating facility to remote area. Necessary hardware / software shall be provided for this purpose.

5.3.2.9 DGFAP shall provide indications for communication with the CFAP, as well as, alarm and trouble conditions in the sensor loops.

### **5.3.3 Repeat Alarm Panels**

5.3.3.1 Repeat alarm panels shall be fabricated out of 16 gauge CRCA sheets. The panels shall have IP-41 enclosure protection as a minimum. The repeat alarm panel shall be suitable for wall mounting. Cable entry provision shall be from bottom by means of cable glands. The panels shall be epoxy painted fire red to shade 536 of IS-5.

5.3.3.2 Repeat alarm panel shall be capable to receive signals from either the CFAP or the DGFAP and shall have provision to annunciate the same using audio-visual annunciation.

5.3.3.3 Visual annunciation shall be by means of 2x40 character fluorescent display on the panel front. The display shall indicate the detector address, its location, action to be taken in case of fire etc. The display shall indicate the instances of fire and fault.

5.3.3.4 Electronic hooters shall be provided for audible annunciation.

5.3.3.5 Additionally LEDs shall be provided for power ON, fault, fire, multiple alarm indication etc. Push buttons shall be provided for alarm accept and hooter reset, as well as, for LED test. Switch shall be provided for power ON.

5.3.3.6 Repeat alarm panel shall derive power from the associated fire alarm panel.

### **5.3.4 Data Highway**

5.3.4.1 Communication between CFAP, DGFAPs, repeater panels etc. shall be realized by means of data highway. Unless specified otherwise, data highway shall consist of 1.5mm<sup>2</sup> copper conductor, twisted pair, PVC insulated, PVC inner sheathed, overall screened and overall PVC sheathed cables. Data highway cables shall be 100% redundant, to ensure reliability of communication.

Wherever required, due to cable capacitance limitation, modems shall be employed for data highway communication. In such cases, modems shall be powered as well as located in the respective DGFAPS or CFAP.



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5.3.4.2 Alternately, optical fibre cables, may be used as data highway. The fibers shall be as per latest CCITT recommendation for single mode optical fibers and shall be laid in slots/tubes filled-up with moisture resistant jelly. Polymer coated aluminium tape around the cable core shall provide a moisture barrier. Optical fibre cables shall have an inner polyethylene sheath with corrugated steel tape armouring and a polyethylene outer sheath.

#### **5.4 Panel Construction (Central Fire Alarm Panel, Zonal Fire Alarm Panel, Data Gathering cum Fire Alarm Panel, Repeat Alarm Panel etc.)**

5.4.1 Panel(s) shall be free standing/wall mounting type, made out of minimum 16 gauge CRCA sheets. Doors and covers shall be made out of 14 gauge CRCA sheets. The panel shall be naturally ventilated totally enclosed dust and vermin proof with IP-41 enclosure as a minimum. The construction of the panel enclosure shall be designed to allow for at least 10% expansion for future additions without involving any major modifications in the system. In general, these panels, shall generate/receive/display the required signals for Fire Alarm and Suppression systems.

##### **5.4.2 Equipment Mounting**

5.4.2.1 All apparatus, instruments and alarm facias mounted on the panel front shall be flush mounted type. The panel wiring shall not be terminated directly on the base connector of PCBs. It shall either be terminated through a separate terminal block or multipin connectors. Routine calibration and adjustments shall be accessible from the front of the panel without having to remove any wiring or causing loss of the panel function. In addition, total removal of the instrument(s) and replacement with a spare shall be possible from the front of the panel.

5.4.2.2 All annunciator components except the alarm horn and auxiliary contact relays (if used) shall be mounted integrally in a protective enclosure. Sufficient spare terminals shall be provided to accommodate all spare / future alarm points in the display. Access shall be provided to permit checking and / or changing the wiring at these terminal strips.

5.4.2.3 Lamps shall be capable for removal and replacement from the panel front via individual snap out windows or a swing out hinged door on which all windows are mounted.

5.4.2.4 There shall be separate hooters for faults/ malfunction and fire alarm having distinct audible tones.

5.4.2.5 Fluorescent lamp(s) shall be installed within the panel to provide adequate lighting for maintenance of equipments. Door interlock switch shall be provided for this purpose.

5.4.2.6 Cable entry shall be from bottom unless otherwise specified in the Scope of work. A terminal strip shall be provided for incoming / outgoing cables. Supporting facilities shall be provided for clamping the cables.

##### **5.4.3 Wiring and Terminals**

5.4.3.1 Wiring within the panel shall be in slotted plastic raceways enclosed with cover. Interconnecting wiring shall be done with 1 sq. mm. Cross-section, copper conductor, PVC insulated, 660V wires. Power circuit wiring shall be with minimum 2.5 sq.mm. Cross section,



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copper conductor. Panels shall be supplied completely pre-wired including spare points of modules / controllers etc. so that only field termination is required before energisation.

5.4.3.2 Cables shall be terminated on terminal blocks. Clamp type terminals shall be of spring-loaded, stacking type, mounted on rails. Terminals shall be sized to accept as a minimum 2.5 sq.mm. Cross section conductors. Not more than one conductor shall be terminated on the outgoing side of each terminal. At least 20% spare terminals shall be provided in each panel.

5.4.3.3 Suitably sized terminals shall be provided for terminating main power supply cables.

#### **5.4.4 Cable Glands**

5.4.4.1 All the cable glands for outdoor application shall be weatherproof, nickel plated brass and double compression type, whereas those for indoor application shall be single compression type.

5.4.4.2 Cable glands for hazardous area equipment shall be flameproof, weatherproof and nickel plated brass double compression type.

#### **5.4.5 Earthing**

5.4.5.1 A common earth bar of minimum 25 x 3 mm copper or equivalent aluminium shall be provided throughout the length of the panel. All non-current carrying metallic parts of the panel mounted equipment shall be earthed. All doors and movable parts shall be connected to the earth bus by flexible jumpers. 2Nos. earth lugs shall be provided outside the panel.

#### **5.4.6 Name Plates**

5.4.6.1 All name plates for panel shall be engraved out of 3 ply (black-white black) lamicoide sheets or anodized aluminium. Back engraved Perspex sheet nameplates will also be acceptable. Engraving shall be done with square groove cutters. Hard paper or self-adhesive plastic tape nameplates will not be acceptable.

5.4.6.2 All panels mounted equipments (e.g. lamps, push buttons, switches PCBs etc.) shall be provided with suitable nameplates.

5.4.6.3 Labels shall be provided for every component on the cards, connecting wires as well as for the terminals in the terminal strip inside the panel.

5.4.6.4 Special warning plates shall be provided on all removable covers or doors giving access to energized metallic parts above 24 volts.

#### **5.4.7 Painting**

5.4.7.1 All metal surfaces shall be thoroughly cleaned and degreased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The undersurface shall be made free from all imperfection before undertaking the finishing coat.





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5.4.7.2 After preparation of the undersurface, the panel shall be epoxy painted with two coats of final paint. Alternatively the panels may be powder coated. The colour shade of final paint shall be as specified in the Scope of work. If not specified therein, the final paint shall be fire red, shade 536 of IS-5. The finished panels shall be dried in stoving oven in dust free atmosphere. Panel finish shall be free from imperfections like pin holes, orange peels, run-off paint etc.

All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust-corrosion. Moving elements shall be greased.

## **6.0 AUTOMATIC FIRE DETECTORS AND ACCESSORIES**

### **6.1 General Specifications**

6.1.1 All the detectors shall be plug-in type and shall have twist lock action fitting. An LED shall be incorporated which shall normally flicker indicating alertness and should turn steady when a fire is sensed, enabling immediate identification of the affected detector.

6.1.2 The mounting base of all type of detectors shall be identical. It should be possible to plug-in any type of detector at any location without changing the base and without distributing the external wiring. The detector housing shall be damage resistant made of polycarbonate or aluminium with plug-in housing base of universal type suitable for either surface or recess mounting. Junction boxes for detector mounting shall be complete with terminal block, etc. Additional terminals shall be provided to fit end of line resistance, wherever applicable.

6.1.3 The detectors, which employ a Radio Active source shall be such that the strength of the Radio Active material shall not exceed 1 micro curie.

6.1.4 It shall be possible to install all type of detectors (manual as well as automatic) in the same fire alarm circuit/loop.

6.1.5 All the detectors shall have inbuilt safety device to monitor the removal and pilferage of the detector.

6.1.6 All the detectors shall be on the approved list of Loss Prevention Council, Under Writers Laboratory (USA) / Factory Mutual (USA) / Tariff Advisory Committee.

6.1.7 All detectors shall be suitable for operation at DC power supply. All analogue addressable detectors shall be suitable for installation using fault tolerant wiring (class-A, style-6 wiring as per NFPA). Tapping shall not be permitted in the case of such wiring.

6.2 All automatic detectors for microprocessor based fire alarm system shall be analogue addressable type. The analogue addressable detectors shall be continuously monitored to measure any change in their sensitivity due to the environment (dirt, dust, temperature, humidity etc.). These detectors shall give an advance indication to the panel regarding the need for maintenance. The analogue reading sent by the detectors shall be sensed and if there is a rapid increase, an alarm shall be generated. However, if there is a gradual increase in the analogue reading, a maintenance alert shall be generated by the DGFAP. It shall be possible to generate maintenance reports from DGFAP.



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6.3 All analogue addressable detectors shall preferably have the facility to set the addresses from the DGFAP. Alternately dip switches in the detector base shall be used for setting the detector address.

6.4 Manual call points/break glass boxes for microprocessor based fire alarm system shall be addressable type. Each device shall have its own address module which shall send a status signal to the DGFAP regarding its state of actuation.

### **6.5 Heat Detectors**

6.5.1 Heat detectors shall be of dual thermistor (negative temperature coefficient resistor)/bimetallic/electro-pneumatic/thermo electric type, working on the two methods i.e. rate of rise and fixed temperature.

6.5.2 The rate of rise element shall be carefully calibrated to ignore any normal fluctuation in temperature, but to respond quickly when the temperature rise is  $9^{\circ}\text{C}$  or more per minute.

6.5.3 The fixed temperature feature should be entirely independent of the rate of rise element. The operating temperature of fixed temperature element should be factory set at  $57^{\circ}\text{C} \pm 5^{\circ}\text{C}$ .

6.5.4 The detector shall be self-restoring type ensuring repeated use and easy maintenance.

### **6.6 Ionization Type Smoke Detector**

6.6.1 Smoke detector shall be solid state type, working on ionization principle and shall preferably be of dual chamber and dual source type.

6.6.2 The radioactive source used in the detector shall not emit beta and gamma rays and the strength of radioactive material shall not be more than 1 micro curie.

6.6.3 The detector shall be able to sense incipient fire by detecting the presence of visible and invisible products of combustion like wood, paper, ammonia processing paper, cloth, PVC, Bakelite, nylon, foam, acrylic, thermo Cole, Photo film, nylon, polyester, painted sheets, Teflon, leather etc.

6.6.4 The sensitivity of the detector shall not vary with change in ambient temperature, humidity, pressure or permissible voltage variation. Its performance shall not be affected by an air current of 5 meter per second. It shall have an inbuilt arrangement such that puffs of smoke or hot air pockets do not inadvertently trigger the alarm. The detector shall be protected against dust accumulation / ingress. It shall have insect resistant screen to prevent nuisance alarms. All detectors shall be identical in construction, design and characteristics to facilitate easy replacement.

### **6.7 Photo Electric / Optical Type Smoke Detector**

6.7.1 Photo electric/optical type smoke detectors shall work on the principle of light scattering, utilizing a light emitting diode. The sensitivity of the detector shall be preset by the supplier to suit the site conditions.

### **6.8 UV Flame Detector**





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6.8.1 UV flame detectors shall work on the principle of a vacuum photodiode tube to detect the UV radiation that is produced by a flame.

6.8.2 UV flame detectors shall react to ultraviolet rays of a flame. The detector shall not be actuated by artificial lights, sunlight incident through a window pane. False alarm check circuit shall be incorporated to prevent false due to intermittent flash or lightning.

## **6.9 IR Detectors**

6.9.1 IR detectors shall work on the principle of a single wavelength infrared flame detector using one of several different photocell types to detect the infrared emissions in a single wave length band that are produced by a flame.

6.9.2 IR detectors shall react to the infrared rays of a flame. It should be sensitive enough to detect smoky fires in which flame is hardly recognizable. The detector should not react to extremely glaring artificial light or direct sunlight. The detector shall be completely solid state type.

## **6.10 Linear Beam Detector**

6.10.1 The linear beam detector shall work on the principle of obscuration of infrared light beam by particles of smoke. The sensitivity shall be such as to enable operation at 30% to 50% obscuration.

6.10.2 Linear beam detector shall consist of separate transmitter and receiver. Linear beam detector shall be suitable for application in high roofed locations such as ware houses etc. The detector shall preferably be powered from the loop signal itself. However if external power supply is required the same shall be explicitly stated by the vendor and the supply shall be supplied from source with battery back-up as specified in clause 4.1.2.

## **6.11 Heat Sensing Cables**

6.11.1 Heat sensing cable shall be analogue type. It shall consist of four copper conductors, each covered with a colour coded, negative temperature coefficient material. The cores shall be twisted together and protected by an outer sheath of high temperature flame retardant PVC insulation. External mechanical protection shall be provided over the sensor cables. Vendor shall provide control unit for each 10 mtr. Length of the sensor cable.

## **6.12 Manual Break Glass Boxes**

6.12.1 The break glass box shall be fabricated out of 14 gauge cold rolled sheet steel. Alternately the break glass box may be made of die cast aluminium alloy such as LM6. It shall have IP-55 enclosure and weatherproof construction suitable for outdoor installation. The break glass box shall have a minimum dimension of 100x100x80mm.

6.12.2 The box shall be fabricated in such a way so that it can be mounted, flush to the wall or on the surface without any modification. Two nos. 19mm knock outs shall be provided at the bottom of the box to facilitate the cable/conduit entry. The glass shall cover at least 30cm<sup>2</sup> area and shall have a thickness not exceeding 2mm.



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6.12.3 The break glass box shall have a push button element kept in pressed condition by a glass sheet fitted in the front of the box.

6.12.4 The break glass box enclosure shall be painted with fire red colour (shade 536 of IS-5) epoxy painting and an inscription "Break Glass in Case of Fire", shall be painted in white letters or riveted on the enclosure by a steel nameplate. A suitable nickel plated brass hammer, duly chained to the box with stainless steel chain shall be provided with each box for breaking the glass. Each box shall have a distinct identification number boldly painted on it.

6.12.5 If specified in the enquiry documents / Scope of work, the break glass box shall have a suitably wired telephone hand set to facilitate communication between the break glass box and the central annunciation panel. In such a case the telephone hand set mounted on hook switch shall be provided in a separate lockable weather proof enclosure.

### **6.13 Response Indicator**

6.13.1 If specified in the enquiry documents/ Scope of work, response indicators shall be provided in a weatherproof box which shall be suitable for wall mounting. The response indicators shall be connected to the detectors directly and shall be complete with terminal blocks suitable to accept cables with up to 2.5 sq.mm. Copper conductor. In the normal state of detector, the LED shall flicker, but in the event the detector goes into alarm condition, the LED shall glow steadily. LEDs shall be red in colour with 5mm dia as a minimum.

6.13.2 Response indicators shall be employed only in case of non-addressable systems.

### **6.14 Exit Signs**

6.14.1 Exit signs shall be fabricated out of 16 gauge cold rolled sheet steel. This shall be suitable for wall mounting or hanging from ceiling.

6.14.2 Fire Exit / No Fire Exit shall be displayed on opposite of the exit sign by means of 5mm dia. Red LEDs or back-lit text. It shall derive power from data gathering cum fire alarm panel and shall operate on DC power supply.

### **6.15 Hooters**

6.15.1 The unit shall consist of solid state circuitry on a printed circuit board, a loudspeaker and a flashing lamp housed in a weatherproof dust tight, wall mounting type enclosure. The hooters shall, at least, have 102db (A) output measured at 1 meter distance. The unit shall derive power from the fire alarm panel and operate on DC power. In the event of fire, the hooter shall raise pulsating audio alarm and the lamp shall flash.

### **6.16 Flashing Lights**

6.16.1 The unit shall consist of solid state circuitry on a printed circuit board and a red capped incandescent lamp and audio unit housed in a dust tight, wall / ceiling mounting type enclosure. It shall derive power from the data gathering cum fire alarm panel and operate on DC supply.

6.16.2 Flashing lights shall be installed in the enclosed areas where clean agent / CO2 is to be dumped. In the event a signal for clean agent / CO2 release is given, the lamp shall start



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blinking with a warning sound enabling operating personnel to evacuate the area. The audio unit (hooter) shall have 102 dB (A) output measured at 1 meter distance.

#### **6.17 Clean Agent / CO2 Release and Inhibit Switches**

6.17.1 This unit shall consist of pull type release and inhibit switches clean agent / CO2. The unit shall be fabricated out of 18 gauge cold rolled sheet suitable for wall mounting. Switches shall be pulled to release or inhibit clean agent / CO2.

Release switches shall have inscription:

“PULL TO RELEASE CLEAN AGENT / CO2 “

And inhibit switches shall have inscription:

“PULL TO RELEASE CLEAN AGENT / CO2 “

#### **6.18 Zener Barrier**

6.18.1 Zener barriers, located necessarily in unclassified/nonhazardous areas, may be employed for wiring detectors/break glass boxes installed in hazardous areas. These shall render the circuit beyond the zener barrier intrinsically safe.

6.18.2 Not more than 10 detectors shall be connected to one zener barrier. Zener barriers may be located either in the Zonal panel or DGFAP, if permitted by geographic proximity of detectors and zonal panel or DGFAP or may be located close to the detectors / manual call points.

6.18.3 Wherever zener barriers are provided, in safe area outside the zonal panel or DGFAP, they shall be housed in their own enclosure and shall be dust and vermin proof, weatherproof with IP-55 degree of protection as a minimum.

#### **6.19 Short Circuit Isolator/Fault Isolator**

6.19.1 Short circuit isolator/Fault isolator shall be installed, if specified in the Scope of work.

Fault isolator shall be designed to provide short circuit protection to an analogue addressable detector loop. It shall be possible to wire the fault isolator at any point in the detector loop.

6.19.2 On occurrence of a fault (short circuit), the isolator shall cut power to all devices installed beyond the isolator in the loop.

6.19.3 The fault isolator shall have the capability to continuously check the faulted side of the loop to determine if the fault still exists. On rectification of the fault, the isolator shall automatically reset itself.

6.19.4 In case the fault isolator nearest to the fault does not activate first, the isolator shall query other isolators nearest to the short circuit and then de-activate/restore itself. The restoration shall continue along the loop until only the isolator closest to the fault is left activated.

6.19.5 The DGFAP panel shall be capable of accessing detectors/devices installed outside the zone covered by the fault isolator modules.



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6.19.6 Fault isolator modules shall be housed in a dust and vermin proof, weather proof enclosure, with IP-55 degree of protection as a minimum.

## **6.20 Sirens**

6.20.1 Sirens shall be industrial type with minimum 2.5km unidirectional range (i.e. 5km diametrical range) against the wind direction.

6.20.2 The decibel level of the siren shall, at least be, 132db(A) at 1 meter, to meet the audibility requirement for the above range. Unless otherwise specified, Sirens shall operate at 240V, 3ph. AC. Sirens shall be housed in weatherproof enclosure and shall be supplied along with direct-on-line starters. Power supply for sirens shall be derived from a source with battery back-up as specified in clause 4.1.2.

## **7.0 ADDITIONAL REQUIREMENTS FOR FIRE ALARM SYSTEM TO BE INSTALLED IN HAZARDOUS AREA**

7.1 In general the CFAP, DGFAPs, Zonal fire alarm panels, mimic panels and repeat alarm panels shall be located in control room environment which is non-hazardous. However, if specified in the enquiry Scope of work, the enclosure for the detectors, panels and other equipment shall have flameproof construction, conforming to IS-2148 and shall be suitable for installation in hazardous areas classified as Zone-1 and/or Zone-2, with gas group IIB or as specified in the Scope of work. All equipment for hazardous area installation shall be complete with cable glands as specified in clause 5.4.4.2.

7.2 Equipments which cannot have flameproof construction shall be intrinsically safe in design and Zener barriers shall be provided to restrict the energy levels.

7.3 For analogue addressable fire alarm systems, manual call points, address interface units, automatic detectors etc. which are to be installed in hazardous area shall preferably have flame proof construction to permit the use of class-A, style-6 fault tolerant wiring as per NFPA-72, without employing T-tapping. As an alternative, intrinsically safe address interface units, automatic detectors etc. may be permitted provided they are wired beyond zener barriers, located in non-hazardous area. Fire Alarm Circuit beyond zener barrier shall be “intrinsically safe” type confirming to IS5780.

7.4 For conventional fire alarm systems, manual call points, automatic detectors etc. which are to be installed in hazardous area shall preferably have flameproof construction. As an alternative, intrinsically safe automatic detectors may be permitted provided they are wired beyond zener barriers, located in non-hazardous area and meet the requirements of IS-5780.

7.5 Manual call points shall, however, be in flameproof construction only for either of the above fire alarm systems.

## **8.0 SPECIFIC REQUIREMENTS FOR INTERFACE WITH CLEAN AGENT / CO<sub>2</sub> RELEASE SYSTEM**

8.1 In the case of conventional fire alarm system, clean agent / CO<sub>2</sub> dumping area shall be divided at least into two zones for fire detection purposes. The detectors shall be installed in



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cross zoning manner. Signals for clean agent / CO<sub>2</sub> release shall be sent only when at least two zones have detected the fire. The blinking lights shall operate in the affected area. Two type of detectors in cross zones shall be provided in each dumping area.

On detection of fire (Min. two detectors), a signal from zonal Fire Alarm Panel shall be generated which shall open the valves for dumping clean agent / CO<sub>2</sub>.

8.2 In the case of analogue addressable fire alarm system, cross-zoning may not be necessary as the system shall be deemed to be capable of filtering out false alarms due to dust, dirt and other atmospheric changes. Signals for clean agent / CO<sub>2</sub> release shall be initiated on receipt of fire alarm from any detector in the protected area. The blinking lights shall operate in the affected area.

8.3 Clean agent / CO<sub>2</sub> can be released or inhibited by the "Clean Agent/ CO<sub>2</sub>" release and inhibit switch located outside the protected area or from the fire alarm panel. The contact for clean agent / CO<sub>2</sub> release alarm shall be taken from the pressure switch provided in the clean agent / CO<sub>2</sub> manifold. Provision in F.A. panel shall be kept to wire pressure switch contacts.

## **9.0 ENGINEERING REQUIREMENTS**

9.1 The vendor shall perform basic and detailed engineering activities, unless specified otherwise in the Scope of work.

### **9.1.1 Conventional Fire Alarm System**

9.1.1.1 For conventional fire alarm systems basic engineering shall include the development of block-diagram furnished by Employer.

9.1.1.2 The detailed engineering shall broadly include the preparation of MCP/detector layout drawings, based on Employer building / plant layout drawings. Preparation of cable schedules, interconnection drawings, equipment installation drawings, sizing of various equipment such as batteries, battery chargers etc. preparation of G.A. drawings of various equipment.

### **9.1.2 Analogue Addressable Fire Alarm System**

9.1.2.1 For microprocessor based analogue addressable fire alarm systems basic engineering shall include the development of block-diagram, finalizing the requirement of maximum permissible lengths for data highway/detector loops, configuring the central fire alarm panel requirements etc.

9.1.2.2 The detailed engineering shall broadly include the preparation of MCP/detector layout drawings, based on Employer building/plant layout drawings. Preparation of cable schedules, interconnection drawings, equipment installation drawings, sizing of various equipment such as batteries, battery charger, UPS etc. allocating addresses to various detectors and defining their sensitivity settings.

## **10.0 TESTING AND ACCEPTANCE**

10.1 During fabrication, panel shall be subject to inspection by Employer or by any authorized representative, to assess the progress of work. The manufacturer shall furnish all necessary



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information concerning the supply to Employer representative. Employer representative shall be given free access in the manufacturer's works from time to time to inspect the progress of the work. Three weeks notice shall be given by the vendor to Employer for witnessing the final routine tests of complete assembly to ensure satisfactory working of all components.

10.2 All routine tests as specified by the applicable codes and standards shall be carried out at the manufacturer's work under his care and expense.

10.3 Type test certificates, from a recognized testing organization, shall be furnished along with the bids. Type test certificates for hazardous area equipment shall also be furnished along with the bids.

10.4 Panels shall be tested for functional adequacy, at manufacturers works by simulation of fire/fault condition. Minimum testing shall include tests as specified in IS-2189 or as per the standards prevalent in the country of origin.

10.5 As specified in the Scope of work vendor shall conduct tests at site, after the entire fire alarm system is installed and inter connected by cables. These tests shall establish the operational correctness of the system i.e. all panels, detectors etc. Minimum testing shall included tests as specified at clause 11.2 of IS-2189.

#### **11.0 PACKING AND DESPATCH**

11.1 All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. The panel shall be wrapped in polythene sheets before being placed in crates to prevent damage to finish. Crates shall have skid bottom for handling. Special notations such as 'Fragile', 'This side up', 'Centre of gravity', 'Weight' etc. shall be clearly marked on the package together with Tag nos. P.O. Nos. etc.

11.2 The equipment may be stored outdoors for long periods before erection. The packing shall be completely suitable for outdoor storage in areas with heavy rains/high ambient temperature.





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4.0	Flushing
5.0	Testing



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6.0	Painting
7.0	Inspection and final acceptance
8.0	Treatment of underground pipelines

## **1.0 Specifications for erection**

### **1.1 Erection of Equipment**

Major activities involved in erection, testing & commissioning are enumerated below. However, any other activity not mentioned but required for total work execution shall be included in the scope of work of the Tenderer.





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- i) Receiving of equipment/ material, unpacking, storage, transporting the same to respective erection site.
- ii) Safe custody of equipment/ material from time of receipt till these are installed and handed over.
- iii) Cleaning, flushing and lubricating equipment / material before assembly, erection and testing. Servicing, greasing, packing the supplied valves as required by Employer
- iv) Checking of foundation levels, center lines, orientation, locations etc.
- v) Assembling, coupling, fitting, fixing, jointing, aligning various sections of equipment etc. by welding /bolting etc. as per the drawings.
- vi) Servicing of anchor bolts.
- vii) Supply and fabrication of liner plates, shim plates.
- viii) Installing the equipment on foundation /structures/ platforms / walls/ columns as the case may be in proper orientation.
- ix) Construction of civil pedestals for supporting the pipelines and construction of foundations for structural columns of pipe bridge
- x) Fixing and grouting of anchor bolts and base frame for pumps including supply of non-shrink grouting mix.
- xi) Supply, assembly, positioning, fixing of all accessories (platform, ladder, internals) on the main equipment.
- xii) Providing temporary supports, scaffolding, staging etc for supporting equipment, pipes etc as required during the construction, installation, and erection or testing. Removing the same after the completion of the job and keeping the area clean. Wooden ladders are not acceptable. Tenderer shall use metallic ladders only.
- xiii) Protecting properly all installed and uninstalled equipment/ material from theft, damage, pilferage and becoming a hazard to life and property. Protecting nozzles, flanges, machined parts, open pipe ends etc. by covering them with plastic pipe caps/ flange caps, wooden blanks, etc.
- xiv) Cleaning of equipment (internal & external) before testing.
- xv) Testing of pipelines, equipment as per the requirement, specifications and standards.
- xvi) Draining, emptying and cleaning the pipelines, equipment after testing and painting providing necessary drain points.
- xvii) Opening/closing manholes/ nozzles etc. as required during pre-commissioning.
- xviii) The following jobs are also included under Tenderer's scope of work for pumps, motors (Fixing, aligning etc of equipment shall be done only by skilled millwright fitter who will be approved by Employer before commencement of such work in case felt necessary).



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- Servicing of coupling, stuffing box, and bearings.

## 1.2 Erection of Fire Fighting Pipeline

The handling, laying and welding of pipelines shall be carried out conforming to relevant codes / standards unless otherwise stated in the specification given below.

There may be variation between dimensions shown in drawings and actually existing at site due to minor variations in the location of equipment, inserts, structures, etc. To take care of these variations "Field welds" shall be provided during piping fabrication. An extra pipe length of 100 mm over and above the dimensions indicated in the drawings may be left on one side of the pipe at each of the field welds. During erection, the pipe end with extra length at each field weld, shall be cut to obtain the actual dimension occurring at site. Isometrics, if supplied may have the field welds marked on them. However, it is the responsibility of the Tenderer to provide adequate number of field welds. In any case no extra claims will be entertained from the Tenderer on this account. Wherever errors / omissions occur in drawings and Bills of materials, it shall be the Tenderer's responsibility to notify the Engineer-in-charge prior to fabrication or erection.

Based on the site conditions, the routing of pipelines shown in the drawings may require modification. The Tenderer shall execute the work under his scope of work accordingly as directed by the Engineer in charge.

The measurement for laying of pipelines shall be based on measurement along the center line of the pipeline, inclusive of fittings but exclusive of items such as valves, strainers, etc.

The anti-corrosive treatment to the pipes to be laid underground shall be provided as specified in 11.00.

## 1.3 Erection of pipe above ground

Firefighting pipelines shall be routed and located as per final approved piping drawings keeping in view the piping specifications. No deviations from the arrangement shown shall be permitted without the written consent of DPT.

In general, pipelines shall be routed above ground. However, where road crossing is involved as indicated in the layout drawing, the pipelines shall be routed underground.

Pipelines shall be routed in a pipe bridge at about 6.5m height between the pump house and Tank lorry-filling gantry. At the Tank lorry-filling gantry, the pipelines shall be laid at around 5m level supported from building structures.

All pipe work shall be designed with sufficient flexibility to prevent development of undesirable forces or movements at the point of connection to equipment at anchorage or due to thermal expansion. Flexibility shall be provided by change of direction or by use of bends, loops or offsets.

Location and design of pipe supports shown in approved arrangement drawings/ support drawings should be strictly adhered to. Pipe supports i.e. restraints, such as guides, stops,



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anchors must be made in such a manner that they will not contribute to the over stressing of a line, while protecting a weaker or more sensitive component. e.g. pump.

Flanged joint shall be used for connections to vessels, equipment, flanged valves and road crossings and also on suitable straight lengths of pipelines at strategic points to facilitate erection and subsequent maintenance work.

While fitting/ welding of matching flanges care shall be exercised to properly align the pipes and to check the flanges for trueness, so that faces of the flanges can be pulled up together without inducing any stress at the pipes and equipment nozzles.

All flange facings shall be true and perpendicular to the axis of pipe to which they are attached. Bolt holes of the flanges shall straddle the normal centerlines unless different orientation is shown in the drawing.

Steel to cast iron flange joints shall be made up with extreme care, tightening the bolts uniformly after bringing flange flush with gaskets with accurate parallel and lateral alignment.

Flanged connections at the pumps, fittings, accessories, etc. shall be made in such a way as not to induce any stress due to misalignment, excessive gap etc. The final tightening shall be carried out when the machines are aligned completely and specifically authorized by Engineer-in-Charge. Temporary protection covers shall be provided at all flanged connections of pumps, until the piping is finally connected.

Pipelines shall be laid sloping towards drainage points.

The Tenderer shall maintain slopes specified for various lines in the drawing. Corrective action shall be taken by the Tenderer in consultation with Engineer-in-charge wherever the Tenderer is not able to maintain the specified slope.

Vents and drains shall be provided on each line at the highest and lowest points respectively to release the trapped air during hydraulic testing and to drain out the test fluid after testing. These openings shall be plugged and welded after the test.

After the piping is erected in final position, it shall be cleaned, tested for tightness and kept dry as described in the specification.

All valves shall be provided with the operating handle/ lever/ wrench within easy reach. Where ever necessary, operating platforms shall be provided.

Installation of line mounted equipment / items like filters, strainers sight glasses, etc., including their supporting arrangements shall form part of piping erection work and no separate payment shall be made for this work.

The Tenderer shall provide all required supports, anchors, saddles, hangers, rollers, clamps, u-bolts, guides, spring supports, sway bracings, vibration dampers etc for aligning and controlling the pipe work. Supports shall prevent, under operating conditions, excessive stresses and excessive vibration of supporting elements from possible resonance with imposed vibrations.



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Wherever additional flange joints/valve fittings are required, the same shall be provided after taking approval of the Engineer – in-charge.

All suitable hoisting tackles/ equipment should be used for speedy and safe handling of pipes while laying the pipes on supports, specifically in case of surface coated pipes. Such tackles/ equipment shall be provided with cushioning material to avoid damage to the lining / coating of the pipes.

The inside of the pipes shall be cleaned of stones, sand, dirt, oil, grease etc. thoroughly before laying. The cleaning process shall include removal of foreign matter such as scale, sand, weld spatter, cutting chips etc. by wire brushes, cleaning tools etc and blowing out with compressed air and / or flushing out with ordinary water.

#### **1.4 Buried Pipe**

All buried pipe work shall be laid with earth cover sufficient to avoid damage from pressure of vibration caused by surface traffic. Minimum earth covering over the pipe shall be 1200 mm from the finished ground level area in areas subject to temporary loads and 1000 mm from finished ground level in areas not subject to temporary loads. Where the buried depth is less than these limits, permission from the Engineer-in-charge shall be taken. All buried pipelines shall be provided with anti-corrosion wrapping and coating as specified.

The excavation of trenches shall be so carried out that the digging of trenches does not go far ahead of the pipe laying operations, so as to prevent risk of landslide. All work shall be so organized that trench digging, pipe laying, testing and back filling of trenches follow one another closely.

All buried pipes shall be hydro tested before wrapping and coating.

Where loose earth is met during excavation or where trench is very deep, sidewalls shall be shored properly with timber or other means.

The trench shall be excavated to proper width (min. for single pipe 800mm) and depth. In case of pipeline passing through existing RCC/ asphalt driveway, Tenderer shall refill the excavated driveway and bring it to its original finish. No additional claim for such work will be entertained.

All underground pipelines crossing rail tracks or roads shall be through culverts or RCC non pressure pipes of the approximate class as indicated in the drawings to suit the site conditions.

It should be ensured that while laying the pipes no foreign materials like stones, sand, gunny bags, bits of welding rods, muck, weld materials etc. are left inside the laid pipes. The Tenderer should ensure that the coating / wrapping of the pipes are not damaged while drawing the pipes through RCC pipes. If there is any damage, it shall be rectified by the Tenderer at his cost.

At the end of each day of work, the free ends of the laid pipes must be kept properly sealed.

Special care shall be taken to place the pipes in the trenches. If any damages are caused during laying/ residual welding of pipes in trenches, floating of pipes in water in trenches, it shall be the Tenderer's responsibility to get them repaired and no claim whatsoever on this account will be entertained by DPT.



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On completion of testing and painting of pipelines, the trenches shall be filled as per specification. The entire responsibility lies with the Tenderer for taking care of the pipes including lining/ coating of the pipes.

### **1.5 Pipe Sleeves**

Pipe sleeves shall be provided for pipes passing through foundations, walls, floors, roofs etc., they shall be of sufficient size to permit the passage of flanges or fittings assembled with the line. The annular space at the ends between the sleeve and the pipe shall be sealed with cement concrete.

All required operating platforms, valve stands, access ladders, handrails, pipe crossovers etc shall be erected after the piping has been installed. Structural steelwork in connection with those items shall conform to the relevant Indian Standards for structural steel work.

### **2.0 Welding**

All pipe work shall be of butt weld construction. Flanged joints shall also be provided to match the connecting ends of equipment, valves or where specified. Where specific equipment-piping connection necessitates several joints, unions shall also be provided. Only qualified welders proficient in welding in the vertical and overhead positions shall be allowed to weld these pipelines. Preferably welders with proficiency certificate from Govt. Test House or equivalent recognized authority should be put on the job. It shall be Tenderer's responsibility to arrange for and bear all costs towards testing of welders.

The following steps shall be taken besides controlling quality in general, to make effective control in carrying out welding:

Welding procedure (PQR & WPS) shall be prepared in line with ASME SEC. IX and tests shall be carried out to qualify the procedures. Number of procedures will depend on variables like positions of welding, thickness range, etc. Once a welding procedure is qualified, strict adherence to it shall be made during actual welding.

Welders employed shall be qualified as per ASME SEC. IX. DPT will have the right to check/ witness the certificate(s) / test(s) before and / or during execution of work.

Makes of welding consumables such as electrodes, filler wires, argon, etc. shall be approved by DPT before they are used. Such consumables are, however, subject to qualifying initial check tests as per ASME codes.

The Tenderer shall submit batch test certificates, from the electrode manufacturers, giving details of physical and chemical tests carried out by them, for each batch of electrodes to be used.

Guidelines for acceptance of weld defects detected by radiographic / ultrasonic tests, wherever applicable, shall be governed by ASME SEC.VIII, Div-I.

All electrodes shall be purchased in sealed containers and stored properly to prevent deterioration. The electrodes removed from the containers shall be kept in holding oven at temperatures recommended by the electrode manufacturer. "Out of the oven time" for



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electrodes, before they are consumed, shall not exceed the limits recommended by the electrode manufacturer. The electrode shall be handled with care to avoid any damage to the flux covering.

All low hydrogen type of electrodes shall be rebaked at 350°C for 1-hour minimum and stored in ovens kept at 80-100°C before use. Recommendation of the electrode manufacturer shall be followed if available.

The electrodes, filler wire and flux used shall be free from rust, oil, grease, earth and other foreign matter, which affect the quality of welding.

Welder's qualification test report as per IS: 817, electrode and material test certificate from manufacturer shall be furnished. Welding process shall be manual shielded metal arc process. Standard quality line up jigs and fixtures should be used to ensure sound welds. The cutting of pipes and welding shall conform to specifications and to the satisfaction of Employer site engineers.

Welding shall not be performed when surfaces to be welded are wet, when rain is falling on such surfaces or during the period of high winds unless the welder and the works are shielded in an approved manner.

Joint preparation for welding shall be so as to leave a smooth finished profile free of cavities and conforming to standard practice. Edges shall be cleaned of paint, rust, scale, slag, dirt and other foreign matter before welding.

The throat thickness of the tack welds shall be similar to that of the initial root to be deposited in the groove and where necessary the extremities of the tack welds shall be dressed by grinding, chipping and flame gauging to facilitate proper fusion when they are incorporated in the initial root run. Bridge tacks (above the weld) shall be removed.

All slag and scales etc. shall be removed from the surfaces of each completed bead before depositing the next bead.

The finished weld shall present a smooth bright and shiny surface of constant width and uniformly spaced ripples. The welds shall be free from slag pockets, porosity, undercutting, incomplete penetration and fusion and other weld defects.

The weld protrusions, spatter etc., on the weld surface and adjacent area shall be removed so as to leave the surface smooth and clean.

The weld shall not project beyond the plain surface in butt weld by more than 2mm.

All valves, flanges, risers, bends and other fittings shall be in perfect plumb and care shall be taken to align the pipelines and bends properly to keep the symmetry of the pipeline layout.

To maintain the specified alignment and gap during welding the pipes shall be securely held in position by technical means, tack welding or by welding on bridge pieces. Electrodes or filler rods used for tack welding shall be of the same quality as those for completing the first run of the weld. Welding electrodes used shall have approval from Employer. The following make of electrodes are acceptable:





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- Advani Oerlikon,
- Philips,
- D & H Sechron,
- GEE,
- Esab,
- Honavar Electrode Ltd.,
- Mailam.

Any other reputed make with the approval of Employer

Welding Electrodes for wall thickness up to 14mm shall be 6013 AWS and for wall thickness more than 14mm the electrode shall conform to 7018 AWS.

For root welding of pipe joints, the electrodes shall be 6010 AWS

All electrodes shall be purchased in sealed containers and stored properly to prevent deterioration. The electrodes removed from the container shall be kept in holding ovens at temperature recommended by the manufacturer.

## 2.1 Visual Inspection

Inspection of all welds shall be carried out as per the latest editions of the applicable codes and specifications. All finished welds shall be visually inspected for parallel and axial alignment of the work, excessive reinforcement, concavity of welds, shrinkage cracks, inadequate penetration, unrepaired burn-through, under cuts, dimensions of the weld, surface porosity and other surface defects. Undercutting adjacent to the completed weld shall not exceed the limits specified in the applicable standard/code.

## 2.2 Preparation of pipe ends

For pipes intended to be in axial alignment, the plane of the pipe ends shall be square with the axis of the pipe.

The pipes, which were intentionally out of the axial alignment, the plane of the joint shall bisect the angle between adjacent pipes.

All tack welded butt joint assemblies shall be inspected to ensure root gap alignment, quality of tack welds, their root penetration section and cleaning and freedom from crack. Any substandard tack weld shall be cut out and remade up to the standard before starting the welding.

## 2.3 MS pipe joints

The ends of pipe 4.5mm and under in wall thickness need not to be beveled. The ends of all pipes over 4.5mm wall thickness shall be bevelled to an angle of 30 degree for electric arc welding and to an angle 37-1/2 degree for gas welding. Where bevel is made with a cutting



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torch, the cut edge shall be mechanically cleaned to remove all scale, oxides and irregular edges.

In aligning the ends of pipe for welding, a space at the root of the joint about 1.5mm wide shall be allowed before tack welding. Where chill rings are used spacing up to 4.5mm should be allowed.

A wire spacer of suitable diameter may be used for maintaining the weld root opening while tacking, but it must be removed after tack welding and before laying the root bead.

For pipes of wall thickness 5 mm and above, the ends to be welded shall be secured in position with the aid of couplers, yokes and 'C' clamps, to maintain perfect alignment. Yokes shall be detached after the completion of weld, without causing any surface irregularity on the pipe. Any irregularity caused on the pipe surface must be suitably repaired to the satisfaction of the Engineer –in – charge.

Tack welds, for maintaining the alignment, of pipe joints shall be made only by qualified welders using approved WPS. Since the tack welds become part of the final weldment they shall be executed carefully and shall be free from defects. Defective tack welds must be removed prior to the actual welding of the joints. While practical aligning, clamps should be used and the ends shall be tack welded to retain their position during welding. The number of tack welds shall be not less than:

3 tacks - for pipe sizes smaller than 50mm NB.

4 tacks - for pipe sizes more than 50mm NB upto 300mm NB.

6 tacks - for pipe sizes more than 350mm NB.

The tack welds shall be approximately 25mm long and well fused along with sides of end to the bottom of "V" or groove.

Welding shall commence only after approval of fit-up by the Engineer – in – charge.

### **3.0 Welding Techniques**

#### **3.1 Root Pass**

Root pass shall be made with electrodes / filler wires recommended in the welding specification chart. For fillet welding, root welding shall be done with consumables recommended for filler passes. The preferred size of the electrodes is 2.5mm diameter (12 SWG) but in any case not greater than 3.25mm (10 SWG).

Upward technique shall be adopted for welding pipe held fixed with its axis horizontal.

The root pass of butt joints should be executed so as to achieve full penetration with complete fusion of the root edges. Weld projection inside the pipe shall be as per applicable code. It shall be limited to 3mm maximum, when the applicable code does not place any restriction.





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Any deviation desired from the recommended welding technique and electrodes indicated in the welding specification chart should be adopted only after obtaining express approval of the Engineer – in – charge.

Welding shall be uninterrupted.

While the welding is in progress care should be taken to avoid any kind of movement of the components, shocks, vibrations and stresses to prevent occurrence of weld cracks.

Peening shall not be used.

### **3.2 Joint Completion**

Joint shall be completed using the class of electrodes, recommended in the welding specification chart. Size of the electrode shall not exceed 4mm in diameter for stainless steel and alloy steels used for low temperature applications.

Two weld beads shall not be started at the same point in different layers.

Butt joint shall be completed with a cover layer that would ensure good fusion at the joint edges and a gradual notch free surface.

Each weld joint shall have a workmanship like finish. Weld identification mark shall be stamped clearly at each joint, just adjacent to the weld. Metal stamping shall not be used on thin pipe having wall thickness less than 3.5mm. Suitable paint shall be used on thin wall pipes for identification.

Rust preventive / protective painting shall be done after the weld joint has been approved.

The weld shall be thoroughly fused to both sides of the "V" or groove and through the bottom of the joint. The pipes shall be welded with three runs of weld. There shall be good fusion between each run and scale shall be thoroughly removed from the surface of each bead or layer of scaling or moderately peeling before the next one is applied. In the event of any cracks occurring, tack welds shall be chipped out before welding is continued. Special care shall be exercised to remelt the tack welds to fuse them with the weld.

Where the pipe can be turned, all welding shall be carried out in the down hand position.

The finished weld shall be uniform and of smooth finish. There shall be no overlapping or excessive undercutting of the pipe at the edge of the weld.

### **3.4 Repairs of welds**

Defects ascertained, through the inspection methods, which are beyond acceptable limits shall be removed after the joint is completely radiographed by the process of chipping and grinding.

When the entire joint is judged unacceptable, the welding shall be completely cut and edges suitably prepared as per required alignment tolerances. The rewelded joint shall again be examined following standard practices.

No repair shall be carried out without prior permission of the Owner's inspector.



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Repairs and / or rework of defective welds shall be done in time to avoid difficulties in meeting the construction schedules.

### 3.4 Riser and Branch Connections

The end of the riser or branch connection and the opening in the line or header shall be prepared by gas cutting or machining along templates lines to ensure accurate cutting and proper fit up. After gas cutting the edge forming the pipes, opening shall be beveled so as to permit welding completely around the joint for connections. Any rough gas cut edges shall be cleaned and or removed by chipping or other mechanical means. The riser may be fitted inside the opening in the header, or set in top. In the latter case the branch shall be beveled for welding. It is preferable to have the riser at least one size smaller than the header but risers of the same sizes as the header are permitted. The use of welding toes in such case is recommended.

After beveling the work shall be assembled and checked as regards matching of ends, uniformity of spacing and bevel angle and any defects noted shall be corrected prior to welding.

The joint shall be tack welded in a manner similar to that required for 'Pipe line joint'.

Where the riser is set in, the weld shall be thoroughly fused to both the beveled edge of the header and to the sidewalls of the riser. Where the branch or riser is beveled for setting on top of the opening care shall be exercised to penetrate well, metal shall be fused through at the root. Where the riser is placed on top of the header it should be back welded on the inside, wherever possible.

All set in connections shall be prepared so that the ends are at least flush with the inside wall of the header.

In the case of an off set riser subjected to excessive stresses, knee braces gaskets shall be used.

### 3.5 Supports

Cement concrete/ brick masonry pedestal supports with metal inserts shall be provided for yard piping by the civil works Tenderer. Sliding contact between the support and the pipe is achieved by providing 25mm dia MS rod supplied and erected by the Tenderer. This rod shall be welded to the insert plate. If the level of the top of the rod does not match the required level, proper level of the bottom of the pipe is achieved by raising the rod by means of packing plates between the rod and insert plate. After leveling, the packing plate is welded to the insert and the rod in turn welded to the packing plate.

The heights of the supports shall be adjusted so as to suit the pipeline gradient required and also the pipe work installed. The underside of the pipe should have a minimum distance of 300mm from the ground level. This enables easy maintenance of the pipelines and fittings. Special consideration should be given to the control valves etc. in the pipe run.



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Grade stakes set to correct levels shall be provided along the pipeline alignment at suitable intervals for checking the levels of the pipe supports/ pipeline during construction of supports/ laying of pipelines.

Due care shall be taken while laying the pipeline on the supports. The Tenderer shall correct any damage caused to supports. No claims whatsoever will be entertained by DPT on this account.

The Tenderer shall provide pipe supports on steel structures:

Near changes in direction, branch lines and particularly near valves

On pipe and not on valves, fittings or expansion joints

On pipe and not on sharp radius bends or elbows

On runs which do not require frequent removal for maintenance

As close as practical to heavy load concentrations such as vertical runs which do not require removal for maintenance.

As close as practical to heavy load concentrations such as vertical runs, branch lines, heavy valves, separators, strainers etc. and as per direction of site engineer.

In establishing the location of pipe supports, the Tenderer should be guided by two requirements:

The horizontal span must not be so long that sag in the pipe will impose an excessive stress in the pipe wall

The pipeline must be pitched downward so that outlet of such span is lower than maximum sag in the span in order to facilitate drainage.

#### **4.0 Flushing**

Flushing of all lines shall be done before pressure testing.

Flushing shall be done by fresh potable water or dry compressed air, wherever water flushing is not desirable, to clean the pipe of all dirt, debris or loose foreign material.

Required pressure for water flushing shall meet the fire hydrant pressure or utility water pressure. For air flushing, the line / system will be pressurized by compressed air at the required pressure which shall be 50 psi maximum. The pressure shall then be released by quick opening of a valve, already in line or installed temporarily for this purpose. This procedure shall be repeated as many times as required till the inside of the pipe is fully cleaned.

In line instruments like control valves, orifice plates, rotameters, safety valves and other instruments like thermo wells, which may interfere with flushing, shall not be included in flushing circuit.

The screens / meshes shall be removed from all permanent strainers before flushing. Screens / meshes shall be reinstalled after flushing but before testing.



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During flushing temporary strainers shall be retained. These shall be removed, cleaned and reinstalled after flushing but before testing.

In case equipment such as column, vessel, exchanger etc. form part of a piping circuit during flushing, this shall be done with the approval of Engineer – in – charge. However, equipments thus included in circuit shall be completely drained and dried with compressed air after flushing is completed.

During flushing discharged water / air shall be drained to the place directed by the Engineer – in – charge. If necessary, proper temporary drainage shall be provided by the Tenderer

Care shall be taken during flushing so as not to damage / spoil work of other agencies. Precautions shall also be taken to prevent entry of water / foreign matter into equipments, electric motors, instruments, electrical installation etc. in the vicinity of lines being flushed.

The Tenderer shall carry out all the activities required before, during and after the flushing operation, arising because of flushing requirements, such as but not limited to the following:

Removing of valves, specials, distance pieces, inline instruments and any other piping part before flushing. The flanges to be disengaged for this purpose shall be envisaged by the Tenderer and approved by the Engineer – in - charge. These flanges shall be provided with temporary gaskets at the time of flushing.

After flushing is completed and approved, the valve distance pieces, piping specials, etc. shall be reinstalled by the Tenderer with permanent gaskets. However, flanges at equipment nozzles and other places where isolation is required during testing, only temporary gaskets shall be provided.

Records in triplicate shall be prepared and submitted by the Tenderer for each piping system for the flushing done.

## **5.0 Testing**

### **5.1 General:**

Soundness of the welds shall be tested by means of hydrostatic tests. The test shall be conducted only after fulfilling the requirements of visual inspection, radiography, etc., and when the entire work is certified by the engineer-in-charge for performance of such testes.

This specification recommends minimum procedure to be followed, equipment to be used and conditions to be considered during the hydrostatic testing of pipelines.

Nothing in this recommended procedure should be considered as a fixed rule for application without regard to sound engineering judgment. Certain Governmental requirements may differ from the criteria set forth in this recommended procedure and its issuance is not intended to supersede/override such requirements.

### **5.2 Extend of Testing**



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With the exclusion of instrumentation, piping systems fabricated or assembled in the field shall be tested irrespective of whether or not they have been pressure tested prior to site welding or fabrication.

To facilitate the testing of piping systems, vessels and other equipments may be included in the system with the prior approval of Engineer – in – charge if the test pressure specified is equal to or less than that for the vessel and other equipments.

Pumps, Compressors and other rotary equipments shall not be subjected to field test pressure.

Lines, which are directly open to atmosphere such as vents, drains, safety valves discharge need not be tested, but all joints shall be visually inspected. Wherever necessary, such lines shall be tested by continuous flow of fluid to eliminate the possibility of blockade. However, such lines if provided with block valve shall be pressure tested up to the first block valves.

Seats of all valves shall not be subjected to a pressure in excess of the maximum cold working pressure of the valve. Test pressure applied to valves shall not be greater than the manufacturer's recommendation nor less than that required by the applicable code. Where allowable seat pressure is less than test pressure, test shall be made through an open valve.

Instruments in the system to be tested shall be excluded from the test by isolation or removals, unless approved otherwise by the Engineer – in – charge.

Restrictions, which interfere with filling, venting and draining such as orifice plates etc. shall not be installed unless testing is complete.

Control valves shall not to be included in the test system. Where bypasses are provided test shall be performed through the bypass and / or necessary spool pieces shall be used in place of the control valve.

Pressure gauges, which are part of the finished system, but cannot withstand test pressure, shall not be installed until the system has been tested. Where piping systems to be tested are directly connected at the battery limits to piping for which the responsibility rests with other agencies, the piping to be tested shall be isolated from such piping by physical disconnection such as valve or blinds.

### **5.3 General Requirement / Preparation for Testing**

Testing shall be carried out with permanent gaskets installed unless specified otherwise or instructed by the Engineer – in – charge

No pressure test shall be carried out against closed valve unless approved by the Engineer – in – charge.

The Engineer- in – charge shall be notified in advance by the Tenderer, of the testing sequence and programme, to enable him to be present for witnessing the test.

Before testing, all piping shall be cleaned by flushing to make it free from dirt, loose scale, debris and other loose foreign materials.



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All piping system to be hydrostatically tested shall be vented at the high points and the systems purged of air before the test pressure is applied.

Wherever in the line any void exists due to any reasons, like absence of control valves, safety valves, check valves etc. it shall be filled with temporary spool pieces.

All joints welded, screwed or flanged shall be left exposed for examination during the test. Before pressuring the lines, each weld joint shall be cleaned by wire brush to free it from rust and any other foreign matter.

Where a system is to be isolated at a pair of companion flanges, a blank shall be inserted between the companion flanges. Minimum thickness of the blank shall be designed in accordance with applicable design code.

Open ends of piping system where blanks cannot be used, such as pumps, compressors, turbines or wherever equipment or pipe spool pieces have been removed or disconnected prior to hydrostatic testing, shall be blinded off by using standard blind flanges of same rating as the piping system being tested.

Pressure gauges used in testing shall be installed as close as possible to the lowest point in the piping system to be tested, to avoid overstressing of any of the lower portions of the system. For longer lines and vertical lines two or more pressure gauges shall be installed at locations decided by the Engineer – in – charge.

For lines containing check valves any of the following alternatives shall be adopted for pressure testing:

Wherever possible pressurise up- streamside of valve.

Replace the valve by a temporary spool pieces and reinstall the valve after testing.

Provide blind on valve flanges and test the upstream and downstream of the line separately and remove the blind after testing. At these flanges, temporary gaskets shall be provided during testing and shall be replaced by permanent gaskets subsequently.

For check valves in lines 1 ½" and below flapper or seat shall be removed during testing (if possible). After completion of testing the flapper / seat shall be refitted.

Gas lines when hydrostatically tested shall be provided with additional temporary supports during testing as directed by the Engineer – in – charge.

Piping which is spring or counter weight supported shall be temporarily supported, where the weight of the fluid would overload the support. Retaining pins for spring supports shall be removed only after testing is completed and test fluid is completely drained.

When testing any piping system, air or steam of approximately 2 kg / cm<sup>2</sup> g may be used as preliminary test to detect missing gaskets etc. as this avoids the necessity of draining the line to make repairs. However, steam shall not be used for this purpose, if the steam temperature is more than the design temperature of the line.

#### **5.4 Testing media, test pressure and test pressure gauges**





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#### **a. Testing Media**

In general all pressure test shall be hydrostatic using iron free water, which is clean and free of silt

Air shall be used for testing only if water would cause corrosion of the system or overloading of supports etc. in special cases as directed by Engineer – in – charge.

#### **b. Test Pressure**

The hydrostatic / pneumatic test pressure shall be as indicated in the line list or as per the instruction of Engineer – in – charge.

The selection of the piping system for one individual test shall be based on the following:

Test pressure required as per piping drawing.

Maximum allowable pressure for the material of construction of piping.

Depending upon the above requirements and based on construction progress, maximum length of piping shall be included in each test.

#### **c. Test Pressure Gage**

All gauges used for field-testing shall have suitable range so that the test pressure of the various systems falls in 40 % to 80 % of gauge scale range. Gauge shall be of a good quality and in first class working condition.

Prior to the start of any test or periodically during the field test programme, all test gauges shall be calibrated using a standard dead weight gauge tester or other suitable approved testing apparatus. Any gauge showing an incorrect zero reading or error of more than +2% of full scale range shall be discarded. The Engineer – in – charge shall check the accuracy of master pressure gauge used for calibration.

### **5.5 Testing Procedure**

#### **a. Air Test**

When testing with air, pressure shall be supplied by means of a compressor. The compressor shall be portable type with a receiver, after cooler and oil separator.

Piping to be tested by air shall have joints covered with a soap and water solution so that the joint can be examined for leaks.

All other details shall be same as per hydro testing procedure (specified above).

#### **b. Completion of Testing**

After the hydrostatic test has been completed, pressure shall be released in a manner and at a rate so as not to endanger personnel or damage equipments.



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All vents and drains shall be opened before the system is to be drained and shall remain open till all draining is complete, so as to prevent formation of vacuum in the system. After draining, lines / systems shall be dried by air.

After testing is completed the test blinds shall be removed and equipment / piping isolated during testing shall be connected using the specified gaskets, bolts, and nuts. These connections shall be checked for tightness in subsequent pneumatic tests to be carried out by the Tenderer for complete loop / circuit including equipments (except rotary equipments).

Pressure test shall be considered complete only after approved by the Engineer – in – charge. Defects, if any, noticed during testing shall be rectified immediately and retesting of the system / line shall be done by the Tenderer at his cost.

#### **c. Test Records**

Records in triplicate shall be prepared and submitted by the Tenderer for each piping system, for the pressure test done.

#### **d. Hydraulic test**

The Tenderer shall ensure that the pipelines have been thoroughly cleaned up by flushing with clean water/ compressed air of any foreign matter inside the pipes and dried before taking up for hydro test. The procedure adopted for cleaning shall be indicated by the Tenderer and subject to approval by Employer.

All equipments materials, consumables including water and services required for carrying out the pressure testing of piping system shall be provided by the Tenderer at his own cost.

In case of buried pipes the trenches shall be kept free of water and the pipeline surfaces dry. The pipeline shall be filled with water and the pressure built up by means of test pump with a gauge to the specified pressure.

With the exclusion of instrumentation, piping systems fabricated or assembled in the shop / factories shall be tested at the site, irrespective of whether or not they have been pressure tested prior to site welding or fabrication.

The site – in – charge shall be notified in advance by the Tenderer of testing sequence / Programme, to enable him to be present for witnessing the test.

All vents and other connections used as vents shall be left open while filling the line with test fluid for complete removal of air. In all lines, for pressurizing and depressurizing the system, temporary isolating valves shall be provided if valved vents and drains do not exist in the system.

Pressure shall be applied only after the system / line is ready and approved by the Engineer – in – charge. Pressure shall be applied by means of a suitable test pump or other pressure source, which shall be isolated from the system, as soon as test pressure is reached and stabilized in the system.





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A pressure gauge shall be provided at the test pump discharge for guidance in bringing the system to the required pressure.

The test pump shall be attended constantly during the test by an authorized person. The pump shall be isolated from the system whenever the pump is to be left unattended.

Test pressure shall be maintained for a sufficient length of time to permit thorough inspection of all joints for leakage or signs of failure. Any joint found leaking during a pressure test shall be retested to the specified pressure after repair. Test pressure shall be maintained for a minimum of two hours.

The pump and the piping system to be tested are to be provided with separate pressure indicating test gauge. These gauges are to be checked by the standard test gauge before each pressure test.

Care shall be taken to avoid increase in the pressure due to temperature variation during the test.

## **5.6 Equipment for a Hydrostatic Test**

Equipment for the hydrostatic test should be properly selected and in good working order.

Equipment affecting the accuracy of the measurements used to validate the specified test pressure should be designed to measure the pressures to be encountered during the hydrostatic test.

Equipment for conducting the hydrostatic test may include the following:

A high volume pump capable of filling the line at minimum velocity of 2 km/hr.

A test medium supply line filter capable of ensuring a clean test medium.

An injection pump to introduce corrosion inhibitors or other chemicals into the test segment, if their use is required. A meter or other comparable means of measuring line fill.

A variable speed positive displacement pump capable of pressurizing the line at 7 kg/cm<sup>2</sup> (approximately 100 psi) in excess of the specified test pressure. The pump should have a known volume per stroke and should be equipped with a stroke counter (a constant speed pump having a variable flow rate control may be used in lieu of the above if the liquid test medium injected into the pipeline is measured during pressurization).

Portable tank, if required, capable of providing a source of liquid test medium.

A large diameter bourdon tube type pressure gauge with a pressure range and increment divisions necessary to indicate anticipated test pressures.

A deadweight tester certified for accuracy and capable of measuring increments of 0.1 kg/cm<sup>2</sup> (1.5psi).

A 24-hours recording pressure gauge with charts and ink. This gauge should be deadweight tested immediately prior to and after use



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Two glass laboratory thermometers, with a 75mm. (approximately 3") immersion capability of measuring temperatures from 0 deg.C (32 Degree F) to 50 Degree C (122 Degree F).

A 24 hours recording thermometer capable of recording temperatures from 0 deg.C (32 Degree F) to 50 Degree C (122 Degree F).

Pigs, spheres and similar devices to be used to clean the test segment and to facilities the removal of air from the line.

Temporary manifolds and connections as necessary.

Equipment, materials and fluids needed to displace the test medium from the test segment.

### 5.7 Test Plan

The following factors should be considered in planning a hydrostatic test:

Maximum operating pressure anticipated through the life of the facility.

Location of pipe and other piping components in the test segment by size, wall thickness, grade type and internal design pressure(s).

Shell pressure rating and location of pipeline valves, air vents and connections to the segment.

Anticipated temperature of test medium, atmosphere and ground.

Source(s) of test medium and any inhibiting or other treating requirements

Locations and requirements for test medium disposal.

Profile and alignment drawing maps.

Safety precautions and procedures.

### 5.8 Test Pressures

A hydrostatic test procedure diagram with explanatory notes and data should be prepared prior to testing and should indicate in a detailed fashion the following:

The length and location of the test segment(s).

Test medium to be used.

Procedures for cleaning and filling the line.

Procedures for the pressurisation of test segment(s) including the locations of the injection points and the specified minimum and maximum test pressures.

Minimum test duration for test segment(s).

Procedures for removal and disposal of test medium.

Safety precautions and procedures.

A specified test pressure is defined as the minimum test pressure, which should be applied to the most elevated point in the test segment. A detailed analysis of the profile to determine static and dynamic pressures while the pipeline is being tested should be performed so that the pipeline will not be over pressurized at points, which are at low elevations.

### 5.9 Line fill and Cleaning



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The line fill operation should serve the dual function of cleaning the line and introducing the necessary test medium into the test segment. Screens or filters should be installed in the test medium supply line to control the contamination of the test medium by debris or sediment. The quality and source of water should be determined. Water, which is not free of sediments and may be injurious to the pipe, valves, equipments, etc., should not be used unless it is filtered. The filling operation should be planned and executed in a manner, which prevents the infusion of air into segment to permit the purging of trapped air.

### **5.10 Pressurization**

Personnel conducting the test should maintain continuous surveillance over the operation and ensure that it is carefully controlled.

The test segment should be pressurized at a moderate and constant rate. When approximately 70% of the specified test pressure is reached, the pumping rate should be regulated to minimise pressure variations and to ensure that increments of no greater than 1 kg/cm<sup>2</sup> may be accurately read and recorded. Pipe connections should be periodically checked for leaks during pressurization.

### **5.11 The Test Hold**

When the test pressure is reached, pumping should be stopped and all valves and connections to the line should be inspected for leakage, a period of conservation to the line should follow during which test personnel verify that specified test pressure is being maintained at the line pressure and temperature has stabilized. Upon completion, the injection pump should be disconnected of its connection to the pipelines and checked for leakage. Pressure should be monitored and recorded continuously during the duration of the test.

### **5.12 Displacement of Test Medium**

Water should be completely drained off. Water should be disposed of at approved locations in a manner that will cause minimal environment effects.

The pressure shall be maintained for a minimum period of 1/2 hour unless otherwise specified by the client. The hydrostatic test shall be considered positive only if there is no drop in pressure at the end of the specified period.

All welded and flange joints and the seam welds on the ERW pipe shall be inspected for leaks.

Leaky joints shall be repaired by chipping or gauging out such defects as required and rewelded. The cut out of joints shall be just sufficient to correct the defects. After repairing the leaky joints, the line shall be tested to prescribed pressure. No claims for expenditure incurred by the Tenderer towards such repairs of defective work and testing will be entertained.

After test, the water shall be completely emptied out and the line shall be made free of water.

All underground piping shall be tested and ensured of no leakage at test pressure before filling up trenches.

No painting shall be done at weld joints till the system is accepted in all respects.



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## 6.0 Painting

### 6.1 General

This specification covers the requirement of selection, supply, application and workmanship of protective coating system for piping.

It is deemed that the work will be carried out by the Tenderer with the best quality of specified material and workmanship at his own cost.

Adequate numbers of required tools, brushes, blast material, scaffolding, shot / sand blast cleaning equipment, air compressors, etc., shall be arranged by the Tenderer at site.

During storage and application of paints, the paint manufacturer's instructions shall be strictly followed. Particular attention shall be paid to the following:

Proper storage avoiding exposure and extreme temperature.

Specified surface preparation.

Mixing and thinning.

Application of paints and the recommended time intervals between consecutive paint coats.

Two-pack paint system shall be mixed by mechanical means. The Engineer – in – charge may allow hand mixing of small quantities at his discretion.

Final Painting of pipelines / structural steel works shall be done only after the mechanical completion and testing of the system are completed.

'Fire Red' colour paint shall be used for painting firewater network, hydrant monitors, hoses, boxes etc.

Colour schemes shall be in line with standard industrial codes in line with OWNER practices, which will be indicated to the successful Tenderer.

Scope of pipeline painting work covered in the specification shall include:

Structural steel work, walkways, pipes supports, ladders, etc.

All above ground piping and fittings including identification marks.

Painting of valves.

Identification colour bands and directions on all piping as required.

Supply of all primers, paints and all other material required for painting.

Coating and wrapping of underground pipelines.

### 6.2 Surface cleaning

All rough welds, burrs, weld splatter, indentations and all other sharp surface projections shall be ground smooth prior to further surface preparation. Surface shall be blast cleaned to SA 2 ½.



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Maximum peak of surface profile shall be less by 5 – 10 microns from the primer DFT. Any protective coating used by the pipe manufacturer/ supplier shall be removed during blast cleaning.

All boltholes shall be drilled and smoothened before cleaning.

Any oil, grease, dust or foreign matter deposited on the surface after the surface preparation is completed shall be removed prior to painting. In the event rusting occurs after completion of surface preparation and before application of the primer the surfaces shall again be cleaned in accordance with the specified method.

Name plates, Manufacturer's identification tags, machined surfaces, instrument glass, control valve stems and other items in contact with or near the surface being coated shall be removed or marked as appropriate for protection, prior to protective coating application.

In order to achieve maximum durability, one or more of following methods of surface preparation shall be followed before blast cleaning:

**a. Manual or Hand Tool Cleaning**

This normally consists of hand descaling and / or hammering, hand scraping and hand wire brushing. Rust, mill scales, weld spatters, old coatings and other foreign matter shall be removed by hammering, scraping tools, emery paper cleaning, wire brushing or combination of the above methods. On completion of cleaning, loose material shall be removed from the surface by clean rags and the surface shall be brushed, swept, re-dusted and blown off with compressed air to remove all loose matter.

**b. Mechanical or power tool cleaning**

Power tool cleaning shall be done by mechanical striking tools, chipping hammers, grinding wheels or rotating steel wire brushes. Excessive brushing of surface shall be avoided as it can reduce paint adhesion. On completion of cleaning, the detached rust, mill scale, etc. shall be removed by clean rags and / or washed by water or steam and thoroughly dried with compressed air jet before application of paint.

**c. Blast Paint**

The sand / shots used for blasting shall be free from moisture, salt. Sand size should be 16 mesh to 30 mesh in order to have surface profile range 55 – 65 microns.

Size of abrasive: 16 – 30 mesh. The particle should pass through 100% when sieved with 16 mesh and nothing to pass through when sieved with 30 mesh i.e., size below 16 and above 30 mesh are not recommended.

Shape of abrasive: Shape, semi-sharp, spherical or near spherical. Semi-sharp means some sharp as well as round edge in one particle grit.

The total surface shall then be blast cleaned to Swedish standard SA 2 ½.

The blasting has to be carried out at a pressure of 7 kg/cm<sup>2</sup> at the nozzle tip. Compressed air is to be free from moisture and oil.



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On completion of blasting operation, the blasted surface shall be made clean and free from any dust and scale or rust and must show a grey white metallic luster as demonstrated in SA 2 ½.

Blast cleaning shall not be done in bad weather without adequate protection or when there is dew on the metal, which is to be cleaned, or humidity exceeding 85%. Surface profile shall be uniform to provide good key to the paint.

Primer or first coat of paint shall be applied within 3 hours of sand blasting or as directed by Engineer – in – charge depending on weather conditions.

### **6.3 Coating Procedure**

#### **a. Coating System**

Painting system for the pipelines and other structures shall be as indicated in this specification.

#### **b. Application**

Before application of primer, the surface shall be cleaned of dust etc. Surfaces shall not be coated in adverse weather conditions, rain, wind, snow, fog, mist, or / and in areas where injurious airborne elements exist.

Cleaned surfaces shall be coated with one complete application of primer as soon as practicable but in no case more than three hours after surface preparation.

Application of coats shall not be carried out if the atmospheric temperature is less than 5°C or if the temperature exceeds 40°C in the shadow, 50°C due to the influence of sun or if relative humidity exceeds 85% or in case of adverse weather conditions like rain, fog, dust storm etc.

All paints shall be thoroughly stirred up prior to and during their application.

To the maximum extent practicable, each coat of material shall be applied as a continuous film of uniform thickness free of pores.

Coating media shall be applied in uniform thickness. All slots, recesses, grooves, corners, angles and interstices shall be covered by paint. Sag and runs shall be distributed or removed and new paint shall be applied uniformly.

Any thin spots or area missed in the application shall be recoated and allowed to dry before the next coat is applied.

Each coat shall be in proper state of cure / dryness before the application of the succeeding coat. Material shall be considered dry for recoating when an additional coat can be applied without development of any detrimental line irregularities, such as lifting or loss of adhesion of the undercoat.

When successive coats of the same colour have been specified, alternate coats shall be tinted, when practical, sufficient to produce enough contrast to indicate complete coverage of the surface. When the material is of the same colour as of the steel, or when the tinting of the final coat is objectionable, the first coat to be applied shall be tinted. The tinting material shall be





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compatible with the material and not detrimental to its service life. Shade of each coat shall be got approved by Engineer – in – charge.

All containers of coating material shall remain as unopened original Manufacturer's containers until required for use. Coating materials that have jelled or deteriorated during storage shall not be used.

Paint containers shall be opened only prior to utilisation and shall be carefully closed immediately after withdrawal of paint. Expiry date of the paint should be checked before opening the container. Paints, which have become unserviceable during storage, shall not be applied. All painting material shall be kept in weatherproof barracks and shall be kept cool and dry.

All ingredients shall be thoroughly mixed before use to a smooth and uniform consistency using mechanical means. No air bubbling shall be used for this purpose.

All pigmented material shall be strained after mixing so as to remove any skin, etc. before use. Coating material shall not remain in spray pots or buckets over night but shall be gathered into a closed container and remixed before use.

All thinning and mixing shall be done strictly in accordance with the Manufacturer's instructions for the particular materials and under the supervision and direction of the engineer-in-charge or his representative.

Where brush coating is applicable, brushes shall be of a style and quality that will enable proper application of paint. Wide flat brushes are suitable for large flat areas but they shall not have width over five inches. Rough or oval shaped brushes shall be used for irregular and rough surfaces.

The brushes shall conform to IS: 384. The width of the brushes shall not be more than 15cms.

Paint shall be applied by brush / conventional spray / airless spray. During spraying the paint shall be maintained thoroughly mixed in the spray gun.

Tenderer shall obtain approval for specification for spraying installation concerned, the type of equipment, nozzle diameter, pressure setting etc. The paint shall be sprayed uniformly. Surfaces impossible to be coated by spraying must be painted by brush.

Painting work shall be done in daytime only preferable between 9 am and 5 pm.

#### **6.4 Repair of damaged paint surface**

The Tenderer shall rectify painting work found defective under this specification at no additional cost to DPT.

Where shop paint has been damaged in handling, all damaged and loosely adhering paint shall be removed and the surface thoroughly cleaned. Edges of the breaks shall be lathered and the designated number of prime and finish coats applied.

#### **6.5 Paint Material**



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Primer and finish coats shall be of first class quality and shall conform to the specification indicated below:

**a. Specification for paints:**

**Zinc Ethyl Silicate Primer (P1)**

The zinc ethyl silicate consists of two packs. One pack contains the ethyl silicate binder with suitable solvents. The other pack contains zinc dust with additives. They have to be mixed in suitable proportions before application as recommended by manufacturer.

Colour	: Grey
Application	: Spray (airless / air)
Dry film thickness per coat	: 65-75 microns
Theoretical coverage	: 8 sq.m / litre
Drying time	: 4 hours
Re-coating time	: 10 hours (min)
% of total metallic zinc in dry film	: 85 – 90 % by wt.
(As per the ASTM D520 – Spherical size storage life)	: 4 months under sealed conditions.

**b) Epoxy primer (P2)**

The primer is a two pack anti corrosive epoxy primer for use on steel surfaces.

Volume of solids	: 40 ± 2%
Composition	: Epoxy resin/ Zinc
Phosphate Colour	: Red Oxide
Pigment volume concentration	: 25-35%
Application	: Brush or spray Dry film thickness per coat : 40-50 µm
Theoretical coverage	: 8-10 sq.m/ litre
Drying time	: Touch dry – 1 hour; Hard dry – over night
Storage life	: 9 months under sealed conditions.

**c) Two pack epoxy – polyamid mio undercoat (U1)**

These coatings are high build paints based on cold cured epoxy polyamide system pigmented with chemically inert pigments and extenders formulated to permit application at a DFT higher than 100 microns per coat.

Type of epoxy	: Condensation product of bisphenol A and epichlorohydrin with terminal epoxides groups.
Epoxide equivalent	: 450 – 500
Curing agent	: Polyamide
Volume of solids	: 55 – 60 %
Pigment	: The main pigment shall be micaceous iron oxide (MIO – Lamellar) constituting a minimum of about 65% w/w of total pigments.
Pigment volume	





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Concentration : 40 – 45 %  
Application : Airless spray  
Dry film thickness / coat : 110 – 120 microns  
Spreading rate : 5- 5.5 sq. m / litre  
Drying time : Touch dry in 2 hours, hard dry in 48 hours  
Over coating time : 24 – 48 hours. This should be very strictly adhered to in order to avoid peeling of subsequent coat.  
Storage life : 12 months under sealed conditions.

**d) Epoxy high build finish paint (F1)**

Type and composition : Two pack poly amide/polyamine cured epoxy resin medium suitably pigmented.  
Volume of solids : 62%  
DFT(dry film thickness) : 100-125microns  
Theoretical coating capacity : 5-6  
Weight per litre (app) kgs/lts : 1.4  
Touch dry at 30°C : 3hrs  
Hard dry at 30°C : Overnight  
Over coating interval : Min: Overnight Max: 5days  
  
Pot life at 30°C for two component Paints (app.) : 4-6 hrs

**e) Two pack aliphatic acrylic polyurethane finish paint (F2)**

Part-A: Part-A consists of polyacrylate polyol with appropriate primary extenders, solvent and additives.

Part-B: Part-B consists of an aliphatic polyisocyanate with appropriate solvents and additives.

Part A and Part B are to be mixed together to form a pigmented polyurethane paint in suitable proportions as recommended by manufacturer.

Volume of solids : 45 %  
Main pigment : Rutile TiO<sub>2</sub> (min. 80% w/w on total pigment weight) and extenders with pigment weight) and extenders with other desired colour  
Colour : As desired Pigment  
volume concentration : 15 – 20 %  
Application : Brush or spray  
Dry film thickness per coat : 40-50 microns  
Theoretical coverage : 11 – 13 sq.m / litre  
Drying time : Surface dry 1 hr. Full cure 7 days.  
Storage life : 3 months under sealed conditions



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#### f) Synthetic Enamel (F3)

A high quality enamel based on synthetic resin vehicle stable weather resistant pigment designed for both protection and decoration.

Volume of solids	: 38 -40%
Application	: by brush or conventional spray
DFT/Coat	: 30-35 microns
Spreading rate	: 11-13 sq. m/ lt
Drying time	: Surface dry-4hrs Hard dry-18hrs
Storage life	: 12 months under scaled conditions

#### g) Painting System

For coastal area- Ennore Terminal

Painting specification for pipes and other connected item

Surface preparation	Blast clean to SA 2½
Paint system recommended	First coat of P2 (50 µm each) +second coat (intermediate) of U1 (75 µm) To be deleted + third coat of F1 (90µm) +Finish coat of F2 (35µm)
Total DFT(min)	250 µm

#### For Structurals

Surface preparation	Blast clean to SA2 ½
Paint system recommended	First coat of P2 (50 µm each) +second coat (intermediate) of U1 (75 µm) To be deleted + third coat of F1 (90µm) +Finish coat of F2 (35µm)
Total DFT(min)	250 µm

#### 6.6 Paint Manufacturers

An indicative list given below of the paint manufacturers whose product conforming to the respective qualities specified herein may be considered for use. However, the site engineer has the right to reject any material of these manufacturers, which do not conform to the specifications.

M/s Asian Paints India Ltd.

M/s Bombay Paints Ltd. Mumbai.



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M/s Berger Paints India Ltd. Mumbai.

M/s Ameron / Goodlass Nerolac Paints Ltd. Mumbai.

M/s Jenson & Nicholson India Ltd. Kolkata.

M/s CDC Carboline, Chennai.

M/s Shalimar Paints Ltd. Mumbai.

M/s Solvo-Sol Paints (P) Ltd. Hyderabad.

M/s Grand Polycoats Company Pvt Ltd. Vadodara.

Sigma Coatings Mumbai

Akzo Noble coatings India Ltd.,

Bangalore or Any other reputed make with the approval of Employer

### **7.0 Inspection and final acceptance**

Required painting materials for application shall be procured directly from manufacturers as per specification. Manufacturer's test certificates for every batch should be submitted to Engineer – in – charge without which paints will not be accepted.

Engineer – in – charge at his discretion may call for tests for paint formulation. Tenderer shall arrange to have tests performed including batch wise test of wet paints for physical and chemical analysis at no extra costs to OWNER.

Painting work shall be subject to inspection and approval by Employer.

The painting work shall be subject to inspection by Engineer – in – charge at all times. Following aspects will be considered during inspection and Tenderer shall offer the work for inspection and approval of site Engineer before proceeding with the next stage. Stages of inspection are as follows.

Surface preparation

Primer Application

Each coat of paint

Any defect noticed during the inspection is to be rectified by the Tenderer to the satisfaction of Engineer – in – charge before proceeding further.

Each batch of paint shall be offered to him for approval before commencing application. Preparation of surface shall be subject to spot examination and approval, and where it is evident that surface preparation has been inadequate, the Engineer may require the surface to be stripped, cleaned etc. as necessary. Paint film thickness shall be examined at random locations after completion of primary coat, and also as completion of the final finishing coat.



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Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make up the DFT specified without any extra cost to the Tenderer.

The Tenderer has to position an ELCOMETER at site for checking the paint thickness by the site engineer.

The Tenderer shall arrange and keep a Holiday Detector at site for testing of wrapping coating of underground pipelines.

Paint operations shall be aimed at producing smooth and neat finished surfaces and inspection of edge and lining details will take this requirement into consideration in accepting each part of the work. All splashes shall be cleaned up as they occur, and empty paint containers and other debris shall be removed from site.

All inspecting and examining instruments shall be calibrated and checked to indicate their proper functioning.

Irrespective of the inspection, repair and approval at intermediate stages of work, Tenderer shall be responsible for making good any defects found during the final inspection / guarantee period / defect liability period as defined in general conditions of contract.

## **8.0 Treatment of underground pipelines**

### **a. Surface Preparation and primer application**

The pipe shall be sand blasted to SA 2 ½. Primer shall be applied over the pipe at 150-gm/sq.m. The primer shall be allowed to dry until the solvent evaporates and the surface become tacky.

### **b. Wrapping**

Underground pipes shall be wrapped with 4mm thick polymeric corrosion protection tape, which shall conform to IS: 10221-1982 / AWWA C 203.

Polymeric tape (4mm) shall then be wound around the pipe in spiral fashion and bonded completely to the pipe by thermo fusion process. The same thermo-fusion process shall seal the overlaps.

Polymeric protection tape shall incorporate a center core of approx. 100-micron HDPE film. It shall have a second center core of textile fabric to give mechanical strength and dimensional stability to the tape. 3 layers of polymeric based coal tar, rubber and other polymers shall be interleaved between the above centre cores. All the seven layers shall be calendared together to create the above protection tape.

### **c. Testing of wrapping**

Holiday test shall be conducted over the coated surface accordingly to AWWAC 203. After testing, the defective coating should be repaired and holiday test carried out again.

### **d. Adjacent Pipelines, Structures, etc.**



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If any damage is caused to the coating and wrapping of adjacent pipes or any other existing structure during excavation or subsequent work or during coating or wrapping of flanged joints, the Tenderer shall carry out necessary repairs at his own cost in a manner as directed by the Engineer-in-Charge.

# STANDARD TECHNICAL SPECIFICATION FOR HOSE CABINET



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## 1.0 SCOPE

This standard lays down overall requirements regarding construction, material, design, shape and fixing arrangements of fire hose cabinet to be installed near fire hydrants and to be used for keeping fire fighting accessories.

## 2.0 DESCRIPTION OF CABINET

2.1 Depending upon place of installation to suit the requirement, hose cabinets shall be of two sizes and types for accommodating delivery hose, jet nozzle with branch pipe, or universal pipe, fireman axe (if required). The two types of hose cabinets have been defined as Type-A and Type-B.

2.2 Type-A hose cabinets are suitable for wall mounting installations. They shall be able to accommodate, one 63mm delivery hose having length 15m with end male / female coupling, one jet nozzle with branch pipe or alternately one universal branch pipe.

2.3 Type-A cabinet shall have single panel glass door. Necessary hangers and brackets for proper keeping / positioning of delivery hose, nozzles and branch pipe or universal branch pipe inside shall be provided with the cabinet.

2.4 Type-B hose cabinet shall be of self-supporting type and shall be suitable for outside installation. They shall be capable to accommodate two 63mm delivery hoses of 15m length with end couplings, two jet nozzles with branch pipe or two universal branch pipes.

2.5 Type-B hose cabinet shall have double panel glass door. Necessary hangers and brackets for proper keeping / positioning of delivery hose, nozzles and branch pipe or universal branch pipe inside shall be provided with the cabinet.

2.6 Both types of hose cabinets shall be provided with handle type lock, a small recess to keep cabinet key under glass cover, a small hammer secured to the cabinet with a chain to break open the key glass cover.

## 3.0 MATERIAL OF CONSTRUCTION

3.1 The hose cabinet shall be made of 16 gauge M.S. sheet suitably welded with single / double MS door frame glass covered, depending upon the type of hose cabinet. Glass shall be fitted to the door with gasket and rubber bidding so that it fits securely.

3.2 Door of the hose cabinet shall be provided with standard handle type lock – Godrej, Mortise or equivalent with prior approval of Employer.

3.3 Hammer shall be made of M.S. whereas Chain for securing purpose of hammer shall be made of G.I.

3.4 Angle iron or M.S. round pipe of suitable size as per instruction of Employer shall be provided for supporting Type-B cabinet.

3.5 Universal branch pipe shall confirm to IS: 2171. End coupling jet nozzle and branch pipe shall confirm to IS: 903.





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#### **4.0 MARKING AND PAINTING**

4.1 Each hose cabinet shall be painted with 3 coats of anti-corrosive paint of fire red colour from outside and white paint from inside. Each cabinet shall be clearly and permanently marked as following:

- i. The word in bold letters marked as “FIRE HOSE CABINET”
- ii. Method of operation regarding opening and operation of equipments placed inside.
- iii. List of equipments placed inside the fire cabinet.
- iv. Year of manufacture.



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# **STANDARD TECHNICAL SPECIFICATION FOR NON-PERCOLATING FLEXIBLE FIRE-FIGHTING DELIVERY HOSE WITH COUPLING**



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## **1.0 Scope:**

This specification covers the general requirement regarding the material, design and construction, performance and test for non-percolating flexible fire fighting delivery hose with gunmetal male & female type instantaneous coupling.

## **2.0 Material:**

2.1 The material for Delivery hose shall be rubberised fabric lined as per IS: 636 TYPE A.

2.2 The material for Male and Female instantaneous type coupling shall be of Gunmetal as per IS: 903.

## **3.0 Design and Construction:**

3.1. The hose shall be constructed from a circular woven jacket having a waterproof rubberized fabric lining on the inside, facing the waterway. The jacket shall be seamless and compactly woven from good quality cotton yarn or from yarn made from suitable synthetic fibre of polyamide or polyester type of good quality or from their combinations.

3.2. Fire hose with outer coating/covering shall be manufactured using synthetic yarn only.

3.3. The Fire hose shall be of 15m length and of  $\phi$  63mm.

3.4. If cotton yarn is used in the construction of jacket, this shall be rootproofed as per IS: 636 and method as per IS: 11662.

3.5. The average mass of hose per metre length shall not exceed 0.425kg.

3.6. The delivery hose couplings shall be of  $\phi$  63mm and consist of male half and female half coupling assembled with washer as per IS: 903.

## **4.0 Performance Requirements**

4.1 The delivery hose pipe shall be tested for kink, hydrostatic burst pressure, change in length and diameter, adhesion, abrasion resistance, moisture absorption and heat resistance as per methods and parameters mentioned in IS: 636.

4.2 The couplings shall be subjected to a hydraulic pressure of 2.1MN/mm<sup>2</sup> for a period of 2.5 minutes for the purpose of locating porosity in the casting and other defects. The couplings shall not show any sign of leakage or sweating.

## **5.0 Workmanship and Finish**

5.1 The jacket shall be practically free from dirt, knots, lumps, irregularities of the yarn and other visible defects.

5.2 Inner lining shall be of rubberised fabric and shall be generally smooth and practically free from pitting and other imperfections.

5.3 All fittings shall be of good workmanship, finish, clear of burrs and sharp edges. All forgings and castings shall be clean and sound and shall be free from porosity, blowholes, scales, cracks



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and other imperfections and shall not be repaired or filled so as to hide casting defects. The water way of the fillings shall have a smooth finish

## **6.0 Packing and Marking**

### **6.1 Packing**

The hoses may be dusted with French Chalk as per IS: 380 on the inside and shall be packed and delivered in a length of 15M in neat, clean and dry condition in Polyethylene bags.

### **6.2 Marking**

#### **A) Fire Hose**

Beginning at a point not less than one metre from each end, each length of hose shall be marked with clear and indelible letters at least 20mm in height indicating:

- a) Manufacturers name or trade-mark or both
- b) Type, length and size of Hose
- c) Month and year of manufacture
- d) The Fire Hose shall also be marked with the BIS certification mark.

#### **B) Delivery Couplings**

The male and female instantaneous couplings shall be separately, clearly and permanently marked with following information:

- a) Manufacturers name and trade-mark
- b) Size of couplings
- c) Year of manufacture
- d) The Couplings shall also be marked with the BIS certification mark.



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# STANDARD TECHNICAL SPECIFICATION FOR LANDING VALVE



**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

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## 1.0 SCOPE:

This standard lays down the requirements of type, shape, materials, dimensions and test for vertical stand post type fire hydrant to be installed on fire water main with an isolation valve. The single / double outlet landing valve mainly consists of landing valve with complete set.

## 2.0 CODES AND STANDARDS:

The applicable codes and standards to be followed are as follows:

- TAC Manual
- IS: 5290 and IS: 903
- Other Government regulations / Codes
- All codes / standards mentioned elsewhere in this specification.

## 3.0 MATERIAL:

S.No	ITEM / COMPONENT	MATERIAL OF CONSTRUCTION
1.	Valve body	Shall be of corrosion resistant alloy steel or nickel brass casting conforming to IS: 3444
2.	Bonnet, check-nut, stop valve, instantaneous female outlet and blank cap	Shall be of leaded tin bronze conforming to grade LT B-2 of IS: 318 or aluminium alloy conforming to IS designation 4225, 4450 and 4600 of IS: 617. All aluminium parts shall of be die-cast.
3.	Valve spindle	Shall be made of brass rod conforming to IS: 320 for valve body of leaded tin bronze and of stainless steel conforming to IS: 6603 for valve body of aluminum.
4.	Handle wheel	Shall be made of M.S. conforming to IS: 1030.
5.	Seat valve and washer	Shall be of leather conforming to IS: 581
6.	Gland packing	Shall be asbestos threaded conforming to IS: 4687.
7.	Spring	Shall be of phosphor wire conforming to IS: 7608 for valve body of leaded tin bronze and of stainless steel wire conforming to IS: 6528 for valve body of aluminium.
8.	Tooth	Shall be forged from forged brass material conforming to grade FLB of IS: 6912 of IS: 291
9.	Blank cap	ABS plastic

## 4.0 Design and Construction:



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The design and construction of landing valve shall be as per IS:5290, TAC guidelines and other government codes / regulations and as mentioned in this specification.

1. Water mains coming to post shall be of  $\phi$  150 & 100mm M.S construction and provided with Double outlet landing valve.
2. All hydrant outlets shall be situated 1m above floor level.
3. Only oblique hydrants with outlet angled towards floor shall be used. The hydrant couplings shall be of the instantaneous spring lock (female) type of 60mm dia and valves shall be of the slow down type.

## **5.0 Performance Requirements**

### **5.1 Water Tightness Test for the valve**

The stop valve shall be fully closed by screwing down the spindle. A hydrostatic pressure of  $1.4 \text{ MN/m}^2$  ( $14 \text{ kgf/cm}^2$ ) shall then be applied to each valve on its inlet side. There shall be no leakage through the valve and its seat.

### **5.2 Hydrostatic Pressure Test.**

Each assembled landing valve shall be subjected to a hydrostatic pressure of  $2.1 \text{ MN/mm}^2$  ( $21 \text{ kg/cm}^2$ ) as per IS:5290 with the valve open and outlet closed for a period of  $2\frac{1}{2}$  minutes for the purpose of locating porosity in the casting when so tested, it shall not fail or show any sign of leakage either through the valve body or through the gland of the spindle.

### **5.3 Flow Test**

Test shall be discharged through the valve assembly and its flow shall be measured using flow meter or V-notch. The flow shall not be less than 900 LPM for Type A and 1800 LPM for Type B at  $7 \text{ MN/m}^2$  ( $7 \text{ kgs/cm}^2$ ) provided feed to the valves is not less than these figures.

## **6.0 Workmanship and Finish**

6.1 All parts shall be of good finish, clear of burrs and sharp edges. All castings shall clean and sound and shall be free from plugging, welding or repair of any defects.

The valve top except the face of the flange and the instantaneous outlet shall be painted fire red of shade no. 536 of IS: 5. The outside of instantaneous outlet shall be highly polished. The hand wheel shall be painted black. Paints shall conform to IS: 2932: 1974.

## **7.0 Anticorrosive Treatment and Painting**

7.1 All steel components subject to direct water contact shall be hot dipped galvanised to minimum thickness of 0.12mm. The thickness of coating shall be measured as per IS 3203. External surfaces and non-ferrous components may be wetted with lead tin alloy by electrical deposition process.

7.2 The stand post and its arms, valve top except the face of the flange and the instantaneous outlet from outside shall be painted with three coats of anti corrosive fire red paint of shade No.





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536 of Is 5. The outside of instantaneous outlet shall be highly polished. The hand wheel shall be painted black. Paints shall conform to IS 2932. Internal surface shall be painted with three coats of chlorinated rubber based resin paint or zinc chromate paint.

7.3 The stand post and its arms shall be painted with three coats of anti corrosive fire red paint conforming to IS: 2932 from outside while internal surface shall be painted with three coats of chlorinated rubber based resin paint or zinc chromate paint. The paint shall conform to shade no. 536 of IS: 5 and IS: 2982.

7.4 All steel parts coming in direct contact with water shall be hot dipped galvanized to a thickness of not be less than 0.12 mm. The thickness of the coating shall be measured as per IS: 3203. External surfaces and non-ferrous components may be coated with lead-tin alloy by electrical deposition process.

### 8.0 Marking

1. Each assembled valve shall be clearly and permanently marked on the valve body as follows:

- a) Manufacturers name or trade-mark
- b) Code letter indicating the type of valve (Inscribing type of instantaneous female outlet),
- c) Year of manufacture
- d) The valve assembly shall also be marked with the BIS certification mark and IS: 5290.

### 9.0 Inspection

There shall be provision for inspection by third party inspection agency at contractor's cost. The agency shall have access at all reasonable times to the manufacturer's works, where hydrants are being manufactured and / or tested. However specifically prior call for inspection shall be communicated for performance test of hydrants. (during Detail Engineering)



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**TECHNICAL DATA SHEET (During detail engineering) FOR LANDING VALVE AND ACCESSORIES**

1.0	Type	:	Type A Single outlet or Type B Double outlet
2.0	Code Standard	:	IS: 5290
3.0	Material of construction	:	
3.1	Body	:	Leaded Tin Bronze Gr. LTB-2 of IS:318 or Aluminium alloy of IS designation 4225,4450 and 4600 of IS:617
3.2	Stop Valve	:	Leaded Tin Bronze to Gr. LTB-2 of IS:318
3.3	Spindle	:	Brass Rod to IS 320 or IS 319
3.4	Spindle Body	:	S.S. to IS 6603
3.5	Hand wheel	:	M.S to IS 1030 or C.I. to IS 210
3.6	Washer, Gasket etc.	:	Rubber IS:937 or leather to Is 581
3.7	Spring	:	Phosphor Bronze wire to IS:7608
4.0	Inlet flange	:	Size 100mm (100 NB) the drilling dimension including O.D. of flange shall be as per ANSI-B-16.5 class 150.
5.0	Working pressure	:	3.5 to 12 kg/cm <sup>2</sup>
6.0	Hydrostatic test pressure	:	21 kg/cm <sup>2</sup>
7.0	low/Hydrant	:	900LPM for Type A or 1800LPM at 7kg/cm <sup>2</sup> for Type B
8.0	Approval	:	TAC approved



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# **STANDARD SPECIFICATION FOR PORTABLE FIRE EXTINGUISHERS CARBON DI OXIDE TYPE**



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## **CO<sub>2</sub> PORTABLE EXTINGUISHER – TECHNICAL SPECIFICATION**

### **1.0 SCOPE**

This standard lays down requirements regarding construction, material, shape, and method of operation, performance and test of portable fire extinguisher of carbon dioxide type.

### **2.0 MATERIAL, SHAPE, CONSTRUCTION, METHOD OF OPERATION, PERFORMANCE, CONTENTS AND TESTS**

2.1 The construction, material, shapes, method of operation, performance, and test shall comply with IS: 2878 (latest edition) with ISI mark and approved by C.C.E. Nagpur.

2.2 Nominal size.

2.2.1 The extinguisher shall be following nominal sizes in kg: 1,2,3,4,5 and 6. The sizes being denoted as per clause 4.11 of IS: 2878.

2.4 Carbon Di-oxide gas used shall conform to IS: 15222 and extinguisher shall be filled as per IS 2878 Cl. 6.0.

2.5 The cylinder shall be made of cold drawn seamless steel cylinders as per IS: 7285 and fitted with screw down type high pressure control valve as per IS: 3224 with a provision of safety release. Riveted joints will not be acceptable.

2.6 The extinguishers shall be fitted with discharge tube with swivel joint of atleast 1m length with elect. non-conductor discharge horn.

### **3.0 APPROVALS**

3.0 Approval/clearance certificate of filling the extinguisher from “chief controller explosive” govt. of India, Nagpur shall be submitted for each cylinder. Testing of the extinguisher, painting, markings etc. shall be as per IS: 2878 with ISI marked

### **4.0 MARKING**

4.1 Each extinguisher shall be clearly and permanently marked as per IS: 2878 along with BIS certification mark and following:

- i. Manufacturer's name and trade mark.
- ii. Method of operation.
- iii. A large size picture showing a man operating the extinguisher in the correct manner
- iv. The word " CO<sub>2</sub> Type (Capacity)".
- v. The size of gas cartridge used.
- vi. Liquid level to which the extinguisher is to be checked.
- vii. Year of manufacture.



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## **5.0 ACCESSORIES**

Each extinguisher shall be supplied with M.S. bracket and spanner as may be necessary. The details of the same shall be submitted. The extinguisher shall be complete with wall mounting brackets and screws.

## **6.0 INSPECTION**

6.1 Third party inspection agency at Contractor's cost shall have access at all reasonable times to the manufacturer's work where extinguishers are being manufactured and / or tested.



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# STANDARD SPECIFICATION FOR PORTABLE EXTINGUISHERS



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## **DRY CHEMICAL POWDER EXTINGUISHER – Technical Specification**

### **1.0 SCOPE**

This standard lays down requirements regarding construction, material, shape, anticorrosive treatment and test for ordinary dry powder type fire extinguisher.

### **2.0 MATERIAL, SHAPE TYPES, CONSTRUCTION, ANTICORROSIVE TREATMENT, PAINTING AND TESTS.**

The construction, material, shape, anticorrosive treatment, painting, and test shall comply with IS: 2171 (latest edition).

Extinguisher body shall be made out of M.S. sheet of not less than 1.6mm thickness as per IS: 513. All the fire extinguishers shall be of welded construction fitted with leaded tin bronze (Gunmetal) cap as per IS: 318, high pressure discharge hose and squeeze grip nozzle. Plastic or PVC fittings will not be provided with initial fittings.

Dry chemical powder supplied with extinguisher shall be non-toxic as per IS: 4308 and ISI marked. The extinguisher shall have gas cartridge of pressure type. CO<sub>2</sub> gas cartridge shall be ISI marked and shall not be less than a capacity of 120gms as per IS: 4947.

The extinguisher shall have cap having vent holes, gas cartridge holder, plunger rod & piercing mechanism cap joint washers siphon tubes, braided hose of sufficient length and discharge nozzle.

All the extinguishers shall be treated with lead - tin alloy for anti-rust, anti-corrosive treatment by electrolytic deposition process. Extinguishers coated by dip coating process will not be acceptable.

### **3.0 PRINCIPLE**

The method of expulsion of dry powder shall be as per IS: 2171 (latest edition) with either of the method of operation specified therein. Vendor shall indicate clearly the method adopted for operation.

### **4.0 CAPACITY**

Nominal capacity of the extinguisher and the dry powder contents of the assembled body or dry powder container shall be as follows when charged with dry powder conforming to IS: 4308 (latest edition).

<b>NOM. EXTINGUISHER ( KG)</b>	<b>CAPACITY OF DRY POWDER CONTENTS WHEN CHARGED MIN (KG)</b>
1	1
2	2
5	5
10	10

Only dry powder confirming to IS: 4308 (latest edition) shall be used for charging the extinguisher.





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## 5.0 ACCESSORIES

Each extinguisher shall be supplied with a suitable wall bracket or holder into which it may be mounted and from which it may be removed for use in an emergency and screws and spanner as may be necessary. Extinguishers shall be supplied with all accessories, initial charge etc.

## 6.0 MARKING

Each extinguisher shall be clearly and permanently marked with the information specified in IS: 2171 along with BIS certification mark and purchaser's name. Each extinguisher shall be painted fire red and clearly marked with following:

- i. Manufacturer's name and trade mark.
- ii. Method of operation.
- iii. A large size picture showing a man operating the extinguisher in the correct manner.
- iv. The word "DCP Type (Capacity)".
- v. The size of gas cartridge used.
- vi. Liquid level to which the extinguisher is to be checked.
- vii. The word "Tested to a hydraulic pressure 2.5 MN/m<sup>2</sup>".
- viii. The word "Keep this end up".
- ix. Year of manufacture.

## 7.0 INSPECTION

Third party inspection agency at Contractor's cost shall have access at all reasonable times to the Manufacturer's work where extinguishers are being manufactured and / or tested. Samples from lots under a quality control system shall be done as per Appendix B of IS: 2171. The cylinder shall be hydraulically tested for 30kg/cm<sup>2</sup> of pressure.



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# **STANDARD SPECIFICATION FOR PORTABLE FIRE EXTINGUISHER (FOAM TYPE)**



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### **FOAM EXTINGUISHER – MOBILE TYPE- TECHNICAL SPECIFICATION**

The Foam type fire extinguishers shall confirm to IS: 5507-1979 with ISI mark and approved by TAC / any other statutory certifying agency.

The cylinder shall be filled with initial charge of chemical.

The extinguishers shall be fitted with discharge tube with swivel joint of atleast 1m length with elect. non-conductor discharge horn.

Testing of the extinguisher, painting, markings etc. shall be as per IS: 5507 with ISI marked.

Each extinguisher shall be painted fire red and clearly marked with following:

1. Manufacturer's name and trade mark.
2. Method of operation.
3. A large size picture showing a man operating the extinguisher in the correct manner.
4. The word "Foam Type (Capacity)".
5. Liquid level to which the extinguisher is to be checked.
6. Year of manufacture.



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# STANDARD SPECIFICATION FOR PRESSURE GAUGE

## CONTENTS



**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

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Clause No.	ITEM
1.0	Scope of this Document
2.0	Standards & Specifications
2.1	Reference Specifications
2.2	Other Specifications To Be Followed
3.0	Scope Of Supply
4.0	Pressure Gauge
4.1	General
4.2	Material
4.3	Range
4.4	Accuracy
4.5	Reading scales
4.6	Enclosure class
5.0	Equipment Protection
6.0	Installation Requirement
7.0	Calibration, Inspection And Testing
8.0	Documentation
9.0	Tagging & Nameplates
10.0	Review And Approval
11.0	Vendor Pre-Qualification Requirements
12.0	Preparation For Shipment
13.0	Receipt And Storage
Annexure I	Material Selection Chart For Pressure Gauges
Annexure II	Hook-up drawing for Pressure Gauges
Annexure III	Typical data sheet (during detail engineering) for Pressure Gauges

## 1.0 SCOPE



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1.1 This specification describes the essential considerations in the selection, installation, calibration and testing of pressure gauge.

The Contractor shall be responsible for the selection of Pressure Gauge suitable for its intended application, its procurement, packing, calibration, testing at yard and offshore, shipment to yard and offshore site, installation and commissioning at site.

## **2.0 CODES & STANDARDS:**

2.1 Project Specifications:

- a) Particular Job Specification
- b) Tender Document
- c) Project P& IDs

2.2 Other Specifications To Be Followed; NIL

## **3.0 SCOPE OF SUPPLY:**

3.1 The number of Pressure Gauges to be supplied and installed shall be as per the process requirements indicated in the SOR and the P & IDs.

3.2 The scope of supply shall also include commissioning spares and two years' spares and as suggested by the Manufacturer.

## **4.0 PRESSURE GAUGE:**

### **4.1 General:**

4.1.1 The pressure gauges shall be used for local indication. These local pressure indicators shall in general be heavy duty, weatherproof, with minimum 150mm (6") dials, white dials with black numerals and markings and external zero adjustment.

4.1.2 Case diameters shall not be less than 6". Instrument air / gas supply gauges used as output gauge may have 50 mm (2") dials. Gauges that are 150 mm (6") or larger diameter shall have micrometer pointers for zero adjustment. Gauge pointers shall be adjustable without removal from shaft.

4.1.3 Pressure gauge measuring element shall generally be Bourdon / Bellows / Diaphragm type. For measurement of slurries, viscous and corrosive fluids, Diaphragm seals shall be used.

4.1.4 Pressure gauges shall have liquid filled damping. Pressure instruments in field shall have 1/2" NPTM bottom connections. Diaphragm seals with capillary shall in general be 1 1/2" flanged.

### **4.2 Material:**

4.2.1 The material requirements for pressure gauges shall in general be according to latest IS / API standards and as described in this specification.



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4.2.2 The material of all wetted parts shall be compatible with the process fluid and shall be SS 316 as a minimum, unless otherwise specified. For raw seawater service, all wetted parts shall be of Monel.

4.2.3 Pointer / Movement shall be of SS 316. Process connection shall be bottom entry type of SS 316 and 1/2" NPT.

4.2.4 Case material for all pressure gauges shall be SS 316 with a screwed bezel / bayonet bezel retaining ring and weatherproof design.

4.2.5 The Window material shall be of Shatter-proof glass or acrylic plastic.

4.2.6 Gauge saver and snubber when used shall be of the same material as that of the pressure element.

#### **4.3 Range:**

4.3.1 The range shall be selected such that the normal operating pressure will read approximately 1/3 of full scale to 2/3 of full scale.

#### **4.4 Accuracy:**

4.4.1 The maximum error shall not exceed 1% of the span.

#### **4.5 Reading Scales:**

4.5.1 Indicating scales shall be direct reading type in Kg/cm<sup>2</sup> g.

### **5. EQUIPMENT PROTECTION:**

5.1 Pressure Gauge protection requirements shall in general as per latest Is / API / BS standards and as listed in this specification.

5.2 The pressure gauge enclosure shall be weather proof to IP 65 or better. The pressure gauge shall be capable of withstanding 130% of maximum range without affecting its calibration / accuracy. Pressure gauges shall also have rear blowout discs for blowout prevention.

5.3 Gauges and instruments subject to damage from pulsating pressures shall be provided with Snubber type pulsation dampeners. Snubber shall be provided on all pump/compressor discharge service.

5.4 Gauge savers shall be provided wherever maximum working pressure exceeds 130% of range. Gauges in vacuum service shall have over range protection to full vacuum.

### **6.0 INSTALLATION REQUIREMENTS:**

6.1 The installation of pressure gauges shall in general be according to standard engineering practice and as per the hook-up drawings & details given in this document.

6.2 Pressure gauges shall not be installed in such a way that it depends for support on the impulse piping. Pressure gauges shall not be mounted directly on lines where vibration is likely to be present.





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6.3 Pressure gauges shall be mounted such that they may be easily removed and adjusted without deforming impulse lines. All pressure gauges shall be installed so as to minimize the length of impulse lines. Necessary isolation valves shall be provided for all pressure gauges.

#### **7.0 CALIBRATION, INSPECTION & TESTING:**

7.1 Calibration, inspection and testing requirements shall in general be as per standard engineering practice. In addition, the following shall also be taken care of:

7.2 Direct connected pressure gauges shall be dead-weight tested or tested against a test gauge prior to installation.

7.3 Receiver type pressure gauges shall be three (3) point calibrated using a manometer or precision pressure gauge and precision air regulator. Three-point calibration shall refer to the input signal to an instrument equivalent to 0%, 25%, 75% and 100% of the instrument range upscale and 75%, 25% and 0% of the instrument range downscale.

#### **8.0 DOCUMENTATION:**

8.1 The documentation requirements shall in general be according to the project specific requirements.

#### **9.0 TAGGING & NAMEPLATES:**

9.1 Tagging & Nameplate requirements shall in general be according to the project requirement and standard engineering practice. Vendor has to submit the document in advance for approval.

#### **10.0 REVIEW & APPROVAL:**

10.1 Review and approval of purchase specifications and other related documents shall in general be according to the project requirement.

#### **11.0 VENDOR PRE-QUALIFICATION REQUIREMENTS:**

11.1 The Vendor pre-qualification requirements shall in general be according to the BEC / Equipment qualification criteria.

#### **12.0 PREPARATION FOR SHIPMENT:**

12.1 The pressure gauges shall be prepared for shipment after inspection / inspection waiver and dispatch clearance.

#### **13.0 RECEIPT & STORAGE:**

13.1 Receipt and storage of the pressure gauges shall be in accordance to the approved procedure to be submitted by the vendor.

### **ANNEXURE – I**



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### MATERIAL SELECTION CHART FOR PRESSURE GAUGES

S. No.	Piping Class	Element
1.	A1, B1, D1, E1, F1, XF1, F1, PA1, PB1, PD1, PE1, PXF1, PF1, A2, B2, D2, E2, XG1, A1H, A3, B3, A8 (EXCEPT WAT. INJ. SERVICE)	SS 316
2.	INJECTION WATER SERVICE	MONEL
3.	A4, A6, A9, B9, D9, E9	SS 316
4.	A5	MONEL
5.	A7	
6.	A1N, B1N, D1N, E1N, F1N, XF1N, PA1N, PB1N, PD1N, PF1N, XG1N	SS 316
7.	A10, B10, D10, E10, F10	SS 316 L
8.	A11, B11, D11, E11, F11, PA11, PB11, PD11, PE11, PF11	MONEL 400

### ANNEXURE – II HOOK-UP DRAWING: PRESSURE GAUGE

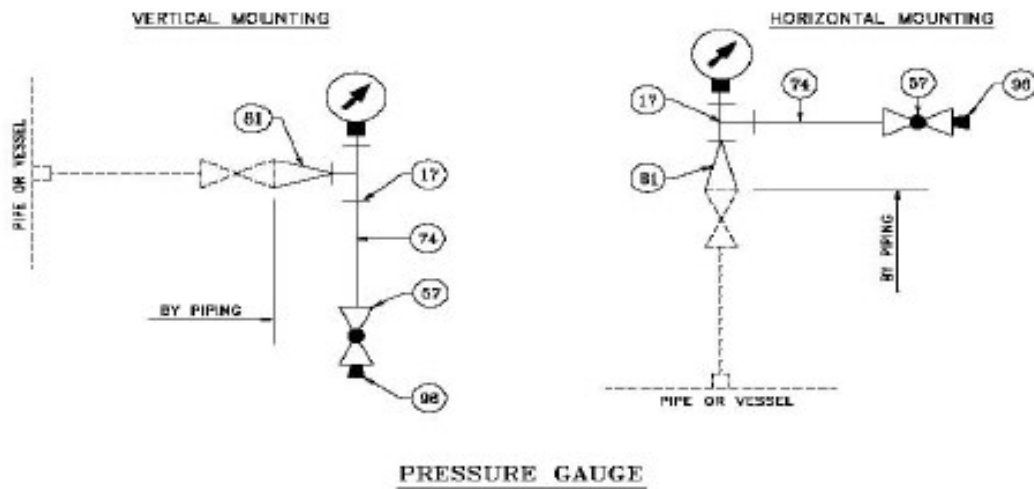


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## ANNEXURE – II

### HOOK-UP DRAWING: PRESSURE GAUGE



ITEM	QTY	SIZE	DESCRIPTION	MATERIAL
17	1	1/2"	EQUAL TEE, SCRWO	
57	1	1/2"	GLOBE VALVE SCRWD	
74	1	1/2"	NIPPLE, THxTH	
96	1	1/2"	PLUG, SCRWD	
81	1	3/4" X 1/2"	SWAGE NIPPLE, PLxTH	

## ANNEXURE – III



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### TYPICAL DATA SHEET (during detail engineering) – PRESSRUE GAUGE

PRESSRUE GAUGES								
UNITS :-Flow Liquid – M3/HR Gas – NM3/HR Pressure – kg/cm2 Temperature – deg C Level/length -M								
1.	Type			15	Diaphragm Seal (wherever required)			
2.	Mounting			a)	Type			
3.	Dial Size/Colour			b)	Wetted Parts			
4.	Case Material			c)	Other Material			
5.	Bezel Ring			d)	Process Connection			
6.	Window Material			e)	Facing & Finish			
7.	Enclosure Class			f)	Capillary Material			
8.	Pressure Element			g)	Armour type			
9.	Element Material			h)	Armour Material			
10.	Socket Material			i)	Capillary Length			
11.	Accuracy			j)	Flushing Filling Conn			
12.	Zero Adjustment			16	Over range protection			
13.	Connection & Location			17	Blow out protection			
14.	Movement			18	Options			
					a)	Snubbet		
					b)	Siphon		
					c)	Gauge saver		
					d)	Liquid filled casing		
					e)	Vacuum protection		
TAG No.	Range	Oper. Pressure	Max Service Temp.	Oper. Temp	Max. Service Temp.	Fluid	Service	Options
As per P & ID								



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# STANDARD SPECIFICATION FOR WATER CUM FOAM MONITOR

## CONTENTS

### 1. SCOPE



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2. MATERIAL
3. DESIGN AND CONSTRUCTION
4. HYDRAULIC PERFORMANCE
5. WORKMANSHIP AND FINISH
6. ANTICORROSIVE TREATMENT AND PAINTING
7. TEST
8. MARKING

## 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

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This specification covers the general requirements regarding the material, design and construction, performance and test for stand post type water cum foam monitor.

## **2.0 MATERIAL**

2.1 Monitor body, swivel joints, worm wheel, base flange and change over valve assembly shall be made of copper alloy confirming to IS:8442 Cl. 3.3.1. Body shall be of C.S. pipe heavy grade to IS: 1239 and base flange shall be of M.S. to IS 226 or IS 6392.

2.2 Foam and water barrel shall be extruded aluminium pipe to IS:1285. Water barrel can be from M.S. seamless pipe to IS:1239 heavy grade.

2.3 Water nozzle shall be made from aluminium alloy to IS:617 designation 4450 when water barrel is made from extruded aluminium pipe. It shall be made from copper alloy as specified in IS: 8442 Cl. 3.3.1 when water barrel is of MS pipe to IS: 1239 H. gr.

2.4 Pickup tube shall be made from rubber hose with chrome plated brass strainer.

2.5 Worm gear for traverse mechanism shall be made from phosphorus bronze or copper alloy as per Cl. 3.3.1 of IS: 8442.

2.6 Nuts and bolts for base flange and change over valve shall confirm to IS:1367 Cl.10.9 and 12 respectively while gasket shall be of CAF 40 to IS:2712.

2.7 Drain valve shall confirm to IS: 778 class 2. Locks on swivels shall be made of brass to IS: 291.

## **3.0 DESIGN AND CONSTRUCTION**

3.1 Monitor shall be capable of discharging 1750 lpm / 2580 at a pressure of 7 Kg/cm<sup>2</sup>.

3.2 It shall have traversing mechanism to give 360° in either direction in horizontal plane and 125° in vertical plane (80°, -45°) through geared unit with worm wheel operated by separate hand wheel for horizontal and vertical rotation. Swivel joints shall be provided both for horizontal and vertical rotation. The arrangement shall be such that monitor shall be self locking type and operated by a single person.

3.3 The monitor shall be provided with a change over valve along with its assembly for instantaneous switch over of discharge from water to foam or vice versa as desired. The valve shall be lever operated type.

3.4 A foam inductor shall be provided behind the air intake chamber of foam maker in foam monitor. A flexible rubber pick up tube of 3m length having strainer at the inlet shall be provided. A foam compound control valve capable of metering and inducing 3% to 6% of foam compound shall also be provided.

3.5 The monitor shall be mounted on a 100mm (4") N.B. flat face slip on type flange confirming to ANSI B 16.5 150lbs rating. Bolts and nuts for base flange shall have dimension confirming to ANSI B 16.5 Gasket shall be full face 3mm thick with drilling dimension same as for flange.





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3.6 Near the base flange a drain connection shall be provided with a 15mm (1/2") NB drain valve at the end of pipe. The drain pipe shall be long enough to drain water away from the base flange.

3.7 The threaded end of the water nozzle shall be hexagonal to facilitate screwing of the nozzle on the water barrel with nozzle spanner. Threads shall confirm to IS:2643 (Pt.-1) with class A tolerance.

3.8 The inner surface of the nozzle shall be finished smooth and polished for the converging length of the nozzle.

#### **4.0 HYDRAULIC PERFORMANCE**

4.1 Monitor shall be capable of discharging 1750lpm at a pressure of 7 Kg/cm<sup>2</sup>.

4.2 The horizontal ranges for water and foam jet shall be 60m and 45m respectively while the vertical throw shall be 30m and 20 to 25m respectively.

#### **5.0 WORKMANSHIP AND FINISH**

5.1 All the parts shall have good workmanship and finish. All burrs and sharp edges shall be removed particularly water way foam way and nozzle shall have smooth finish.

#### **6.0 ANTICORROSIVE TREATMENT AND PAINTING**

6.1 All steel components subject to direct water or foam contact shall be hot dipped galvanized to a minimum thickness of 0.12mm. The thickness of coating shall be measured as per IS:3203. External surfaces and non ferrous components may wetted with lead tin alloy by electrical deposition process.

6.2 Monitor's steel part shall be painted with fire red colour confirming to IS: 5 shade no. 536 and the paint shall confirm to IS:2932 and copper alloy part shall be polished.

#### **7.0 TEST**

7.1 Monitor shall be tested to fulfill requirements at clause 4.0.

7.2 The entire assembly shall be hydraulically tested to a pressure of 2.1 MN/M<sup>2</sup> (21 Kg/Cm<sup>2</sup>) for 5 minutes without any leakage.

#### **8.0 MARKING**

8.1 Each monitor shall be clearly and permanently marked with the following:

- a) Manufacturer's name or trade mark
- b) Year of manufacture
- c) Purchaser's name



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# STANDARD SPECIFICATION FOR RESTRICTION ORIFICE PLATES

## CONTENTS

### 1.0 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

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2.0 DESIGN AND CONSTRUCTION

3.0 NAMEPLATE

4.0 INSPECTION AND TESTING

5.0 SHIPPING

6.0 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

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1.1.1 This specification covers the requirements for the design, materials, nameplate marking, inspection, testing and shipping of restriction orifice plates and multistage restriction orifice assemblies.

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: -

ASME American Society of Mechanical Engineers

B 16.5 Pipe Flanges and Flanged Fittings

B16.34 Valves Flanged, Threaded and Welding End

B 36.10 Welded and Seamless Wrought Steel Pipe.

EN European Standards

10204 Inspection Documents for Metallic Products

ISO International Organisation for Standardisation

5167 Measurement of fluid flow by means of orifice plates, nozzles and venturi tubes inserted in circular cross-section conduits running full.

1.1.3 In the event of any conflict between this standard specifications, statutory regulations, related standards, codes etc., the following order of priority shall govern:

- a) Statutory Regulations
- b) Standard specification
- c) Codes and standards

## 1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instruction to the vendor attached with the material requisition.

1.2.2 All items as offered, shall be field proven and should have completed trouble free satisfactory operation individually for a period of minimum 4000 hours on the bid due date in the similar application with process conditions similar to those as specified in the purchaser's sheet (during detail engineering). Items with prototype design or items not meeting provenness criteria shall not be offered.

1.2.3 All documentation submitted by the vendor including their quotation, drawings, installation, operation and maintenance manuals etc. shall be in English language only.

## 1.3 Drawing and Data

1.3.1 Detailed drawings, data, specification sheet and manuals required from the vendor are indicated by the purchaser in vendor data requirement sheets.. The required number of prints



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and soft copies should be dispatched to the address mentioned, adhering to the time limits indicated.

1.3.2 Final documentation consisting of design data, installation manual, operation and maintenance manual etc., submitted by the vendor after placement of purchase order shall include the following, as a minimum;

- a) Specification sheet for each restriction orifice plate.
- b) Certified drawing sheets for each restriction orifice plate, which shall provide dimensional details, constructional details and material of construction.
- c) Sizing calculation for multi-stage restriction orifice plate assemblies.
- d) Copy of test certificates for all the tests indicated in clause 4.0 of this specification.
- e) Installation procedure for each restriction orifice plate.

## **2.0 DESIGN AND CONSTRUCTION**

2.1 Unless otherwise specified, restriction orifice plates shall be concentric square edge type.

2.2 Whenever multi-orifice plate assembly is specified, vendor shall supply complete assembly with orifice plates, spool piece and flanges duly welded. The orifice plate design shall be either of the concentric or eccentric type. The number of stages of orifice plates shall be calculated by vendor based upon the process data as per site requirement.

2.3 Each restriction orifice plate shall have an integral handle, which upon assembly shall extend by minimum of 50mm beyond flange edge.

2.4 Where weld-in type restriction orifice plates have been specified, the welding and edge preparation shall be as per ASME B 36.10.

2.5 Where the restriction orifice plate is to be mounted between ring-type joint flanges, vendor shall reply the plate with a plate-carrying holder.

2.6 The inlet face of the orifice plate shall be as per ISO-5167 or any other standard indicated in the purchaser's datasheet (during detail engineering).

2.7 The fluid outlet surface of the plate should be flat and smooth and shall not have roughness and scores that can be ascertained by touch or sight.

2.8 Restriction orifice plates in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride and all connections shall be plugged after degreasing process in order to avoid entrance of grease or oil particles.

## **3.0 NAMEPLATE**

3.1 Each restriction orifice plate shall have the following nameplate information punched on its handle: -

- a) Tag no. as per purchaser's data sheets (during detail engineering).



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b) Nominal pipe size in inches and rating in pounds.

c) Material of plate.

3.2 Each multi-orifice plate assembly shall have a stainless steel nameplate attached firmly to it at a visible place, furnishing the following information:

a) Tag number as per purchaser's datasheet (during detail engineering)

b) Manufacturer's name / trade mark

c) Nominal end connection size and rating

d) Orifice plate and assembly material of construction

e) Number of orifice plate stages

#### **4.0 INSPECTION AND TESTING**

Purchaser reserves the right to inspect and witness testing at vendor's works as per Inspection Test Plan and approved quality documents. All these tests shall be completed by the vendor and test reports shall be submitted to Purchaser for scrutiny.

#### **5.0 SHIPPING**

5.1 Each restriction orifice plate shall be packed inside thick polythene bags with suitable protective packing outside.

5.2 Each plate shall be packed separately.

5.3 All restriction orifice plates in oxygen and chlorine service shall be separately packed along with a certificate indication 'SUITABLE FOR OXYGEN/CHLORINE SERVICE', as applicable.

#### **6.0 REJECTION**

6.1 Vendor shall prepare their offer strictly as per clause 1.2 of this specification and shall attach only those documents, which are specifically indicated in the material requisition.

6.2 Any offer not conforming to the above requirements, shall be summarily rejected.





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# SPECIFICATION FOR Y / T TYPE STRAINERS

## CONTENTS

- Sl. Description
- 1.0 GENERAL



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- 2.0 SCOPE OF WORK OF VENDOR
- 3.0 DESIGN
- 4.0 TECHNICAL REQUIREMENTS
- 5.0 INSPECTION AND TESTING
- 6.0 PROTECTION AND PAINTING
- 7.0 PACKAGING AND IDENTIFICATION
- 8.0 SPARE PARTS AND TOOLS
- 9.0 WARRANTY

## 1.0 GENERAL

1.1 This specification along with data sheets (during detail engineering), other specifications & attachments to inquiry / order describes and constitutes the minimum requirement according to which vendor / manufacturer shall design, manufacture, test and supply the Y/T type strainer for removing solid contaminants from the liquid / gaseous stream.



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The intent of these requirements is to supplement the requirements as given in data sheets (during detail engineering)/other specifications and other applicable codes / standards referred to in data sheets (during detail engineering)/ specifications.

1.2 Except as specified herein, the strainers shall be designed, manufactured, tested and supplied in accordance with data sheets (during detail engineering), specifications and applicable codes / standards (latest edition).

1.3 Manufacturer / Vendor shall seek Purchaser / Consultant's approval regarding such features which are not specified by Purchaser / Consultant but requirements call for purchaser decision on these matters.

1.4 Strainer model offered shall be from the existing regular manufacturing range of the strainer vendor. Vendor's / manufacturer's catalogue and general reference list shall be furnished along with the offer.

1.5 The offered strainer shall be of a proven design in similar service.

## **2.0 SCOPE OF WORK OF VENDOR**

2.1 Engineering, design, manufacturing and supply of strainer.

2.2 Procurement of raw materials etc. from sub-vendors.

2.3 Preparation and submission of documentation for design approval by purchaser/ consultant.

2.4 Supply of recommended spare parts needed for start-up and commissioning and special tools or fixtures, if any.

2.5 Inspection and testing as per T.S.

2.6 Surface preparation, protective coating and painting as per T.S.

2.7 Packaging and transportation to site.

## **3.0 DESIGN**

3.1 Following standards and codes (latest edition) shall be followed for design, fabrication, testing etc. of the equipment.

ASME SEC. II & ASTM : Material specification

ASME SEC. VIII DIV. I : Boiler and pressure vessel code

ASME SEC. IX : Welding and brazing qualifications

ANSI B 16.5 : Pipe flanges

ANSI B 16.9 : Butt-welded fittings.

ANSI B 16.11 : Forged steel fittings socket welded and threaded.



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3.2 Material of construction shall be as per data sheet (during detail engineering). Manufacturer / Vendor shall however assume responsibility for suitability of selected material for specified service. If necessary, vendor should furnish superior materials than specified.

#### **4.0 TECHNICAL REQUIREMENTS**

4.1 The equipment shall be of the type as mentioned in the data sheet (during detail engineering); and shall meet the duty requirements and performance parameters as mentioned therein.

4.2 Material of construction of body, filter medium, etc. of Y/T strainer shall be as compatible with connecting pipe specification and as per data sheets (during detail engineering).

4.3 Effective free area of basket shall be minimum 3 times of the inlet nozzle area.

4.4 Corrosion allowance of 3 mm shall be considered for all carbon steel parts, unless otherwise mentioned in the data sheets (during detail engineering).

4.5 Dimensions of flanges including shell flanges, nozzle flanges and blind cover flanges shall be as per ANSI B 16.5. Larger flanges not covered by ANSI shall be as per MSS-SP-44.

4.6 Drain and vent connections wherever provided shall be with matching blind cover flanges along with necessary gaskets, bolts and nuts.

4.7 Pressure parts joined by butt, Welds shall be with full penetration welds. Where both sides welding is not accessible, root run by tungsten Inert gas process or backing strip, shall be used to ensure full penetration. Backing, strip if used shall be removed after welding.

4.8 Fabricated body shall be post weld heat treated, whenever it is required due to service requirement or due to code requirements. Body shall be post weld heat treated as a complete unit and no welding shall be permitted after the post weld heat treatment is completed.

#### **5.0 INSPECTIONS AND TESTING**

5.1 Equipment shall be subjected to stage wise expediting, inspection and Testing at vendor's/ sub-vendor's works by purchaser/ its authorised inspection agency. Vendor shall submit Quality Assurance (QA) procedures before commencement of fabrication. Approved QA procedures shall form the basis for equipment inspection. The QAP shall generally be in done with one, which is enclosed with the tender enquiry.

5.2 Testing at vendor's works shall include but not limited to the following:

- Non-destructive tests such as radiography, dye penetration tests as per data sheet (during detail engineering) and other requirements,
- Hydrostatic test at a pressure not less than 150% of design pressure for the body.
- Any other tests as per data sheets (during detail engineering)/ codes / standards and covered under approved QAP.



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5.3 Any or all the tests, at purchaser's option, shall be witnessed by purchaser/ its authorised inspection agency. However, such inspection shall be regarded as check-up and in no way absolve the vendor of his responsibility

5.4 Extent of radiography shall be 100%.

## **6.0 PROTECTIONS AND PAINTING**

6.1 All exposed carbon steel parts to be painted shall be thoroughly cleaned from inside and outside to remove scale, rust, dirt and other foreign materials by wire brushing and sand blasting as applicable. Minimum acceptable standard in case of power tool cleaning shall be St.3 and in case of blast cleaning shall be Sa 2½ as per Swedish Standard SIS 0055900.

6.2 Non-ferrous materials, austenitic stainless steels, plastic or plastic coated materials and insulated surfaces of equipment shall not be painted. 6.3 Stainless steel surfaces both inside and outside shall be pickled and passivated.

6.4 Machined and bearing surface shall be protected with rust preventive agent like varnish or thick coat of grease.

6.5 Depending on the environment, following primer and finish coats shall be applied:

### **Environment (Description).**

i) Normal Industrial Surface : Sa 2½ Preparation

Primer : 2 coats of Red oxide zinc chromate each 25 microns ( min. ) thick

Finish : 2 coats of Synthetic enamel, Each 25 microns (min. ) thick.

ii) Corrosive Industrial Surface : Sa 2½ Preparation

Primer : 2 coats Epoxy zinc chromate, each 35 microns ( min. ) thick

Finish : 2 coats of Epoxy high build paint, each 100 microns (min.) thick.

iii) Coastal and Marine Surface : Sa 2½ Preparation

Primer : 2 coats of High build chlorinated rubber zinc phosphate, each 50 microns (min.) thick.

Finish : 2 coats of Chlorinated rubber paint each 35 microns ( min. )thick.

(All values refer to dry film thickness).

6.6 The colour of finish coat shall be as indicated in datasheet (during detail engineering) / approved by the Purchaser / Consultant.

## **7.0 PACKAGING AND IDENTIFICATION**

7.1 All packaging shall be done in such a manner as to reduce the volume. The equipment shall be dismantled into major components suitable for shipment and shall be properly packed to provide adequate protection during shipment. All assemblies shall be properly match marked for site erection.



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7.2 Attachments, spare parts of the equipment and small items shall be packed separately in wooden-cases. Each item shall be appropriately tagged with identification of main equipment, item denomination and reference number of the respective assembly drawing.

7.3 Detailed packing list in waterproof envelope shall be inserted in the package together with equipment.

7.4 Each equipment shall have an identification plate giving salient equipment detail / data, name of manufacturer, make / model, equipment number, year of manufacture etc.

## **8.0 SPARE PARTS AND TOOLS**

8.1 Vendor shall provide spare parts needed for start-up and commissioning. Vendor shall furnish a separate itemized priced list of recommended spares for one as well as two (2) years normal operation and maintenance. Lists shall include part number, part description, serial number and normal delivery lead time. Vendor shall ensure listed parts are available for shipment at the time of equipment shipment.

8.2 Recommended spares should take into account related factors of equipment reliability, effect of equipment downtime upon production or safety, cost of parts and, availability of equipment service facilities. Recommend spares shall be limited to basket( s) and gasket( s) / O-rings only.

8.3 All spare parts furnished by Vendor should be wrapped and packaged so that they will be preserved in original as new condition under the normal conditions of storage to be anticipated in India. Spare parts shall be properly tagged and coded so that later identification as to intended equipment usage will be facilitated. They shall be packaged separately clearly marked as "spare parts" and shipped at the same time as the equipment. Packing lists shall be furnished so that the parts can be handled without uncrating, if required. Start-up spares shall be packed and identified separately.

8.4 Vendor shall provide two sets of special tools or fixtures as required, for installation / erection, operation & maintenance and disassembly of the furnished equipment.

8.5 All such tools shall be permanently tagged with information pertaining to their use. Any special drawings or instructions pertaining to the use of such tools shall be included in the instruction manual.

## **9.0 INFORMATIONS/ DOCUMENTS/ DRAWINGS TO BE SUBMITTED WITH THE OFFER**

Contractor shall submit with the offer four copies each of the following:

9.1 Manufacturer's complete descriptive and illustrative catalogue/ literature and identification of model selected.

In case of failure to submit the documents listed above, the offer may be rejected.

## **10.0 WARRANTY**

Vendor shall have final and total responsibility for the design and mechanical performance of all equipment supplied under this specification. Vendor shall warrant the equipment furnished by



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him and the performance of the said equipment in accordance with this specification and with warranty requirements given elsewhere in bid package.



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# STANDARD SPECIFICATION FOR MEDIUM VELOCITY WATER SPRAY SYSTEM

## 1.0 SCOPE OF SUPPLY OF EQUIPMENT AND SERVICES

### 1.1 GENERAL

This specification lays down the broad technical specification for the medium velocity water spray system to be provided for various areas as specified in SOR, specifications.

For fluids flashing at below 65° C (150° F), extinguishments is always not possible or even desirable and for these, Medium Velocity Water Sprayers need to be installed to provide





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cooling, controlling the burning and/or exposure protection to protect processing blocks, processing equipments, structures, flammable liquid and gas vessel, piping and equipment LPG bottling plants, spot protection etc..

## 1.2 SCOPE

This specification covers design, supply, fabrication, erection, testing and commissioning complete with all mechanical and electrical items as elaborated in the following paragraphs. The system shall consist of the following as mechanical part of the system.

- ☐ Deluge valve assembly
- ☐ Piping for Water, pipe support, flanges etc.
- ☐ Sprinkler based detectors
- ☐ Medium velocity spray nozzles or sprayers
- ☐ Fittings and valves viz. sluice valve, non-return valve, float valve, drain valve etc.

## 2.0 DESCRIPTION OF THE SYSTEM

This is a special fixed pipe system connected to a reliable source of fire protection water supply and equipped with water spray nozzles for specific water discharge and distribution over the surface or area to be protected. The piping system is connected to the water supply through an automatically actuated Deluge Valve, which initiates flow of water. Automatic actuation is achieved by operation of automatic detecting equipment installed alongwith water spray nozzles. The system comprises of:

### a) SPRAY NOZZLE

It is normally open water discharging device called Sprayers which, when supplied with water under pressure will distribute the water in a special, directional pattern peculiar to the particular device. These nozzles are made in a range of orifice sizes with varying discharge angles so that discharge can be controlled for optimum protection.

### b) DELUGE VALVE

Deluge valve is quick opening valve, which admits water automatically to a system of projectors or sprayers and is operated by a system of detectors and/or sprinklers installed in the same areas as nozzles.

### c) DETECTION SYSTEM

In case of water spray systems, detection systems are required for activating the Deluge system for spot protection (outdoors and indoors).

For the above protections, sprinklers are found in extensive application in view of their reliability. However the contractor can recommend / suggest other types of detection systems. The design of detection system by sprinklers varies from risk to risk in case of water spray systems and shall be governed in accordance with TAC guidelines for rules of water spray systems.



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The system shall comprise water supply at high pressure, adequate number of spray nozzles and quartzoid bulb detectors to be located at strategic points, deluge valve, piping, audio-visual alarm system, control panel etc. Water shall be tapped from nearby sprinkler line. Water from static water tank shall be pumped to the system by means of the main pump to obtain the required minimum pressure at the remotest nozzle. Provision for 100% standby pump set to meet the emergency requirement shall be made. The delivery side of the pump shall be connected through a set of back pressure valves and stop valves to the Emulsifier System. These pumps shall have automatic starting facility, which will start the pumps whenever the delivery pressure drops below a preset valve.

High velocity water spray nozzles shall be installed all around the transformers. The number, spacing and discharge angles shall be so decided as to give effective coverage.

The quartzoid bulb heat detectors shall be placed on all sides of the transformer. The detectors shall be planned to be mounted on independent pipe line of compressed air. The heat sensing quartzoid bulb detectors shall shatter at 79 deg. C in case of a fire, creating a drop in the air pressure in the detector pipe line.

Under normal condition the system shall be kept in automatic mode. Due to leakage of water in the system, the water level in the tank shall fall resulting in pressure drop in the system. This shall actuate the pressure switch to start the pump. The jockey pump shall be automatically started by the actuation of level switch. When the water level rises beyond a preset level, the jockey pump shall be stopped automatically by the actuation of the level switch.

In case of fire, the temperature will rise and the gas inside the quartzoid bulb detector will expand to shatter the bulb. Water will then be released through the detector openings reducing the pressure rapidly. This will cause the deluge valve clack to get lifted by the hydraulic thrust on the downside of the deluge valve, which in turn shall allow water to get sprayed through the nozzles. This will result in rapid fall in pressure in the water line, which will actuate the pressure switch to start the main electrically driven pump. In case of power failure the pressure shall drop further to actuate the pressure switch for starting the standby pump.

### **3.0 EQUIPMENT DETAILS (MECHANICAL)**

#### **3.1 AUTOMATIC DELUGE VALVE**

The deluge valve shall be a basically hydraulically operated water valve actuated by release of water in the detector pipe work. The deluge valve assembly shall be provided with 'Y' type strainers in order to segregate foreign matter.

#### **3.2 QUARTZOID BULB DETECTORS**

Quartzoid bulb detectors shall be provided as heat sensing elements. The detectors shall be placed encompassing the entire surface of the transformer. The detectors shall be mounted on independent pipeline charged with water at pressure of about 4 kg/sq.cm. The heat sensing quartzoid bulb shall operate at 79 deg. C. Area covered by each detector shall not be more than 9.0 sq.m.

#### **3.3 SPRAY NOZZLES**



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High velocity water spray nozzles shall be installed all around the transformer in such a manner that the entire surface of the transformers is encompassed for uniform spray of water. For this a piping cage shall be erected around the transformer. The number, spacing and discharge angles of the nozzles shall be so decided as to give effective coverage with an optimum discharge of water (11 l/sq.m/minute) to minimise the extent of damage to the equipment.

### 3.4 VALVES

All the valves shall be provided with matching flanges, bolts, nuts, gaskets, washers etc. Gate valves shall conform to the relevant class of IS: 780/ IS: 2906 while non return valves shall be as per IS: 5312. All the valves shall be provided with proper support.

### 3.5 PIPES AND FITTINGS

Pipes upto DN 150 shall be ERW steel pipes as per IS: 1239 Part-I (medium) and pipes above DN 150 shall be ERW steel pipes as per IS: 3589. Pipe fittings such as bends, tees, reducers of size less than DN 150 shall be as per IS: 1239 Part-II and of sizes above DN 150 shall be fabricated. All the pipes shall be adequately supported.

The underground pipe shall be laid 1 m below the ground. The MS pipes to be laid underground shall have suitable coating and wrapping with 2 coats of coal tar, hot enamel paint and two wraps of reinforced fibre glass tissue or bitumenised Hessian.

The piping shall be capable of withstanding for two hours a pressure of 3.5 kg/sq.cm in excess of the maximum working pressure.

All the flanges shall be faced and have jointing of rubber insertion or asbestos compound. Wherever the underground pipes cross the road, suitable encasing pipes shall be provided.

The laying of pipes shall be included in the tenderer's scope of work.



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# FUNCTIONAL SPECIFICATION FOR PRESSURE GAUGE

## CONTENTS

Clause No.	ITEM
1.0	Scope Of This Document
2.0	Standards & Specifications
2.1	Reference Specifications
2.2	Other Specifications To Be Followed
3.0	Scope of Supply
4.0	Pressure Gauge



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	4.1	General
	4.2	Material
	4.3	Range
	4.4	Accuracy
	4.5	Reading scales
	4.6	Enclosure class
5.0	Equipment Protection	
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Annexure I	Material Selection Chart For Pressure Gauges	
Annexure II	Hook-up drawing for Pressure Gauges	
Annexure III	Typical data sheet (during detail engineering)for Pressure Gauges	

## 1.0 SCOPE

1.1 This specification describes the essential considerations in the selection, installation, calibration and testing of pressure gauge.

The Contractor shall be responsible for the selection of Pressure Gauge suitable for its intended application, its procurement, packing, calibration, testing at yard and offshore, shipment to yard and offshore site, installation and commissioning at site.

## 2.0 CODES & STANDARDS:

2.1 Project Specifications:

- a) Particular Job Specification
- b) Tender Document



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c) Project P& IDs

## **2.2 Other Specifications To Be Followed; NIL**

## **3.0 SCOPE OF SUPPLY:**

3.1 The number of Pressure Gauges to be supplied and installed shall be as per the process requirements indicated in the SOR and the P & IDs.

3.2 The scope of supply shall also include commissioning spares and two years' spares and as suggested by the Manufacturer.

## **4.0 PRESSURE GAUGE:**

### **4.1 General:**

4.1.1 The pressure gauges shall be used for local indication. These local pressure indicators shall in general be heavy duty, weatherproof, with minimum 150mm (6") dials, white dials with black numerals and markings and external zero adjustment.

4.1.2 Case diameters shall not be less than 6". Instrument air / gas supply gauges used as output gauge may have 50 mm (2") dials. Gauges that are 150 mm (6") or larger diameter shall have micrometer pointers for zero adjustment. Gauge pointers shall be adjustable without removal from shaft.

4.1.3 Pressure gauge measuring element shall generally be Bourdon / Bellows / Diaphragm type. For measurement of slurries, viscous and corrosive fluids, Diaphragm seals shall be used.

4.1.4 Pressure gauges shall have liquid filled damping. Pressure instruments in field shall have 1/2" NPTM bottom connections. Diaphragm seals with capillary shall in general be 1 1/2" flanged.

### **4.2 Material:**

4.2.1 The material requirements for pressure gauges shall in general be according to latest IS / API standards and as described in this specification.

4.2.2 The material of all wetted parts shall be compatible with the process fluid and shall be SS 316 as a minimum, unless otherwise specified. For raw seawater service, all wetted parts shall be of Monel.

4.2.3 Pointer / Movement shall be of SS 316. Process connection shall be bottom entry type of SS 316 and 1/2" NPT.

4.2.4 Case material for all pressure gauges shall be SS 316 with a screwed bezel / bayonet bezel retaining ring and weatherproof design.

4.2.5 The Window material shall be of Shatter-proof glass or acrylic plastic.

4.2.6 Gauge saver and snubber when used shall be of the same material as that of the pressure element.



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#### **4.3 Range:**

4.3.1 The range shall be selected such that the normal operating pressure will read approximately 1/3 of full scale to 2/3 of full scale.

#### **4.4 Accuracy:**

4.4.1 The maximum error shall not exceed 1% of the span.

#### **4.5 Reading Scales:**

4.5.1 Indicating scales shall be direct reading type in Kg/cm<sup>2</sup> g.

### **5. EQUIPMENT PROTECTION:**

5.1 Pressure Gauge protection requirements shall in general as per latest Is / API / BS standards and as listed in this specification.

5.2 The pressure gauge enclosure shall be weather proof to IP 65 or better. The pressure gauge shall be capable of withstanding 130% of maximum range without affecting its calibration / accuracy. Pressure gauges shall also have rear blowout discs for blowout prevention.

5.3 Gauges and instruments subject to damage from pulsating pressures shall be provided with Snubber type pulsation dampeners. Snubber shall be provided on all pump/compressor discharge service.

5.4 Gauge savers shall be provided wherever maximum working pressure exceeds 130% of range. Gauges in vacuum service shall have over range protection to full vacuum.

### **6.0 INSTALLATION REQUIREMENTS:**

6.1 The installation of pressure gauges shall in general be according to standard engineering practice and as per the hook-up drawings & details given in this document.

6.2 Pressure gauges shall not be installed in such a way that it depends for support on the impulse piping. Pressure gauges shall not be mounted directly on lines where vibration is likely to be present.

6.3 Pressure gauges shall be mounted such that they may be easily removed and adjusted without deforming impulse lines. All pressure gauges shall be installed so as to minimize the length of impulse lines. Necessary isolation valves shall be provided for all pressure gauges.

### **7.0 CALIBRATION, INSPECTION & TESTING:**

7.1 Calibration, inspection and testing requirements shall in general be as per standard engineering practice. In addition, the following shall also be taken care of:

7.2 Direct connected pressure gauges shall be dead-weight tested or tested against a test gauge prior to installation.

7.3 Receiver type pressure gauges shall be three (3) point calibrated using a manometer or precision pressure gauge and precision air regulator. Three-point calibration shall refer to the



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input signal to an instrument equivalent to 0%, 25%, 75% and 100% of the instrument range upscale and 75%, 25% and 0% of the instrument range downscale.

## 8.0 DOCUMENTATION:

8.1 The documentation requirements shall in general be according to the project specific requirements.

## 9.0 TAGGING & NAMEPLATES:

9.1 Tagging & Nameplate requirements shall in general be according to the project requirement and standard engineering practice. Vendor has to submit the document in advance for approval.

## 10.0 REVIEW & APPROVAL:

10.1 Review and approval of purchase specifications and other related documents shall in general be according to the project requirement.

## 11.0 VENDOR PRE-QUALIFICATION REQUIREMENTS:

11.1 The Vendor pre-qualification requirements shall in general be according to the BEC / Equipment qualification criteria.

## 12.0 PREPARATION FOR SHIPMENT:

12.1 The pressure gauges shall be prepared for shipment after inspection / inspection waiver and dispatch clearance.

## 13.0 RECEIPT & STORAGE:

13.1 Receipt and storage of the pressure gauges shall be in accordance to the approved procedure to be submitted by the vendor.

## ANNEXURE – I

### MATERIAL SELECTION CHART FOR PRESSURE GAUGES

S. No.	Piping Class	Element
9.	A1, B1, D1, E1, F1, XF1, F1, PA1, PB1, PD1, PE1, PXF1, PF1, A2, B2, D2, E2, XG1, A1H, A3, B3, A8 (EXCEPT WAT. INJ. SERVICE)	SS 316
10.	INJECTION WATER SERVICE	MONEL
11.	A4, A6, A9, B9, D9, E9	SS 316
12.	A5	MONEL
13.	A7	-





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14.	A1N, B1N, D1N, E1N, F1N, XF1N, PA1N, PB1N, PD1N, PF1N, XG1N	SS 316
15.	A10, B10, D10, E10, F10	SS 316 L
16.	A11, B11, D11, E11, F11, PA11, PB11, PD11, PE11, PF11	MONEL 400

## ANNEXURE – II HOOK-UP DRAWING: PRESSURE GAUGE

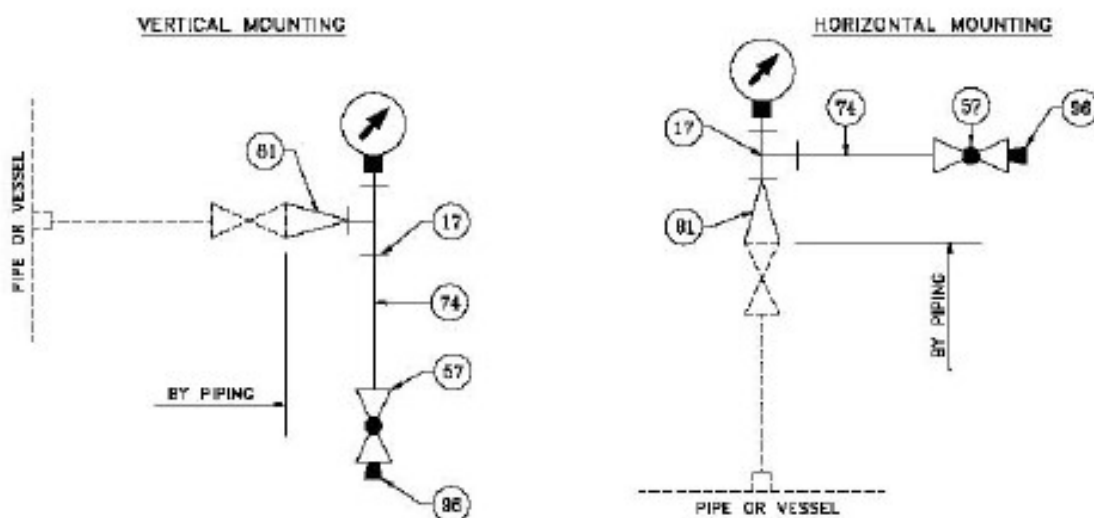


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## ANNEXURE – II

### HOOK-UP DRAWING: PRESSURE GAUGE



### PRESSURE GAUGE

ITEM	QTY	SIZE	DESCRIPTION	MATERIAL
17	1	1/2"	EQUAL TEE, SCRWO	
57	1	1/2"	GLOBE VALVE SCRWD	
74	1	1/2"	NIPPLE, THxTH	
96	1	1/2"	PLUG, SCRWD	
81	1	3/4" X 1/2"	SWAGE NIPPLE, PLxTH	

## ANNEXURE – III

### TYPICAL DATA SHEET (during detail engineering)– PRESSRUE GAUGE



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PRESSRUE GAUGES								
UNITS :-Flow Liquid – M3/HR Gas – NM3/HR Pressure – kg/cm2 Temperature – deg C Level/length -M								
15.	Type			15	Diaphragm Seal (wherever required)			
16.	Mounting			a)	Type			
17.	Dial Size/Colour			b)	Wetted Parts			
18.	Case Material			c)	Other Material			
19.	Bezel Ring			d)	Process Connection			
20.	Window Material			e)	Facing & Finish			
21.	Enclosure Class			f)	Capillary Material			
22.	Pressure Element			g)	Armour type			
23.	Element Material			h)	Armour Material			
24.	Socket Material			i)	Capillary Length			
25.	Accuracy			j)	Flushing Filling Conn			
26.	Zero Adjustment			16	Over range protection			
27.	Connection & Location			17	Blow out protection			
28.	Movement			18	Options			
				a)	Snubbet			
				b)	Siphon			
				c))	Gauge saver			
				d)	Liquid filled casing			
				e)	Vacuum protection			
TAG No.	Range	Oper. Pressure	Max Service Temp.	Oper. Temp	Max. Service Temp.	Fluid	Service	Options
As per P & ID								



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# **SPECIFICATION FOR HEALTH, SAFETY AND ENVIRONMENT (HSE) MANAGEMENT**



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5.0	RECORDS ANNEXURE-A ANNEXURE-B ANNEXURE-C ANNEXURE-D ANNEXURE-E



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## 1.0 SCOPE

This specification establishes the Healthy, Safety and Environment (HSE) management requirement to be complied with by the Contractors during construction.

This specification is not intended to replace the necessary professional judgement needed to design & implement an effective HSE system for construction activities and the contractor is expected to exceed requirements given in this specification.

Requirement stipulated in this specification shall supplement the requirement of HSE management given in relevant Act (S)/ legislations. General Condition of Contract (GCC) Special Condition of Contract (SCC) and Job Specifications. Where different documents stipulate different requirements, the most stringent shall be adopted.

## 2.0 REFERENCES

This document should be read in conjunction with following:

- General Conditions of Contract (GCC)
- Special Conditions of Contract (SCC)
- Building and other construction workers (regulation of employment and condition of Service) Act, 1996
- Job Specifications
- Relevant IS Codes (refer Annexure-A)
- Reporting Formats (refer Annexure-B)
- Statutory requirements

## 3.0 REQUIREMENT OF HEALTH, SAFETY & ENVIRONMENT (HSE) MANAGEMENT SYSTEM TO BE COMPLETED BY BIDDERS.

### 3.1 Management Responsibility

3.1.1 The Contract should have a document HSE policy to cover commitment of the organization to ensure health, safety and environment aspects in their line of operations

3.1.2 The HSE management system of the Contractor shall cover HSE requirement including but not limited to what specified under clause 1.0 & 2.0 mentioned above

3.1.3 Contractor shall be fully responsible for planning and implementing HSE requirement to the satisfaction of the company. Contractor as a minimum requirement shall designate/deploy the following to co-ordinate the above:

No. Of workers deployed Up to 250	Designate one safety supervisor who will guide the workers from time to time, as well as impart training basic guidelines at least
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	weekly once.
Above 250 & up to 500	Deploy one qualified and experienced safety Engineer/ Officer who will guide the workers from time to time as well as impart basic guideline & training at least weekly once. He / She shall possess a recognized Degree in any branch of engineering or technology or architecture and had a post qualification construction experience of minimum two years or possess a recognized Diploma in any branch of engineering or technology or Graduate in Science stream and had a post qualification construction experience of minimum five years.'
Above 500 (For every 500 or less)	One additional safety engineer/Officer whose function will be as mentioned above

Contractor shall indemnify and hold harmless Employer & their representatives from any and all liabilities arising out of non-fulfillment of HSE requirements.

Above is the minimum requirement and the Contractor shall ensure physical presence of a safety personnel at each place where Hot work permit is required. No work shall be started at site until above safety personnel are physically present at site. The contractor shall submit a safety organogram clearly indicating the lines of responsibility and reporting system. He shall furnish Bio-Data/Resume/Curriculum Vitae of the safety personnel he intends to mobilize, at least 1 month before the intended mobilization, for Employer approval.

3.1.4 The Contractor shall ensure that the Health, Safety and Environment (HSE) requirements are clearly understood & faithfully implemented at all levels, at each and every site/ work place.

3.1.5 The Contractor shall promote and develop consciousness for Health, Safety and Environment among all personnel working for the Contractor. Regular awareness programs and fabrication shop/work site meeting shall be arranged on HSE activities to cover hazards involved in various operations during construction.

3.1.6 Arrange suitable first aid measures such as First Aid Box, trained personnel to give First Aid, Stand by Ambulance or Vehicle and install fire protection measures such as: adequate number of steel buckets with sand and water and adequate fire extinguishers to the satisfaction of Employer. In case the number of workers exceeds 500, the Contractor shall position an ambulance /vehicle on full time basis very close to the worksite.

3.1.7 The Contractor shall evolve a comprehensive planned and documented system for implementation and monitoring of the HSE requirements. This shall submitted to OWNER & Employer for approval well in advance, prior to start of work. The monitoring for implementation shall be done by regular inspection and compliance to the observations thereof. The Contractor



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shall get similar HSE requirements implemented at his sub-contractor (s) work site/ Office. However, compliance of HSE requirement shall be the sole responsibility of the Contractor. Any review/ approval by Employer shall not absolve the Contractor of his responsibility/ liability in relation to all HSE requirements.

3.1.8 Non-Conformance on HSE by the Contractor (including his Sub-contractors) as brought out during review/ audit by Employer representative shall be resolved forthwith by Contractor. Compliance report shall be possibility submitted to Employer at the earliest.

3.1.9 The Contractor shall ensure participation of his Resident Engineer/Site-in-Charge in the Safety Committee/HSE Committee meetings arranged by Employer. The compliance of any observation shall be arranged urgently. Contractor shall assist Employer to achieve the targets set by them on HSE during the project implementation.

The contractor shall ensure that his staff members & workers (permanent as well casual) shall not be in a state of intoxication during working hours and shall abide by any law relating to consumption & possession of intoxicating drinks or drugs in force. Awareness about local laws on this issue shall form part of the Induction Training.

The contractor shall ensure that all personnel working for him comply with No smoking requirements of the owner as notified from time to time. Cigarettes, lighters, auto ignition tools or appliances shall not be allowed inside the plant complex. Smoking shall be permitted only inside smoking booths expressly designated & authorized by the Employer.

3.1.10 The Contractor shall adhere consistently to all provisions of HSE requirements. In case of non-compliance or continuous failure in implementation of any of HSE provisions; Employer may impose stoppage of work without any Cost & Time implication to Owner and/or impose a suitable penalty for non-compliance with a notice of suitable period, up to a cumulative limit of 1.0% (one percent) of Contract value with a ceiling of Rs. 10 lakhs.

0.2% (Zero decimal two percent) of the contract value for LSTK, EPC, EPCC or Package contracts with an overall ceiling of Rs. 1,00,00,000/- (Rupees one crore).

S. No.	Violation or HSE norms	Penalty Amount
1.	For not using personal protective equipment (Helmet, Shoes, Goggles, Gloves, Full body harness, Face shield, Boiler suit, etc.)	Rs. 250/- per day / item / person
2.	Working without Work Permit / Clearance	Rs.5,000/- per occasion
3.	Unsafe electrical practices (not installing ELCB, using poor joints of cables, using naked wire without top plug into socket, laying wire / cables on the roads, electrical jobs by incompetent person, etc.)	Rs.3, 000/- per item per day.
4.	Working at height without full body harness, using non-standard / rejected scaffolding and not arranging fall protection arrangement as required like Safety Nets.	Rs.1, 000/ per case per day.
5.	Unsafe handling of compressed gas cylinders (No trolley, jubilee clips double gauge regulator, improper	Rs. 100/- per item per day





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	storage / handling).	
6.	Use of domestic LPG for cutting purpose.	Rs.1,000/- per occasion
7.	No fencing / barricading of excavated areas.	Rs.1,000/- per occasion
8.	Not providing shoring / strutting / proper slope and not keeping the excavated earth at least 1.5 M away from excavated area.	Rs.5,000/- per occasion
9.	Non display of caution boards, list of hospitals, emergency services available at work locations.	Rs.500/- per occasion
10.	Traffic rules violations like over speeding of vehicles, rash driving, wrong parking, not using seat belts, vehicles not fitted with reverse warning alarms.	Rs.1,000/- per occasion
11.	Absence of Contractor's top most executive at site in the safety meetings whenever called by Employer	Rs.1,000/- per occasion
12.	Failure to maintain safety records by Contractor Safety personnel.	Rs.1, 000/- per month.
13.	Failure to conduct daily safety site inspection, HSE meeting and HSE audit at predefined frequencies.	Rs.1,000/- per occasion
14.	Failure to submit the monthly HSE report by 5th of subsequent month to Engineer-in-Charge.	Rs. 1,000/- per occasion and Rs. 100/- per day for further delay.
15.	Poor House Keeping	Rs.1,000/- per occasion
16.	Failure to report & follow up accident (including Near Miss) reporting system.	Rs. 10,000/- per occasion
17.	Degradation of environment (not confining toxic spills oil / lubricants onto ground)	Rs.1,000/- per occasion
18.	Not medically examining the workers before allowing them to work at height, not providing ear muffs while allowing them to work in noise polluted areas, made them to work in air polluted areas without respiratory protective devices, etc.	Rs.1,000/- per occasion
19.	Violation of any other safety condition as per job HSE plan, work permit and HSE conditions of contract (using crowbar on cable trenches, improper welding booth, not keeping fire extinguisher ready at hot work site, unsafe rigging practices, non-availability of First-Aid box, etc.)	Rs.1,000/- per occasion
20.	Any violation not covered above.	To be decided by Employer

This penalty shall be in addition to all other penalties specified elsewhere in the contract. The decision of imposing stoppage of work, its extent & monetary penalty shall rest with Employer & binding on the Contractor.

3.1.11 All fatal accidents and other personnel accidents shall be investigated by a team of Contractor's senior personnel for root cause and recommend corrective and preventive actions.



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Findings shall documented and suitable actions taken to avoid recurrences shall be communicated to Employer. Employer shall have the liberty to independently investigate such occurrences and Contractor shall extend all necessary help and co-operation in this regard. Employer shall have to right to share the content of this report with the outside world.

### **3.2 House Keeping**

3.2.1 Contractor shall ensure that a high degree of housekeeping is maintained and shall ensure the followings:

- a. All surplus earth and debris are removed/disposed off from the working site to identified location (s).
- b. Unused/Surplus Cables Steel items and steel scrap lying scattered at different places within the working areas are removed to identified location (s).
- c. All wooden scrap, empty wooden cable drums and other combustible packing materials shall be removed from work place to identified location(s).
- d. Roads shall be kept clear and materials like pipes, steel, sand, boulders, concrete chips and bricks, etc. shall not be allowed in the roads to obstructs free movement of men & machineries.
- e. Fabricated steel structurals, pipes & piping materials shall be stacked properly for erection.
- f. Water logging on rods shall not be allowed.
- g. No parking of trucks/ trolleys, cranes and trailers etc. shall be allowed on of roads, which may obstruct the traffic movements.
- h. Utmost care shall be taken to ensure over all cleanliness and proper up keep of the working areas.
- i. Trucks carrying sand, earth and pulverized materials etc. shall be covered while moving within the plant areas.
- j. The contractor shall ensure that the atmosphere in plant area and on roads is free from particulate matter like dust, sand, etc. by keeping the top surface wet for ease in breathing.
- k. At least two exits for any unit area shall be assured at all times.

### **3.3 Healthy, Safety and Environment**

a) The Contractor shall provide safe means of access to any working place including provision of suitable and sufficient scaffolding at various stages during all operations of the work for the safety of his workmen, and Employer. Contractor shall ensure deployment of appropriate equipment and appliances for adequate safety and healthy of the workmen and protection of surrounding areas.

Contractor shall ensure identification of all Occupational Health, Safety & Environmental hazards in the type of work he is going to undertake and enlist mitigation measures. Contractor shall carry out Job Safety Analysis (JSA) specifically for high risk jobs like working at height & in



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confined space, deep excavations, radiography jobs, electrical installations, blasting operations, demolishing / dismantling activities, welding / gas cutting jobs and submit the findings to Employer. The necessary HSE measures devised shall be in place prior to start of an activity by the contractor.

b) The Contractor shall ensure that all their staff workers including their subcontractor (s) shall wear Safety Helmet and Safety shoes. Contractor shall also ensure use of safety belt, protective goggles, gloves etc. by the personnel as per jobs requirements. All these gadgets shall conform to relevant IS specification equivalent.

The Contractor shall ensure that all their staff, workers and visitors including their subcontractor(s) have been issued (records to be kept) & wear appropriate PPEs like nape strap type safety helmets preferably with head & sweat band with  $\frac{3}{4}$ " cotton chin strap (made of industrial HDPE), safety shoes with steel toe cap and antiskid sole, full body harness (CE marked and conforming to EN361), protective goggles, gloves, ear muffs, respiratory protective devices, etc. All these gadgets shall conform to applicable IS Specifications / CE or other applicable international standards.

Owner may issue a comprehensive color scheme for helmets to be used by various agencies. The Contractor shall follow the scheme issued by the owner. All Safety / Fire personnel shall preferably wear red colour helmet so that workmen can approach them for guidance during emergencies.

For shot blasting, the usage of protective face shield and helmets, gauntlet and protective clothing is mandatory.

For offshore jobs/contracts, contractor shall provide PPEs (new) to Employer personnel, at his (contractor's) cost. All personnel shall wear life jacket at all time.

An indicative list of HSE standards/codes is given under Appendix-A.

The contractor shall issue height permit for working at height after verifying and certifying the checkpoints as specified in the attached permit (Format No. HSE-6). He shall also undertake to ensure compliance to the conditions of the permit during the currency of the permit including adherence to personal protective equipments.

The permit shall be issued initially for one week or expected duration of an activity and extended further for the balance duration. This permit shall be applicable in areas where specific clearance from Owner's operation Dept. / Safety Dept. is not required. Employer field Engineers / Safety Officers / Area Coordinators may verify and counter sign this permit (as an evidence of verification) during the execution of the job.

In case work is undertaken without taking sufficient precautions as given in the permit, Employer Engineers may cancel the permit and stop the work till satisfactory compliance is arranged. Contractors are expected to maintain a register for issuance of permit and extensions thereof including preserving the used permits for verification during audits etc.

Contractor shall arrange (at his cost) and ensure use of Fall Arrester Systems by his workers. Fall arresters are to be used while climbing / descending tall structures. These arresters should



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lock automatically against the anchorage line, restricting free fall of the user. The device is to be provided with a double security opening system to ensure safe attachment or release of the user at any point of rope. In order to avoid shock, the system should be capable of keeping the person in vertical position in case of a fall.

Contractor shall ensure that Full body harnesses conforming EN361 and having authorized CC marking is used by all personnel while working at height. The lanyards and life lines should have enough tensile strength to take the load of the worker in case of a fall. One end of the lanyard shall be firmly tied with the harnesses and the other end with life line. The harness should be capable of keeping the workman vertical in case of a fall, enabling him to rescue himself.

Contractor shall provide Roof Top Walk Ladders for carrying out activities on sloping roofs in order to reduce the chances of slippages and falls.

c) Contractor shall ensure that a proper Safety Net System shall be used at appropriate locations. The safety net shall be located not more than 30 feet (9.0 metres) below the working surface at site to arrest or to reduce the consequences of possible fall of persons working at different heights.

d) Contractor shall ensure that flash back arrestors conforming to BS: 6158 or equivalent are installed on all gas cylinders as well as at the torch end of the gas hose, while in use. All cylinders shall be mounted on trolleys and provided with a closing key. The burner and the hose placed downstream of pressure reducer shall be equipped with Flash Back Arrestor / Non Return Valve device. The hoses for acetylene and oxygen cylinders must be of different colours. Their connections to cylinders and burners shall be made with a safety collar. At end of work, the cylinders in use shall be closed and hoses depressurized. All welding machines shall have effective earthing. In order to help maintain good housekeeping, and to reduce fire hazard, live electrode bits shall be contained safely and shall not be thrown directly on the ground.

e) The Contractor shall assign to his workmen, tasks commensurate with their qualification, experience and state of health for driving of vehicles, handling and erections of materials and equipment's. All lifting equipments shall be tested certified for its capacity before use. Adequate and suitable lighting at every work place and approach there to shall be provided by the contractor before starting the actual work/ operation at night.

Contractor shall ensure installation of Safe Load Indicator (SLI) on all cranes (while in use) to minimize overloading risk. SLI shall have capability to continuously monitor and display the load on the hook, and automatically compare it with the rated crane capacity at the operating condition of the crane. The system shall also provide visual and audible warnings at set capacity levels to alert the operator in case of violations.

The contractor shall be responsible for safe operations of different equipments mobilized and used by him at the workplace like transport vehicles, engines, cranes, mobile ladders, scaffoldings, work tools, etc.

f) Hazardous and/or toxic material such as solvent coating or thinners shall be stored in appropriate containers.



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g) All hazardous materials shall be labeled with the name of the materials, the hazards associated with its use and necessary precautions to be taken. The work place shall be checked prior to start of activities to identify the location, type and condition of any asbestos materials which could be disturbed during the work. In case asbestos material is detected, usage of appropriate PPEs by all personnel shall be ensured and the matter shall be reported immediately to Employer.

h) Contractor shall ensure that during the performance of the work all hazards to the health of personnel have been identified assessed and eliminated.

i) Chemical spills shall be contained & cleaned up immediately to prevent further contamination.

j) All personnel exposed to physical agents such as ionizing or non-ionizing radiation ultraviolet rays or similar other physical agents shall be provided with adequate shielding or protection commensurate with type of exposure involved. For ionizing radiation, requirements of Bhabha Atomic Research Centre (BARC)/ Atomic Energy Regulatory Board (AERB) shall be followed.

k) Where contract or exposure of hazardous materials could exceed limits or could otherwise have harmful affects, appropriate personal protective equipment's such as gloves, goggles, aprons, chemical resistant clothing and respirator shall be used.

l) Contractor shall ensure the following facilities at work sites:

I) A Crèche where 10 or more female workers are having children below the age of 6 years.

II) Reasonable Canteen facilities are made available at appropriate location depending upon site conditions.

m) Suitable facilities for toilet, drinking water, proper lighting shall be provided at site and labor camps, commensurate with applicable Laws/Legislation.

n) Contractor shall ensure storage and utilization methodology of material that are not detrimental to the environment. Wherever required Contractor shall ensure that only the environment friendly material are selected.

Emphasize on recycling of waste materials such as metals, plastics, glass, paper, oil & solvents. The waste that cannot be minimized, reused or recovered shall be stored and disposed of safely. In no way, toxic spills shall be allowed to percolate into the ground. The contractor shall not use the empty areas for dumping the wastes.

o) All person deployed at site shall be knowledgeable of and comply with the environmental laws, rules & regulation relating to the hazardous materials substance and wastes. Contractor shall not dump, release or otherwise discharge or dispose off any such materials without the authorization of Employer.

Suitable scaffoldings shall be provided to workmen for all works that cannot be safely done from the ground or from solid construction except such short period work that can be safely done using ladders. When a ladder is used, an extra workman shall be engaged for holding the ladder.



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The contractor shall ensure that the scaffolds used during construction activities shall be strong enough to take the designed load. Employer reserves the right to ask the contractor to submit certification and or design calculations from his Engineering regarding load carrying capacity of the scaffoldings.

All scaffolds shall be inspected by a Scaffolding Inspector of the contractor. He shall paste a GREEN tag on each scaffold found safe and a RED tag on each scaffold found unsafe. Scaffolds with GREEN tag only shall be permitted to be used and RED ones shall immediately be removed from the site.

All electrical installations / connections shall be carried out as per the provisions of latest revision of following codes/standards, in addition to the requirements of Statutory Authorities and IE / applicable international rules & regulations:

- OISO SID 173: Fire prevention & protection system for electrical installations
- SP 30 (BIS): National Electric Code

All electrical installations shall be approved by the concerned statutory authorities.

• The contractor shall meet the following requirements:

- i) Ensure that electrical systems and equipment including tools & tackles used during construction phase are properly selected, installed, used and maintained as per provisions of the latest revision of the Indian Electrical / applicable international regulations.
- ii) Shall deploy qualified & licensed electricians for proper & safe installation and for regular inspection of construction power distribution system / points including their earthing. A copy of the license shall be submitted to Employer for records. Availability of at least one competent licensed electrician shall be ensured at site round the clock to attend to the normal / emergency jobs.
- iii) All switchboards / welding machines shall be kept in well-ventilated & covered shed. The shed shall be elevated to avoid water logging. No flammable materials shall be used for constructing the shed. Also flammable materials shall not be stored in and around electrical equipment / switchboard. Adequate clearances and operational space shall be provided around the equipment.
- iv) Fire extinguishers and insulating mats shall be provided in all power distribution centers.
- v) Temporary electrical equipment shall not be employed in hazardous area without obtaining safety permit.
- vi) Proper house keeping shall be done around the electrical installations.
- vii) All temporary installations shall be tested before energizing, to ensure proper earthing, bonding, suitability of protection system, adequacy of feeders/cables etc.
- viii) All welders shall use hand gloves irrespective of holder voltage.





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ix) Multilingual (Hindi, English and local language) caution boards, shock treatment charts and instruction plate containing location of isolation point for incoming supply, name & telephone No. of contact person in emergency shall be provided in substations and near all distribution boards / local panels.

x) Operation of earth leakage device shall be checked regularly by temporarily connecting series test lamp (2 bulbs of equal rating connected in series) between phase and earth.

xi) Regular inspection of all installations (at least once in a month)

• The following features shall also be ensured for all electrical installations during construction phase by the contractor:

i) Each installation shall have a main switch with a protective device, installed in an enclosure adjacent to the metering point. The operating height of the main switch shall not exceed 1.5 M. The main switch shall be connected to the point of supply by means of armoured cable.

ii) The outgoing feeders shall be double or triple pole switches with fuses / MCBs. Loads in a three phase circuit shall be balanced as far as possible and load on neutral should not exceed 20% of load in the phase.

iii) The installation shall be adequately protected against overload, short circuit and earth leakage by the use of suitable protective devices. Fuses wherever used shall be HRC type. Use of rewirable fuses shall be strictly prohibited. The earth leakage device shall have an operating current not exceeding 30 mA.

iv) All connections to the hand tools / welding receptacles shall be taken through proper switches, sockets and plugs.

v) All single phase sockets shall be minimum 3 pin type only. All unused sockets shall be provided with socket caps.

vi) Only 3 core (P+N+E) overall sheathed flexible cables with minimum conductor size of 1.5 mm<sup>2</sup> copper shall be used for all single phase hand tools.

vii) Only metallic distribution boxes with double earthing shall be used at site. No wooden boxes shall be used.

viii) All power cables shall be terminated with compression type cable glands. Tinned copper lugs shall be used for multistrand wires / cables.

ix) Cables shall be free from any insulation damage.

x) Minimum depth of cable trench shall be 750 mm for MV & control cables and 900 mm for HV cables. These cables shall be laid over a sand layer and covered with sand, brick & soil for ensuring mechanical protection. Cables shall not be laid in waterlogged area as far as practicable. Cable route markers shall be provided at every 25 M of buried trench route. When laid above ground, cables shall be properly cleated or supported on rigid poles of atleast 2 M high. Minimum head clearance of 6 meters shall be provided at road crossings.



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xi) Underground road crossings for cables shall be avoided to the extent feasible. In any case no underground power cable shall be allowed to cross the roads without pipe sleeve.

xii) All cable joints shall be done with proper jointing kit. No taped / temporary joints shall be used.

xiii) An independent earthing facility should preferably be established within the temporary installation premises. All appliances and equipment shall be adequately earthed. In case of armoured cables, the armour shall be bonded to the earthing system.

xiv) All cables and wire rope used for earth connections shall be terminated through tinned copper lugs.

xv) In case of local earthing, earth electrodes shall be buried near the supply point and earth continuity wire shall be connected to local earth plate for further distribution to various appliances. All insulated wires for earth connection shall have insulation of green colour.

xvi) Separate core shall be provided for neutral. Earth / Structures shall not be used as a neutral in any case.

xvii) ON/OFF position of all switches shall be clearly designated / painted for easy isolation in emergency.

The contractor shall identify all operations that can adversely affect the health of its workers and issue & implement mitigation measures.

For surface cleaning operations, sand blasting shall not be permitted even if not explicitly stated elsewhere in the contract.

To eliminate radiation hazard, Tungsten electrodes used for Gas Tungsten Arc Welding shall not contain Thorium.

Appropriate respiratory protective devices shall be used to protect workmen from inhalation of air borne contaminants like silica, asbestos, gases, fumes, etc.

Workmen shall be made aware of correct methods for lifting, carrying, pushing & pulling of heavy loads. Wherever possible, manual handling shall be replaced by mechanical lifting equipments.

For jobs like drilling / demolishing / dismantling where noise pollution exceeds the specified limit of 85 decibels, ear muffs shall be provided to the workers.

To avoid upper limb disorders and backaches, Display Screen Equipments' workplace stations shall be carefully designed & used with proper sitting postures. Power driven hand-held tools shall be maintained in good working condition to minimize their vibrating effects and personnel using these tools shall be taught how to operate them safely & how to maintain good circulation in hands.

The contractor shall arrange health checkup for all the workers at the time of induction. Health check may have to be repeated if the nature of duty assigned to him is changed necessitating





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health check or doubt arises about his wellness. Employer reserve the right to ask the contractor to submit test reports.

#### Weather Protection

Contractor shall take appropriate measures to protect workers from severe storms, solar radiations, poisonous gases, dust, etc. by ensuring proper usage of PPEs like Sun glasses, Sun screen lotions, respirators, dust masks, etc. and rearranging / planning the construction activities to suit the weather conditions.

#### Communication

All persons deployed at the work site shall have access to effective means of communication so that any untoward incident can be reported immediately and assistance sought by them.

All health & safety information shall be communicated in a simple & clear language easily understood by the local workforce.

#### Unsuitable Land Conditions

Contractor shall take appropriate measures and necessary work permits / clearances if work is to be done in or around marshy areas, river crossings, mountains, monuments, etc.

#### Under Water Inspection

Contractor shall ensure that boats and other means used for transportation, surveying & investigation works shall be certified seaworthy by a recognized classification society. It shall be equipped with all life saving devices like life jackets, adequate fire protection arrangements and shall possess communication facilities like cellular phones, wireless, walkie-talkie. All divers used for seabed surveys, underwater inspections shall have required authorized license, suitable lifesaving kit. Number of hours of work by divers shall be limited as per regulations. Employer shall have the right to inspect the boat and scrutinize documents in this regard.

#### TOOL BOX MEETING (TBM)

Contractor shall conduct daily TBM with workers prior to start of work and shall maintain proper record of the meeting. A suggested format is given below. The TBM is to be conducted by the immediate supervisor of the workers.

#### TOOLBOX MEETING RECORDING SHEET

Date & Time Subject Presenter		
Hazards involved		
Precautions to be taken		
Worker's Name	Signature	Section



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Remarks, if any		
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The topics during TBM shall include

- Hazards related to work assigned on that day and precautions to be taken.
- Any forthcoming HSE hazards / events / instruction / orders, etc.

The above record can be kept in local language, which workers can read. These records shall be made available to Employer whenever demanded.

### TRAINING

Contractor shall ensure that all his personnel possess appropriate training to carry out the assigned job safely. The training should be imparted in a language understood by them and should specifically be trained about

- Potential hazards to which they may be exposed at their workplace
- Measures available for prevention and elimination of these hazards

The topics during training shall cover, at the minimum;

- Education about hazards and precautions required
- Emergency and evacuation plan - HSE requirements
- Firefighting and First-Aid
- Use of PPEs
- Local laws on intoxicating drinks, drugs, smoking in force

Records of the training shall be kept and submitted to Employer whenever demanded.

For offshore and jetty jobs, contractor shall ensure that all personnel deployed have undergone a structured sea survival training including use of lifeboats, basket landing, use of radio communication etc. from an agency acceptable to Employer.

### INSPECTION

The contractor shall carryout daily HSE inspection and record observations at a central location. These inspection records shall be freely accessible to Employer representatives. The contractor shall also assist Employer representatives during the HSE inspections conducted by them.

### ADDITIONAL SAFETY REQUIREMENTS FOR WORKING INSIDE A RUNNING PLANT

As a minimum, the contractor shall ensure adherence to following safety requirements while working in or in the close vicinity of an operating plant:



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- a) Contractor shall obtain permits for Hot work, Cold work, Excavation and Confined Space from Owner in the prescribed format.
- b) The contractor shall monitor, record and compile list of his workers entering the operational plant/unit each day and ensure & record their return after completing the job.
- c) Contractor's workers and staff members shall use designated entrances and proceed by designated routes to work areas only assigned to them. The workers shall not be allowed to enter units' area, tanks area, pump rooms, etc. without work authorization permit.
- d) Work activities shall be planned in such a way so as to minimize the disruption of other activities being carried out in an operational plant / unit and activities of other contractors.
- e) The contractor shall submit a list of all chemicals / toxic substances that are intended to be used at site and shall take prior approval of the Owner.
- f) Specific training on working in a hydrocarbon plant shall be imparted to the work force and mock drills shall be carried out for Rescue operations / First-Aid measures.
- g) Proper barricading / cordoning of the operational units / plants shall be done before starting the construction activities. No unauthorized person shall be allowed to trespass. The height and overall design of the barricading structure shall be finalized in consultation with the Owner and shall be got approved from the Owner.
- h) Care shall be taken to prevent hitting underground facilities such as electrical cables, hydrocarbon piping during execution of work.
- i) Barricading with water curtain shall be arranged in specific/critical areas where hydrocarbon vapors are likely to be present such as near Horton spheres or tanks. Positioning of fire tenders (from owner) shall also be ensured during execution of critical activities.
- j) Emergency evacuation plan shall be worked out and all workmen shall be apprised about evacuation routes. Mock drill operations may also be conducted.
- k) Flammable gas test shall be conducted prior to any hot work using appropriate measuring instruments. Sewers, drains, vents or any other gas escaping points shall be covered with flame retardant tarpaulin.
- l) Respiratory devices shall be kept handy while working in confined zones where there is a danger of inhalation of poisonous gases. Constant monitoring of presence of Gas / Hydrocarbon shall be done.
- m) Clearance shall be obtained from all parties before starting hot tapping, patchwork on live lines and work on corroded tank roof.
- n) Positive isolation of line/equipment by blinding for welding/cutting/grinding shall be done. Closing of valve will not be considered sufficient for isolation.
- o) Welding spatters shall be contained properly and in no case shall be allowed to fall on the ground containing oil. Similar care shall be taken during cutting operations.



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- p) The vehicles, cranes, engines, etc. shall be fitted with spark arresters on the exhaust pipe and got it approved from Safety Department of the Owner.
- q) Plant air should not be used to clean any part of the body or clothing or use to blow off dirt on the floor.
- r) Gas detectors should be installed in gas leakage prone areas as per requirement of Owner's plant operation personnel.
- s) An experienced full time safety personnel shall be exclusively deployed to monitor safety aspects in running plants.

## **HSE PROMOTION**

The contractor shall encourage his workforce to promote HSE efforts at workplace by way of organizing workshops / seminars / training programmes, celebrating HSE awareness weeks & National Safety Day, conducting quizzes & essay competitions, distributing pamphlets, posters & material on HSE, providing incentives for maintaining good HSE practices and granting bonus for completing the job without any lost time accident.

## **4.0 DETAILS OF HSE MANAGEMENT SYSTEM BY CONTRACTOR**

### **4.1 On Award of Contract**

The Contractor shall prior to start of work submit his Health, Safety and Environment Manual of procedure and HSE Plans for approval by Employer. The Contractor shall participate in the pre-start meeting with Employer to finalize HSE plans including the following.

- Job procedure to be followed by Contractor for activities covering Handling of equipment's, Scaffolding, Electric Installation, describing the risks involved, actions to be taken and methodology for monitoring each.
- Organizations structure alongwith responsibility and authority records/ reports etc. on HSE activities.

### **4.2 During job execution**

4.2.1 Implement approved Health, Safety and Environment management procedure including but not limited to as brought out under para 3.0. Contractor shall also ensure to: - Arrange workmen compensation insurance, registration under ESI Act, third party liability insurance etc. as applicable.

- Arrange all HSE permits before start of activities (as applicable) like hot work, confined space, work at heights, storage of Chemicals/explosives materials and its use and implement all precautions mentioned therein
- Submit timely the completed check list on HSE activities, Monthly HSE report, accident report, investigation report, etc. as per Employer requirements. Compliance of instructions on HSE shall be done by Contractor and informed urgently to Employer.



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- Ensure that resident Engineers/Site-In-Charge of the Contractor shall amend all the Safety Committee/HSE meeting arranged by Employer only in case of his absence from site, a seconds senior most person shall be nominated by him in advance and communicated to Employer.
- Display at site office and work locations caution boards, list of hospitals for emergency services available.
- Provided posters, banners, for safe working to promote safety consciousness
- Carryout audits/inspection at sub-Contractor work as per approved HSE documents & submit the reports for Employer review
- Assist in HSE audits by Employer and submit compliance report.
- Generate & submit HSE records/ reports as per HSE Plan.
- Appraise Employer on HSE activities at site.

## 5.0 RECORDS

At the minimum, the contractor shall maintain/ submit HSE records in the following reporting formats:

1. Monthly HSE Checklist cum compliance report	HSE-1
2. Accident / Incident Report	HSE-2
3. Supplementary Accident / Incident Investigation report	HSE-3
4. Near Miss Incident Report	HSE-4
5. Monthly HSE Report	HSE-5
6. Permit for working at height	HSE-6
7. Permit for working in confined space	HSE-7
8. Permit for radiation work	HSE-8
9. Permit for demolishing / dismantling	HSE-9

## ANNEXURE-A

### A. I.S. CODES ON HSE

SP: 53 Safety code for the use, Care and protection of hand operated tools.

IS: 818 Code of practice for safety and health requirements in electric and gas welding and cutting operations

IS: 1179 Eye and Face precautions during welding, equipment etc.



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IS: 1860 Safety requirements for use, care and protection of abrasive grinding wheels.

IS: 1989(Part-I & II) Leather safety boots and shoes

IS: 2925 Industrial Safety Helmets

IS: 3016 Code of practice for fire safety precautions in welding and cutting operations.

IS: 3043 Code of practice for earthing.

IS: 3764 Code of safety for excavation work

IS: 3786 Methods for computation of frequency and severity rates for industrial injuries and classification of industrial accidents.

IS: 3996 Safety Code of scaffolds and ladders.

IS: 4082 Recommendation on stacking and storage of construction materials and components at site.

IS: 4770 Rubber gloves for electrical purposes

IS: 5121 Safety code for piling and other deep foundations

IS: 5216 (Part-I) Recommendations on Safety procedures and practices in electrical works

IS: 5557 Industrial and Safety rubber lined boots.

IS: 5983 Eye protectors

IS: 6519 Selection, care and repair of Safety footwear

IS: 6994 (Part-I) Industrial Safety Gloves (Leather & Cotton Gloves)

IS: 7293 Safety Code for working with construction Machinery

IS: 8519 Guide for selection of industrial safety equipment for body protection IS: 9167 Ear protectors IS: 11006 Flash back arrestor (Flame arrestor)

IS: 11016 General and safety requirements for machine tools and their operation

IS: 11057 Specification for Industrial safety nets

IS: 11226 Leather safety footwear having direct moulded rubber sole

IS: 11972 Code of practice for safety precaution to be taken when entering a sewerage system

IS: 13367 Code of practice-safe use of cranes

IS: 13416 Recommendations for preventive measures against hazards at working place

## **B. INTERNATIONAL STANDARDS ON HSE**



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Safety Glasses : ANSI Z 87.1, ANSI ZZ 87.1, AS 1337, BS 2092, BS 1542, BS 679, DIN 4646 / 58211

Safety Shoes : ANSI Z 41.1, AS 2210, EN 345

Hand Gloves : BS 1651

Ear Muffs : BS 6344, ANSI S 31.9

Hard Hat : ANSI Z 89.1 / 89.2, AS 1808, BS 5240, DIN 4840

Goggles : ANSI Z 87.1

Face Shield : ANSI Z 89.1

Breathing Apparatus : BS 4667, NIOSH

Welding & Cutting : ANSI Z 49.1

Safe handling of compressed Gases : P-1 (Compressed Gas Association  
1235 Jefferson Davis Highway, Arlington VA 22202 – USA)  
in cylinders

## ANNEXURE-B

### DETAILS OF FIRST AID BOX

SL. NO	DESCRIPTION	QUANTITY
1.	Small size Roller Bandages, 1 inch wide (Finger Dressing small)	6 Pcs.
2.	Medium size Roller Bandages, 2 inch wide (Hand and Foot Dressing)	6 Pcs.
3.	Large size Roller Bandages, 4 inch wide (Body Dressing Large)	6 Pcs.
4.	Large size Burn Dressing (Burn Dressing Large)	4 Pkts.
5.	Cotton wool (20 gms packing)	4 Pkts.
6.	Antiseptic Solution Dettol (100 ml.) or Savlon	1 Bottle
7.	Mercurochrome Solution (100 ml.) 2% in water	1 Bottle
8.	Ammonia Solution (20 ml.)	1 Bottle





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9.	A Pair of Scissors	1 Piece
10.	Adhesive Plaster (1.25 cm x 5 m)	1 Spool
11.	Eye pads in Separate Sealed Packet	4 Pcs
12.	Tourniquet	1 No.
13.	Safety Pins	1 Dozen
14.	Tinc. Iodine / Betadin (100 ml.)	1 Bottle
15.	Ointment for burns (Burnol 20 gms.)	1 Bottle
16.	Polythene Wash cup for washing eyes	1 No.
17.	Potassium Permanganate (20 gms.)	1 Pkt.
18.	Tinc. Benzoine (100 ml.)	1 Bottle
19.	Triangular Bandages	2 Nos.
20.	Band Aid Dressing	5 Pcs.
21.	Iodex / Moov (25 gms.)	1 Bottle
22.	Tongue Depressor	1 No.
23.	Boric Acid Powder (20 gms.)	2 Pkt.
24.	Sodium Bicarbonate (20 gms.)	1 Pkt.
25.	Dressing Powder (Nebasulf) (10 gms.)	1 Bottle
26.	Medicinal Glass	1 No.
27.	Duster	1 No.
28.	Booklet (English & Local Language)	1 No. each
29.	Soap	1 No.
30.	Toothache Solution	1 No.
31.	Eye Ointment	1 Bottle
32.	Vicks (22 gms.)	1 Bottle
33.	Forceps	1 No.
34.	Cotton Buds (5 nos.)	1 Pkt.
35.	Note Book	1 No.
36.	Splints	4 Nos.
37.	Lock	1 Piece
38.	Life Saving/Emergency/Over-the Counter Drugs	As decided at site
	Box size : 14" x 12" x 4"	

Note: The medicines prescribed above are only indicative. Equivalent medicines can also be used. A prescription, in this regard, shall be required from a qualified Physician.





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## ANNEXURE – C

### TYPE OF FIRES VIS-À-VIS FIRE EXTINGUISHERS

Fire	Fire Extinguishers				
	Water	Foam	CO2	Dry Powder	Multi-Purpose (ABC)
Originated from paper, clothes, wood	√	√	Can control minor surface fires	Can control minor surface fires	√
Inflammable liquids like alcohol, diesel, petrol, edible oils, bitumen	x	√	√	√	√
Originated from gases like LPG, CNG, H2	x	x	√	√	√
Electrical Fires	x	x	√	√	√

Legend: √ can be used

x Not to be used

Note: Fire extinguishing equipment must be checked atleast once a year and after every use by an authorized person. The equipment must have an inspection label on which the next inspection date is given: Type of extinguisher shall clearly be marked on it.

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### **Indicative List of Statutory Acts & Rules Relating to HSE**

- The Indian Explosives Act and Rules
- The Motor Vehicle Act and Central Motor Vehicle Rules
- The Factories Act and concerned Factory Rules
- The Petroleum Act and Petroleum Rules
- The Workmen Compensation Act
- The Gas Cylinder Rules and the Static & Mobile Pressure Vessels Rules.
- The Indian Electricity Act and Rules
- The Indian Boiler Act and Regulations
- The Water (Prevention & Control & Pollution) Act
- The Water (Prevention & Control of Pollution) Cess Act
- The Mines & Minerals (Regulation & Development) Act
- The Air (Prevention & Control of Pollution) Act
- The Atomic Energy Act
- The Radiation Protection Rules
- The Indian Fisheries Act
- The Indian Forest Act
- The Wild Life (Protection) Act
- The Environment (Protection) Act and Rules
- The Hazardous Wastes (Management & Handling) Rules
- The Manufacturing, Storage & import of Hazardous Chemicals Rules
- The Public Liability Act
- The Building and Other Construction Workers (Regulation of Employment and Condition of service) Act
- Other statutory acts Like EPF, ESIS, Minimum Wage Act.



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## ANNEXURE – E

### CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
(A)EXCAVATION  Pit Excavation up to 3.0m	➤ Falling into pit	➤ Personal injury	➤ Provide guard rails/barricade with warning signal. ➤ Provide at least two entries/exits. ➤ Provide escape ladders.
	➤ Earth Collapse	➤ Suffocation / Breathlessness ➤ Buried	➤ Provide suitable size of shoring and strutting, if required. ➤ Keep soil heaps away from the edge equivalent to 1.5m or depth of pit whichever is more. ➤ Don't allow vehicles to operate too close to excavated areas. Maintain at least 2m distance from edge of cut. ➤ Maintain sufficient angle of repose. Provide slope not less than 1:1 and suitable bench of 0.5m width at every 1.5m depth of excavation in all soils except hard rock. ➤ Battering/benching the sides.
	➤ Contact with buried electric cables ➤ Gas/ Oil Pipelines	➤ Electrocution ➤ Explosion	➤ Obtain permission from competent authorities, prior to excavation, if required. ➤ Locate the position of buried utilities by referring to plant



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			<p>drawings.</p> <ul style="list-style-type: none"> <li>➤ Start digging manually to locate the exact position of buried utilities and thereafter use mechanical means.</li> </ul>
Pit Excavation beyond 3.0m	<ul style="list-style-type: none"> <li>➤ Same as above plus</li> <li>➤ Flooding due to excessive rain/ underground water</li> </ul>	<ul style="list-style-type: none"> <li>➤ Can cause drowning situation</li> </ul>	<ul style="list-style-type: none"> <li>➤ Prevent ingress of water</li> <li>➤ Provide ring buoys</li> <li>➤ Identify and provide suitable size dewatering pump or well point system</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Digging in the vicinity of existing Building/ Structure</li> </ul>	<ul style="list-style-type: none"> <li>➤ Building/ Structure may collapse</li> <li>➤ Loss of health &amp; wealth</li> </ul>	<ul style="list-style-type: none"> <li>➤ Obtain prior approval of excavation method from local authorities</li> <li>➤ Use under-pining method</li> <li>➤ Construct retaining wall side by side</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Movement of vehicles / equipments close to the edge of cut</li> </ul>	<ul style="list-style-type: none"> <li>➤ May cause cave-in or slides</li> <li>➤ Persons may get buried</li> </ul>	<ul style="list-style-type: none"> <li>➤ Barricade the excavated area with proper lighting arrangements</li> <li>➤ Maintain at least 2m distance from edge of cut and use stop block to prevent over-run.</li> <li>➤ Strengthen shoring and strutting</li> </ul>
Narrow deep excavations for pipelines, etc.	<ul style="list-style-type: none"> <li>➤ Same as above plus</li> <li>➤ Frequent cave-in or slides</li> </ul>	<ul style="list-style-type: none"> <li>➤ May cause severe injuries or prove fatal</li> </ul>	<ul style="list-style-type: none"> <li>➤ Battering/benching of sides</li> <li>➤ Provide escape ladders</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Flooding due to Hydrostatic testing</li> </ul>	<ul style="list-style-type: none"> <li>➤ May arise drowning situation</li> </ul>	<ul style="list-style-type: none"> <li>➤ Same as above plus</li> <li>➤ Bail out accumulated water</li> <li>➤ Maintain adequate ventilation</li> </ul>
Rock excavation by blasting	<ul style="list-style-type: none"> <li>➤ Improper handling of</li> </ul>	<ul style="list-style-type: none"> <li>➤ May prove fatal</li> </ul>	<ul style="list-style-type: none"> <li>➤ Ensure proper storage, handling &amp;</li> </ul>



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	explosives		carrying of explosives by trained personnel. ➤ Comply with the applicable explosive acts & rules.
	➤ Uncontrolled explosion	➤ May cause severe injuries or prove fatal	➤ Allow only authorized persons to perform blasting operations. ➤ Smoking and open flames are to be strictly prohibited.
	➤ Scattering of stone pieces in atmosphere	➤ Can hurt people	➤ Use PPE like goggles, face mask, helmets etc.
Rock excavating by blasting (Contd)	➤ Entrapping of persons/ animals.	➤ May cause severe injuries or prove fatal	➤ Barricade the area with red flags and blow siren before blasting.
	➤ Misfire	➤ May explode suddenly	➤ Do not return to site for at least 20 minutes or unless announced safe by designated person.
Piling Work equipment	➤ Failure of pile driving	➤ Can hurt people	➤ Inspect Piling rigs and pulley blocks before the beginning of each shift.
	➤ Noise pollution	➤ Can cause deafness and psychological imbalance	➤ Use personal protective equipments like ear plugs, muffs, etc.
	➤ Extruding rods / casing	➤ Can hurt people	➤ Barricade the area and install sign boards ➤ Provide first-aid
	➤ Working in the vicinity of 'Live-Electricity'	➤ Can cause electrocution / asphyxiation	➤ Keep sufficient distance from Live-Electricity as per IS code. ➤ Shut off the supply, if possible ➤ Provide artificial/rescue breathing to he



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			injured.
(B) CONCRETING	➤ Air pollution by cement	➤ May affect Respiratory System	➤ Wear respirators or cover mouth and nose with wet cloth.
	➤ Handling of ingredients	➤ Hand s may get injured	➤ Use gloves and other PPE.
	➤ Protruding reinforcement rods.	➤ Feet may get injured	➤ Use Safety shoes. ➤ Provide platform above reinforcement for movement of workers.
	➤ Earthing of electrical mixers, vibrators, etc. not done	➤ Can cause electrocution / asphyxiation	➤ Ensure earthing of equipments and proper functioning of electrical circuit before commencement of work.
	➤ Falling of materials from height	➤ Persons may get injured	➤ Use hard hats ➤ Remove surplus material immediately from work place ➤ Ensure lighting arrangements during night hours.
	➤ $\frac{3}{4}$ Continuous pouring by same gang	➤ Cause tiredness of workers and may lead to accident.	➤ Insist on shift pattern ➤ Provide adequate rest to workers between subsequent pours.
	➤ Revolving or concrete mixer/ vibrators	➤ Parts of body or clothes may get entrapped.	➤ Allow only mixers with hopper ➤ Provide safety cages around moving motors ➤ Ensure proper mechanical locking of vibrator
Super-structure	➤ Same as above plus ➤ Deflection in props or shuttering material	➤ Shuttering / props may collapse and prove fatal	➤ Avoid excessive stacking on shuttering material ➤ Check the design and strength of shuttering material before commencement of



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			<ul style="list-style-type: none"> <li>work</li> <li>➤ Rectify immediately the deflection noted during concreting</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Passage to work place</li> </ul>	<ul style="list-style-type: none"> <li>➤ Improperly tied and designed props / planks may collapse</li> </ul>	<ul style="list-style-type: none"> <li>➤ Ensure the stability and strength of passage before commencement of work</li> <li>➤ Do not overload and under the passage.</li> </ul>
(C) REINFORCEMENT	<ul style="list-style-type: none"> <li>➤ Curtailment and binding of rods</li> </ul>	<ul style="list-style-type: none"> <li>➤ Persons may get injured</li> </ul>	<ul style="list-style-type: none"> <li>➤ Use PPE like gloves, shoes, helmets, etc.</li> <li>➤ Avoid usage of shift tools</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Carrying of rods for short distance/ at heights</li> </ul>	<ul style="list-style-type: none"> <li>➤ Workers may injure their hands and shoulders</li> </ul>	<ul style="list-style-type: none"> <li>➤ Provide suitable pads on shoulders and use safety gloves.</li> <li>➤ Tie up rods in easily liftable bundles</li> <li>➤ Ensure proper staging.</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Checking of clear distance/ cover with hands</li> </ul>	<ul style="list-style-type: none"> <li>➤ Rods may cut or injure the finger</li> </ul>	<ul style="list-style-type: none"> <li>➤ Use measuring devices tape, measuring rods, etc.</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Hitting projected rods and standing on cantilever rods</li> </ul>	<ul style="list-style-type: none"> <li>➤ Persons may get injured and fall down</li> </ul>	<ul style="list-style-type: none"> <li>➤ Use safety shoes and avoid standing unnecessarily on cantilever rods</li> <li>➤ Avoid wearing loose clothes</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Falling of material from height</li> </ul>	<ul style="list-style-type: none"> <li>➤ May prove fatal</li> </ul>	<ul style="list-style-type: none"> <li>➤ Use helmets</li> <li>➤ Provide safety nets</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Transportation of rods by trucks / trailers</li> </ul>	<ul style="list-style-type: none"> <li>➤ Protruded rods may hit the persons</li> </ul>	<ul style="list-style-type: none"> <li>➤ Use red flags/lights at the ends</li> <li>➤ Do not protrude the rods in front of or by the side of driver's cabin.</li> <li>➤ Do not extend the rods 1/3rd of deck length or 1.5 m which</li> </ul>



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			is less
(D) WELDING AND GAS CUTTING	<ul style="list-style-type: none"> <li>➤ Welding radiates invisible ultraviolet and infrared rays</li> </ul>	<ul style="list-style-type: none"> <li>➤ Radiation can damage eyes and skin.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Use specified shielding devices and other PPE of correct specifications Avoid throated tungsten electrodes for GTAW.</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Improper placement of oxygen and acetylene cylinders</li> </ul>	<ul style="list-style-type: none"> <li>➤ Explosion may occur</li> </ul>	<ul style="list-style-type: none"> <li>➤ Move out any leaking cylinder</li> <li>➤ Keep cylinder in vertical position</li> <li>➤ Use trolley for transportation of cylinders and chain them</li> <li>➤ Use flash back arrestors</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Leakage / cuts in hoses</li> </ul>	<ul style="list-style-type: none"> <li>➤ May cause fire</li> </ul>	<ul style="list-style-type: none"> <li>➤ Purge regulators immediately and then turn off</li> <li>➤ Never use grease or oil on oxygen line connections and copper fittings on acetylene lines</li> <li>➤ Inspect regularly gas carrying hoses</li> <li>➤ Always use red hose for acetylene &amp; other fuel gases and black for oxygen.</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Opening-up of cylinder</li> </ul>	<ul style="list-style-type: none"> <li>➤ Cylinder may burst</li> </ul>	<ul style="list-style-type: none"> <li>➤ Always stand back from the regulator while opening the cylinder</li> <li>➤ Turn valve slowly to avoid bursting</li> <li>➤ Cover the lug terminals to prevent short circuiting.</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Welding of tanks, container or pipes</li> </ul>	<ul style="list-style-type: none"> <li>➤ Explosion may occur</li> </ul>	<ul style="list-style-type: none"> <li>➤ Empty &amp; purge them before welding</li> <li>➤ Never attach the ground cable to tanks,</li> </ul>





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	storing flammable liquids		container or pipe storing flammable liquids ➤ Never use LPG for gas cutting
(E) RADIOGRAPHY	➤ Ionizing Radiation	➤ Radiations may react with the skin and can cause cancer, skin irritation, dermatitis, etc.	➤ Ensure safety regulations as per BARC/AERB before commencement of job. ➤ Cordon off the area and install Radiation warning symbols ➤ Restrict the entry of unauthorized persons ➤ Wear appropriate PPE and film badges issued by BARC/AERB
	➤ Transportation and Storage of Radiography source	➤ Same as above	➤ Never touch or handle radiography source with hands ➤ Store radiography source inside a pit in an exclusive isolated storage room with lock and key arrangement. The pit should be approved by BARC/AERB ➤ Radiography source should never be carried either in passenger bus or in a passenger compartment of trains. ➤ BARC/AERB have to be informed before source movement. ➤ Permission from Director General of Civil Aviation is required for booking



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			radio isotopes with airlines.
	➤ Loss of Radio isotope	➤ Same as above	<ul style="list-style-type: none"> <li>➤ Try to locate with the help of Survey Meter.</li> <li>➤ Inform BARC/AERB(*)</li> <li>➤ (*) Atomic Energy Regulatory Board (AERB), Bhabha Atomic Research Centre (BARC) Anushaktinagar, Mumbai – 400 094</li> </ul>
F) ELECTRICAL INSTALLATION AND USAGE	➤ Short circuiting	➤ Can cause Electrocutation or Fire	<ul style="list-style-type: none"> <li>➤ Use rubberized hand gloves and other PPE</li> <li>➤ Don't lay wires under carpets, mats or doorways. Allow only licensed electricians to perform on electrical facilities</li> <li>➤ Use one socket for one appliance</li> <li>➤ Ensure usage of only fully insulated wires or cables</li> <li>➤ Don't place bare wire ends in a socket</li> <li>➤ Ensure earthing of machineries and equipments</li> <li>➤ Do not use damaged cords and avoid temporary connections</li> <li>➤ Use spark-proof/flame proof type field distribution boxes.</li> <li>➤ Do not allow open/bare connections</li> <li>➤ Provide all connections through ELCB</li> <li>➤ Protect electrical</li> </ul>



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			<p>cables / equipment's from water and naked flames</p> <ul style="list-style-type: none"> <li>➤ Check all connections before energizing.</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Overloading of Electrical System</li> </ul>	<ul style="list-style-type: none"> <li>➤ Bursting of system can occur which leads to fire</li> </ul>	<ul style="list-style-type: none"> <li>➤ Display voltage and current ratings prominently with 'Danger' signs.</li> <li>➤ Ensure approved cable size, voltage grade and type.</li> <li>➤ Switch off the electrical utilities when not in use.</li> <li>➤ Do not allow unauthorized connections. Ensure proper grid wise distribution of Power.</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Improper laying of overhead and underground transmission lines / cables</li> </ul>	<ul style="list-style-type: none"> <li>➤ Can cause electrocution and prove fatal</li> </ul>	<ul style="list-style-type: none"> <li>➤ Do not lay unarmored cable directly on ground, wall, roof of trees</li> <li>➤ Maintain at least 3m distance from HT cables</li> <li>➤ All temporary cables should be laid at least 750 mm below ground on 100 mm fine sand overlying by brick soling</li> <li>➤ Provide proper sleeves at crossings/ intersections</li> <li>➤ Provide cable route markers indicating the type and depth of cables at intervals not exceeding 30m and at the diversions / termination.</li> </ul>
G) FIRE PREVENTION AND	<ul style="list-style-type: none"> <li>➤ Small fires can</li> </ul>	<ul style="list-style-type: none"> <li>➤ Cause burn injuries and</li> </ul>	<ul style="list-style-type: none"> <li>➤ In case a fire breaks out, press fire alarm</li> </ul>



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PROTECTION	become big ones and may spread to the surrounding areas	may prove fatal.	<p>system and shout "Fire, Fire"</p> <ul style="list-style-type: none"> <li>➤ Keep buckets full of sand &amp; water/fire extinguishing equipment near hazardous locations</li> <li>➤ Confine smoking to 'Smoking Zones' only</li> <li>➤ Train people for using specific type of fire equipments under different classes of fire</li> <li>➤ Keep fire doors/shutters, passages and exit doors unobstructed</li> <li>➤ Maintain good house-keeping and first-aid boxes (for detail refer Annex-2)</li> <li>➤ Don't obstruct access to Fire extinguishers</li> <li>➤ Do not use elevators for evacuation during fire</li> <li>➤ Maintain lightning arrestors for elevated structures</li> <li>➤ Stop all electrical motors with internal combustion.</li> <li>➤ Move the vehicles from dangerous locations.</li> <li>➤ Remove the load hanging from the crane booms.</li> <li>➤ Remain out of the danger areas.</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Improper selection of Fire Extinguisher</li> </ul>	<ul style="list-style-type: none"> <li>➤ It may not extinguish the fire</li> </ul>	<ul style="list-style-type: none"> <li>➤ Ensure usage of correct fire extinguisher meant for the specified fire (for</li> </ul>



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	r		<p>details refer Appendix-C)</p> <ul style="list-style-type: none"> <li>➤ Do not attempt to extinguish Oil and electric fires with water. Use foam cylinders/CO2/sand or earth.</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Improper storage of highly inflammable substances</li> </ul>	<ul style="list-style-type: none"> <li>➤ Same as above</li> </ul>	<ul style="list-style-type: none"> <li>➤ Maintain safe distance of flammable substances from source of ignition</li> <li>➤ Restrict the distribution of flammable materials to only min. necessary amount</li> <li>➤ Construct specifically designed fuel storage facilities</li> <li>➤ Keep chemicals in cool and dry place away from hat. Ensure adequate ventilation</li> <li>➤ Before welding operation, remove or shield the flammable material properly</li> <li>➤ Store flammable materials in stable racks, correctly labeled preferably with catchments trays.</li> <li>➤ Wipe off the spills immediately</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Short circuiting of electrical system</li> </ul>	<ul style="list-style-type: none"> <li>➤ Same as above</li> <li>➤ Can cause Electrocutation</li> </ul>	<ul style="list-style-type: none"> <li>➤ Don't lay wires under carpets, mats or doorways Use one socket for one appliance</li> <li>➤ Use only fully insulated wires or cables</li> <li>➤ Do not allow</li> </ul>



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			<p>open/bare connections</p> <ul style="list-style-type: none"> <li>➤ Provide all connections through ELCB</li> <li>➤ Ensure earthing of machineries and equipments</li> </ul>
H) VEHICULAR MOVEMENT	<ul style="list-style-type: none"> <li>➤ Crossing the Speed Limits (Rash driving)</li> </ul>	<ul style="list-style-type: none"> <li>➤ Personal injury</li> </ul>	<ul style="list-style-type: none"> <li>➤ Obey speed limits and traffic rules strictly</li> <li>➤ Always expect the unexpected and be a defensive drive</li> <li>➤ Use seat belts/helmets</li> <li>➤ Blow horn at intersections and during overtaking operations.</li> <li>➤ Maintain the vehicle in good condition</li> <li>➤ Do not overtake on curves, bridges and slopes</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Adverse weather condition</li> </ul>	<ul style="list-style-type: none"> <li>➤ Same as above</li> </ul>	<ul style="list-style-type: none"> <li>➤ Read the road ahead and ride to the left</li> <li>➤ Keep the wind screen and lights clean</li> <li>➤ Do not turn at speed</li> <li>➤ Recognize the hazard, understand the defense and act correctly in time.</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Consuming alcohol before and during the driving operation</li> </ul>	<ul style="list-style-type: none"> <li>➤ Same as above</li> </ul>	<ul style="list-style-type: none"> <li>➤ Alcohol and driving do not mix well. Either choose alcohol or driving.</li> <li>➤ If you have a choice between hitting a fixed object or an oncoming vehicle, hit the fixed object</li> <li>➤ Quit the steering at once and become a passenger. Otherwise</li> </ul>



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			<p>take sufficient rest and then drive.</p> <ul style="list-style-type: none"> <li>➤ Do not force the driver to drive fast and round the clock</li> <li>➤ Do not day dram while driving</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Falling objects / Mechanical failure</li> </ul>	<ul style="list-style-type: none"> <li>➤ May prove fatal</li> </ul>	<ul style="list-style-type: none"> <li>➤ Ensure effective braking system, adequate visibility for the drives, reverse warning alarm.</li> <li>➤ Proper maintenance of the vehicle as per manufacturer instructions</li> </ul>
<p>(I) PROOF TESTING (HYDROSTATIC/ PNEUMATIC TESTING</p>	<ul style="list-style-type: none"> <li>➤ Bursting of piping</li> <li>➤ Collapse of tanks</li> <li>➤ Tanks flying off</li> </ul>	<ul style="list-style-type: none"> <li>➤ May cause injury and prove fatal</li> </ul>	<ul style="list-style-type: none"> <li>➤ Prepare test procedure &amp; obtain CONSULTANT/ Employer's approval</li> <li>➤ Provide separate gauge for pressurizing pump and piping/equipment</li> <li>➤ Check the calibration status of all pressure gauges, dead weight testers and temperature recorders</li> <li>➤ Take dial readings at suitable defined intervals and ensure most of them fall between 40-60% of the gauge scale range</li> <li>➤ Provide safety relief valve (set at pressure slightly higher than test pressure) while testing with air/nitrogen</li> <li>➤ Ensure necessary precautions, stepwise increase in pressure, tightening of bolts/</li> </ul>



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			<p>nuts, grouting, etc. before and during testing</p> <ul style="list-style-type: none"> <li>➤ Keep the vents open before opening any valve while draining out of water used for hydro testing of tanks</li> <li>➤ Pneumatic testing involves the hazard of released energy stored in compressed gas. Specific care must therefore be taken to minimize the chance of brittle failure during a pneumatic leak test. Test temperature is important in this regard and must be considered when the designer chooses the material of construction</li> <li>➤ A pressure relief device shall be provided, having a set pressure not higher than the test pressure plus the lesser of 345 KPa (50 psi) or 10% of the test pressure. The gas used as test fluid, if not air, shall be nonflammable and nontoxic.</li> </ul>
(J) WORKING AT HEIGHTS	<ul style="list-style-type: none"> <li>➤ Person can fall down</li> </ul>	<ul style="list-style-type: none"> <li>➤ May sustain severe injuries or prove fatal</li> </ul>	<ul style="list-style-type: none"> <li>➤ Provide guard rails/barricade at the work place</li> <li>➤ Use PPE like safety belts, full body harness, life line, helmets, safety shoes, etc.</li> </ul>





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			<ul style="list-style-type: none"> <li>➤ Obtain a permit before starting the work at height above 3 meters</li> <li>➤ Fall arrest systems like safety nets, etc. must be installed</li> <li>➤ Provide adequate working space (min. 0.6 m) Tie/weld working platform with fixed support Use roof top walk ladder while working on a slopping roofs</li> <li>➤ Avoid movement on beams</li> </ul>
		<ul style="list-style-type: none"> <li>➤ May hit the scrap / material stacked at the ground or in between</li> </ul>	<ul style="list-style-type: none"> <li>➤ Keep the work place neat and clean</li> <li>➤ Remove the scrap immediately</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Material can fall down</li> </ul>	<ul style="list-style-type: none"> <li>➤ May hit the workers working at lower levels and prove fatal.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Same as above plus</li> <li>➤ Do not throw or drop material or equipment from height</li> <li>➤ All tools to be carried in a toolkit bags or on working uniform</li> <li>➤ Remove scrap from the planks</li> <li>➤ Ensure wearing of helmet by the workers at low level</li> </ul>
(K) CONFINED SPACES	<ul style="list-style-type: none"> <li>➤ Suffocation / drowning</li> </ul>	<ul style="list-style-type: none"> <li>➤ Unconsciousness, death</li> </ul>	<ul style="list-style-type: none"> <li>➤ Use respiratory devices, if required</li> <li>➤ Avoid overcrowding inside a confined space</li> <li>➤ Provide Exhaust Fans for ventilation</li> <li>➤ Do not wear loose clothes, neck ties, etc.</li> <li>➤ Fulfill conditions of the</li> </ul>



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			<p>permit.</p> <ul style="list-style-type: none"> <li>➤ Check for presence of hydrocarbons, O2 level</li> <li>➤ Obtain work permit before entering a confined space</li> <li>➤ Ensure that the connected piping of the equipment which is to be opened is pressure free, fluid has been drained, vents are open and piping is positively isolated by a blind flange</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Presence of foul smell and toxic substances</li> </ul>	<ul style="list-style-type: none"> <li>➤ Inhalation can pose threat to life.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Same as above plus</li> <li>➤ Check for hydrocarbon and Aromatic compounds before entering a confined space</li> <li>➤ Depute one person outside the confined space for continuous monitoring and for extending help in case of an emergency</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Ignition / flame can cause fire</li> </ul>	<ul style="list-style-type: none"> <li>➤ Person may sustain burn injuries or explosion may occur</li> </ul>	<ul style="list-style-type: none"> <li>➤ Keep fire extinguishers at a hand distance</li> <li>➤ Remove surplus material and scrap immediately</li> <li>➤ Do not smoke inside a confined space</li> <li>➤ Do not allow gas cylinders inside a confined space</li> <li>➤ Use low voltage (24V) lamps for lighting</li> <li>➤ Use tools with air motors or electric tools with max.voltage</li> </ul>



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			of 24V ➤ Remove all equipments at the end of the day
(L) HANDLING AND LIFTING EQUIPMENTS	➤ Failure of load lifting and moving equipments	➤ Can cause accident and prove fatal	➤ Avoid standing under the lifted load and within the operating radius of cranes Check periodically oil, brakes, gears, horns and tyre pressure of all moving machinery ➤ Check quality, size and condition of all chain pulley blocks, slings, U-clamps, D-shackles, wire ropes, etc. ➤ Allow crane to move only on hard, firm and leveled ground ➤ Allow lifting slings as short as possible and check gunny packings at the friction points ➤ Do not allow crane to tilt its boom while moving ➤ Install Safe Load Indicator ➤ Ensure certification by applicable authority.
	➤ Overloading of lifting equipments	➤ Can cause electrocution and fire	➤ Safe lifting capacity of derricks and winches written on them shall be got verified. ➤ The max safe working load shall be marked on all lifting equipments ➤ Check the weight of columns and other heavy items painted on them and accordingly decide



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			<p>about the crane capacity, boom and angle of erection</p> <ul style="list-style-type: none"> <li>➤ Allow only trained operators and riggers during crane operation</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Overhead electrical wires</li> </ul>	<ul style="list-style-type: none"> <li>➤ Can cause electrocution and fire</li> </ul>	<ul style="list-style-type: none"> <li>➤ Do not allow boom or other parts of crane to come within 3 m reach of overhead HT cables</li> <li>➤ Hook and load being lifted shall preferably remain in full visibility of crane operator.</li> </ul>
M) SCAFFOLDING, FORMWORK AND LADDERS	<ul style="list-style-type: none"> <li>➤ Person can fall down</li> </ul>	<ul style="list-style-type: none"> <li>➤ Person may sustain severe injuries and prove fatal</li> </ul>	<ul style="list-style-type: none"> <li>➤ Provide guard rails for working at height</li> <li>➤ Face ladder while climbing and use both hands</li> <li>➤ Ladders shall extend about 1m above landing for easy access and tying up purpose</li> <li>➤ Do not place ladders against movable objects and maintain base at</li> <li>➤ unit of the working length of the ladder</li> <li>➤ Suspended scaffolds shall not be less than 500 mm wide and tied properly with ropes</li> <li>➤ No loose planks shall be allowed</li> <li>➤ Use PPE, like helmets, safety shoes, etc.</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Failure of scaffolding material</li> </ul>	<ul style="list-style-type: none"> <li>➤ Same as above</li> </ul>	<ul style="list-style-type: none"> <li>➤ Inspect visually all scaffolding materials for stability and</li> </ul>



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			<p>anchoring with permanent structures.</p> <ul style="list-style-type: none"> <li>➤ Design scaffolding for max. load carrying capacity</li> <li>➤ Scaffolding planks shall not be less than 50x250 mm full thickness lumber or equivalent. These shall be cleared or secured and must extend over the end supports by at least 150mm and not more than 300 mm</li> <li>➤ Don't overload the scaffolds</li> <li>➤ Do not splice short ladders to make a longer one. Vertical ladders shall not exceed 6m.</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Material can fall down</li> </ul>	<ul style="list-style-type: none"> <li>➤ Persons working at lower level gets injured.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Remove excess material and scrap immediately</li> <li>➤ Carry the tools in a tool-kit bag only</li> <li>➤ Provide safety nets</li> </ul>
N) STRUCTURAL WORKS	<ul style="list-style-type: none"> <li>➤ Personal negligence and danger of fall</li> </ul>	<ul style="list-style-type: none"> <li>➤ Can cause injury or casualty</li> </ul>	<ul style="list-style-type: none"> <li>➤ Do not take rest inside rooms built for welding machines or electrical distribution system</li> <li>➤ Avoid walking on beams at height</li> <li>➤ Wear helmet with chin strap and safety belts when working at height</li> <li>➤ Use hand gloves and goggles during grinding operations</li> <li>➤ Cover or mark the sharp and projected</li> </ul>



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			<p>edges</p> <ul style="list-style-type: none"> <li>➤ Do not stand within the operating radius of cranes</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Lifting / slipping of material</li> </ul>	<ul style="list-style-type: none"> <li>➤ Same as above</li> </ul>	<ul style="list-style-type: none"> <li>➤ Do not stand under the lifted load</li> <li>➤ Stack properly all the materials. Avoid slippage during handling</li> <li>➤ Control longer pieces lifted up by cranes from both ends</li> <li>➤ Remove loose materials from height</li> <li>➤ Ensure tightening of all nuts and bolts</li> </ul>
O) PIPELINE WORKS	<ul style="list-style-type: none"> <li>➤ Erection / lowering failure</li> </ul>	<ul style="list-style-type: none"> <li>➤ Can cause injury</li> </ul>	<ul style="list-style-type: none"> <li>➤ Do not stand under the lifted Load</li> <li>➤ Do not allow any person to come within the radii of the side boom handling pipes</li> <li>➤ Check the load carrying capacity of the lifting tools and tackles</li> <li>➤ Use safe Load Indicators Use appropriate PPEs</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Other</li> </ul>	<ul style="list-style-type: none"> <li>➤ Same as above</li> </ul>	<ul style="list-style-type: none"> <li>➤ Wear gum boots in marshy areas</li> <li>➤ Allow only one person to perform signaling operations while lowering of pipes</li> <li>➤ Provide night caps on pipes</li> <li>➤ Provide end covers on pipes for stoppage of pigs while testing/cleaning operations.</li> </ul>



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**FORMAT NO. : HSE-1**

**HSE CHECKLIST CUM COMPLIANCE REPORT (1/6)**

Project: \_\_\_\_\_ Contractor: \_\_\_\_\_

Date: \_\_\_\_\_ Owner: \_\_\_\_\_

Inspection By: \_\_\_\_\_ Report No. : \_\_\_\_\_

Frequency: Fortnightly

Job No: \_\_\_\_\_

Note: write 'NA' wherever the item is not applicable

SL. NO.	ITEM	YES	NO	REMARKS	ACTION
1	<b>HOUSEKEEPING</b>				
a)	Waste containers provided and used				
b)	Sanitary facilities adequate and clean				
c)	Passageways and Walkways clear				
d)	General neatness of working areas				
e)	Others				
2	<b>PERSONNEL PROTECTIVE EQUIPMENT</b>				
a)	Goggles; Shields				
b)	Face protection				
c)	Hearing protection				
d)	Safety shoes				
e)	Hand protection				
f)	Respiratory Masks etc.				
g)	Safety Belts				
h)	Safety Helmet/Hard Hat				
i)	Others				
3	<b>EXCAVATIONS/OPENINGS</b>				
a)	Openings properly covered or barricaded				
b)	Excavations shored				
c)	Excavations barricaded				



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d)	Overnight lighting provided				
e)	Others				
4	<b>WELDING &amp; GAS CUTTING</b>				
a)	Gas cylinders chained upright				
b)	Cables and hoses not obstructing				
c)	Screens or shields used				
d)	Flammable materials protected				
e)	Fire extinguisher(s) accessible				
f)	Others				

SL. NO.	ITEM	YES	NO	REMARKS	ACTION
5	<b>SCAFFOLDING</b>				
a)	Fully decked platforms				
b)	Guard and intermediate rails in place				
c)	Toe boards in place				
d)	Adequate shoring				
e)	Adequate access				
f)	Others				
6	<b>LADDERS</b>				
a)	Extension side rails 1m above				
b)	Top of landing				
c)	Properly secured				
d)	Angle + 70 from horizontal				
e)	Others				
7	<b>HOISTS, CRANES AND DERRICKS</b>				
a)	Condition of cables and sheaves OK				
b)	Condition of slings, chains, hooks and eyes OK				
c)	Inspection and maintenance logs maintained				
d)	Outriggers used				
e)	Signs/barricades provided				
f)	Signals observed and understood				
g)	Qualified operators				
h)	Others				
8	<b>MACHINERY, TOOLS AND EQUIPMENT</b>				
a)	Proper instruction				
b)	Safety devices				
c)	Proper cords				
d)	Inspection and maintenance				
e)	Others				
9	<b>VEHICLE AND TRAFFIC</b>				





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a)	Rules and regulations observed				
b)	Inspection and maintenance				
c)	Licensed drivers				
d)	Others				
10	<b>TEMPORARY FACILITIES</b>				
a)	Emergency instructions posted				
b)	Fire extinguishers provided				
c)	Fire-aid equipment available				
d)	Secured against storm damage				
e)	General neatness				
f)	In accordance with electrical requirements				
g)	Others				
<b>SL. NO.</b>	<b>ITEM</b>	<b>YES</b>	<b>NO</b>	<b>REMARKS</b>	<b>ACTION</b>
11	<b>FIRE PREVENTION</b>				
a)	Personnel instructed				
b)	Fire extinguishers checked				
c)	No smoking in Prohibited Areas				
d)	Hydrants Clear				
e)	Others				
12	<b>ELECTRICAL</b>				
a)	Use of 3-core armoured cables				
b)	Usage of 'All insulated' or 'double insulated' electrical tools				
c)	All electrical connection are routed through ELCB				
d)	Natural Earthing at the source of power (main DB)				
e)	Continuity and tightness of earth conductor				
f)	Covering of junction boxes, panels and other energized wiring places				
g)	Ground fault circuit interrupters provided				
h)	Prevention of tripping hazards				
i)	Others				
13	<b>HANDLING AND STORAGE OF MATERIALS</b>				
a)	Properly stored or stacked				
b)	Passageways clear				
c)	Others				
14	<b>FLAMMABLE GASES AND LIQUIDS</b>				
a)	Containers clearly identified				
b)	Proper storage				
c)	Fire extinguishers nearby				



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d)	Others				
15	<b>WORKING AT HEIGHT</b>				
a)	Erection plan and work permit obtained				
b)	Safety nets				
c)	Full body harness and lanyards; chute lines				
d)	Health Check record available for workers going up?				
e)	Others				
16	<b>CONFINED SPACE</b>				
a)	Work permit obtained				
b)	Test for toxic gas and sufficient availability of oxygen conducted				
<b>SL. NO.</b>	<b>ITEM</b>	<b>YES</b>	<b>NO</b>	<b>REMARKS</b>	<b>ACTION</b>
c)	At least one person outside the confined space for monitoring deputed				
d)	Availability of sufficient means of entry, exit and ventilation				
e)	Fire extinguishers and first-aid facility ensured				
f)	Lighting provision made by using 24V lamps				
g)	Proper usage of PPEs ensured				
17	<b>RADIOGRAPHY</b>				
a)	Proper storage and handling of source as per BARC / AREB guidelines				
b)	Working permit obtained				
c)	Cordoning of the area done				
d)	Use of appropriate PPE's ensured				
e)	Proper training to workers/supervisors imparted				
f)	Minimum occupancy of workplace ensured				
18	<b>HEALTH CHECKS</b>				
a)	Workers medically examined and found to fit for working: i) At heights ii) In confined space.				
b)	Availability of First-aid facilities				
c)	Proper sanitation at site, office and labour camps				
d)	Arrangement of medical facilities				
e)	Measures for dealing with illness				
f)	Availability of Portable drinking water for				



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	workmen & staff				
g)	Provision of crèches for children				
h)	Stand by vehicle available for evacuation of injured.				
19	<b>ENVIRONMENT</b>				
a)	Chemical and other effluents properly disposed				
b)	Cleaning liquid of pipes disposed off properly				
c)	Seawater used for hydro-testing disposed off as per agreed procedure				
d)	Lubricant Waste/Engine oils properly disposed				

SL. NO.	ITEM	YES	NO	REMARKS	ACTION
e)	Waste from Canteen, offices, sanitation etc. disposed properly				
f)	Disposal of surplus earth, stripping materials, oily rags and combustible materials done properly				
g)	Green belt protection				

\_\_\_\_\_  
Signature of Resident

\_\_\_\_\_  
Engineer with Seal

**FORMAT NO. : HSE-2**

### ACCIDENT/INCIDENT REPORT

(To be submitted by Contractor after every Accident / Incident within 24 hours)

Report No: \_\_\_\_\_

Date: \_\_\_\_\_

Name of Site:- \_\_\_\_\_

CONTRACTOR \_\_\_\_\_

Type of Accident / Incident: ☐ Fatal ☐ Other ☐ Lost Time Non Lost ☐ First-Aid case ☐



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NAME OF THE INJURED .....

AGE: .....

SUB-CONTRACTOR M/S.....

DATE & TIME OF ACCIDENT / INCIDENT .....

LOCATION.....

BRIEF DESCRIPTION OF ACCIDENT

CAUSE OF ACCIDENT

NATURE OF INJURY/DAMAGE

MEDICAL AID PROVIDED/ACTIONS TAKEN

INTIMATION TO LOCAL AUTHORITIES (IF APPLICABLE)

DATE:

SIGNATURE OF CONTRACTOR WITH SEAL

To : OWNER.....

1 COPY

: RCM/SITE-IN-CHARGE, Employer

3 COPIES

→ Divisional Head (Constn.) through RCM

→ Project Manager Employer, through RCM

**FORMAT NO. : HSE-3**

**SUPPLEMENTARY ACCIDENT / INCIDENT INVESTIGATION REPORT**

Supplementary to Report No: \_\_\_\_\_ (Copy enclosed)

Project: \_\_\_\_\_

Site: \_\_\_\_\_

Name of Work: \_\_\_\_\_

Date: \_\_\_\_\_

Contractor: \_\_\_\_\_

Work Order / LOI No. : \_\_\_\_\_

NAME OF THE INJURED .....

AGE: .....



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SUB-CONTRACTOR M/S.....

DATE & TIME OF ACCIDENT / INCIDENT .....

LOCATION.....

BRIEF DESCRIPTION & CAUSE OF A ACCIDENT/ INCIDENT

NATURAL OF INJURY/DAMAGE

COMMENTS FROM MEDICAL PRACTITIONER WHO ATTENDED THE VICTIM/INJURED

SUGGESTED IMPROVEMENT IN THE WORKING CONDITION IF ANY

LOSS OF MANHOURS AND IMPACT ON SITE WORKS

ANY OTHER COMMENT BY SAFETY OFFICER.

DATE: SIGNATURE OF CONTRACTOR WITH SEAL

To : OWNER..... 1 COPY

: RCM/SITE-IN-CHARGE, Employer 3 COPIES

→ Divisional Head (Constn.) through RCM  
→ Project Manager Employer, through RCM

**FORMAT NO. : HSE-4**

**NEAR MISS INCIDENT – SUGGESTED PROFORMA**

Report No: \_\_\_\_\_

Name of Site: \_\_\_\_\_

Date: \_\_\_\_\_

Name of Work: \_\_\_\_\_

Contractor: \_\_\_\_\_

INCIDENT REPORTED BY:

DATE & TIME OF INCIDENT:



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LOCATION:

BRIEF DESCRIPTION OF INCIDENT

PROBABLE CAUSE OF INCIDENT

SUGGESTED CORRECTIVE ACTION

STEPS TAKEN TO AVOID RECURRENCE

YES

☐

NO

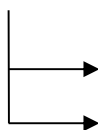
☐

DATE: SIGNATURE OF CONTRACTOR

WITH SEAL

To : OWNER..... 1 COPY

: RCM/SITE-IN-CHARGE, Employer 3 COPIES



Divisional Head (Constn.) through RCM

Project Manager Employer, through RCM

**FORMAT NO. : HSE-5**

**MONTHLY HEALTH, SAFETY & ENVIRONMENT (HSE) REPORT**

(To be submitted by each Contractor)

Actual work start Date:\_\_\_\_\_ For the Month of:\_\_\_\_\_

Project:\_\_\_\_\_ Report No:\_\_\_\_\_

Name of the Contractor:\_\_\_\_\_ Status as on:\_\_\_\_\_

Name of Work:\_\_\_\_\_ Name of Safety officer:\_\_\_\_\_



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ITEM	UPTO PREVIOUS MONTH	THIS MONTH	CUMULATIVE
a) Average number of Staff & Workmen (average daily headcount, not man days)			
b) Manhours Worked			
c) Number of HSE meeting organized at site			
d) Number of HSE awareness programmes conducted at site			
e) Number of Lost Time Accidents (LTA)	Fatal		
	Other LTA		
f) Number of Loss time Injuries (LTI)	Fatalities		
	Other LTI		
g) Number of Loss Time Accidents			
h) Number of First Aid Cases			
i) Number of Near Miss Incidents			
j) Man-days lost due to accidents			
k) LTA Free Manhours i.e. Number of LTA free manhours from the Lst LTA			
l) Compensation cases raised with Insurance			
m) Compensation case resolved and paid to workmen			
n) Whether workmen compensation policy taken	Y/N		
o) Whether workmen compensation policy valid	Y/N		
p) Whether workmen registered under ESI Act	Y/N		
Remark			

DATE: \_\_\_\_\_ Safety Officer /Resident Engineer (Signature and Name)

To : OWNER

: RCM/, Employer (2 COPIES)

**FORMAT NO. : HSE-6**

**PERMIT FOR WORKING AT HEIGHT (ABOVE 2 METER)**

Project Site: ..... Sr. No.: .....

Name of the work: ..... Date: .....

Name of Contractor: ..... Nature of Work: .....

Total No.of Workers: ..... Exact location of work: .....

Duration of work: from..... to .....



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The following items have been checked and compliance shall be ensured during the currency of the permit:

**SI. ITEM DONE NOT REQD.**

1. Equipment/Work Area inspected	<input type="checkbox"/>	<input type="checkbox"/>
2. Considered hazard from other routine/non-routine operations and concerned person alerted	<input type="checkbox"/>	<input type="checkbox"/>
3. ELCB provided	<input type="checkbox"/>	<input type="checkbox"/>
4. Proper lighting provided	<input type="checkbox"/>	<input type="checkbox"/>
5. Area cordoned off.	<input type="checkbox"/>	<input type="checkbox"/>
6. Precautions against public traffic taken	<input type="checkbox"/>	<input type="checkbox"/>
7. Sound Scaffolding provided	<input type="checkbox"/>	<input type="checkbox"/>
8. Adequate protected Platform provided	<input type="checkbox"/>	<input type="checkbox"/>
9. Access and Exit to the area (Ladder properly fixed)	<input type="checkbox"/>	<input type="checkbox"/>
10. Floor Openings covered	<input type="checkbox"/>	<input type="checkbox"/>
11. Safety Net provided	<input type="checkbox"/>	<input type="checkbox"/>
12. Health check of personnel	<input type="checkbox"/>	<input type="checkbox"/>

A. Following personal protective equipment are provided (mark) and used as relevant Safety helmet/Gloves/Goggles/Shoes/Face Shield/Life Line/Safety Belt/Safety Harness.

B. This permit shall be available at the work site at all times.

C. Permit shall be issued for maximum one week only (Monday to Sunday).

D. This permit shall be applicable in non-operational areas.

E. After completion of the work, used permits shall be preserved for record purposes.

F. Additional precautions, if any .....

**Permission is granted to work (See overleaf) = Yes/No**





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Name of Contractor's Supervisor  
(Initiator)

Name of Contractor's Safety Officer  
(Issuing Authority)

### GRANT OF PERMIT AND EXTENSIONS

Sl. No.	Validity Period From ..... To .....	Work time From .....Hrs. To .....Hrs.	Initiator (Supervisor of Contractor)	Issuing Authority (Safety Officer) of Contractor	Verification by CONSULTANT with date

Additional safety instructions, if any.

**FORMAT NO. : HSE-7**

### CONFINED SPACE ENTRY PERMIT

Project Site: ..... Sr. No.: .....

Name of the work: ..... Date: .....

Name of Contractor: ..... Nature of Work: .....

Exact location of work: .....

**Safety Requirements:** POSITIVE ISOLATION OF THE VESSEL IS MANDATORY



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**(A) Has the equipment been?**

Y NR	Y NR	Y NR
<input type="checkbox"/> isolated from power / steam / air <input type="checkbox"/> isolated from liquid or gases <input type="checkbox"/> depressurized &/or drained <input type="checkbox"/> blanked/blinded/disconnected	<input type="checkbox"/> water flushed &/or steamed <input type="checkbox"/> Manways open & ventilated <input type="checkbox"/> cont. inset gas flow arranged <input type="checkbox"/> adequately cooled	<input type="checkbox"/> radiation sources removed <input type="checkbox"/> Proper lighting provided

**(B) Expected Residual Hazards**

Y NR	Y NR	Y NR
<input type="checkbox"/> lack of O2 <input type="checkbox"/> corrosive chemicals <input type="checkbox"/> Heat / stream / frost	<input type="checkbox"/> combustible gas / liquid <input type="checkbox"/> pyrophoric iron / scales <input type="checkbox"/> high humidity	<input type="checkbox"/> H2S / toxic gases <input type="checkbox"/> electricity / static <input type="checkbox"/> ionizing radiation

**(C) Protective Measures**

Y NR	Y NR	Y NR
<input type="checkbox"/> gloves protective clothing <input type="checkbox"/> Grounded air educator / blower / AC <input type="checkbox"/> Firefighting arrange	<input type="checkbox"/> ear plug / muff <input type="checkbox"/> dust / gas / airline mask <input type="checkbox"/> attendant with SCBA / air mask <input type="checkbox"/> safety harness & lifeline	<input type="checkbox"/> goggles / face shield <input type="checkbox"/> personal gas alarm <input type="checkbox"/> rescue equipment / team <input type="checkbox"/> communication equipment

Authorization / Renewal (It is safe to enter the confirmed space)

Date	No. of Persons Allowed	Name of Persons allowed	Signature		Time		Signature Workman
			Contractor's Supervisor	Contractor's Safety Officer	From	To	



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Permit Closure:

(A) ☐Entry ☐was closed ☐stopped ☐will continue on

(B) ☐Site left in a safe condition

☐Housekeeping done

(C) ☐Multi lock ☐ removed ☐key transferred

☐Ensured all men have come out ☐ Manways barricaded

Remarks, if any:

**FORMAT NO. : HSE-8**

### **RADIATION WORK PERMIT**

Project:

Sr. No.:

Name of the work:

Date:

Name of Contractor:

Job No. :

Location of work:



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Source Strength:

Cordoned distance (m):

Name of radiographing agency: Approved by Employer

The following items have been checked & compliance shall be ensured during currency of the permit:

S. No.	Item Description	Done
1.	Safety regulations as per BARC/AERB ensured while source in use/ in transit & during storage.	<input type="text"/>
2.	Area cordoned off.	<input type="text"/>
3.	Lighting arrangements for working during nights ensured.	<input type="text"/>
4.	Warning signs / flash lights installed.	<input type="text"/>
5.	Cold work permit taken (if applicable)	<input type="text"/>
6.	PPEs like film badges, dosimeters used.	<input type="text"/>

Additional precautions, if any \_\_\_\_\_

(Radiography Agency's BARC / AREB authorized Supervisor) (Contractor's Safety Officer)

**Permission is granted.**

Permit is valid from \_\_\_\_\_ AM/PM \_\_\_\_\_ Date to \_\_\_\_\_ AM/PM \_\_\_\_\_  
Date

(Signature of permit issuing authority)

Name: Designation: Date:

**Permit renewal:**

Permit extended upto		Additional precautions required, if any.	Sign of issuing authority with date
Date	Time		



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Work completed / stopped / area cleared at \_\_\_\_\_ Hrs. of Date \_\_\_\_\_

(Sign of permit issuing authority)

Name:

**FORMAT NO. : HSE-9**

**RADIATION WORK PERMIT**

Project: Sr. No.:

Name of the work: Date:

Name of Contractor: Job No. :

Name of Contractor:



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Line No. / Equipment No. /Structure to be dismantled:

Location details of dismantling / demolition with sketch: (Clearly indicate the area)

The following items have been checked & compliance shall be ensured during currency of the permit:

Sl.No.	Item Description	Done	Not Applicable
1.	Services like power, gas supply, water, etc. disconnected.	<input type="checkbox"/>	<input type="checkbox"/>
2.	Dismantling / Demolishing method reviewed & approved.	<input type="checkbox"/>	<input type="checkbox"/>
3.	Usage of appropriate PPEs ensured.	<input type="checkbox"/>	<input type="checkbox"/>
4.	Precautions taken for neighboring structures	<input type="checkbox"/>	<input type="checkbox"/>
5.	First-Aid arrangements made	<input type="checkbox"/>	<input type="checkbox"/>
6.	Firefighting arrangements ensured	<input type="checkbox"/>	<input type="checkbox"/>
7.	Precautions taken for blasting	<input type="checkbox"/>	<input type="checkbox"/>

(Contractor's Supervisor)

(Contractor's Safety Officer)

**Permission is granted.**

(Permit issuing authority)

Name:

Date:

### Completion Report:

Dismantling / Demolishing is completed on \_\_\_\_\_ Date at \_\_\_\_\_ Hrs.

Materials / debris transported to identified location ☐

Tagging completed (as applicable) ☐

Services like power, gas supply, water, etc. restored ☐



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(Permit issuing authority)