4.0 INSPECTION AND TESTING

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

5.0 SHIPPING

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

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

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STANDARD SPECIFICATION FOR INSTRUMENTATION ERECTION WORKS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	19.03.24	Revised and Reissued as Standard Specification	AT/RS	AJS	MN	MN
3	17.01.19	Revised and Reissued as Standard Specification	HMX	MN	RG	RKT
2	25.04.13	Revised and Reissued as Standard Specification	MA	RG	RP/JMS	DM
1	16.10.07	Revised and Reissued as Standard Specification	RP	TGM	HCJ	VC
0	17.07.97	Issued as Standard Specification	RK	BRS	RB	AS

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Abbreviations:

ERTL	Electronics Regional Testing Laboratory
FRP	Fiberglass Reinforced Plastics
GRP	Glass Reinforced Plastics
HDPE	High Density Poly Ethylene
IDEMI	Institute for Design of Electrical Measuring Instruments
MCT	Multi Cable Transit
MS	Mild Steel
SS	Stainless Steel
NABL	National Accreditation Board for Testing and Calibration Laboratories
NPL	National Physical Laboratory
PMI	Positive Material Identification
PTFE	Poly Tetra Fluoro Ethylene
PVC	Poly Vinyl Chloride

Instrumentation Standards Committee

Convener: Mr. Mainak Nandi

Members:
Mr. Arupjyoti Saikia
Mr. Sachin Garg
Ms. Rimpa Saha Chakraborty
Mr. Ankit Tiwari
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Mr. Ravindra Kumar Gupta (Projects)

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1.0 GENERAL

1.1 This standard specification covers in general the scope of work, scope of supply, execution methodology and criteria for handling scrap and excess material and various other requirements, which are required to be met during the course of execution of instrumentation works.

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

1.3 Standards

The instrumentation erection and calibration works shall be carried out in accordance with various National, International and Indian Standards for instrumentation listed below but not limited to the following. The standards referred to herein and mentioned below shall be of the latest editions unless otherwise specified:

API	American Petroleum Institute	
	MPMS	Manual of Petroleum Measuring Standards
	RP	Recommended Practices
	RP 551	Process Measurement Instrumentation
	RP 552	Transmission Systems
	RP 554	Process Instrumentation and Control
ASME	American Society of Mechanical Engineers	
	B16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
	B16.11	Forged Fittings, Socket-Welding and Threaded
	B16.20	Ring Joint Gaskets and Grooves for Steel Pipe Flange
	B16.47-B	Large diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard
	B31.1	Power Piping ASME Section 1 Boiler and Pressure Vessel Power Boilers
	B31.3	Process Piping
	B1.20.1	Pipe Threads General Purpose, Inch
BS	British Standards	
	6739	Code of practice for instrumentation in process control systems: installation design and practice
EN	European Standard	
	10204	Inspection Documents for Metallic Products
ISA	International Society of Automation	
	Standards, Recommended Practices and Technical Reports	
	RP 7.1	Pneumatic Control Circuit Pressure Test
	ISA S5.1	Instrument Symbols and Identification

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IS/IEC	Indian Standards/International Electro Technical Commission
	IS/IEC 60079 Electrical Apparatus for Explosive Gas Atmospheres
	IS/IEC 60529 Degree of protection provided by Enclosures (IP code).
	IEC 60028 International Standard of Resistance Cooper
	IEC 60085 Electrical Insulation — Thermal Evaluation and Designation
	IEC 60228 Conductors of Insulated Cable
	IEC 60331 Fire Resisting Characteristics of Electric Cables
	IEC 60332 Tests on electric and optical fibre cables under fire conditions Part 1-1: Test for vertical flame propagation for a single insulated wire or cable - Apparatus Parts and Sections
ISO	International Standards Organization
	ISO 9001 Quality Management Systems
7-52-0253	Duct Fabrication – Welded Construction Detail
7-52-0254	Duct Fabrication – Bolted Construction Detail
7-52-xxxx	Instrumentation Installation Standards and Instrumentation Supports Standards attached with the tender
	Manufacturer's standards and practices
6-44-0016	Specification for Non-Destructive Examination requirements of Piping
6-77-0001	Welding Specification for Fabrication of piping
6-77-0005	Welding Specification Charts for piping classes
6-79-0020	Standard Specification for Surface Preparation and Protective Coating (New Construction)
6-82-0001	Standard specification for health, safety and environmental management at construction sites
6-82-0002	Standard Specification for Positive Material Identification (PMI) at Construction Sites
6-82-3400	Inspection and test plan (ITP) for field instrumentation works (item rate contracts-with categorization)
6-82-6100	Standard quality assurance plan (for item rate contracts)

2.0 DEFINITIONS

2.1 Close coupled Installation

The installations where the distance of the instrument is within 600 mm from the primary tapping are termed as close coupled installations.

2.2 Remote Installation

The installations where the distance of the instrument is more than 600 mm from the primary tapping are termed as remote installations.

2.3 Pre-fabricated Hook-up Installation

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The installation hook-up shall be standard bought-out complete engineered, integrated and pre-hydro tested assembly, consisting of isolation / block valves, fittings, 2-valve/ 3 valve/ 5 valve manifolds in 316 SS metallurgy as a minimum and ready to install at site by welding with pipe/flange assemblies having different material like Carbon Steel etc.

2.4 Manifold

2.4.1 For close coupled installation, 'Manifold' shall mean complete piping of instruments after first block valve upto the instruments.

2.4.2 For remote installation, 'Manifold' shall mean the assembly of nipples, pipes, valves and fittings after the first block valves upto the instrument. Wherever the instruments are installed with integral 2-way, 3-way or 5-way valve manifold, the definition shall not be applicable as they are considered part of the instrument.

2.5 Instrument Impulse Line

Instrument impulse line shall mean piping and/or tubing from the first block valve upto the instrument including for drains and vent as applicable for an installation.

2.6 First Block Valve

First block valve shall mean the valve/valves, which are generally mounted directly on equipments, columns, vessels, pipes, standpipes etc. and shall be operated to isolate the instrument and interconnected instrument impulse lines.

2.7 Supports

Supports shall mean the Mild Steel angles, flats, channels which are generally provided to support the main cable trays, cable ducts, junction boxes, angle trays, perforated trays, instrument piping, signal tubing, instrument air supply lines, steam tracing tubing, diaphragm seal capillary tubing etc., at specified intervals from the instruments, concrete columns etc., to keep all items firmly secured against vibration, warping, bending etc.

2.8 Instrument Stanchion

Instrument stanchion shall mean the mounting arrangement necessary for the installation of one or more instruments and junction boxes. This shall consist of pipes, supports, clamps and fasteners as per applicable standards.

2.9 Scrap

2.9.1 Salvageable Scraps

Salvageable scrap shall mean the cut piece lengths recovered after consumption of tubes, pipes, single pair/multipair cables, other cables etc. that can be used one time or the other at a later date.

2.9.2 Non Salvageable Scrap

Non-salvageable scrap shall mean the cut piece lengths recovered after consumption of tubes, pipes, single pair/multipair cables, cables etc. that cannot be used at all, at any time.

3.0 SCOPE OF WORK

3.1 Contractor's scope of work shall include the following:

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3.1.1 Complete instrumentation erection works with details as listed under schedule of quantities attached elsewhere in the tender document.

3.1.2 Supply of all hardware such as lugs, ferrules, U-clamps, washers, nuts, sealant, sealing tape, anchor fasteners, welding electrodes/filler wires, NDT test materials/Dye penetrant spray etc and carry out all residual activities not listed specifically in schedule of quantities but are necessary to ensure proper execution and completeness of instrumentation works.

3.1.3 Supply of all items specifically listed in the schedule of quantities as per specifications attached elsewhere in the tender document.

3.1.4 As-built construction drawings and documents as detailed out in this specification

3.1.5 Arranging all necessary test and calibration equipments as per the details provided in this specification.

3.1.6 To ensure proper execution and completeness of works, any or all, of the following activities, as necessary, shall also form part of the contractor's scope of work. The price of all such activities shall be covered in the rates quoted against the various activities covered under schedule of rates.

3.1.6.1 Fabrication of pipe nipples, as necessary, from the running pipe including cutting of pipes and making threads as necessary, as per installation standards.

3.1.6.2 Drilling of holes in blind flanges including threading, bolt tensioning as necessary, as per installation standards, wherever required.

3.1.6.3 Filling of seal pots and/or impulse lines, as applicable, with filling liquids as per the instructions of engineer-in-charge including supply of seal fill liquid.

3.1.6.4 Seal welding of screwed fittings and screwed connections as required by standards or as per the instructions of Engineer-in-charge. This may involve welding of dissimilar materials using appropriate electrodes/filler wires.

3.1.6.5 Dye penetration/magnetic particle test shall be carried out for all weld joints irrespective of their pipe classes and the charges for the same shall be included in the quoted rates of instrument installation.

3.1.6.6 Installation of devices like purge rotameter, restriction orifice plate, pressure gauge etc, as applicable for purged installation, for instruments, instrument systems and pipelines as per installation standards.

3.1.6.7 Civil works including casting of foundation as required for instrument supports, stanchions etc, where paved surfaces do not exist and supply of anchor bolts/ fasteners.

3.1.6.8 Minor civil works like chipping of pavement, grouting of instrument panels/supports/stanchions on the pavement, laying of conduits below pavement after chipping and refinishing of pavement as necessary. Contractor's scope shall include making holes in the RCC for fixing up of supports for instrumentation items, trays, JB frames etc.

3.1.6.9 Sealing of cables/tubes entries into the control room after laying and testing of all cables/ tubes by filling with sealing compound including supply of sealing compound. Wherever the sealing of cables/tubes entries into the control room is through MCT frame/blocks, fixing of MCT frame and blocks shall be also carried out by contractor as covered in the schedule of quantities.

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3.1.6.10 Degreasing of handwheels of control valves, stud bolts, nuts of side and bottom flange of control valves, stud bolts and nuts of orifice flanges/ or other primary elements and degreasing of any other instrument as per manufacturer's instructions or as required by Engineer-in-charge.

3.1.6.11 Degreasing of impulse lines, instrument valves, instruments and other instrument items in oxygen and chlorine service as per manufacturer's instructions or as required by engineer-in-charge.

3.1.6.12 Rotation of top works of displacer type level instruments, wherever required.

3.1.6.13 Rotation of control valve and on-off valve/shutdown bonnet etc, wherever required.

3.1.6.14 Reversing the action of control valves either by replacement of actuator springs and accessories or positioner, wherever required, as per manufacturer's instructions.

3.1.6.15 Minor modifications/repairs required to be carried out on the instruments namely, replacement of dial and/or glass for pressure gauges/temperature gauges or any other similar instruments, replacement of rotameter tubes and level gauge glasses, replacement of damaged signal tubes on control valves, rectification/ replacement of tubes in fire-safe boxes, rectification in fire jacket enclosures, canopies for transmitters & JB, instrument air manifolds etc., tapping of damaged threads on couplings, tees and other fittings, cleaning of nozzles and relays in pneumatic instruments.

3.1.6.16 Painting of all structural supports required for trays, pipes, junction boxes, instruments, ducts as per painting specification or as instructed by Engineer-in-charge.

3.1.6.17 Identification of instruments/impulse lines/manifold connected with trip circuit in red color of paint or as per painting/colour philosophy of the project.

3.1.6.18 Punching of tag numbers and supply of stainless-steel tag plates wherever required as per instructions of Engineer-in-charge.

3.1.6.19 Fabrication and installation of pipe stanchion as per instrument support standards including casting of concrete pedestal, grouting, welding etc. as necessary. The type of instrument stanchions shall be at the discretion of Engineer-in-charge. Contractor's scope shall include installation of ISMC for Junction box installation, wherever any column/structure not available. This includes providing anchor/ fasteners/ welding of base plate etc.

For installation of instruments on Pre-fabricated hookups, Contractor's scope shall include erection of supports on the main pipeline wherever required, as per the respective installation standards and as per the instruction of Engineer-in-charge. Field transmitter supports should be properly clamped to the pipe for prefabricated and closed couple installation wherever required. No air gap shall be kept between support clamp and pipe.

3.1.6.20 Drilling holes in the gland plate for providing glands/grommets on panels/ cabinets, local control panels, pneumatic enclosures, junction boxes etc., wherever required for cables/multitubes entry and sealing of spare holes.

3.1.6.21 Grounding the shields of shielded cables to respective instrument earth bus- bar provided in the control room/local control room/local panel/analyzer shelter/thermocouple head etc. as required and instructed by Engineer-in-charge.

3.1.6.22 Laying and termination of earth cable at instrument earth bus-bar provided in the control room/local control room/local panel to instrument earth pits provided by other contractors unless specified otherwise.

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3.1.6.23 Grounding of one of the thermocouple lead in the head using 10K ohm resistance including supply of resistance for grounded thermocouples.

3.1.6.24 Loop validation of all temperature elements (Thermocouples/RTDs) up to control room/ transmitters including verification of element integrity, i.e. element open or element short and shall be included in the installation of temperature element.

3.1.6.25 Supply of all types of consumables required for the execution of the job without any exception.

3.1.6.26 Sealing of safety valves with standard lead seals after final setting and fixing of blind tapes in inlet/outlet of safety valves to prevent dust, in the presence of Engineer-in-charge.

3.1.6.27 Coordination during installation, pre-commissioning and commissioning with mechanical and other sub-contractors for proper installation including verification of location and flow direction of line mounted instruments like control valves, on-off/shutdown valves, orifice assemblies, turbine meters, positive displacement meters, magnetic flowmeters, mass flowmeters, ultrasonic flowmeters etc. This shall also involve removal of instruments, disconnection of tubes/cables, reconnection of the same for alignment and proper installation.

3.1.6.28 Coordination during pre-commissioning/commissioning with mechanical and other sub-contractor for proper installation of vessels/equipment mounted instruments like level transmitters, level gauges, level switches etc. which involves removal of instruments, disconnection of tubes/cables, reconnection of the same for alignment and proper installation.

3.1.6.29 Coordination with control system vendors (Distributed Control System/Programmable Logic Controller/Analyser system/Tank farm automation/Fire and Gas detection system/Machine Monitoring System/Terminal Automation etc.), as necessary, during installation, loop checking and commissioning as per instructions of Engineer-in-charge including handing over of all types of cables laid up to designated cabinets to system vendor with proper tag identification. Contractor shall also coordinate with DCS vendor for all arrangements and facilities required in the field during the testing of fieldbus instruments like signal level, noise, waveform etc., including mobilization of necessary test equipments in field.

3.1.6.30 Coordination with tank fabricator during installation of still well, mechanical float type, Vibration Tuning Fork Level Instrument, Servo type and radar type Tank Level instruments,

3.1.6.31 Removal of false floor slabs and re-fixing, as required, for laying of cables below false floor inside control room/rack room. Cable routing in the cable cellar area where applicable in coordination with DCS Vendor.

3.1.6.32 Shifting of instruments and materials from owner' warehouse/designated place to the work spot, providing suitable storage space and keeping the materials in safe custody and identification of special materials like alloy steel with proper color coding as per instructions of engineer-in-charge. Contractor shall also return the un-used materials including scrap to the owner's warehouse/designated place as per instruction of Engineer-in-charge.

3.1.6.33 Insulation of cable duct and cable trays for fire safety, as per project philosophy. Coordination with mechanical contractor during fire insulation of cable duct and cable trays.

3.1.6.34 Contractor shall also check & report to the Engineer-in-Charge for advising the Piping erection team for the correct orientation of pressure taps of orifice flanges/Venturi/Flow-nozzle prior to welding of the first isolation valves. In case of any discrepancy, the same shall be reported to the Engineer-in-Charge immediately for rectification.

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3.1.6.35 Grinding of thermowell collar, Lapping and greasing of RTJ flanged thermowell, wherever required, shall be carried out by Contractor and rate is deemed to be included by contractor in the SOR clause of thermowell/ temperature instruments Installation.

3.1.6.36 For corrosion coupons and probe, tapping with flanged end shall be by piping and Installation of Probe and coupon shall be by Instrumentation. The rate is deemed to be included by contractor in the SOR rate for corrosion transmitters.

3.1.6.37 Submission of monthly material appropriation statements for instruments, cables, tubes, piping materials and fittings, indicating the quantity issued and consumed in standard Performa.

3.1.6.38 Incorporation of all information in owner's drawings/documents, as per actual execution of work at site including preparation and submission of as-built drawings.

3.1.6.39 Start-up and commissioning assistance as required and agreed upon with Engineer-in-charge.

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

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

3.1.6.42 Any other work, not specifically listed, but necessary for the successful completion of instrumentation erection works defined in this specification or the schedule of quantities.

3.2 Work Excluded

3.2.1 Installation of main panels, cabinets and consoles supplied by control system vendor inside control room unless specified otherwise.

3.2.2 Installation of line mounted instruments like control valves, on-off/shutdown valves orifice plates and flanges, variable area flowmeters (excluding rotameters for purged installation as defined in clause 3.1.6.6), magnetic flow meters, ultrasonic flow meters, turbine flow meters, mass flow meters, PD meter, vortex flow meter etc.

3.2.3 Mechanical installation of tank level instruments except servo/ radar gauges.

3.2.4 Installation of safety valves, breather valves, flame arrestors, rupture discs.

3.2.5 First block valve for instrument tapping points on piping and equipments except pre-fabricated hook-ups where first block valve is part of pre-fabricated hook-up assembly.

3.2.6 Insulation of steam traced instrument primary impulse lines unless otherwise specified.

3.2.7 Painting of impulse lines.

4.0 EXECUTION METHODOLOGY

4.1 Instrument Impulse lines

4.1.1 All impulse lines shall be installed as per applicable installation standards attached with tender with a best workmanship. In case, the installation standard of any instrument in any package unit is different from the installation standard attached with tender, the nearest corresponding standard attached with tender as decided by Engineer-In charge shall be considered and followed.

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4.1.2 Horizontal and vertical lines shall be installed using levels and plumb bobs.

4.1.3 Unless otherwise specified in the drawings, impulse lines shall have a slope of not less than 1 in 12 on the horizontal runs.

4.1.4 All welding shall be carried out as per codes and after approval of welding procedures and electrodes by Engineer-in-charge. Only qualified welders approved by Engineer-in-charge shall carryout welding. The following activities shall be part of contractor's scope of work.

4.1.4.1 Welder qualification including supply of any materials required like electrodes, equipments, consumables, testing charges for various tests etc., required for initial qualification and subsequent validation till the completion of the job.

4.1.4.2 Welding procedure qualification including supply of any materials required for the qualification like electrodes, equipments, consumables, testing charges for tests etc. Contractor scope includes welding procedure qualification for welding of dissimilar materials as envisaged for any process hookup, wherever applicable.

4.1.4.3 The charges towards Positive Material Identification (PMI) shall be quoted as per the schedule of quantities attached elsewhere in tender document. However, Contractor's scope shall include the PMI (Positive material Identification) test for all the pipe and fittings of instrument impulse line hook-ups of Alloy steel (AS) and stainless steel (SS) material as applicable. The cost of the above is deemed to be included by the Contractor in the rate quoted for all impulse line installations in Stainless steel (SS) and Alloy steel (AS). The equipment required for PMI testing shall be arranged by the contractor.

4.1.4.4 The charges towards non-destructive testing like radiography and post weld heat treatment shall be quoted as per the schedule of quantities attached elsewhere in tender document. The contractor is required to carry out 100% radiography of all the butt weld joints indicated in the installation standards which are covered in schedule of quantities of tender document.

For all other installations involving butt weld joints, not covered under 100% radiography as above, radiography shall be carried out by the contractor as per Non-Destructive Examination Requirement (6-44-0016) attached elsewhere in the tender. The charges for these shall be included in the quoted rates of installation of instrument, covered under schedule of quantities.

4.1.5 Welding and Non-Destructive testing shall be carried out by the contractor as per the following specifications or their respective job specifications.

4.1.5.1 Welding Specification for Piping Classes (6-77-0005)

4.1.5.2 Welding Specification for fabrication of piping (6-77-0001)

4.1.5.3 Standard Specification for Surface Preparation and Protective Coating (6-79-0020)

4.1.5.4 Specification of Non-Destructive Examination Requirement of piping (6-44-0016) to carry out the radiography, stress relieving, dye penetration test, magnetic particle test, wet fluorescent magnetic particle test etc.

4.1.6 During fabrication/installation of Impulse pipes, elbows shall be used as required. In unavoidable circumstance, pipe benders shall be used with instructions of Engineer-In Charge. Hot cutting/bending shall not be allowed. Pipes shall be cut using pipe cutting device

4.1.7 Piping/tubing for steam tracing shall be installed according to the standards without any pocket so as to avoid formation of the condensate pockets.

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4.1.8 All threaded joints shall be jointed with PTFE tape only. No other pipe jointing compound shall be used except on high temperature (> 200 deg C) service where graphite sealing compounds shall be used.

4.1.9 All impulse lines shall be properly supported at regular intervals of 1 meter. Wherever insert plates are not available, supports on concrete structures or on ceilings shall be fixed with a minimum of 10 mm expansion bolts. Angle supports shall be fabricated from 40 mm x 40 mm x 5 mm MS angles, as a minimum.

4.1.10 For Impulse line of diaphragm seal flow instruments, proper support with channel/ angle shall be provided as per direction of engineer-in-charge.

4.2 PVC Covered/Bare Tube (Copper/SS/Aluminium)

4.2.1 Single copper/SS/Aluminium tubes shall be laid as per standards on perforated trays or in angle trays of size 25x25x4 mm. The width of the perforated trays shall be selected as per the number of tubes laid. Tubes shall be clamped to the trays at every 300 mm using clamps made of aluminium strips. The practice of flattening tubes for clamping purposes shall not be permitted. In case of PVC covered tubes, any exposed portion at ends and connection shall be neatly taped to appropriate thickness. Open ends shall be covered to prevent ingress of moisture, dust, vermin etc. Plugs should be removed only when final connection is made. Proper clamping of PVC covered tubes, to be done with packing/gasket to avoid PVC tube damage.

4.2.2 Trays shall be properly supported either from any rigid steel structure or concrete member as detailed in clause 4.7.4 of this specification under trays and supports.

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

4.3 Installation of Multitubes and Multicables

4.3.1 Multicables/multitubes in above ground shall always be installed on ducts/trays and shall be properly clamped. At every vertical drop to junction boxes, they shall be clamped at more frequent intervals (maximum of 300 mm). They shall be connected inside junction boxes with proper glanding. At bends minimum radius shall be maintained as per manufacturer's standard. The angle tray for multicable cables/multi tubes shall be fabricated from 50 mm x 50 mm x 6 mm angles, as a minimum.

4.3.2 All multitubes/multicable cables shall be cut after the exact site measurements are taken between ends. The tube/cable drums shall be selected before cutting the lengths so as to avoid any wastage. Contractor shall maintain the records of cable/tube cutting quantity.

4.3.3 All multicables and multitubes laid in ducts shall be properly dressed and tied with stainless steel wire of 3 mm diameter.

4.3.4 Laying of cables and tubes in field shall be through ducts and trays as per layout drawings. Cables shall be buried underground or taken in concrete trenches, wherever required.

4.3.5 The grounding of shields for shielded cables shall not be carried out at field instrument and junction box end. The shields at these ends shall be suitably insulated from the body of the instruments/junction boxes.

4.3.6 In control room, all cables shall be laid in concrete trenches, cable duct in cable cellar area or below false flooring. When laid below the false floor, the cables shall be properly dressed

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and tied as per the instructions of Engineer-in-charge. In control room where the cables are required to enter through Multi Cable Transit, the MCT frames shall be installed by contractor.

4.4 Installation of Instruments

4.4.1 All instruments shall be generally installed on supports as per installation standards, instrument location plan and instructions of Engineer-in-charge. All the instruments installed shall be accessible for ease of operation and maintenance.

4.4.2 Receiver gauges shall be mounted on instrument support itself, as far as possible, as per tubing hookup standards.

4.4.3 Filter regulators shall be mounted on the instrument support below the instruments or on the control valve yoke, as far as possible.

4.4.4 Contractor to ensure that installation of Instrumentation items shall not block the platform walkways and equipment access.

4.4.5 Prefabricated FRP canopy Canopies for Instrument/JB shall be as per EIL standard for canopy (EIL Std. 7-52-0105)

4.5 Instrument Air Supply

4.5.1 The main instrument air header in each area is laid by other contractor. Further distribution of instrument air supply from the main air header take off valve to Air Distribution Manifold and from Air Distribution Manifold to individual instruments shall be through stainless steel pipe and PVC covered copper tube or stainless steel tubes as per the Instrument air distribution schematic and Bill of Material. The threading in pipes/nipples shall be carried out by contractor as per requirement.

4.5.2 Individual take off valves shall generally be located on top of the main air header. Unions shall be provided at convenient locations. There shall be one isolation valve at each instrument end. The pipe shall be supported at a minimum interval of 1.5 meters with 40 mm x 40 mm x 5 mm MS angles. Final connection to the instrument shall be copper/ stainless steel tubing as per tubing hookup standards.

4.6 Instrument Steam Tracing

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

4.6.2 Electrical heat tracing shall be done by others. Assistance, if required, shall be provided by the contractor as per instructions of Engineer-in-charge.

4.7 Cables Ducts/Ladder trays/perforated trays/angle trays and supports

4.7.1 Cable duct, perforated trays shall be generally prefabricated and ladder trays shall be site fabricated as per standard /drawings.

4.7.2 Cable ducts and ladder trays/ angle trays shall be laid as per layout drawings and as per instructions of engineers-in-charge. Contractor shall finalize the installation plan and routing of cable trays for branch cables as per location of instruments, junction boxes and site

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conditions. Ducts shall be fabricated as per the drawing attached elsewhere in the Tender. All the accessories like tee, bends shall be calculated and provided as required.

4.7.3 Generally heavy structural supports for cable ducts, are provided by other agency. However, in critical areas, where additional supports are required to be provided in the opinion of the Engineer-in-charge, the same shall be provided by the contractor.

4.7.4 The perforated trays/angle trays shall be properly supported at a regular interval of maximum of 1 metre from insert plates or steel structures. Wherever insert plates are not available, supports on concrete structures and ceiling shall be fixed with minimum 10 mm diameter expansion bolts. Angle supports for perforated trays/angle trays shall be fabricated from 40 mm x 40 mm x 5 mm MS angles as a minimum.

4.7.5 All supports shall be cut with hacksaw only. Any work executed by gas cutting for making holes and cutting pieces will be totally rejected. Free ends of angle support shall not have sharp edges and shall be properly rounded off.

4.7.6 Perforated trays/angle trays shall be used for branch cables and tube from duct/trays, as per EIL standard drawing of cable trays. Width of trays shall be selected according to number of tubes and cables. Trays shall be laid generally as per site conditions with the approval of Engineer-in-charge. Overfilling of trays to be avoided.

4.7.7 No welding on galvanised trays/perforated trays shall be allowed in general. In specific cases where welding is unavoidable, this shall be carried out as per instructions from engineer-in-charge. For welding, if required, following procedure shall be followed as a minimum:

a) Remove galvanisation thoroughly from the portion to be welded.

b) After welding, clean the welded portion for any slug, sharp edge.

c) Welded portion shall be painted as per procedure described under clause 4.10.

4.7.8 In case of Mild Steel cable ducts, ladder type angle trays, perforated trays and their supports shall be painted as per painting specification detailed in clause 4.10.

4.7.9 Each individual cable routed through trays must be clamped or tied using SS wires/ Nylon Cable Ties as per project specification. The overall clamping shall be with aluminium clamp instead of tying with cable armour. Nuts/Bolts for cable tray fixing shall be SS.

4.7.10 Cleat out of 50mm x 50mm x 6mm angle at 2-meter interval shall be provided to prevent lateral movement of ducts and the same including supply of angles shall be deemed to be included against duct installation clause in the SOR.

4.7.11 Galvanising thickness for ducts shall be as per duct installation drawing. Galvanising thickness for GI angles/ channel cable trays shall be as per ASTM standard A123.

4.7.12 In order to prevent galvanic corrosion, direct contact of trays, supports etc. to non-ferrous metal shall be avoided by applying suitable insulation methods.

4.8 Laying of Cables

4.8.1 All cables shall be laid in accordance with installation drawings and cable schedules. Before laying, cable/multicable on drums shall be meggered (with 500V megger for instrument cables and 1000V megger for power cables) and tested to ensure no damages to cables. The megger testing at site is not required to be carried out for the field bus cables and thermocouple extension cables. However, for field bus cables and thermocouple extension

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cables, the loop resistance and capacitance shall be checked by the contractor before and after the completion of cable laying.

4.8.2 Prior to commencement of cable laying, contractor shall submit a detailed planning/programme with drum cutting plan along with details of drum number, cable number, actual cable length etc. to Engineer-In-Charge for approval.

4.8.3 Cable drum schedule shall be provided with approximate lengths. All cables shall be cut after the actual site measurement including cable length required for termination at both ends. Extra length of cables shall be kept at the glanding/termination end as per the directions of Engineer-In Charge. This portion of the extra cable shall be protected against mechanical damage by a flexible metal conduit if the cable is unarmored. Cables shall have complete uncut lengths from one termination to the other.

4.8.4 All cables laid shall be glanded in junction boxes/ instruments/ panel etc. as applicable with suitable cable glands. The cable glands shall be fixed with PVC shrouds where the same is supplied along with cable glands. An engraved identification SS tag plate shall be provided close to the glanding/termination point for all the cables with cable number. The identification tag plate for cables shall be securely fastened with stainless steel.

4.8.5 All temporary ends of cables shall be protected against dirt and moisture. For this purpose, ends of all cables shall be taped with an approved PVC or rubber insulating tape or end caps.

4.8.6 All cores/pairs numbers of cables shall be identified by means of ferrules. The numbering and identification ferrules shall be as per cable schedules and control room termination drawings. The ferrules shall be screen printed on single sleeve to identify the source and/ or destination as per the instruction of Engineer-in-charge.

4.8.7 The cores of cables shall be terminated at the termination points using proper lugs. However, lugs shall not be used for compensating cables. For field bus applications, tool-torque screw drivers are to be used for termination of field bus cables in the terminals with the torque force of 5 inch- pounds.

4.8.8 The bending radius of cables shall be maintained as per manufacturers' recommendation.

4.8.9 Cables installed above ground on exposed walls, ceilings, structures (where applicable) shall be rigidly supported individually or in groups as required using PVC covered galvanised clips or cable trays. Cable shall be supported at every 500 mm intervals.

4.8.10 All special cables and power supply cables shall be laid direct to the field instrument without any junction boxes, unless otherwise specified.

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

For the cable laying in HDPE conduit, contractor shall consider all the required equipments like blowing machine, compressor etc. and the price for the same shall be deemed to be included in the SOR of respective cable laying in HDPE conduit.

For Optical fiber cable laying, Contractor shall consider all associated activities for cable splicing, light testing etc for each core of the FO cable.

4.8.12 Each underground cable (either in concrete trenches or buried) shall be provided with identifying tag of lead securely fastened every 50 m of its underground length with at least one tag at each end before the cable leaves/enters the ground.

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4.8.13 Cables shall be laid in directly buried cable trenches wherever specified in the layout drawings. Contractor shall ensure that buried trenches shall have sufficient depth and width to accommodate all cables correctly spaced. Pipe sleeves, if required, for cross overs other than roads like drains etc. shall be provided by the contractor as per the instructions of Engineer-in-charge. Before cables are placed, the trench bottom shall be filled with 100 mm layer of sand and leveled. Each layer of cables shall be covered with 150 mm of sand on top and sand shall be lightly pressed. A protective covering of 75 mm thick second class red bricks shall be placed flat on the final layer of sand and cable. The remaining portion of the trench shall be then back filled with soil compacted and leveled. On completion of every group of cable laying and before sand filling, every cable shall be given insulation test in the presence of Engineer-in-charge. Any cable proved to be defective shall be replaced before the next group of cables is laid. Cable route markers indicating number of cables, depth and direction will be placed enroute, on crossovers/turnings etc. to mark the cable route.

4.8.14 At each road crossings/culverts and other places, where cables enter pipe sleeves, adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends after back filling. After laying, the pipe sleeves shall be sealed using sealing compounds. Each cable shall have one tag at each end before the cable enters/leaves conduit pipes

4.8.15 After laying of all the cables and multitubes, the cable entry to control room shall be suitably filled and sealed using sealing compound or by installing MCT blocks, dummy blocks, stay/end plates, etc, so as to achieve a positive seal against the entry of gas/water.

4.8.16 On completion of cable laying in concrete trenches, the trenches shall be filled with sand and pre-cast concrete slabs/ chequered plates shall be placed on the trench. Similarly, on completion of cable laying in cable ducts, it shall be fixed with duct cover with fasteners.

4.9 Earthing

4.9.1 Earthing of instruments, analysers, junction boxes, local panels/cabinets and shelters shall be carried out as per the documents and instructions from Engineer-in-charge.

4.10 Painting

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

4.10.2 The painting shall be carried out as per procedure and the methodology provided in the standard specification attached elsewhere in tender with the approval of Engineer-In Charge.

4.10.3 It shall be noted that final coating of painting for the external surfaces shall be applied just before handing over the plant or commissioning of the plant as per instructions of Engineer-in-charge.

4.10.4 The name of manufacturer, colour and quality of all types of primer and final paint shall be subject to approval of Engineer-in-charge, in line with project paint philosophy.

4.11 Testing

4.11.1 Electrical cables for signal, power supply, alarms and shutdown shall be checked for megger values and continuity before final termination and ferruling.

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

4.11.3 Instrument impulse piping/tubing shall be tested hydraulically or pneumatically to 1.5 or 1.1 times respectively, of the design/maximum pressure after isolating the instruments. Flushing

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of piping shall be carried out as per instructions of Engineer-in-charge. Lines shall be blown after hydro-testing. All external type level instruments with chamber/cage and level gauges shall also be tested as per instructions of Engineer-in-charge at site.

4.11.4 Instrument air manifolds (wherever applicable) Tubes and air line shall be tested with compressed air to 7 Kg/cm^2 upto the filter regulator. The downstream side of the filter regulator shall be tested for 1.5 Kg/cm^2. The lines shall be blown with the instrument air upto the regulator for 15 minutes to remove any traces of oil, dust and moisture. All lines shall be checked with soap solution and bubbler unit for possible leak at joints. After pressurising, source shall be cut off and rate of fall in pressure shall be less than 1 PSI (Pounds per Square Inch) for each 100 ft. of copper tubing for a test period of 2 minutes as per ISA RP 7-1 `Pneumatic control circuit pressure test'.

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

4.12 Calibration

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

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

4.12.3 Conversion from one unit to another for the purpose of calibration is not allowed.

4.12.4 The procedures for calibration of different items are as outlined below. However, the detailed procedure shall be submitted to Engineer-in-charge for approval before proceeding with calibration.

4.12.5 All types of transmitters, including SMART/FIELDBUS/WIRELESS type, shall be calibrated to the ranges specified in the respective instrument data/specification sheets using suitable test equipments/kits including the verification of the configuration parameters

4.12.6 All thermocouple receiver instruments shall be calibrated by generating millivolt signals suitable for span and the type of thermocouple specified.

4.12.7 Receiver instruments programmed shall be calibrated and aligned using test hook-up as per instructions from manufacturer/engineer-in-charge.

4.12.8 Filled type temperature instruments/temperature gauges shall be calibrated for 0%, 25%, 50%, 75% and 100% of the range using standard thermo-oil.

4.12.9 Pressure transmitters shall be calibrated at 0%, 25%, 50%, 75% and 100% and vice versa of range using dead weight tester/hydraulic pumps with master gauges/pressure calibrators.

4.12.10 DP transmitters shall be calibrated at 0%, 25%, 50%, 75% and 100% and vice versa of range using standard gauges or squeeze bulb type of flow calibrators.

4.12.11 Rotameter transmitters shall be calibrated by moving pointer 0%, 25%, 50%, 75%, 100% and vice versa of the range and monitoring the output at the respective flow range.

4.12.12 The external displacer type of level instruments shall be dry calibrated as per manufacturer's instructions or wet calibrated by filling the displacer chamber with water for level 0%, 25%, 50%, 75% and 100% and draining the water at 100%, 75%, 50%, 25% and 0% of the ranges after applying suitable specific gravity corrections of the process fluid as per data sheets.

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4.12.13 The internal displacer/float type level instruments shall be dry calibrated as per manufacturer's instruction or using calibration chamber fabricated out of steel pipes and filling the same with water after applying specific gravity corrections of process fluid as per data sheets.

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

4.12.15 Tank level indicators shall be calibrated by manually lifting the float at 0%, 25%, 50%, 75% and 100% and vice versa of the ranges.

4.12.16 Control valves and positioners of all types (Pneumatic / SMART / Fieldbus) shall be checked for hysteresis and linearity and shall be calibrated for rated strokes. The valves shall be checked for hysteresis to the accuracy of 1% full scale with Fieldbus / SMART / Pneumatic positioner and 5% full scale without positioners. Stroke speed has to be evaluated for trip/shutdown valves as per safety requirements identified by Engineer-in-charge.

4.12.17 All calibration readings shall be recorded in the enclosed format and submitted to engineer-in-charge for approval. Where significant deviations from specifications are obtained, the matter shall be brought to the immediate notice of the Engineer-in-charge for corrective action.

4.12.18 Furnished hereunder is a list of recommended calibration and test equipments required as a minimum for calibration work. The contractor shall provide the complete list of calibration and test equipments along with the range, accuracy and quantity which he proposes to use for this job. Contractor should also ensure that any equipment not listed below but required at the time of calibration shall be made available at his own cost. All the instruments are to be calibrated using the test equipments and kits approved by NPL/IDEMI/ERTL authorities or by any laboratory accredited by NABL having valid calibration report at the time of calibration. In the event, any test equipment is sent to a laboratory for enhancing validity, it shall be contractor's responsibility to arrange alternate test equipments, duly meeting the above criteria, to carry out calibration/loop checking activities.

a)	Controller test stands	Mfr. Standard
b)	Indicator/Recorder test stands	Mfr. Standard.
c)	Squeeze bulb (Flow calibrator) Range: 0 to -10,000 mm wg.	-
d)	Dead weight testers for ranges upto 350 kg/cm^2	± 0.05 %
e)	Gauge comparator for pressure gauges Rating: upto 350 kg/cm^2	± 0.2 %
f)	Oil bath for temperature instrument calibration Max. temperature 350°C (suitable upto immersion length of 500 mm)	Mfr. Standard
g)	Standard mercury in glass thermometers Range: -50 to + 50°C, 0 to 100°C (NPL certified) 0-250°C.	± 0.25 %
h)	Standard gauges for Ranges upto 350 kg/cm^2	± 0.1 %

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i)	Multimeters	± 0.05mV
j)	Potentiometer/Direct digital calibrator (capable of generating and measuring mV& Resistance)	-
k)	Meggers 500v/1000v	-
l)	Air hydro pump/hydraulic pump	-
m)	Vacuum pump	-
n)	Instrument air compressor with filters and regulators and deoilers.	-
o)	Current generator (Instrument checker) 4-20mA DC with 24VDC power source	-
p)	Fieldbus calibrator	-
q)	Safety valve test jig for sizes from ¾" to 10" (up to 600#)	

4.13 Loop Checking

4.13.1 Loop checking shall be performed after calibration, installation, interconnection, continuity check and leak/hydraulic testing of instrument impulse lines for all instruments. Loop checking is conducted to verify the functional performance of all elements comprising the loop, thereby ensuring proper interconnections and operation. The results of various activities completed like calibration, installation, interconnection, loop checking and logic checking shall be recorded in the loop checking report format, which is attached as Annexure 1 (4 sheets).

Any punch points observed while carrying out loop checking or activities required as pre-requisite to loop checking shall be recorded in the loop check/ logic check punch points format attached as Annexure 2. The loop checking shall be performed only after the resolution of the punch points.

4.13.2 Before proceeding for loop checking, the calibration results of individual elements shall be separately recorded on the calibration reports and shall be approved by Engineer-in-charge for correctness of calibration results.

4.13.3 Loop checking of various types of loops shall be performed as follows, however, detailed procedure shall be submitted to the engineer-in-charge for approval before proceeding with the loop checking;

a) The loop checking of all the open loops with smart or field bus shall be performed using hand held communicator / field bus calibrator by simulating 0%, 25%, 50%, 75% and 100% of full scale input in the field. The tests shall also include the verification of tag configuration parameters e.g. ranges etc as per instrument data sheet.

However loop checking of conventional (non-SMART & non-FIELDBUS) transmitter in open loop shall be performed by physically applying 0%, 25%, 50%, 75% and 100% of process parameters as per instrument data sheet in the field.

b) The loop checking of all close loops with conventional (non-SMART & non-FIELDBUS) / SMART / Fieldbus transmitters shall be carried out by physically simulating the process conditions for at least 0%, 25%, 50%, 75% and 100% of full-

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scale input and verifying the values in receiver instruments/operator station in the control room. Similarly, the control valves operation shall be verified by feeding 0%, 25%, 50%, 75% and 100% output from the operator stations/controllers in the control room.

c) In case of shutdown systems, field switches/receiver switches/field transmitters shall be simulated for abnormality by disconnecting the wires at terminals in case of switches and physically simulating the process for the corresponding trip point signal in case of transmitters and the function of all associated systems are checked including performance of solenoid valves, on-off type control/shutdown valves including proper functioning of limit switches and other accessories. Adjustment of limit switches wherever necessary shall also form part of checking of the loop.

d) Loop checking of Temperature transmitter shall include loop checking from the respective RTD/Thermocouple.

4.13.4 Performance of individual loops shall be accepted for an overall accuracy of ± 1.5%. Where deviation is found to exist more than the specified limit, contractor shall recalibrate the instruments which shall also form part of loop testing wherever required, at no extra cost.

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

4.13.6 A loop shall be considered as handed over only when the loop checking of that particular loop is complete in all respects and the loop checking report is completely filled in all respects, approved and accepted by Engineer-in-charge and Client. In case of loops in which certain instruments of the loops are calibrated by other agency, loop checking shall be performed in coordination with the agency involved. If a defect in the calibration of the instruments in contractor's scope is observed, same shall be rectified to the satisfaction of the Engineer-in-charge. However, if defect is detected in the calibration of the instruments in the scope of other agency, same shall be rectified by the agency involved. After the calibration has been rechecked by other agency/agencies, the loop checking would be performed to the satisfaction of Engineer-in-charge. This is part of the contractor's scope of work.

4.13.7 The loop checking results shall be recorded in Annexure 1 referred at clause 4.13.1 above.

4.13.8 Whenever the installation of central control system like Distributed Control System/Programmable Logic Controllers/Terminal automation system etc in control room is carried out by any other agency, contractor's scope of work for the loops connected to these systems shall include the following:

a) Laying of all related cables upto the designated panels/cabinets/consoles, dressing of cables including inside control room, identification of cables and cores/pairs of each cable, coordination with control system vendor during glanding and termination.

b) Calibration of all field instruments independently.

c) Providing all assistance to control system vendor during loop checking. This shall include physical simulation of signals from the field instruments through approved test equipments and checking the control valve operation with the output provided from control system to enable control system vendor to verify loop performance.

d) Coordination with control system vendor to meet loop-checking schedule. It shall be contractor's responsibility to demonstrate/prove measuring signal levels of field instrument output in control room in the respective identified pair in case of any problem.

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e) Rectification/recalibration of field instruments if found defective during loop checking.

However, the glanding and termination of field cables, checking of interconnection between instrument/equipments within control room, ferruling/tagging of interconnecting cables inside control room shall all be in the scope of control system vendor.

4.13.9 It shall be contractor's responsibility to complete all entries in the 'Loop Checking Report' attached as Annexure 1, related to field instrumentation and loop checking results, including calibration, installation checks, interconnection of tubing and cabling, hydrotest etc. and get it duly signed by the Engineer-in-charge. The final certified loop sheets shall be submitted as per tender requirement.

4.14 Cable Duct/ Tray Fire protection requirements

4.14.1 Contractor shall be responsible for providing fire protection system wherever specified in the tender document, for all cable ducts & cable trays carrying multipair cables / FF trunk cables and angles carrying multipair cables / FF trunk cables to ducts, using flexible ceramic fiber blanket system. Quantity shall be as per the quantity mentioned in SOR.

The system provided shall be readily removable and re-installable type on-line without the use of any elaborate procedure, need of structure and damaging the blanket used.

4.14.2 The system shall typically utilise compressed layers of asbestos free, non-toxic, non-fumble ceramic fibre blanket. The design selected should be able to prevent any ingress of water and dust into the system.

4.14.3 The system supplied shall be able to provide fire coverage of minimum half an hour of hydrocarbon fire to cable ducts / trays without damaging the cables. Contractor to ensure that the blanket thickness and fibre density is selected to meet the temperature in the unexposed portion of coverage to less than 100°C, which is the tolerance temperature of PVC cable.

Contractor to ensure that the selected system should have undergone type fire test as per UL1709 / ASTM E 1529 for hydrocarbon fire. The type testing should have been carried out / witnessed either by any recognized testing authority or test house such as Under Writers Lab. Certification of the same shall be provided as per UL 1709 / ASTM E 1529 fire test standard as part of pre-bid requirements.

4.14.4 Contractor shall decide the number of layers of blanket required, longitudinal and transversal overlap and the clamping procedure for the desired fire rating, in line with project specifications. The blanket shall be removable from the duct / tray top side and shall be reusable. Metallic cladding shall be provided over the blanket with clamps. All clamps shall be reusable and easily removable type. The material of construction of clamps shall be minimum SS304.

4.14.5 Contractor shall provide drawings showing the typical installation details, procedure and methodology used for installation of such a system.

4.14.6 Contractor shall furnish calculations for actual thickness, density and the number of layers of blanket provided to meet the fire coverage requirement as per point no. 3 and 4 above.

4.15 General

4.15.1 The fieldwork shall be carried out under strict safety regulations and work permits as laid down by the client. The Contractor shall take extreme care in ensuring the safety and all safety gear like helmets, belts, safety shoes etc., for the Contractor's personnel.

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4.15.2 Contractor shall ensure adequate monsoon protection while carrying out instrumentation work stipulated under the Contract. Also ensure that all spare cable entries of Instruments/JBs/LCPs are plugged for weather protection and hazardous area protection where applicable.

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

5.1 General layout plan for all units, showing all information like location of field instruments, junction boxes, indicative routes of cables, main duct/ cable trays.

5.2 Cable schedules for alarm/ signal/ shutdown and power supply

5.3 Termination details/drawings for connecting at control room end.

5.4 Individual instrument specifications/ Data sheets.

5.5 Bill of Materials

5.6 Installation standards/hook up.

5.7 Manufacturer's hand books with instruction for installation and calibration wherever necessary, for reference.

6.0 DRAWINGS AND DOCUMENTS TO BE PROVIDED BY CONTRACTOR

6.1 The drawings for materials those are included in contractor's scope of supply namely local control panel, junction boxes and local cabinets, as applicable.

6.2 The detailed engineering drawings wherever such work is assigned.

6.3 Hard copies (4 sets) and soft copies (uploaded in the web-portal) of as-built drawings consisting of instrument layout drawings, instrument index, installation standards, bill of material, cable schedules etc. duly incorporating the changes/ modification carried out during the course of execution of works. The drawings/ documents shall be provided by the owner for the above purpose.

6.4 Final material appropriation statement for all the free issue materials as well as materials issued on chargeable basis, indicating shortages if any, in the Performa duly approved by Engineer-in-charge.

6.5 Indicative cable tray routing details for approval by Engineer-in-charge.

7.0 SCOPE OF SUPPLY FOR MATERIALS

7.1 Materials to Be Supplied By the Owner Free Of Cost

7.1.1 All pipes, tubes and piping materials such as fittings, steam traps, valves, flanges, gaskets, bolts and nuts for flanges necessary for primary piping, air supply and steam tracing.

7.1.2 Tubes, tube fittings, polyethylene tubes and fittings.

7.1.3 All field mounted instruments like pneumatic, electronic and analyser instruments, pressure gauges, temperature elements, dial thermometers, thermowells, switches and accessories like air filter regulators, receiver pressure gauges, solenoid valves etc.

7.1.4 Pneumatic and electric junction boxes for field mounting.

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7.1.5 Single pair/Single triad/multi-pair/multi triad shielded cables/thermocouple extension cables for signal/alarm/temperature signals and any other special cable specifically indicated in Schedule of Quantities.

7.1.6 Two-core/three core power cable.

7.1.7 All electrical conduits, fittings, cable glands and cable accessories unless otherwise specifically indicated.

7.1.8 Local panels.

7.2 Materials to be supplied by the contractor at his own cost, as part of this specification

7.2.1 The procurement and supply in sequence and at the appropriate time of all materials and consumables except for the materials specifically enlisted under owner's scope of supply shall be entirely the contractor's responsibility and his rates for execution shall be inclusive for all these items. These are as, but not limited to, the following:

a) All industrial gases like oxygen, acetylene or inert gases, compressed air and all types of electrodes, filler wires, brazing rods, flux etc. for welding purpose, with necessary facilities for testing the welded joints.

b) PTFE tape and other pipe jointing compounds for threads and material for sealing of cable entries to control room, local panels, insulation tapes, sealing compounds for flame proof conduit fittings.

c) Bolts and nuts for supports, U-bolts with nuts, clamps for tubes and pipes, anchor bolts for panels, expansion bolts (pinch anchor/raw bolts) of various sizes for fixing to concrete structures.

d) Polythene bags with Nylon Ties for protection of instruments against rain.

e) Paints, primers and solvents.

f) Plastic tags for identifications of tubes/wires at panel/junction boxes.

g) All materials for minor civil works like grouting etc.

h) Structural steel, MS Plates, GI plates, flats, pipe etc. required for fabrication of instruments supports and tray supports wherever required.

i) All accessories for electrical wiring like cable lugs, ferrules for identification etc.

7.2.2 Prefabricated main cable ducts and perforated/ladder trays with necessary accessories like tees, bends, crosses etc. as specified in schedule of quantities.

7.2.3 Mounting accessories for the above like bolts, supports etc.

7.2.4 Spool pieces and blinds for testing wherever required.

7.2.5 Any other item not specified, but required for the completion of the job.

Note: The contractor shall submit in sealed cellophane packets samples of all consumables like bolts, nuts, lubricants, ferrules, lugs and any other material included in their scope of supply for approval of engineer-in-charge which then forms the standards for erection work.

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8.0 SCRAP AND EXCESS MATERIAL

8.1 Every month, the contractor shall submit an account for all the materials issued to him by the owner in the standard Performa prescribed for this purpose by the engineer-in-charge.

8.2 On completion of the work, the contractor shall submit 'material appropriation' statements for all the materials issued by the owner in the Performa prescribed by the Engineer-in-charge.

8.3 The following scrap allowances are permissible:

	Non salvageable	Unaccountable
Length below 0.5 metres Steel pipes, SS tubes	2%	0.5%
Length below 2.0 metres Single pair, Single triad, two core/ three core cables	2%	0.5%
Length below 15 metres Multitube, Multicables	2%	0.5%

8.4 All excess materials and scrap shall be returned after duly accounting for, to the storage points designated by the owner. Where materials are to be weighed before return, the contractor shall be responsible for making the necessary arrangements for weighing etc. The contractor shall not use scrap section obtained during the course of construction for fabricating temporary supports or other items without prior permission of the Engineer-in-charge.

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

8.6 Radioactive element safe storage.

Use of radioactive sources must be in accordance with the recommendations of the International Commission on Radiological Protection (ICPR) and AERB (Atomic Energy Regulatory Board) requirements. The source holder is to be fully protected, leaving no possibility to be physically damaged by mechanical impacts.

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CALIBRATION REPORT

LOOP NO: _____ **CALIBRATION COMPLETED ON:** _____

CL1 TAG NO: TYPE: TRANSMITTER
RANGE:

INPUT		OUTPUT		MEAN	% ERROR
%	ACT.	INC	DEC		
0					
25					
50					
75					
100					

REAMARK:

CL2 TAG NO: TYPE: CONTROL VALVE

INPUT	MEAN VALVE POSITION		MEAN LIFT	REMARKS
%	INC	DEC		
0				
25				
50				
75				
100				

REMARK:

CL3 TAG NO: TYPE: TRANSMITTER
RANGE:

INPUT		OUTPUT		MEAN %	% ERROR INC
%	ACT.	INC	DEC		
0					
25					
50					
75					
100					

REMARK:

CL4 TAG NO: TYPE: CONTROL VALVE

INPUT	MEAN VALVE POSITION		MEAN LIFT	REMARKS
%	INC	DEC		
0				
25				
50				
75				
100				

REMARK:

CL5 TAG NO TYPE: TRANSMITTER
RANGE:

INPUT		OUTPUT		MEAN %	% ERROR INC
%	ACT.	INC	DEC		
0					
25					
50					
75					
100					

REMARK:

CL6 TYPE: SWITCH

TAG NO	SET POINT	CONTACT TYPE NO/NC	ALARM TYPE TRIP/L/H	SET POINT		DIFF
				INC	DEC	

REMARK:

BLOCK NO	CL1	CL2	CL3	CL4	CL5	CL6
CONTRACTOR						
EIL						
CLIENT						

INSTALLATION CHECK REPORT

INSTALLATION CHECK COMPLETED ON : _____

A	MOUNTING (LINE MOUNTING)	B	MOUNTING (TEMP ELEMENT)	C	MOUNTING (FIELD INST/GAS DET)	D	IMPULSE PIPING	E	CABLING
1	STUD BOLTS/NUTS □	1	ELEMENT TYPE □	1	STANCHION INSTN □	1	INSTALLATION □	1	CABLE TYPE &SIZE □
2	GASKETS □	2	'U' LENGTH □	2	CALIBRATION □	2	SUPPORTING □	2	CABLE TAG □
3	ALIGNMENT □	3	CABLE COLOUR □	3	INST. INSTALLATION □	3	HYDROTEST □	3	DRESSING □
4	RATING □	4	POLARITY □	4	CANOPY □	4	RADIOGRAPHY □	4	MEGGERING □
5	MATERIAL □			5	STANCHION TAG NUMBERING □	5	DP/MP TESTING □	5	CONTINUITY □
						6	PWHT	6	FERRULING □
								7	LUGS □
								8	SHIELD CONNECTION □

F	AIR SUPPLY DISTRIBUTION	G	JUNCTION BOX	H	POWER SUPPLY DISTRIBUTION	I	CONTROL VALVE/ ON-OFF VALVE	J	I/P CONVERTER
1	PIPE/TUBE ROUTING □	1	TYPE (WP/EP) □	1	SUPPLY TYPE □	1	STUD BOLTS/NUTS □	1	STANCHION INSTN □
2	SUPPORTS □	2	INSTALLATION □	2	GLANDING & TERMINATION □	2	GASKETS □	2	CALIBRATION □
3	TAG PLATE □	3	GLANDING, FERRULING & TERMINATION □	3	MEGGERING □	3	RATING □	3	INST. INSTALLATION □
4	TAP-OFF IDENTIFICATION □	4	GROUNDING □	4	CONTINUITY □	4	MATERIAL □	4	AIR SUPPLY SET □
		5	TAG NUMBERING □	5	FUSE RATING □	5	PORT CONFIGURATION □	5	PNEUMATIC TUBING □
		6	COLOUR □	6	CABLE TAG □	6	SIGNAL TUBING □	6	GLANDING & TERMINATION □
						7	AIR TUBING & AFR □		
						8	SUPPORT/CLAMPING □		

K	CONTROL VALVE / ON OFF VALVE ACCESSORIES		L	HEAT TRACING & INSULATION	M	FLOW ELEMENT CHECK
1	POSITIONER □	CABLE TERMINATION	1	INSTALLATION □		CHECK, ORIFICE PLATE / FLOW NOZZLE
2	SOLENOID VALVE □	1) GLANDING □	2	STEAM TRAP □	1	BORE VERIFICATION □
3	LIMIT SWITCH (OPEN) □	2) FERRULING □	3	ELECTRIC TRACER □	2	NOZZLE/PLATE DIRECTION ☑
4	LIMIT SWITCH (CLOSE) □	3) LUGS □	4	INSULATION TYPE □		
5	AIR FILTER REGULATOR □	4) CONTINUTY □	5	INSULATION CLADDING □	3	TAP ORIENTATION □
6	VOLUME TANK WITH ACCESSORIES	5) SHIELD CONNECTION □	6	DRAIN □		AVG PITOT TUBE
7	ACTUATOR FIREBOX □				1	ELEMENTT LENGTH □
8	PNEUMATIC TUBE □				2	ELEMENT ORIENTN □

CLIENT: _____ EIL: _____ SYSTEM VENDOR: _____ CONTRACTOR: _____

PROJECT: _____ JOB NO: _____ SHT__OF___

FIELD BUS INSTRUMENTS TESTING RESULTS

Segment No:	**Device No:**
Cal Equipment used:	**Validity Date:**

Sr No	Test input	Resistance Measurement		Capacitance Measurement	
		Expected	Actual	Expected	Actual
1a	(+) to (-) signal	> 50 KΩ		1 µF ±20 %	
1b	(+) to shield	> 20 MΩ		< 300 nF	
1c	(-) to shield	> 20 MΩ		< 300 nF	
1d	(+) to ground bar:	> 20 MΩ		< 300 nF	
1e	(-) to ground bar	> 20 MΩ		< 300 nF	
1f	Shield to ground bar	> 20 MΩ		< 300 nF	

Type of Power supply: **FISCO** ☐ **FINICO** ☐ **Field Barrier** ☐

Sr No	Measurement Location	DC Voltage Measurement (in DC Volts)					
		FISCO		FINICO		Field barrier	
		Expected	Actual	Expected	Actual	Expected	Actual
2a	Power supply conditioner voltage input, (+) to (-) signal	12.4		12.4		14.7	
2b	Power supply conditioner field side output, (+) to (-) signal	20~30		20~30		16~32	
2c	Field barrier input, (+) to (-) signal	-		-		16~32	
2d	Field barrier output, (+) to (-) signal	-		-		10	

Sr No	Measurement Location	Signal Level Measurement	
		Expected(in DC mV)	Actual (in DC mV)
3a	At Marshalling end(*), signal level from FB Monitor, (+) to (-) signal	350 to 700	
3b	At Field end(**), Signal level from FB Monitor, (+) to (-) signal	350 to 700	

Sr No	Measurement Location	Noise Level Measurement	
		Expected (in DC mV)	Actual (in DC mV)
4a	At Marshalling end(*), Noise level from FB Monitor, (+) to (-) signal	< 25	
4b	At Field end(**), Noise level from FB Monitor, (+) to (-) signal	< 25	

(*) At Marshalling end means power supply conditioner output to H1 module.
(**) At Field end means power supply conditioner output to field.

LOOP CHECKING REPORT

LOOP NO: _____ **LOOP CHECK COMPLETED ON:** _____

PROCESS SIMULATION DONE BY: ACTUAL ☐ **BY HART COMMUNICATOR** ☐

BL 1 TAG NO. TYPE: TRANSMITTER
RANGE.: SET POINT: L/LL H/HH

INPUT		TRANSMITTER OUTPUT		LOOP INDICATOR READING		DCS READING		DCS MEAN
%	ACT.	INC	DEC	INC	DEC	INC	DEC	
0								
25								
50								
75								
100								
H								
HH								
L								
LL								

BL 2 TAG NO. TYPE: CONTROL VALVE

CONTROLLER OUTPUT (%)	INPUT		POSITIONER OUTPUT		CONTROL VALVE LIFT		MEAN
	INC	DEC	INC.	DEC	INC	DEC	
0							
25							
50							
75							
100							

BL 3 TAG NO. TYPE: TRANSMITTER
RANGE.: SET POINT: L/LL H/HH

INPUT		TRANSMITTER OUTPUT		LOOP INDICATOR READING		DCS READING		DCS MEAN
%	ACT.	INC	DEC	INC	DEC	INC	DEC	
0								
25								
50								
75								
100								
H								
HH								
L								
LL								

BL 4 TAG NO. TYPE: CONTROL VALVE

CONTROLLER OUTPUT (%)	INPUT		POSITIONER OUTPUT		CONTROL VALVE LIFT		MEAN
	INC	DEC	INC.	DEC	INC	DEC	
0							
25							
50							
75							
100							

BL 5 TAG NO. TYPE: TRANSMITTER
RANGE.: SET POINT: L/LL H/HH

INPUT		TRANSMITTER OUTPUT		LOOP INDICATOR READING		DCS READING		DCS MEAN
%	ACT.	INC	DEC	INC	DEC	INC	DEC	
0								
25								
50								
75								
100								
H								
HH								
L								
LL								

BL 6 TAG NO. TYPE: SWITCH
RANGE: SET POINT: L/LL H/HH

TAG NO	SET POINT	CONTACT TYPE NO/NC	TYPE TRIP L/H	SET POJINT		DIFF
				INC	DEC	

NOTES:

BLOCK NO	BL1	BL2	BL3	BL4	BL5	BL6
CONTRACTOR						
SYSTEM VENDOR						
EIL						
CLIENT						

CLIENT: _____ EIL: _____ SYSTEM VENDOR: _____ CONTRACTOR: _____

PROJECT: _____ JOB NO: _____ SHT__OF___

LOGIC CHECKING REPORT

INTERLOCK NO: _____ **LOGIC VERIFICATION IN:** **DCS** ☐ **PLC** ☐

LOGIC INPUT (TAG NO)	TYPE (TRANSMITTER / SWITCH)	CALIBRATED	SET POINT FOR TRIP	ON/OFF VALVE / CONTROL VALVE		MCC OUTPUT		REMARK
				TAG NO	ACTION	TAG NO	ACTION	
			SET					
			RESET					
			SET					
			RESET					
			SET					
			RESET					
			SET					
			RESET					
			SET					
			RESET					
			SET					
			RESET					
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			RESET					
			SET					
			RESET					
			SET					
			RESET					
			SET					
			RESET					

INTERLOCK CHECK COMPLETED SUCCESSFULLY : YES ☐ **NO** ☐

CONTRACTOR:_____ SYSTEM VENDOR:_____ EIL: _____ CLIENT:_____

(A) CALIBRATION RESULTS PUNCH POINT

SL NO	LOOP NO/TAG NO	PUNCH POINT	ACTION REQUIRED	BY

CONTRACTOR:_____ EIL : _____ CLIENT:_____

(B) INSTALLATION CHECK PUNCH POINTS:

SL NO	LOOP NO/TAG NO	PUNCH POINT	ACTION REQUIRED	BY

CONTRACTOR:_____ EIL : _____ CLIENT:_____

(C) LOOP CHECKING PUNCH POINTS:

SL NO	LOOP NO	PUNCH POINT	ACTION REQUIRED	BY

CONTRACTOR:_____ SYSTEM VENDOR: _____ EIL : _____ CLIENT:_____

(D) LOOP CHECK PUNCH POINTS:

SL NO	LOOP NO	PUNCH POINT	ACTION REQUIRED	BY

CONTRACTOR:_____ SYSTEM VENDOR: _____ EIL : _____
CLIENT:_____

CLIENT: _____ CONTRACTOR:_____ SYSTEM VENDOR:_____

PROJECT:_____ JOB NO:_____ SHT____OF ____

यांत्रिक ट्यूब फिटिंग्स के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR INSTRUMENT TUBE FITTINGS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
7	30.12.24	Revised and Reissued as Standard Specification	TNK	AJS	MN	MN
6	05.09.19	Reaffirmed and Re-issued	JJ	AJS	RG	RKT
5	06.06.14	Revised and Reissued as Standard Specification	JJ	MN	RG	SC
4	09.11.10	Revised and Reissued as Standard Specification	CS	RP	TGM/JMS	ND
3	03.05.05	Revised and Reissued as Standard Specification	RG	HCJ	PM	VJN

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Abbreviations:

HRB	:	Rockwell Hardness - Scale B
NPT	:	National Pipe Thread

Instrumentation Standards Committee

Convenor	:	Mr. Mainak Nandi
Members	:	Mr. Arupjyoti Saikia
		Mr. Sachin Garg
		Ms. Rimpa Saha Chakraborty
		Mr. Ankit Tiwari
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ANNEXURE – 1 : HYDROSTATIC TEST PRESSURES FOR INSTRUMENT TUBE FITTINGS

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1.0 GENERAL

1.1 Scope

1.1.1 This standard specification, together with the data sheets attached herewith, covers the requirements for the design, materials, inspection, testing and shipping of instrument tube fittings which includes the following types:

a) Stainless steel compression fittings (for stainless steel tube)
b) Brass compression fittings (for copper tube)

1.1.2 The related standards referred to herein and mentioned below shall be of the latest editions unless otherwise specified : -

ASME	American Society of Mechanical Engineers	
	B 1.20.1	Pipe Threads General Purpose (Inch).
	B 16.11	Forged Fittings – Socket-Welding and Threaded.
	B 16.5	Pipe Flanges and Flanged Fittings.
ASTM	American Society for Testing and Materials	
	F 1387	Standard Specification for Performance of Piping and Tubing Mechanically Attached Fittings.
EN	European Standards	
	10204	Inspection Documents For Metallic Products.
IS	Indian Standards	
	319	Specifications for Free Cutting Leaded Brass Bars, Rods and Sections.
ISA	International Society of Automation.	
	RP 42.00.01	Nomenclature for Instrument Tube Fittings.
NACE	National Association for Corrosion Engineers.	
	MR 0175	Petroleum and natural gas industries – Materials for use in H2S-containing Environments in oil and gas production.

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

a) Statutory Regulations

b) Data Sheets

c) Standard Specification

d) Codes and Standards

1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instructions to the vendor attached along with the Material Requisition.

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

2.0 DESIGN AND CONSTRUCTION

2.1 Stainless Steel Tube Fittings

2.1.1 Nomenclature of all tube fittings shall be as per ISA RP 42.00.01.

2.1.2 Fittings shall be of flare less compression type having four-piece (for double compression type) construction consisting of two ferrules, nut and body or three piece (for single

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compression type) construction consisting of single ferrule, nut and body suitable for use on tubes of specified material for example stainless steel tubes conforming to ASTM A269 TP 316L with hardness in the range of HRB 70 to 79.

2.1.3 All parts of the tube fittings shall be of 316 Stainless Steel unless specified otherwise.

2.1.4 The ferrule hardness shall not be less than HRB-90.

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

2.1.6 Spanner hold shall be metric.

2.1.7 Threaded ends of fittings shall be NPT as per ASME B 1.20.1.

2.1.8 Specific techniques like silver plating shall be used over threading in order to avoid jamming and galling.

2.1.9 Ferrule finish and fitting finish shall be such that there is no abrasion/galling when the nut is tightened.

2.1.10 All instrument tube fittings in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride. End connection shall be plugged after degreasing process in order to avoid entrance of grease or oil particles.

2.2 Copper Tube Fittings

2.2.1 Nomenclature of all tube fittings shall be as per ISA RP 42.00.01.

2.2.2 Fittings shall be of flare less compression type and of three-piece construction consisting of ferrule, nut and body suitable for use on copper tubes conforming to ASTM B68 /B68M, hardness not exceeding HRB 50.

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

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

2.2.5 Threaded ends of fittings shall be NPT as per ASME B 1.20.1.

2.2.6 Spanner hold shall be metric.

3.0 NAMEPLATE

No separate nameplates are required on the fittings. However, manufacturer's name/trademark should be punched on a visible place on the body of each fitting for easy identification.

4.0 INSPECTION AND TESTING

4.1 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.

4.2 The fittings should qualify all the standard qualification tests mentioned in ASTM F 1387. Supplementary test requirement shall apply only when particularly specified in requisition.

5.0 SHIPPING

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

5.2 All the fittings in oxygen and chlorine service shall be separately packed along with a certificate indicating 'SUITABLE FOR OXYGEN/CHLORINE SERVICE', as applicable.

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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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Sr. No.	Size of Tube Fittings	Material	Line Pressure Class	Maximum Working Pressure	Hydrostatic Test Pressure
1	6mm, ¼" ,12 mm and ½"	Stainless Steel SS 316	≤ Class 600	102 Kg/cm^{2}g	153 Kg/cm^{2}g
2	6mm, ¼" ,12 mm and ½"	Stainless Steel SS 316	≥ Class 900 to ≤ Class 1500	253 Kg/cm^{2}g	383 Kg/cm^{2}g
3	¼", 3/8" and 10 mm [for steam tracing application]	Brass	≤ Class 300	53 Kg/cm^{2}g	80 Kg/cm^{2}g

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इंस्ट्रूमेंट ट्युबिंग के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR INSTRUMENT TUBING

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5	21.12.20	Revised and Reissued as Standard Specification	RRS	KS	MN	SM
4	26.02.16	Revised and Reissued as Standard Specification	PR	MA	RG	SC
3	14.12.10	Revised and Reissued as Standard Specification	SMK	RG	TGM/JMS	ND
2	03.05.05	Revised and Reissued as Standard Specification	RG	HCJ	PM	VJN
1	01.11.96	Revised and Reissued as Standard Specification	RK	BRS	RB	AS

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Abbreviations:

HRB	:	Rockwell Hardness - Scale B
OD	:	Outer Diameter
PVC	:	Polyvinyl Chloride

Instrumentation Standards Committee

Convener: Mr. Mainak Nandi

Members:
Mr. Arupjyoti Saikia
Mr. Sachin Garg
Mr. Jerry Johnson
Mr. Mayank Kaushik
Mr. Sourav Mukharjee
Ms. K. Pratheepa
Mr. R.K. Gupta(Proj.)

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ANNEXURE – 1: MAXIMUM WORKING PRESSURE AND HYDROSTATIC TEST PRESSURES FOR INSTRUMENT TUBING

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1.0 GENERAL

1.1 Scope

1.1.1 This standard specification, together with the data sheets, covers the requirements for the design, materials, inspection, testing and shipping of Instrument Tubing which includes the following types: -

a) Stainless steel tubes

b) Copper tubes

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

ASTM American Society for Testing and Materials.

A269/A269M	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
A632	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small Diameter) for General Service
B 251	Standard Specification for general requirements for wrought seamless copper and copper alloy tube.
B 251M	Standard Specification for general requirements for wrought seamless copper and copper alloy tube (Metric)
B 68/B 68M	Standard Specification for seamless copper tube, bright annealed.
E 243	Standard Practice for Electromagnetic (Eddy – Current) Examination of Copper and Copper – Alloy Tubes

EN European Standards

10204	Inspection Documents for Metallic Products

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

a) Statutory regulations

b) Job specification

c) Standard specification

d) Codes and standards

1.2 Bids

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

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

1.3 Drawings and Data

1.3.1 Detailed drawings, data, catalogues and manuals required from the vendor are indicated by the purchaser in vendor data requirement sheets attached with requisition. The required number of prints and soft copies shall be dispatched to the address mentioned adhering to the time limits indicated.

1.3.2 Final documentation consisting of design data by the vendor shall be submitted by vendor after placement of purchase order, as per vendor data requirements and shall include the following as a minimum:

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a) Specification sheet for each type of tube.

b) Copy of test certificates of all tests indicated in clause 4.0 of this specification.

2.0 DESIGN AND CONSTRUCTION

2.1 Stainless Steel Tubes

2.1.1 The tubes shall be 316L Stainless Steel fully annealed, seamless and cold drawn as per ASTM A 269/A269M.

2.1.2 The hardness of the tubes shall be limited to HRB 70-80. Equivalent hardness as Rockwell superficial scale (30T/15T) or Vicker's hardness scale shall also be acceptable.

2.1.3 Tubes shall have good surface finish and shall be free from scratches burrs etc. and suitable for bending.

2.1.4 Tubes shall have Molybdenum content of minimum 2.5%.

2.1.5 Tubes shall preferably be supplied in length of 4 to 7 metres without welding in between. Tube length less than 4 meters shall be rejected.

2.1.6 All tubes in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetrachloride and tube ends shall be plugged after degreasing process in order to avoid entrance of grease or oil particles.

2.2 Copper Tubes

2.2.1 Copper Tubes (PVC Jacketed)

a) The tube shall be soft annealed copper with 6mm OD and a wall thickness of 1.0mm as per ASTM B68/B68M copper No. C12200.

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

c) The tube shall be continuous length without any brazing in between.

d) The length of single tube shall preferably be 100 metres. However any tube length less than 25 meters shall be rejected unless specifically required otherwise in job specification.

e) The dimensional tolerances shall be as per ASTM B 251/B251M.

2.2.2 Bare Copper Tubes (For Steam Tracing)

a) The tube shall be soft annealed copper with 3/8" (10mm) OD with wall thickness of 0.049" or 1/4" (6mm) OD with wall thickness of 1.0mm as per ASTM B68/B68M copper No. C12200.

b) The tube shall be continuous length without any brazing in between.

c) The length of single tube shall preferably be 100 metres. However any tube length less than 50 meters shall be rejected unless specifically required otherwise in job specification.

d) The dimensional tolerances shall be as per ASTM B 251/B251M.

2.3 Maximum working pressure and hydrostatic test pressure shall be as per Annexure - 1 attached with this specification

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3.0 NAMEPLATE

The following information shall be marked on the stainless steel tubes:

a) Name of manufacturer

b) Type and material grade of tube

c) Tube outer diameter and wall thickness.

4.0 INSPECTION AND TESTING

Purchaser reserves the right to inspect and witness testing at vendor's works as per Inspection Test Plan. All the tests, marking, dimensional tolerance as per applicable code shall be duly completed by the vendor and test reports shall be submitted to Purchaser for scrutiny.

5.0 SHIPPING

5.1 The tube shall be plugged at both ends prior to transportation to prevent entry of foreign matter.

5.2 The tubes shall be packed carefully so as to avoid damage during transport.

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

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Sr. No.	Size of Tube (OD)	Material	Line Pressure Class (lbs per sq. inch)	Thickness	Maximum Working Pressure	Hydrostatic Test Pressure
1	1/8", 3mm	Stainless Steel	≤ Class 600	0.028" (0.8mm)	102 Kg/cm^{2}g	153 Kg/cm^{2}g
2	¼", 6mm	Stainless Steel	≤ Class 600	1.00mm	102 Kg/cm^{2}g	153 Kg/cm^{2}g
			≥ Class 900 to ≤ Class 1500	0.065" (1.65mm)	253 Kg/cm^{2}g	383 Kg/cm^{2}g
3	5/16", 8mm	Stainless Steel	≤ Class 600	0.049" (1.2mm)	102 Kg/cm^{2}g	153 Kg/cm^{2}g
4	3/8",10mm	Stainless Steel	≤ Class 600	0.049"(1.2mm)	102 Kg/cm^{2}g	153 Kg/cm^{2}g
5	½",12mm	Stainless Steel	≤ Class 600	0.049" (1.2mm)	102 Kg/cm^{2}g	153 Kg/cm^{2}g
			≥ Class 900 to ≤ Class 1500	0.065" (1.65mm)	253 Kg/cm^{2}g	383 Kg/cm^{2}g
6	¾", 20mm	Stainless Steel	≤ Class 600	0.049" (1.2mm)	102 Kg/cm^{2}g	153 Kg/cm^{2}g
			≥ Class 900 to ≤ Class 1500	0.065" (1.65mm)	211 Kg/cm^{2}g	317 Kg/cm^{2}g
7	1", (25mm)	Stainless Steel	≥ Class 900 to ≤ Class 1500	0.095" (2.5mm)	211 Kg/cm^{2}g	317 Kg/cm^{2}g
8	3/8",10mm	Copper	≤ Class 300	0.049"(1.2mm)	53 Kg/cm2g	80 Kg/cm2g
9	¼", 6mm	Copper	≤ Class 300	1.00mm	53 Kg/cm2g	80 Kg/cm2g

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इंस्ट्रूमेंट वाल्वों और नानाविध वाल्वों के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR INSTRUMENT VALVES AND MANIFOLDS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	21.12.20	Revised and Reissued as Standard Specification	RRS	KS	MN	SM
5	13.11.15	Revised and Reissued as Standard Specification	IS	SB	RG	SC
4	27.10.10	Revised and Reissued as StandardSpecification	SM	RP	TGM/JMS	ND
3	03.05.05	Revised and Reissued as StandardSpecification	RK	HCJ	PM	VJN
2	28.02.01	Revised and Reissued as StandardSpecification	AKA	PM	BRS	MI

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Abbreviations:

CWP	:	Cold Working Pressure
NPT	:	National Pipe Thread
PTFE	:	Poly Tetra Fluoro Ethylene

Instrumentation Standards Committee

Convener: Mr. Mainak Nandi

Members:
Mr. Arupjyoti Saikia
Mr. Sachin Garg
Mr. Jerry Johnson
Mr. Mayank Kaushik
Mr. Sourav Mukharjee
Ms. K. Pratheepa
Mr. R.K. Gupta(Proj.)

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4.0 INSPECTION AND TESTING 7

5.0 SHIPPING 7

ANNEXURE – 1: HYDROSTATIC TEST PRESSURES FOR INSTRUMENT VALVES AND MANIFOLDS.

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1.0 GENERAL

1.1 Scope

1.1.1 This standard specification, together with the data sheets, describe the requirements for the design, materials, inspection, testing and shipping of instrument valves and manifolds which include the following types:

a) Miniature instrument valves

b) Instrument valve manifolds

c) Instrument air valves

1.1.2 The related standards referred to herein and mentioned below shall be of the latest edition of the following codes, standard practices and publications unless otherwise specified:

ASME	American Society of Mechanical Engineers	
	B 1.20.1	Pipe threads General Purpose (Inch)
	B 16.11	Forged steel fittings-socket welding and threaded.
	B 16.9	Factory made Wrought Steel Butt welding fittings.
	B 16.34	Valves-Flanged, Threaded and welding end.
API	American Petroleum Institute	
	API-598	Valve Inspection and Testing
EN	European Standards	
	10204	Inspection Documents for Metallic Products.
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry.	
	SP99	Instrument Valves

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

a) Statutory Regulations

b) Data Sheets

c) Standard Specification

d) Codes and Standards

1.2 Bids

1.2.1 Vendor's quotation shall be strictly as per the bidding instructions to vendor attached with the Material Requisition.

1.2.2 All items, as offered, shall be field proven and should have completed satisfactory operation for a period of minimum 6 months on the bid due date in similar application to those as specified in the purchaser's requisition sheet. Items with proto-type design or items not meeting provenness criteria specified above shall not be offered.

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

1.3 Drawings and Data

1.3.1 Detailed drawings, data, catalogue and manuals etc. required from the vendor is indicated by the purchaser in vendor data requirement sheets attached with material requisition.

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

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a) Certified dimensional details showing internal constructional details and material of construction.

b) Installation and maintenance procedures.

2.0 DESIGN AND CONSTRUCTION

2.1 The instrument valves shall be of manufacturer proprietary design. However, the minimum requirements specified herein must be complied.

2.2 Qualification tests (hydrostatic proof and burst tests) as per MSS SP-99 shall be conducted by vendor for each design and size of valve to establish the cold working pressure (CWP) rating.

2.3 For all valves and manifolds with body material of carbon steel/stainless steel, the valve trim material shall be 316 Stainless Steel or superior material. Whenever body material is other than that specified above, trim material should be same as body material or superior material.

2.4 Unless otherwise specified, the valve packing material for all valves and manifolds shall be Grafoil only. The o-ring materials wherever used shall also be of Grafoil.

2.5 The finishing and tolerances of parts like stem, piston, stem threading etc. of the offered valves and manifolds shall be properly machined to avoid problems like galling.

2.6 The hand wheel material for all valves and manifolds shall be zinc/nickel plated carbon steel. Any other material, if provided as per standard vendor design, shall also be acceptable.

2.7 Instrument Valves (Miniature)

2.7.1 The instrument valves shall be of globe pattern needle valves forged/ bar stock with inside screwed bonnet, with back-seated blow out proof system.

2.7.2 Body material shall be 316 Stainless Steel unless otherwise specified.

2.7.3 The minimum cold working pressure (CWP) rating of the valve shall be as per Annexure 1 of this specification, unless otherwise specified.

2.7.4 The end connection shall be ½"NPTF to ASME B1.20.1, unless otherwise specified.

2.7.5 Flow direction shall be marked on the body.

2.7.6 The valve dimensions shall be as follows:

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

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

These dimensions are indicative only.

2.8 Valve Manifolds

2.8.1 3-Valve and 5-Valve manifolds:

2.8.1.1 3-Valve manifold

a) 3-Valve manifold shall be designed for direct coupling to differential pressure transmitters having 2 bolt flanges with 54mm (2-1/8") centre-to-centre connections and 41.3mm (1-5/8") bolt-to-bolt distance.

b) 3-Valve manifold shall contain two main line block valves and an equalising bypass valve. The valves shall be needle type. They shall use self-aligning 316 Stainless Steel ball seats, unless otherwise specified.

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2.8.1.2 5-Valve manifold

a) 5-Valve manifold shall be designed for direct coupling to differential pressure transmitters having 2 bolt flanges with 54mm (2-1/8") centre-to-centre connections and 41.3mm (1-5/8") bolt-to-bolt distance.

b) 5-Valve manifold shall contain two main line block valves and a combination double block and bleed for the bypass line. The valve shall of needle type or special ball with bleed hole.

2.8.1.3 The flanges shall be integral part of manifold block.

2.8.1.4 The material of construction shall be 316 Stainless Steel, unless otherwise specified.

2.8.1.5 The minimum cold working pressure (CWP) rating of manifolds shall be as per Annexure 1 of this specification, unless otherwise specified.

2.8.1.6 The process connection shall be ½"NPTF to ASME B 1.20.1.

2.8.1.7 Wherever the manifolds are specified for stanchion mounting, these shall be supplied along with mounting accessories. The bolts and nuts shall be alloy steel as per ASTM A 193 Gr B7 and ASTM A194 Gr. 2H (Hot dip galvanised or zinc plated) respectively. Other accessories shall be zinc plated.

2.8.2 3 way 2 valve manifold for pressure gauges

2.8.2.1 The manifold shall be designed for use with pressure gauges with block and bleed valves. The manifold body shall be either straight or angle type as specified in the data sheet.

2.8.2.2 The valve shall be a needle type.

2.8.2.3 The body material shall be 316 Stainless Steel, unless otherwise specified.

2.8.2.4 The minimum cold working pressure rating of the manifold shall be as per Annexure 1 of this specification, unless otherwise specified.

2.8.2.5 The manifold shall have the following connections:

a) The inlet connection shall be ¾" plain ends with a minimum of 100mm nipple extension suitable for socket weld or butt weld as per B16.11/ B16.9 as specified in the job specifications.

b) The gauge connection shall be with union nut and tail piece threaded to ½"NPTF.

c) The drain connection shall be ½"NPTF.

2.9 Instrument Air Valves

2.9.1 Instrument Air Isolation Valves (Miniature)

2.9.1.1 The valves shall be full-bore ball type with forged body.

2.9.1.2 Body material shall be 316 Stainless Steel.

2.9.1.3 The minimum cold working pressure rating of instrument air isolation valves shall be as per Annexure 1 of this specification, unless specified otherwise.

2.9.1.4 The end connection shall be ½"NPTF to ASME B 1.20.1, unless otherwise specified.

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

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2.9.2 Instrument Air Needle Valves (Miniature)

2.9.2.1 The instrument valves shall be globe pattern-needle valves forged/bar stock with inside screwed bonnet.

2.9.2.2 Body material shall be 316 Stainless Steel.

2.9.2.3 The minimum cold working pressure of Instrument Air Needle valves shall be as per Annexure 1 of this specification, unless otherwise specified.

2.9.2.4 The end connection shall be ¼" NPTF to ASME B1.20.1, unless otherwise specified.

2.9.2.5 Flow direction shall be marked on the body.

2.9.2.6 The valve dimensions shall be as follows:

a) End to end dimensions - 54 mm (approximately).

b) Height in fully open condition - 49 mm maximum.

These dimensions are tentative only.

2.10 All instrument valves in oxygen and chloride service shall be thoroughly degreased using reagents like trichloroethylene or carbon tetrachloride. End connection shall be plugged after degreasing process in order to avoid entrance of grease or oil particles.

3.0 NAMEPLATE

Following information shall be punched on the body of each of these items:

a) Material of construction to the same standards as in purchaser's data sheets.

b) Cold working pressure of each item to the same standards as in purchaser's data sheets.

c) Manufacturer's identification and model number.

d) Flow direction (if applicable)

e) Material of construction.

4.0 INSPECTION AND TESTING

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

5.0 SHIPPING

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

5.2 All instrument valves and manifolds in oxygen and chloride service shall be separately packed along with a certificate indicating 'CERTIFIED FOR OXYGEN/CHLORINE SERVICE' as applicable.

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Sr. No.	Item	Line Pressure Class	Minimum Cold Working Pressure (CWP)	Hydrostatic Test Pressure for	
				Seat Leakage Test	Shell Leakage Test
1	Instrument Valves (Miniature)	≤ Class 600	102kg/cm^{2}g	112kg/cm^{2}g	153kg/cm^{2}g
		≥ Class 900 to ≤ Class 1500	253kg/cm^{2}g	278kg/cm^{2}g	383kg/cm^{2}g
2	Instrument Valve Manifolds	≤ Class 600	102kg/cm^{2}g	112kg/cm^{2}g	153kg/cm^{2}g
		≥ Class 900 to ≤ Class 1500	253kg/cm^{2}g	278kg/cm^{2}g	383kg/cm^{2}g
3	Instrument Air Isolation Valves	≤ Class 600	27kg/cm^{2}g	30kg/cm^{2}g	41kg/cm^{2}g
4	Instrument Air Needle Valves	≤ Class 600	27kg/cm^{2}g	30kg/cm^{2}g	41kg/cm^{2}g

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STANDARD SPECIFICATION FOR CHAIN PULLEY BLOCK

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
			Approved by			
6	13/05/22	REVISED AND REISSUED	RP/MS	RRS	NK	SM
5	14/12/16	REVISED AND REISSUED	AK	KCP	PB	RN
4	01/08/12	REVISED AND REISSUED	SPC	PB	AKN	DM
3	01/06/10	REVISED AND REISSUED	SPC	PB	MK/DM	ND

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Abbreviations:

IS	: Indian Standard
QA	: Quality Assurance

Static & Machinery Equipment Department (Packaged Equipment) Standards Committee

Convenor : Mr. Nalin Kumar

Members :
Mr. Shishupal Choudhary (Coordinator)
Mr. RR Shrivastava
Mr. KC Paikar
Mr. A Natarajan
Mr. Plaban Dan
Mr. Deepak Kumar
Mr. M. G. Venkitesh
Mr. Ayush Mathur (Projects)

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1.0 GENERAL

This specification outlines the minimum requirements for design, engineering, manufacture and assembly at shop, painting, inspection, testing and supply the Chain Pulley Block with or without geared trolley.

2.0 CODES AND STANDARDS

2.1 This standard is based on following Indian Standard, and the standards referred therein, which shall be deemed to be part of this standard.

IS - 3832	:	Hand operated Chain Pulley Blocks- Specification.
IS-15560	:	Specification for Point hooks with shank up to 160 Tonne.
IS-28	:	Phosphor Bronze Ingots and Castings
IS-304	:	High Tensile Ingots and Castings
IS-305	:	Aluminium Bronze Ingots and Castings

Latest revision of the above-mentioned standard as on the date of enquiry shall be applicable.

2.2 Other international standards may also be acceptable subject to their being equivalent or superior with prior approval of purchaser.

2.3 For provisions not covered by the above codes & standards, applicable engineering practices & norms shall govern.

3.0 TECHNICAL REQUIREMENTS

Technical requirements of Chain Pulley Block shall be as per Indian standards referred in clause 2.1 above, subject to the following additions, deletions and modifications:

3.1 **Addition / Deletion / Modification to IS 3832: 2005 (Reaffirmed 2020 including amendment)**

i) Clause no. 4.2.1 (Modification): Mechanism class 2 shall be considered for design of chain pulley Block unless otherwise specified in the data sheet.

ii) Clause no. 5.0 (Addition): Chain Pulley Block shall be detachable type suitable for mounting on geared trolleys of the same ratings/capacities, unless otherwise specified in job specification/data sheet.

iii) Clause no. 5.1 (Addition): The frame shall be built from steel plates with bolted/welded construction.

iv) Clause no. 5.2 (Addition): All gears shall be machine cut.

v) Clause no. 5.5 (Modification): Only anti friction bearing shall be used. Bearing shall have L_{10} life of minimum 25000 hrs.

vi) Clause no. 5.6 (Modification): The block shall be provided with adequate facilities for lubrication and same shall be clearly indicated in the maintenance manual.

vii) Clause no. 5.7.1 (Addition): Hook(s) (top -if applicable and bottom) shall be provided with safety latches to prevent accidental unhooking unless otherwise stated.

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viii) Clause no. 5.7.1.2 (Modification): First line to be modified as "Bottom hook shall be provided with thrust bearing to enable it to rotate freely under load so as to prevent twisting of the load chain.

ix) Clause no. 5.10.3 (Modification): The length of hand chain shall be such that the lowest point of the suspended loop shall be 400 mm (maximum) above operating level.

x) Clause no. 5.11 (Addition): The trolley for the chain pulley block shall be geared type, fabricated construction, 4 wheeled, driven by hand chain and shall have provision for mounting the chain pulley block. Trolley shall be designed to suit the suitable monorail beam size and the hoisting capacity.

xi) Clause no. 11.1 (Addition): Following shall also be marked on Chain Pulley block:

a) Tag number.

b) "Non Sparking Type" on chain pulley block suitable for hazardous area classification.

3.2 For offshore applications, load, hand and trolley chains shall be galvanized.

3.3 Special Requirements for Hazardous Area Chain Pulley Block

The materials for non-lubricated rubbing parts shall be of non-sparking type (non-ferrous). The suggested materials for such components are as follows:

	Part/Component	**Material of Construction**
A	**Lifting Mechanism**	
	Ratchet wheel, chain guides	Solid construction in Aluminium Bronze (IS - 305) / High Tensile Brass (IS - 304)
	Hand chain wheel	Solid construction of Aluminium Bronze / High Tensile Brass (IS- 304) / Phosphor Bronze (IS-28)
	Load chain wheel	Solid construction in Aluminium Bronze (IS - 305)/ High Tensile Brass (IS - 304)
	Hook (Top & bottom)	Bronze coated Forged Steel / bronze coated Forged alloy Steel/Forged Stainless Steel.
B	**Trolley Mechanism**	
	Hand chain wheel guides	Solid construction in Aluminium Bronze (IS-305) / High Tensile Brass (IS-304)/ Phosphor Bronze (IS-28)
	Hand chain wheel	Solid construction of Aluminium Bronze (IS-305) / High Tensile Brass (IS-304)/ Phosphor Bronze (IS-28)
	Ungeared and geared wheels	Solid construction in Aluminium Bronze (IS-305) / High Tensile Brass (IS -304) / SS or tyre of Aluminium Bronze (IS-305) / High Tensile Brass (IS-304) / SS shrunk fitted on core wheel of C55Mn75 or superior MOC

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4.0 INSPECTION AND TESTING

4.1 Equipment shall be subjected to stage-wise inspection and testing at vendor's/subvendor'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.

4.2 **Testing at Works**

4.2.1 Vendor shall perform operational Proof Test, as a minimum, necessary to ensure that the material and workmanship conform to the requirement of Clause 9.2 of IS- 3832.

4.2.2 The trolley (if applicable) shall be tested for smooth operation under loaded condition.

4.2.3 Certificate of test and examination shall be issued with all the chain pulley blocks as specified in clause 10.2 of IS – 3832.

4.2.4 Any or all the tests, at purchaser's option, shall be witnessed by purchaser/its authorized inspection agency. However, such inspection shall be regarded as check-up and in no way absolve the vendor of his responsibility.

5.0 PROTECTION AND PAINTING

5.1 Surface preparation and painting shall be done as per vendor's standard painting suitable for corrosive industrial environment, unless otherwise specified in the Job Specification.

5.2 Stainless steel surfaces, both inside and outside, shall be pickled and passivated.

5.3 Machined and bearing surfaces shall be protected with varnish or thick coat of grease.

6.0 PACKAGING AND IDENTIFICATION

6.1 All packaging shall be done in such a manner as to reduce the volume. The equipment shall be properly packed to provide adequate protection during shipment. All assemblies shall be properly match marked for site erection.

6.2 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

6.3 Detailed packing list in water-proof envelope shall be inserted in the package together with equipment.

6.4 Each equipment shall have an identification plate giving salient equipment data, make, year of manufacture, equipment number, name of manufacturer etc.

7.0 SPARE PARTS

7.1 Vendor shall submit recommended list of spare parts with recommended quantities and itemised prices for first two years of operation of the equipment. Proper coding and referencing of spare parts shall be done so that later identification with appropriate equipment will be facilitated.

7.2 Recommended spares and their quantities shall take into account related factors of equipment reliability, effect of equipment downtime upon production or safety, cost of parts and availability of vendor's service facilities around the proposed location of equipment.

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STANDARD SPECIFICATION FOR EARTHWORK FOR UNDERGROUND PIPING

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	14 03 19	REAFFIRMED AND ISSUED AS STANDARD SPECIFICATION	AVM	AJS	RS	RKT
3	23 05 11	REVISED AND ISSUED AS STD SPEC	ALOK	RKS	RBB	DM

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Abbreviations:

IS	:	India Standard
RCC	:	Reinforced Cement Concrete
U/G	:	Underground

Structural Standards Committee

Convener: Mr. Rajanji Srivastava

Members:
Mr. Anurag Sinha
Mr. VK Panwar
Mr. Samir Das
Mr. Amitabh Kishore
Mr. Gyasuddin
Mr. Charanjeet Singh (Projects)
Mr. Ravindra Kumar (Construction)

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1.0 SCOPE

This specification deals with earthwork in trenches and pits (for valves, manholes, catch pits etc.) for underground piping.

2.0 CODES & STANDARDS

IS: 783	Code of practice for laying of RCC pipes.
IS: 1200 (Part-I)	Method of measurement of building and civil engineering works.
IS: 3764	Excavation work – code of safety.
NOTE:-	Latest Edition of all Codes and Standards shall be followed.

3.0 MATERIAL

All workmanship and materials shall conform to the provisions of IS: 1200 (Part-1) and IS: 3764.

4.0 EARTHWORK IN EXCAVATION FOR TRENCHES / PITS FOR PIPELINES

4.1 Excavation

Plant, machinery and equipments for excavation shall be selected and deployed to provide optimum mechanization in excavation of trenches and pits. The selection for excavation and earth movement machinery etc. shall take into account type of materials to be excavated, method of excavation, prevailing weather conditions and type of transport to be used.

The excavation of area of cut shall be so timed that the bottom level is not exposed to the deteriorating influence of the weather for longer duration.

Excavation and earth moving equipment shall be deployed such that minimum damage is caused to the natural sub-soil structure of exposed formations.

The monitoring of soil deformations, ground water levels during and possibly after construction work shall be taken into consideration.

In the event, when excavation works are carried out in the vicinity of structures of any importance, the above monitoring shall be carried out within a distance, from the edge of the excavation of 5 to 15 times the excavation depth, depending upon the subsoil conditions and the stability of the neighboring structures.

4.2 Trenching work shall be carried out in all classes of soil including soft rock and excluding hard rock and shall be for all depths.

4.3 The trench shall be cut true to the line and level as per drawings.

4.4 If the trench is excavated below the required level than that indicated in the drawing, the extra depth shall be filled with concrete 1:5:10 or approved equivalent materials, as directed by the Engineer-in-Charge, at no extra cost to the owner.

4.5 In case of pressure piping, the trench shall be excavated generally as to provide a cover of 1000 mm or dia of pipe whichever is more. In case of gravity sewers/ pipes, the trench shall be excavated to conform to invert levels as per drawings. However in certain cases, the pipes may run at shallower levels or at deeper levels depending upon drawing, site condition etc.

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No rebate for lesser excavations, nor extra payment due to deeper excavations, shall be admissible in those cases where pipeline laying rates are inclusive of earthwork items. The rates quoted shall be deemed to cover all works connected with trenching, whether trenches are with single pipeline or have multiple pipelines in common trenches including road cutting and making good the same.

4.6 The width of the trench shall be sufficient to give free working space of personnel, equipment, supports and ancillaries on each side of the pipe. The free working space shall conform to IS: 783. Generally it shall not be less than 150 mm on either side or 1/3 dia of outer diameter of the pipe, whichever is greater.

4.7 When pipelines are running parallel, whether the trenching shall be individual or common, shall be decided by the Engineer-in-Charge and such decision shall be final and binding on the contractor. No extra shall be payable for common excavations.

4.8 All earthwork involved in excavations of all types of manholes, catch pits, valve chambers, inspection chambers, chambers for instrumentation tapping etc., which are coming on the alignment of U/G piping or as defined by drawing as a part of U/G piping work, shall be paid extra under Earth work in excavation, back filling and removal of surplus earth etc. under relevant clauses of the SOR.

4.9 Aspects such as variations in the soil conditions and the geological structure, depth of excavation, the existence of ground water and surface water, the type and extent of excavation, the topography of site, the proximity of items such as roads, buildings and buried services, construction traffic and activities near the excavation eg. Stock piling shall be taken into account when determining whether the sides of excavation should be free standing, sloping or temporary supported.

Suitable drainage and / or dewatering system like Well Point method / Bore well method etc. shall be provided to prevent or limit ingress of surface or sub surface water into excavation.

Serviceable materials intended for reuse should be used as soon as possible after excavation otherwise they should be stock piled at a location beyond 1.5m from the top edge of the excavation or beyond a distance equal to the depth of the excavation whichever is higher at a location approved by the Engineer-in-charge. If excavated serviceable material is not possible to be stacked within the limits specified above, due to some constraint, it shall be stacked away at a location approved by Engineer-in-Charge and paid separately under relevant item.

Areas used for temporary stockpiling of excavated material shall be kept clean and orderly, with excavated material kept by the side of road to avoid traffic movement. Excavated areas shall be restored to their original condition before completion of works.

All types of shoring and strutting, wherever necessary, shall be adopted to with hold the face of earth or cutting in slope, as per site requirements and direction of Engineer-in-Charge. Supports shall be maintained such that the integrity of the sides of the excavation is not impaired.

4.10 Any obstacle encountered during excavation shall be reported immediately to the Engineer-in-Charge and shall be dealt with as instructed.

4.11 The contractor shall maintain all excavated trenches and pits, in a dry and trim condition.

4.12 Necessary barricading and protection of slopes against slips due to traffic movement shall be provided to the satisfaction of Engineer-in-Charge. Necessary warning flags and lights shall be provided to caution traffic in the areas where trenches and/ or pits are provided.

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4.13 In case of road cutting, all road material i.e. metal etc., shall be taken out carefully and kept separately for reuse and road work shall be redone up to the original level, as it was prior to cutting the road, with the excavated road materials after laying and testing of the pipeline, within 10 days from the date of starting this work, at the cost of the contractor. The contractor shall provide suitable warning signs and barricades to prevent accidents.

Contractor shall also provide reasonable bye pass at his own cost when a road is cut for laying pipeline. Tankage dykes cut due to laying of the pipes, shall be redone conforming to the original specifications, by the Contractor at his own cost. Secondary dykes, to take care of any eventuality during construction, shall be provided by the Contractor at his own cost.

4.14 Dewatering shall be done in advance of the installation of the pipe to allow adequate inspection of padding of the bottom, if required. Dewatering shall be continued throughout during installation and backfilling.

The trench shall follow the gradient of pipeline as specified in the drawing. The contractor shall keep the trench in good condition, until the pipe is laid and tested. No extra claim shall be entertained due to its caving or setting down, either before or after the pipe is laid.

In case, pipe is lowered in caved trench and backfilled before being inspected by the Engineer-in-Charge, the Contractor shall re-excavate the trench for inspection and backfill it at his own cost.

5.0 BACKFILLING AND COMPACTION

Backfilling

Trenches shall be back filled with suitable materials which should be compacted to the same degree or better as the surrounding soils.

5.1 The soil used should be selected and approved by Engineer-in-Charge. Suitable material can be extracted from available excavated material. The soil should be free from rubbish, grass, organic matter, stones, building waste and Black Cotton Soil etc. It should be free from clods and hard lumps. In case good soil is not available from excavated material for back filling, trench shall be filled back with locally available coarse sand upto 30 cm. thick above the pipe and rest of trench shall be filled back with excavated soil upto required level.'

5.2 The filling should commence only after approval of Engineer-in-Charge is obtained and after the structures or pipes to be buried are tested and approved. Otherwise, if required, contractor shall uncover buried portion and refill at his own cost.

Temporary excavation supports should be removed as back filling and compaction proceeds, such that unacceptable movement of the supported ground does not occur.

Voids caused by extracted supports should be filled and compacted.

5.3 Filling should be done in layers. Each layer should be not more than 15 cm thick when loose and should be well rammed, with necessary watering, to obtain at least 90% of maximum laboratory dry density.

Compaction trials should be carried out on each soil type to be placed in backfill, in order to confirm the type of machine and number of passes required to obtain optimum compaction for given soil moisture contents. These trials should also be used to determine the variability of the proposed fill material for different weather conditions.

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5.4 Care must be exercised to protect cables, pipes, joints, and other features from damage due to backfilling and consolidation.

5.5 Filling should extend up to the level of original ground surface or as per drawing or as directed by Engineer-in-Charge. The finished surface should be properly trimmed and dressed. The adjoining area should be cleaned and no heaps of surplus earth should be left out.

6.0 TRANSPORTATION OF SURPLUS EARTH

Unserviceable materials and serviceable materials not intended for re-use shall be removed from the work site and disposed off at a location as approved by Engineer-in-charge.

The surplus earth is generated due to pipe laying, valve chambers, and manhole construction etc. Surplus earth is also generated due to voids in the back filled volume of earth. The removal of surplus earth shall include excavation, loading, transportation, dumping, stacking or spreading, as per the directions of Engineer-in-charge.

7.0 PAYMENT

7.1 Unless specifically stated in the schedule of rates, no separate payment for earthwork in excavation, backfilling, transportation, dewatering etc. shall be admissible and the payment for the same is deemed to have been included in the relevant items of the contract.

7.2 In case payment for earthwork is specified separately in the Schedule of Rates, the payment shall be based on the actual quantity of excavation, backfilling and transportation done, taking into consideration the slopes authorised by the Engineer-in-Charge for excavation, volume of backfilling calculated on the basis of excavation reduced by the volume of pipes.

7.3 In cases where hard rock excavation is involved, the matter shall be referred to Engineer-in-Charge, before proceeding with the work.

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STANDARD SPECIFICATION FOR CONCRETE PAVEMENT

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
4	04 07 19	REVISED AND ISSUED AS STD SPEC	SD	GS/AK	RS	RKT
3	23 05 11	REVISED AND ISSUED AS STD SPEC	ALOK	RKS	RBB	DM
2	20 01 05	REVISED AND ISSUED AS STD SPEC	GG	SKC	VDS	SKG
1	15 7 98	REVISED AND ISSUED AS STD SPEC	PCS	RJAIN	MMK	ASONI
0	31 3 82	ISSUED AS STANDARD SPECIFICATION	RP	RPB	HVR	RCPC

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Abbreviations:

BS	:	British Standard
IRC	:	Indian Road Congress
IS	:	Indian Standard
MS	:	Mild Steel
PCC	:	Plain Cement Concrete
RCC	:	Reinforced Cement Concrete
DLC	:	Dry Lean Concrete

Structural Standards Committee

Convenor: Mr. Rajanji Srivastava

Members:
Mr. Anurag Sinha
Mr. VK Panwar
Mr. Samir Das
Mr. Amitabh Kishore
Mr. Gyasuddin
Mr. Charanjit Singh (Proj.)
Mr. Ravindra Kumar (Const.)

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1.0 SCOPE

This specification establishes the requirements of material, laying and finishing of concrete pavements and roads.

2.0 REFERENCE CODES AND SPECIFICATIONS

IS: 456	Plain and Reinforced Concrete-Code of Practice.
IS: 1834	Specification for Hot Applied Sealing Compounds for Joints in Concrete.
IS: 1838, Part-1	Specification for Preformed Fillers for Expansion Joints in Pavements and Structures (Non Extruding and Resilient Type): Part 1 Bitumen Impregnated Fibre.
IS: 2720, Part-8	Method of Test for Soils-Part 8: Determination of Water Content-Dry Density Relation Using Heavy Compaction.
IS: 9214	Method of Determination of Modulus of Sub-grade Reaction (k value) of Soils in the Field.
IRC: 57	Recommended practice for sealing of joints in concrete pavement
IRC-15	Standard Specifications and code of Practice for construction of concrete roads
MoRTH	Specification for Road and Bridge Works of Ministry of Road Transport and Highways
6-68-0002	Technical Specification - Civil & Structural Works - Materials.
6-68-0004	Technical Specification - Civil & Structural Works – Plain and Reinforced Cement Concrete.
7-65-0404	RCC Pavement Details
	MoRTH Specification for Road and Bridge

In case of conflict between the Clauses mentioned in this Specification and those in above Codes and Specifications, this Specification shall govern.

3.0 MATERIALS

3.1 Material for Cement Concrete viz. Cement, Sand, Coarse and Fine aggregate and water, Reinforcements Bars, Embedment, Inserts and Admixture etc. shall be as described in EIL Specification no. 6-68-0002.

3.2 Material for DLC shall be as described Specification for Road and Bridge Works of Ministry of Road Transport and Highways (MoRTH).

4.0 GRADES, TYPE OF CONCRETE MIX, PROPORTIONING AND BATCHING

4.1 The grades of concrete shall be as per standard / Job drawing.

4.2 Specification for Concrete mix, Mix Proportioning and Batching shall be as described in EIL Specification no. 6-68-0004 and IS: 456.

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5.0 EQUIPMENTS

All equipments like sub grade templates, hand tempers, vibrating screens, internal vibrators, longitudinal floats, bridges, push brooms, straight edges, edging tools etc. shall be on the worksite in first class working condition and shall have been inspected by the Engineer-in-Charge before paving operations are permitted to start. Throughout the construction period, the contractor shall maintain adequate equipment in first class working conditions to ensure the proper execution of the work.

6.0 PREPARATION OF SUB GRADE

6.1 The area where concrete is to be placed must be cleared of all loose material and virgin soil must be exposed. Such exposed surface must be consolidated properly to obtain 95% of Maximum Laboratory Dry Density of the soil. All soft patches must be worked out to remove the soft soil and selected approved earth must be filled back and compacted.

6.2 For areas, where pavement is to be laid on cutting / natural grade level, Sub grade shall be thoroughly compacted to 95% of laboratory dry density as per IS: 2720 Part VIII. For filled up areas, top 450 mm of the soil shall be compacted to 95% of laboratory dry density below pavement in layers of 150 mm.

6.3 The difference between the sub grade levels of Type-I, Type-II, Type-III and any other type (as per job drawing) Concrete pavements (due to difference in thickness of Type-I, Type-II, Type-III and any other type pavements) shall be achieved by stripping the grade level and not by filling. Hence, site-grading level below pavement shall be kept up to sub grade level of Type-II or Type-III as the case may be, to avoid filling of smaller thickness at later stage.

6.4 The sub grade or sub base for laying of the concrete pavement shall comply with the following requirements:

6.4.1 No soft spots shall be present in the sub grade.

6.4.2 The uniformly compacted sub grade or base course shall extend at least 300mm on either side of the area to be concreted.

6.4.3 The sub grade shall be properly drained.

6.4.4 The minimum modules of sub grade in wet condition, reaction obtained with a Plate Bearing Test as per IS: 9214, shall be 6.0 Kg/cm²/cm.

6.4.5 Sub grade shall be prepared to the lines and grades to match with the slope of pavement as shown on the drawings.

7.0 PREPARATION OF SUB BASE

7.1 The construction of the Dry Lean concrete sub base for cement concrete pavement shall conform to the requirements of section 601.0 of specification for Road and Bridge Works of Ministry of Road Transport and Highways (MoRTH) and EIL standard Drg. No. 7-65-0404/ Job drawing.

7.2 Sub Base layer shall be prepared to the lines and grades to match with the slope of pavement as shown on the drawings.

7.3 No concrete shall be placed around manholes or other structures until they have been brought to required grade and alignment. All sides of manholes / pits etc. shall have same elevation.

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7.4 A separation membrane shall be used between the concrete slab and the sub base (DLC) which shall conform to EIL standard Drg. No. 7-65-0404/ Job drawing. The separation membrane shall be laid flat without creases. Before placing the separation membrane, the sub-base shall be swept clean of all the extraneous materials using air compressor. Wherever overlap of plastic sheets is necessary, the same shall be at least 300 mm and any damaged sheeting shall be replaced at the Contractor's expense. The separation membrane may be nailed to the lower layer with concrete nails.

8.0 FORMS

8.1 All side Forms shall be of mild steel unless use of wooden sections is specially permitted. The steel forms shall be of MS channel sections and their depth shall be equal to thickness of the pavement. The sections shall have a length of at least 3.0m except on curves, where shorter sections may be used. These forms should be provided with ample bracing and supports to prevent the springing of the forms under the concrete pressure or thrust of machinery operating nearby.

8.2 The forms should be in a sufficient number and they should not be removed until concrete has hardened sufficiently.

8.3 In case wooden forms are permitted, these shall have minimum base width of 100 mm for 150mm or lesser thick slabs and 150mm for 200mm thick slabs.

9.0 REINFORCEMENT, MIXING & PLACING OF CONCRETE

9.1 Laying of Reinforcement

All reinforcement work shall confirm to IS: 456 and as described in EIL Specification no. 6-68-0004.

9.2 Mixing

Mixing shall be as described in EIL Specification no. 6-68-0004.

9.3 Placing

9.3.1 The place where concrete is to be poured should be clean and free from all loose dirt, wooden pieces, dust, standing water etc.

9.3.2 Walking on reinforcement layers is not permissible. Walkways of wooden planks or similar material can be placed with removable supports and should be independent of the reinforcement. The reinforcement position should not be disturbed nor should it sag during carriage and placement of concrete.

9.3.3 Placing and vibration should not take totally more than 20 minutes from time of mixing. Method of placing should be got approved by Engineer-in-Charge. Segregation during carriage and placement should be avoided. If during carriage concrete segregates, it should be remixed before placement.

9.3.4 Concrete should not be dropped from a height of over 1.5m.

9.3.5 To ensure bond and water tightness between old concrete surface and fresh concrete to be placed, the surface should be cleaned and roughened by "initial green cut" by wire brushing or chipping. The initial green may be done by wire brush after 6 hours of placing concrete in order to facilitate the work. Chipping can be done only after 48 hours. A layer of cement

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slurry with 1:1 mix (1 cement: 1 sand) should be poured to obtain a uniform coating on old concrete. Immediately thereafter, the fresh concrete should be poured.

9.3.6 Concrete shall be mixed in quantities required for immediate use and shall be deposited on the sub-grade in a single operation to the required depth and width of the pavement. Spreading shall be as uniform as possible to avoid re-handling of concrete. Where however, a certain amount of redistribution is necessary, it shall be done with shovels and not with rakes. Concrete shall be vibrated with internal vibrators. Concrete shall be placed continuously until completion of the part of the work between construction joints or as directed by Engineer-in-Charge continuously until completion of the part of the work between construction joints or as directed by Engineer-in-Charge.

9.3.7 **Placing in inclement weather**

All precautions shall be taken for concreting in extreme weather in accordance with the relevant clauses of IS: 456. Due protection shall be provided to prevent cement being blown away while proportioning and mixing during windy weather. No concreting shall be carried out in continuous heavy rains. Necessary arrangements to cover the freshly poured concrete shall be provided, to protect it from the direct rays of the sun and from drying winds.

9.3.8 All concreting placement should be co-coordinated with placement of conduits, inserts, embedded parts etc. executed either by same agency or separately.

9.3.9 Concrete shall be laid in panels as shown in the standard drawing or as directed by Engineer-in-Charge.

9.4 Compaction & Finishing

9.4.1 **Compaction**

The surface of the pavement shall be compacted either by means of power driven finish machine or a vibrating hand screed. For areas where width of the pavement is very small, hand consolidation and finishing shall be done as follows:

9.4.1.1 Concrete as soon as placed, shall be struck off uniformly and screeted to the crown and cross-section shown on the plans and to such level above the base that when compacted and finished, the pavement shall conform to the grade and cross-section indicated by the plans. The entire surface shall then be tamped until a close-knit dense surface is obtained.

9.4.1.2 The Tamper shall rest on the side forms and shall be drawn ahead with a swing motion in combination with a series of lifts and drops alternating with lateral shifts. The aim of this operation is compaction and screeding to the approximate level required. Subsequent tamping should advance 75 mm at a time in the direction in which the work is proceeding and in final stages, the tamping should be closer, about 12 mm at a time, until a level and dense surface is obtained.

9.4.1.3 If so directed by Engineer-in-charge, hand operated vibrating tamper consisting of normal type of hand tamper attached to a pneumatic or electric vibrating unit shall be used for compaction.

9.4.1.4 Segregated particles of coarse aggregate, which collect in front of the tamper, shall be thrown outside the forms or thoroughly mixed by hand with a mass of concrete already on the base.

9.4.1.5 Compaction by tamping shall be carried on till the mortar in the mix just works up to the surface. The surface shall be examined after compaction correction. If needed correction shall be made by adding or removing concrete, followed by further compaction and finishing.

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9.4.2 **Floating**

As soon as practicable, after concrete has been struck off and compacted, it shall be further smoothened and compacted by means of a longitudinal float, 1200 mm long and 75 mm wide, operated from a foot bridge.

9.4.3 **Straight Edging**

After floating is completed and excess water removed but while concrete is still plastic, the slab surface shall be tested for trueness with a straight edge and rectified, if necessary.

9.4.4 **Brooming**

After belting and as soon as surplus water has risen to the surface, the pavement shall be given a broom finish to produce corrugations of uniform appearance of not more than 1/16 inch in depth.

9.4.5 **Edging**

Before the concrete has its initial set, the edges shall be carefully finished with an edger of the radius required and pavement edge shall be left smooth and true to line.

9.5 Curing

Curing of concrete shall be as described in EIL Specification no. 6-68-0004.

10.0 JOINTS

10.1 Wherever called for on the drawings, expansion joints, construction joints and sealing joints shall be provided as per details indicated in the drawing and as directed by Engineer-in-Charge.

10.2 Sealing of Joints

10.2.1 After the curing, the temporary seal or other intruded materials of all expansion and contraction joints shall be removed completely and the slots filled with approved silicone sealant. It shall be self leveling low modulus type confirming to ASTM 5893. The sealant shall conform to IRC 57. The filler material for Expansion and Sealing joints shall be preformed fillers of Bitumen Impregnated Fiber, conforming to IS: 1838, Part-I.

10.2.2 The edges of the joints shall be thoroughly cleaned and a suitable primer as recommended by sealant manufacturer shall be applied in accordance with IRC:57.

10.2.3 The application of the sealing compound shall conform to the process as specified in IRC 57.

11.0 OPENING TO TRAFFIC

11.1 Traffic shall not be allowed for a period of 28 days after laying of concrete in pavement.

11.2 Before opening the pavement to traffic, all joints shall be filled and trimmed or topped out as required.

11.3 Sampling, testing and acceptance of concrete work for pavement / road shall be according to IS: 456 / IRC -15 as applicable.

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12.0 METHOD AND BASIS FOR PAYMENT

12.1 Plain and Reinforced Concrete

12.1.1 Payment for plane and reinforced concrete in pavements shall be made on cubic metre basis of the volume of the actual finished work done and shall be inclusive of cost of providing Forms, Pockets, Chamfers, Fillets, Grooves, Cement wash, Curing by normal moist curing or using curing compound etc. as directed by Engineer-in-Charge. The rates shall be deemed to include complete cost of getting the respective mix designs approved, making and testing concrete cubes and carrying out other tests including tests of various ingredients, as per specifications and as directed by Engineer-in-Charge.

12.1.2 No separate payment shall be made for any admixture used by the contractor for accelerating or retarding the strength of concrete or for achieving specified workability / water tightness. The rate quoted shall be deemed to be inclusive of all costs related to any such additive / admixture.

12.1.3 The rate shall however be exclusive of reinforcement, metal inserts, pipe sleeves and any filler material in expansion / sealing joints.

12.1.4 Where the strength of concrete mix (nominal or design mix) as indicated by tests, lies in between the strengths of two grades given in Table-1 of EIL Specification No. 6-68-0004 and it is accepted by owner/Engineer-in-charge, such concrete shall be classified as a grade belonging to the lower of the two grades between which it lies. In case the cube strength shows higher results than those specified for the particular grade of the concrete, it shall not be placed in the higher grade nor shall the Contractor be entitled for any extra payment on such account. The concrete giving lower strength than specified may be accepted at reduced rates after satisfying the safety of the structure by checking it with tests as specified or rejected entirely at the discretion of the Engineer-in Charge. The rejected concrete shall be dismantled at no extra cost to the owner and no payment or extension of time shall be granted for the concrete so rejected and the formwork and reinforcement used for the same. Cost of any material supplied by the Owner free of cost shall be recovered from the contractor at double the prevailing market rate. In case the concrete of lower strength can be improved by carrying out some strengthening measures entirely at the discretion of the Engineer-in-Charge, then Contractor shall carry out the said measures including all related tests at his own cost. If the Contractor is able to make up the strength to the required grade by such improvement measures to the entire satisfaction of Engineer-in-Charge, payment shall be made for the grade achieved. However, if the strength of concrete is not made up to the strength of required grade, payment shall be made only for the lower strength if such concrete is accepted by the Engineer-in-Charge.

12.1.5 Deductions for openings, pockets etc. shall be as specified in relevant Indian Standard Codes.

12.2 Reinforcement

12.2.1 Payment for plain round mild steel reinforcement bars and high strength deformed steel bars shall be on the basis of weight of bare steel, irrespective of any coating applied, in metric tons. The weight of the bar shall be derived from the sizes and corresponding unit weights given in hand book of Bureau of Indian Standards. Standard hook length, chairs, spacer bars and authorised laps only shall be included in the weight calculated. Binding wire shall not be weighed nor otherwise measured. Measurement for weight shall not include cutting allowance etc.

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12.2.2 Rate quoted for reinforcement shall include cost of supplying, decoiling, straightening, cleaning, cutting, bending, placing, binding, welding if required, and providing necessary cover blocks of concrete.

12.3 Joints

Payment for expansion joints, construction joints and sealing joints shall be made on running metre basis. The rate shall include cleaning of joints, filler material and sealing with approved compound, all material, labour etc. complete, as per drawing.

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भूमिगत और भूमि ऊपर गैल्वेनाइज्ड स्टील पाइपिंग प्रणाली से जल सप्लाई के लिए मानक विनिर्देशन (जल सेवाएं)

STANDARD SPECIFICATION FOR UNDERGROUND & ABOVE GROUND GALVANIZED STEEL PIPING (WATER SERVICES)

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	27.10.2025	REVISED & ISSUED AS STD. SPEC.	PREETI	RKS	SKN	M.Nandi
5	06.07.18	REAFFIRMED & ISSUED AS STD. SPEC.	LP	VG	RAJANJI SRIVASTAVA	R K TRIVEDI

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Abbreviations:

IS	Indian Standard
Kg/cm^2g	Kilogram per Square Centimeter Guage
MPa	Mega Pascal

General Civil Standards Committee:

Convenor: Mr. Samir Kumar Naskar

Members:
Mr. Amitabh Kishore
Mr. Dinesh Deb Barma
Mr. Gyasuddin
Mr. Raj Kumar Singh
Mr. U.C. Pathak (Piping)
Mr. Charanjeet Singh (Projects)
Mr. Indrajit Neog (Construction)
Mr. Vikram Kumar Gupta (Structural)

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1.0 SCOPE

This specification covers the fabrication and erection of Galvanized Steel piping, both underground and above ground, including excavation, backfilling for the piping and testing.

2.0 CODES AND STANDARDS

IS: 554	Indian Standard- Dimensions for pipe threads where pressure tight joints are made on the threads- Dimensions, Tolerances and Designation
IS: 778	Indian Standard- Copper alloy gate, globe and check valves for water works purposes
IS: 1239 Part I	Indian Standard- Steel Tubes, Tubulars and other wrought steel fittings- Specification (Part 1 Steel Tubes)
IS: 1239 Part II	Indian Standard- Steel Tubes, Tubulars and other Steel fittings- Specification (Part 2 Steel pipe fittings)
-	Piping Material Specification (PMS)
-	Valve Material Specification (VMS)

NOTE: -Latest Edition of all Codes, Specifications and Standards shall be followed.

3.0 MATERIALS

a) All Galvanised piping shall conform to relevant piping material specification class.
b) All valves shall conform to relevant piping/ valve material specification class.
c) All fittings shall conform to relevant piping material specification class.

4.0 EARTHWORK IN EXCAVATION AND BACKFILLING ETC.

All earthwork for underground piping shall be governed by the provisions of EIL specification 6-65-0006,"Earthwork for underground piping", to the extent applicable.

5.0 JOINTING AND ERECTION OF SCREWED/ FLANGED GALVANIZED STEEL PIPING

5.1 Screw socket Joints

The screwed end of all pipes shall be thoroughly cleaned and painted with a mixture of Red and White Lead or Teflon before jointing. The joint shall be made by winding a few threads of hemp round the ends of tubes and then screwing them into sockets to the full depth of threads. Exposed threads shall be coated with approved anticorrosive paint. No pipe shall be bent / offset to save fittings. The offset in pipes shall be made only after the permission of the Engineer-in-Charge. If threaded end of pipe is damaged, the contractor shall cut the end with hacksaw and shall prepare new threads conforming to IS: 554, to required length.

All fittings shall be of Galvanised Steel. Fitting includes all couplings, elbows, tees, bends, unions, nipples, reducers, flanges with nuts, bolts, gaskets and rubber insertion and all other fittings to make a complete job.

5.2 Flanged Joints

Flanged joints shall be made by painting the faces of the flanges with red lead and bolting up evenly on all sides with compressed asbestos gasket as per piping material specification.

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5.3 Valves

Flanged or screwed valves shall be installed in locations shown on the drawings as per specification for screwed or flanged joints.

6.0 JOINTING AND ERECTION OF WELDED GALVANIZED STEEL PIPING

Welded joints shall be made as per relevant piping specification(s).

7.0 FLUSHING & TESTING

Flushing and testing shall be as per specification no. 6-44-0013 (/job specification). Pipes or fittings which are found leaking shall be replaced/ redone, without extra payment.

8.0 PAYMENT

8.1 Payment shall be made on running meter basis of finished piping with fittings after testing etc. complete. No separate payment shall be made for earthwork in trenching and backfill, road cutting etc. Payment for valves and flanges etc. shall be made as per schedule of items on unit rate basis. The unions shall be provided at every 50 meter, unless otherwise stated in schedule of items / construction drawings. Rates shall include all incidental work such as transportation of all materials from Owner's store(s), custody, and fabrication and laying of underground piping.

8.2 The payment clause 8.1 is not applicable in case of LSTK Jobs.

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भूमिगत पाइपिंग के फैब्रिकेशन और उत्थापन के लिए मानक विनिर्देशन

STANDARD SPECIFICATION FOR FABRICATION AND LAYING OF UNDERGROUND PIPING

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	25.11.24	REVISED & ISSUED AS STD. SPEC.	GS	GYAS	S K NASKAR	M NANDI
5	06.07.18	REAFFIRMED & ISSUED AS STD. SPEC.	LP	VG	RAJANJI SRIVASTAVA	R K TRIVEDI
4	20.05.13	REAFFIRMED & ISSUED AS STD. SPEC.	RBT	RKS	RBB	DM

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Abbreviations:

ASME	AMERICAN SOCIETY FOR MECHANICAL ENGINEERS
dia.	DIAMETER
IS	INDIAN STANDARD
Kg/cm^2/minute	KILOGRAME/SQUARE CENTIMETRE/MINUTE
m	METRE
mm	MILLIMETRE
CS	CARBON STEEL

General Civil Standards Committee

Convener: Mr. Samir Kumar Naskar

Members:
Mr. Amitabh Kishore
Mr. Dinesh Deb Barma
Mr. Gyasuddin
Mr. Raj Kumar Singh
Mr. U.C. Pathak (Piping)
Mr. Charanjeet Singh (Projects)
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1.0 SCOPE

This specification covers the technical requirements for the execution of Piping Fabrication, Assembly, Laying and testing of the underground pipe work defined here under, for water and waste pipe lines.

i. Fabrication and erection of underground piping systems from piping materials in accordance with this specification and applicable drawings and standards.

ii. Fabrication and welding of reinforcement pads at branch pipe locations wherever required.

iii. Corrosion protection coating of underground piping.

iv. Repair of damaged corrosion protection coating and coating of field joints.

v. Fabrication and erection of drain assemblies, valves, strainers, instrument connection, flushing connection etc.

vi. Testing and flushing.

Underground piping systems shall be fabricated, installed, flushed, and tested in accordance with this specification and applicable codes, drawings and standards.

2.0 CODES & STANDARDS

ASME B31.3	Chemical Plant and Petroleum Refinery Piping.
6-65-0006	Standard specification for earth work for U/G piping.
6-44-0012	Standard specification for fabrication and erection of piping.
6-44-0013	Standard specification for inspection, flushing and testing of piping systems.
6-44-0016	Standard specification for Nondestructive examination requirement of piping
6-77-0001	Welding specification for the fabrication of piping
6-77-0005	Welding specification charts for piping classes
6-79-0011	Standard specification for corrosion protection tape coating for underground steel piping
6-79-0020	Standard specification for surface preparation and protective coating
6-71-0044	Standard specification for field joint coating (onshore pipeline)
6-71-0048	Standard specification for repair of polyethylene coating
----------	Job specification for 3LPE pre-coated pipes

NOTE 1: Latest Edition of all Codes and Standards shall be followed.
NOTE 2: In case job specification is available, same shall be followed.

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3.0 FABRICATION

3.1 The contractor shall fabricate all the pipe work in conformity with the Job/ Standard Specification for fabrication & Erection of Piping, and requirements of relevant general arrangement drawings/ isometrics. Where specific details of fabrication are not indicated on the drawings or not specified in the specification, fabrication and erection shall be done in accordance with ASME B 31.3.

3.2 The contractor shall be responsible for working to the exact dimensions as shown on the drawings, irrespective of individual tolerances permissible. Where errors and / or omissions occur on the drawings, it shall be the contractor's responsibility to notify the Engineer-in-Charge, prior to fabrication or erection. Dimensional tolerance for fabrication shall be as per EIL standard.

4.0 COATING & LAYING OF UNDERGROUND PIPING

4.1 Coating (for uncoated pipe)/ repair of coating (for pre-coated pipes & fittings)

Corrosion protection tape coating/ Painting of the underground lines shall be in accordance with Job/ Standard specification.

Repair of 3LPE coating of pre-coated pipes if required shall be as per Job/ Standard specification.

4.2 Laying

4.2.1 The Contractor shall lay the underground piping in accordance with the following clauses and as per the piping arrangement drawings and/ or isometrics issued during the course of construction.

4.2.2 The Contractor shall be responsible for alignment as per the drawing. Errors, if any, shall be rectified by the Contractor at his own cost.

4.3 Trenching

4.2.1 The trench shall be cut according to the drawing, true to the line, levelled with the help of sight rails provided at every 30 m, at change of direction / gradient and at any suitable distance, as directed by Engineer-in-Charge. The bottom elevation of pipe shall be maintained as shown in drawing

4.2.2 The width of the trench shall be sufficient to give free working space on each side of the pipe. The free working space shall conform to specifications. Generally, it shall not be less than 150 mm on either side or 1/3 of dia of pipe, whichever is greater.

4.2.3 If the trench is excavated below the required level as indicated in the drawing, the extra depth shall be filled with PCC 1:5:10 or approved equivalent material, as directed by the Engineer-in-Charge, at no extra cost to owner.

4.2.4 No excavated material shall be deposited within 1.5 meters from the excavated trench.

4.2.5 In case of road cutting, all materials i.e. metal, bricks etc., shall be taken out carefully and kept separately for reuse. Road work shall be redone up to the original level and profile with the excavated road materials /fresh material if required, after laying and testing of the pipe line, within 10 days from the date of starting the work, at the cost of the contractor. The contractor shall provide suitable slings and barricades to prevent accidents. He shall also provide reasonable by-pass at his own cost when a road is cut for laying pipeline.

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4.2.6 During excavation, if some obstacle is met with, the same shall be reported to the Engineer-in-Charge and dealt with as instructed by him.

4.2.7 The contractor shall do dewatering, shoring, strutting / timbering if required or do whatever might be required to excavate the trench, install the pipe in it and backfill the trench, in accordance with the specifications, at no extra cost to the Owner. Dewatering shall be done in advance of the laying of the pipe, to allow adequate inspection of padding of the bottom, if required. Dewatering shall be continued throughout during laying of the pipe and backfilling of the trench.

4.2.8 In muddy / slushy ground, the bed shall be provided with a layer of sand or lean concrete as directed by the Engineer-in-Charge.

4.2.9 The trench shall follow the gradient of pipeline as specified in the drawing. The contractor shall keep the trench in good condition, until the pipe is laid and tested. No extra claim shall be entertained due to its caving or settling down, either before or after the pipe is laid. All materials to shore the trench, in order to prevent caving, shall be furnished and removed by the Contractor, at no extra cost to the Owner.

4.2.10 In case pipe is lowered in caved trench and back filled before inspection by the Engineer-in-Charge, the Contractor shall re-excavate the trench for inspection and backfill it at his own cost.

4.3 Lowering & Laying

4.3.1 The pipe shall be lowered by mechanical method when the trench is ready and bottom of the trench is graded as per required pipe laying conditions and specifications.

4.3.2 By Machine

The shop coated pipe already transported to the pipe laying site in convenient length of pipe assembly, near the trench after hydrostatic testing, shall be placed on clean square cut skids suitably spaced, so as to keep the pipe away from touching the ground. The pipe may be lowered down in the trench by the launcher cranes with sufficient care, to protect the coating of the pipeline.

At tie in welds and other site fabrications, the contractor shall clean, prime, coat and wrap manually.

Also, short sections of pipelines, which are impracticable to shop-treat, may be hand treated, but only after obtaining prior written approval of the Engineer-in-Charge.

4.3.3 By Hand

Only in unavoidable circumstances and after obtaining approval of Engineer-in-Charge, the pipe may be lowered with the help of tripods and chain pulley blocks into the trench. However, if in the opinion of the Engineer-in-Charge, the temperature condition does not allow direct lowering, then the pipes shall be set down on clean square cut skids. The skids shall be so spaced as to keep the pipe away from touching the ground.

4.4 Method & Time of Lowering Pipe

4.4.1 Under favorable temperature conditions and using methods, which will not damage the coating, the pipe may be lowered into the trench.

4.4.2 Pipes previously set on skids, because of unfavorable temperature conditions, shall be lowered into the trench normally in the cool of the morning and only when the temperature of the pipes is below the softening point of the coating materials.

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4.4.3 All skid marks and other places of damage shall be thoroughly examined to ensure proper patching where necessary, before the pipe is finally lowered into the trench.

4.5 Handling Coated Pipe

4.5.1 Coated pipe shall not be placed in trench, until cave-in plugs, hard clods, stones, skids and welding rods etc. have been removed from there. Where the trench has a hard or jagged bottom, sufficient fine dirt or sand shall be placed therein, before the pipe is lowered.

4.5.2 Coated pipe shall not be handled or moved by means of cable or chains or by prying with skids or bars. It shall be tied and lowered by using lowering-in belts of a standard width and design, for the size of pipe being handled.

4.5.3 Coated pipe shall not be dragged along the ground or otherwise handled in a manner that will be detrimental to the coating.

4.5.4 Despite all precautions taken during handling of coated pipes, if the coating gets damaged, same shall be recoated by Contractor at site, at his own cost, as per directions of Engineer-in-Charge.

4.6 Lining up & Welding

4.6.1 The ends of the pipeline shall be kept securely closed, to prevent entry of any foreign material/ moisture, after lowering into the trench.

4.6.2 Before making joints, the pipe shall be laid carefully, so as to be perfectly aligned, in both plan and profile and the end closures provided shall be removed.

4.6.3 Tie-in shall be made in the coolness of the morning or when the ambient temperature is not exceeding 29^0C or softening temperature of the coating material, whichever is less. All bevelling, aligning and welding shall be in accordance with the welding specification given in the tender.

4.6.4 Free access shall be provided for the welding of the circumferential joints by increasing the width and depth of the trench at these points. There should be no obstruction to the welder from any side, so that good welded joint is obtained.

4.7 Coating of field welded joints

Field welded joints shall be coated as per Job/ Standard specification. Field joints of externally 3LPE pre-coated pipes shall be coated as per Job/ Standard specification.

4.8 Back Filling

4.8.1 After testing and inspection of the pipeline to the entire satisfaction of the Engineer-in-Charge, the trench shall be back filled with the serviceable soil excavated earlier. No trench shall be back filled without the approval of the Engineer-in-Charge.

4.8.2 Backfilling with the serviceable soil excavated earlier shall be done in layers of 200 mm, well watered and rammed to avoid any settling afterwards.

4.8.3 The earth cover up to 300 mm above the top of the pipe shall be compacted by manual methods, to protect the pipe from any damage by mechanical compactor.

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4.8.4 If due to exigencies of the work, some portion of the pipeline is backfilled without approval of the Engineer-in-Charge, the Engineer-in-Charge shall have the right to order uncovering of the pipe for examination and the cost of such uncovering shall be borne by the Contractor.

4.8.5 The backfill material shall be free from stone pieces/sharp objects/debris.

4.8.6 When the trench has been dug through roads, all backfill shall be thoroughly compacted. In certain cases, special compaction methods may be required by the Engineer-in-Charge. This shall be done by the contractor at no extra cost to the Owner.

4.8.7 When the trench has been dug across unlined ditches, the backfill shall be thoroughly compacted in 150 mm layers for a distance of 1.5m beyond the outside banks of the ditch on either side. The banks of the ditch shall also be compacted in 150mm layers, at no extra cost to the Owner.

4.8.8 After the roads have been already graded, and if they are trenched or otherwise disturbed by the Contractor during laying of the pipe lines, the contractor shall restore the road to its original level and condition. In the event the Contractor is required to place extra fill, gravel, or other special materials, it shall be done by the contractor without any extra cost to the Owner.

4.8 Clean up of Surroundings

4.9.1 As soon as the backfill is completed, the contractor shall immediately clean up the adjoining area by removing all surplus and defective material and dispose off all refuge such as spurs, sheet-iron and broken skids and surplus excavated earth etc., at his own cost, to the entire satisfaction of the Engineer-in-Charge.

4.9.2 The earth on both sides of the pipeline trench, which has been disturbed during the construction of the pipe line, shall be smoothened and left in a condition to the entire satisfaction of Engineer-in-Charge.

5.0 INSPECTION & FLUSHING

Inspection and flushing of the piping shall be done as per Job/ Standard specification (Specification for inspection, flushing and testing of piping system).
Non-Destructive examination of shop/ field fabricated piping shall be as per Job/ Standard specification (Specification for non-destructive examination requirement of piping).

6.0 TESTING

6.1 Pressure Piping

Pressure testing of pressure piping shall be done as per Job/ Standard specification (Specification for inspection flushing and testing of piping system). Test pressure shall be as per line list/ AFC document.

6.2 Gravity/ Non-pressure Piping

6.2.1 Fabrication yard/ facility

All piping sections fabricated at yard, shall be tested in conformance to Job/ Standard specification (Specification for non-destructive examination requirements of piping). In addition to the above, each fabricated section shall be leak tested at atmospheric pressure for water tightness of the fabricated section. Any repair of coating (internal/ external) at joint location shall be carried out only on

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completion of inspection of leak test and subsequent repair of joint, if any. Care shall be taken during transportation of tested pipes for integrity of tested joints.

6.2.2 In-situ fabrication and erection

All piping including sub headers and headers fabricated/ joined and laid in-situ, shall be tested in conformance to Job/ Standard specification (Specification for non-destructive examination requirements of piping). In addition to the above, each fabricated section: piping upstream of a manhole/ between any two manholes/ sump inlet and upstream manhole shall be considered as a single system and each such system (defined in concurrence with Engineer-In-Charge) shall be leak tested at atmospheric pressure for water tightness of the fabricated section. Any repair of coating (internal/ external) at joint location shall be carried out only on completion of inspection of leak test and subsequent repair of joint, if any.

6.3 Leak Test

6.3.1 Fabrication yard/ facility

The pipe section as fabricated, from the funnel to end of transportable length shall be temporarily blanked and filled with water so that water level is up to the top of the funnel. The entire section shall be kept filled for 4 hours.

The drop in water level of all water and sewage (sanitary, chemical and industrial drainage and other gravity sewers) piping being leak tested shall be recorded at end of 4 hour at the funnel. The value so recorded shall represent a total leak test of the section (Pipe/ group of pipes). The total leak observed shall be limited to the evaporation loss for the open funnel. During test, all funnels but for the observation manhole shall be kept sealed and the observation funnel shall be provided with a temporary cover. During leak test, all exposed pipe, joints, fittings, valves, shall be carefully examined for leakage. Leaking pipes, joints, and fittings shall be replaced/repaired.

The hydrostatic test shall be repeated after the repair of any defects until the system is proved satisfactory. The piping shall be satisfactory if there is no evidence of leakage after the 4 hours.

The contractor shall undertake repairing and testing of the joint without any extra cost to the owner. After completion of the test, all temporary covers shall be removed, the test water shall be drained / pumped out and the line cleaned properly.

6.3.2 In-situ fabrication and erection

The pipe system as defined, upstream of a manhole/ between any two manholes/ sump inlet and upstream manhole shall be filled with water so that water level is up to the top of the manholes. The entire system shall be kept filled for 24 hours.

All water and sewage (sanitary, chemical and industrial drainage and other gravity sewers) piping and retaining structures under atmospheric pressure such as manholes, sumps, catch basins etc. being leak tested shall be topped up with Water to the brim after initial 8 hours and then the drop in water level shall be recorded every 4 hours at the observation manhole. The value so recorded shall represent a total leak test of the system (Pipes and Manhole). The total leak observed shall be limited to the evaporation loss for the open system of Pipes funnels and manholes. During test, all manholes and funnels but for the observation manhole shall be kept sealed and the observation manhole shall be provided with a temporary cover. Site testing shall take place prior to backfill. During hydrotest, all exposed pipe, joints, fittings, valves, shall be carefully examined for leakage. Leaking pipes, joints, and fittings shall be replaced/repaired.

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The hydrostatic test shall be repeated after the repair of any defects until the system is proved satisfactory. The piping shall be satisfactory if there is no evidence of leakage after the 24 hours.

The contractor shall undertake repairing and testing of the joint without any extra cost to the owner. After completion of the test, all temporary covers shall be removed, the test water shall be drained / pumped out and the line cleaned properly.

Before commissioning, the cleanliness of the pipeline shall be checked by following test.

Ring Test (Manhole to Manhole)

In this method of testing, two steel / wooden rings of suitable thickness and design shall be fixed facing each other, at a distance of 2 feet or more. The block of rings shall be inserted from one end of the pipeline, inside manhole and pulled by a rope fixed to the block from the other end of the pipeline, inside the next manhole. The rings shall be of dia. 2" less than the inside dia of pipe under testing. The rope used for pulling the ring block may be inserted in the pipeline by the contractor either during construction or afterwards by suitable means. Any obstruction/ debris/ major misalignment will prevent the ring to pass through the pipeline in which case the pipeline shall again be cleaned / rectified and the test redone. The ring test shall be performed for the complete network of the sewer system, before the same is put in service.

8.0 PAYMENT

8.1 Payment for Piping fabrication and erection shall be made based on respective rates. Payment of piping fabrication shall be based on inch dia. measurement whereas payment for erection of piping shall be based on inch meter measurements, calculated on the basis of the execution drawings. The length shall be measured along the center lines of pipes, center lines of bends and elbows, tees, reducers and flanged joints. All types of valves shall be excluded from this measurement. Branch connections shall be measured from the outer surface of the header.

The payment shall be made on per inch metre basis of piping work laid, measured to the nearest centimeter. The unit rates for the underground piping shall be inclusive of earthwork in excavation, backfilling, compaction, disposal of surplus earth and corrosion protection coating/ coating of field joints of 3L PE pre-coated pipes including supply of materials.

All piping attachments, such as couplings, nipples, thermowells etc., shall be installed by the Contractor as part of piping work and no separate payment shall be made for such work. However, extension on such attachments such as vents and drains will be measured and paid as applicable for the respective size and category of piping / valves.

Fabrication of mitre bends, concentric and eccentric reducers fabricated from pipes supplied by owner & fabrication of flanges from plates supplied by owner, will be paid at respective unit rates. However, erection of these items will be along with piping of the respective size and no separate payment will be made for erection.

The reducers will be measured and paid along with the piping of large diameter.

Payment of Reinforcement pads for branch connections shall be made as per respective SOR rates.

Fabrication, installation and removal of temporary spool pieces etc. to aid contractor's work such as fabrication, erection, flushing and testing etc. will neither be measured nor paid separately. The same is deemed to be included in the unit rates for piping. Payment for carrying out radiographic examination shall be based on inch dia. of joint radiographed. Repeat radiography / additional

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radiography required due to contractor's faults / poor performance of his welders and defective films etc., shall be done at contractor's own cost.

8.2 The payment clause(s) as described in the clause no. 8.1 shall not be referred / applicable for LSTK Jobs

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STANDARD SPECIFICATION FOR RUBBER EXPANSION JOINT

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
					Approved by	
5	05.02.2021	REVISED AND ISSUED AS STD. SPEC.	GS	GYAS/AK	A SINHA	SM
4	06.07.18	REAFFIRMED & ISSUED AS STD. SPEC.	LP	VG	RAJANJI SRIVASTAVA	R K TRIVEDI
3	28.05.12	REVISED AND ISSUED AS STD. SPEC.	JKU	RKS	RBB	DM

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Abbreviations:

ANSI	:	American National Standards Institute
IS	:	Indian Standard
PMS	:	Piping Material Specification
psig	:	Pounds per square inch gauge

Structural Standards Committee:

Convenor: Mr. Anurag Sinha

Members:
Mr. C. Damodaran
Mr. VK Panwar
Mr. Samir Das
Mr. Amitabh Kishore
Mr. Gyasuddin
Mr. Charanjeet Singh (Projects)
Mr. Ravindra Kumar (Construction)

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1.0 GENERAL

This specification covers the purchaser's technical requirements for design, supply of material, construction, inspection and testing of Rubber Expansion Joints for using in the low pressure/ambient temperature piping at pump suction lines or any other place as desired for any of the following utilities

a) Fire water
b) Cooling water
c) Raw water

2.0 CODES AND STANDARDS

The rubber expansion joint shall be designed and manufactured as per the relevant Indian and International Standards and sound engineering practice.

3.0 DESIGN REQUIREMENTS

a) Expansion joint shall be normally provided on the suction lines of pumps in the piping manifolds of pump stations, etc. especially when suction pipelines are embedded in sump concrete walls or when no load or vibrations are to be transferred to the piping on the other side of the expansion bellow.

b) The expansion joint shall be provided with control units with steel limiting rods. No thrust shall be transmitted by expansion joint to rotating equipment.

c) The retaining rings shall be provided and shall be of split type with min. four segments.

d) The dimensional specifications operating conditions, number, etc shall be as per Annexure-I.

e) The expansion joint, which is also subjected to vibration and shock during operation, shall be capable of withstanding the following:

- Axial compression : 25 mm min.
- Lateral movement : 12 mm min.
- Axial elongation : 12 mm min.

4.0 MATERIAL OF CONSTRUCTION

a) The rubber expansion joint, corrugated bellow type shall be made of high grade abrasive resistant natural rubber compound reinforced with adequate number of piles heavy cotton duck, rayon cord, impregnated with rubber compound and further reinforced with square metal ring embedded in the carcass. The outer exposed surface of the rubber expansion joint shall be given a thin coating of synthetic neoprene rubber and further painted with chlorinated rubber based paint.

b) Rubber expansion joint shall be complete with galvanised steel retaining ring (Material to IS: 2062 and thickness 12mm) and drilled suitably to match the particular size of rubber expansion joint.

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5.0 INSPECTION AND TESTING

a) Stage wise Inspection and testing shall be carried out at vendor's works by Owner/Owner's representative prior to despatch. Inspection plan shall be submitted by contractor.

b) All expansion joints shall be successfully hydrostatically tested as noted below, under normal as well as extreme displacement conditions.

- Hydrostatic pressure of as per PMS class
- Vacuum test to be conducted at 650 mm of Mercury.

c) Owner/Owner's representative shall have access at all reasonable time to vendor's works where the expansion joints are being fabricated and tested. Vendor shall arrange all the facilities to carry out such inspection/testing.

6.0 SPARES

The vendor shall furnish list of recommended spares for two years trouble free operation.

7.0 TECHNICAL DATA SHEET

Vendor shall furnish the "Technical Data Sheet" (Blank Technical Data Sheet enclosed with the specification – Refer Annexure - II) duly filled up with required information / indicating compliance, etc. along with the offer. **Filled up Technical Data Sheet must accompany the offer failing which the offer can be liable for rejection.**

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ANNEXURE – I

(To be filled up by Job Engineer)

SPECIFICATIONS AND OPERATING CONDITIONS

SPECIFICATIONS

i)	Face to face dimension Including integral flange	
	Upto dia 16"	: 300mm
	Dia 16" and above	: 500mm
ii)	Drilling of Flanges	: As per PMS class
iii)	Job Piping Material Specification No. (to be attached)	: _____
iv)	Hydraulic test pressure	: as per PMS class or as specified by Engineer
v)	Vacuum test pressure	: 650 mm of Mercury

OPERATING CONDITIONS

i)	Fluid to be Handled	: Fresh water / Sea water
ii)	Location	: Suction side of pump / any other location
iii)	Design Temperature	: 65 degree C.

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ANNEXURE - II

TECHNICAL DATA SHEET
(DETAILS TO BE FURNISHED BY THE BIDDER ALONG WITH THE OFFER)

'C' means vendor to furnish data / details

1.0	**GENERAL**	
	a) Supplier's name	(C)
2.0	**CODES AND STANDARDS**	
	Codes and standard practices followed (Specify Code Number)	(C)
3.0	**DESIGN REQUIREMENTS**	
	a) No. of Rubber Expansion joints	(C)
	b) Nominal dia. of Rubber Expansion Joint	(C)
	c) Face to face dimension including integral flange	(C)
4.0	**MATERIAL OF CONSTRUCTION**	
	Vendor to give part-wise material list in line with specification	(C)
5.0	**VENDOR DATA REQUIREMENTS**	
5.1	**Along with the Bid**	
i)	Detailed dimensional and cross sectional drawings.	(C)
ii)	Manufacturer's literature / catalogues etc.,	(C)
iii)	List of deviations if any	(C)
5.2	**After Award of Contract**	
i)	Originals transparencies after incorporating as built information signed by the Inspection Engineer	(C)
ii)	Final drawings as described in Clause 5.1 (6 sets).	(C)
6.0	**SPARES**	
	a) List of recommended spare	(C)

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STANDARD SPECIFICATION FOR PORTABLE FIRE EXTINGUISHER

Rev. No	Date	Purpose	Prepared by	Checked by	Approved By: Standards Committee Convenor	Approved By: Standards Bureau Chairman
1	24.08.18	REVISED & ISSUED AS STD. SPEC.	GAURAV SINGH	GYAS	RS	RKT
0	19.08.10	ISSUED AS STANDARD SPECIFICATION	AS	RKS	RBB	ND

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Abbreviations:

MS	MILD STEEL
IS	INDIAN STANDARD
PESO	PETROLEUM EXPLOSIVE SAFETY ORGANISATION

Structural Standards Committee

Convenor: Mr. Rajanji Srivastava

Members:
Mr. Anurag Sinha
Mr. VK Panwar
Mr. Samir Das
Mr. Amitabh Kishore
Mr. Gyasuddin
Mr. Charanjit Singh (Proj.)
Mr. Ravindra Kumar (Const.)

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1.0 SCOPE

This standard lays down requirements regarding material, shape, construction, method of operation, performance and tests of portable fire extinguisher of Carbon Dioxide type, Dry Chemical Powder type Fire Extinguisher.
The extinguisher shall be supplied along with respective extinguishing media duly charged.

2.0 CODES AND STANDARDS

IS: 5	Colours for ready mixed paints and enamels
IS: 2932	Enamel, synthetic, exterior; a) undercoating, b) finishing - specification
IS: 4308	Dry Chemical Powder for Fighting B and C Class Fires
IS: 4947	Specification for gas cartridges for use in fire extinguishers
IS: 14609	Dry Chemical Powder for Fighting A, B, C Class Fires
IS: 15222	Carbon dioxide as the extinguishing media for fire protection - Specification
IS: 15683	Portable Fire Extinguishers, Performance and Construction – Specification

Note: Latest Edition of all standard documents shall be followed

3.0 MATERIAL OF CONSTRUCTION & BASIC REQUIREMENT

3.1 CARBON DIOXIDE TYPE:-

3.1.1 Extinguisher shall be portable high pressure type with capacities 2 / 4.5 Kg as per requirement.
3.1.2 Requirement of performance, construction, and test shall comply with IS: 15683.
3.1.3 Carbon dioxide of 99.5% purity used as extinguishing media shall comply with IS: 15222 with maximum fill density shall not exceed 0.667Kg/l.
3.1.4 Extinguishers shall have concave base, material for extinguisher body shall be either steel conforming to IS: 7285 or aluminum confirming to IS: 4947 and discharge valve shall be of hand wheel / key / lever operated type conforming to IS: 3224

3.2 DRY CHEMICAL POWDER TYPE:

3.2.1 Extinguisher shall be portable low pressure Cartridge type with capacities 1 / 2 / 4 / 6 /per requirement based on fire rating.
3.2.2 Requirement of performance, construction, and test shall comply with IS: 15683.
3.2.3 Dry powder conforming to IS: 14609, I.S. 4308 and ~~or~~ IS: 4861 shall be used for charging the extinguishers.
3.2.4 Material for extinguisher body shall be carbon steel conforming IS: 513 with no vertical joints on the body. Discharge nozzle, valve assembly shall be SS-316 or brass confirming to IS: 6912.
3.2.5 Carbon di oxide gas cartridge shall be ISI marked as per IS: 4947

4.0 APPROVALS

Carbon di oxide extinguisher and valve shall have approval from PESO, Government of India, Nagpur.

5.0 COLOR & MARKING

The color of extinguisher bodies shall be Red conforming to shade no.536 or 538 of IS: 5. Paint shall conform to IS: 2932. Each extinguisher shall be clearly and permanently marked with the information specified in IS: 15683, along with IS certification mark and purchaser's name.

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6.0 ACCESSORIES

Each extinguisher shall be supplied with MS bracket, screws and spanner as may be necessary. The details of the bracket shall be submitted with the offer.

7.0 INSPECTION

Owner's / EIL's authorized representative shall have access at all reasonable times to vendor's works where Extinguishers are being manufactured and/or tested. Vendor shall arrange for all tests and inspection facilities for checking material, design and fabrication, workmanship, finish, performance (operating performance and performance required for test fires), and testing as per IS: 15683.

8.0 INFORMATION REQUIRED FROM VENDOR

8.1 Following information shall be furnished by the vendor along with the supply of extinguisher:

- Instruction book(s) - Instruction book(s) for guidance of the user including both the operating and normal maintenance procedures shall be supplied. The book(s) shall include an itemized and illustrated part list/spare parts list giving reference number of all the wearing parts.
- Approval certificate from PESO as described in clause 4.

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अग्निशमन के लिए नॉन पेरकोलेटिंग ले फलैट डिलेवरी नली हेतु मानक विनिर्देश

STANDARD SPECIFICATION FOR NON-PERCOLATING LAY FLAT DELIVERY HOSE FOR FIRE FIGHTING

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved By	
5	27.05.24	REVISED & ISSUED AS STD. SPEC.	NS	AK	SKN	MN
4	26.06.18	REVISED & ISSUED AS STD. SPEC.	GAURAV SINGH	GYAS	RS	RKT
3	07.08.12	REVISED & ISSUED AS STD. SPEC.	JAY KUMAR	RC	RBB	DM
2	14.03.08	REVISED & ISSUED AS STD. SPEC.	GAURAV	RLT/ RKS	NK	VC
1	15.02.98	REVISED & ISSUED AS STD. SPEC.	RB	RB	MMK	A SONI
0	31.03.82	ISSUED AS STD. SPEC.	RB	-	HVR	RCPC

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Abbreviations:

BIS	BUREAU OF INDIAN STANDARDS
IS	INDIAN STANDARD
mm	MILLIMETER

General Civil Standards Committee

Convenor: Mr. Samir Kumar Naskar

Members:
Mr. Amitabh Kishore
Mr. Dinesh Debbarma
Mr. Gyasuddin
Mr. Raj Kumar Singh
Mr. U.C. Pathak, (Piping)
Mr. Charanjit Singh (Projects)
Mr. Indrajit Neog (Construction)
Mr. Vikram Kumar Gupta (Structural)

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5.0 INSPECTION 4

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1.0 SCOPE

1.1 This specification covers the general requirements for material, design, performance and test of non-percolating lay flat delivery hose for firefighting.

2.0 CODES AND STANDARDS

IS: 636 Non-Percolating Flexible Fire Fighting Delivery Hose.

Note: - Latest Edition of codes shall be followed

3.0 TYPES, REQUIREMENTS, TESTING, PACKING AND MARKING

3.1 Type 3 Hose shall be supplied conforming to IS 636.

3.2 The requirements of hose, working pressure, testing, its packing and marking shall comply to IS: 636.

3.3 The length of each hose shall be 15 m unless specified otherwise in the datasheet.

4.0 MARKING

4.1 Each hose shall be clearly marked with

a. Manufacturer's name or trademark.
b. Month and year of manufacture.
c. Type of the hose
d. Size of the hose
e. Length of the hose
f. BIS certification mark.

5.0 INSPECTION

Owner's / EIL's authorised representative shall have access at all reasonable times to vendor's works where Fire Fighting Delivery Hoses are being manufactured and / or tested. Vendor shall arrange for all tests and inspection facilities for checking material, design and construction, hydraulic performance, workmanship, finish and hydrostatic testing as per IS: 636. Any shortcoming pointed out shall be rectified to the satisfaction of the inspectors. All consumables for testing shall be arranged by the vendor at his own cost.

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नॉरमल टाइप लैडिंग वाल्व के साथ स्थिर प्रकार की आग बुझाने वाली नलिका का मानक विनिर्देश

STANDARD SPECIFICATION FOR STAND POST TYPE FIRE HYDRANT WITH NORMAL TYPE LANDING VALVE

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved By	
5	08.08.25	REVISED & ISSUED AS STD. SPEC.	NS	AK	SKN	MN
4	26.06.18	REVISED & ISSUED AS STD. SPEC.	GAURAV SINGH	GYAS	RS	RKT
3	23.05.11	REVISED AND ISSUED AS STD. SPEC.	ALOK	RKS	RBB	DM
2	22.12.05	REVISED & REISSUED AS STD. SPEC.	SKC	NK	VDS	VJN
1	15.02.98	REVISED & ISSUED AS STD. SPEC.	VEDA	SM	MMK	ASONI
0	31.03.82	ISSUED AS STD. SPEC.	RB	-	HVR	RCPC

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Abbreviations:

ANSI	:	American National Standards Institute
IS	:	Indian Standard
PMS	:	Piping Material Specification
ASTM	:	American Society for Testing and Materials
Lpm	:	Liter per minute
NFPA	:	National Fire Protection Association
VMS	:	Valve Material Specification

General Civil Standards Committee

Convenor: Mr. Samir Kumar Naskar

Members:
Mr. Amitabh Kishore
Mr. Dinesh Deb Barma
Mr. Gyasuddin
Mr. Raj Kumar Singh
Mr. U.C. Pathak, (Piping)
Mr. Charanjeet Singh (Projects)
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Mr. Vikram Gupta (Structural)

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1.0 SCOPE

This standard lays down the requirements of codes and standards, type, shape, dimensions, material and test for vertical stand post type fire hydrant (with or without pumper connection) to be installed on fire water main with Normal Type Landing Valves as per IS 5290. The Hydrant shall normally be supplied without pumper connection unless otherwise specifically mentioned in the Data sheet/ Material Requisition.

2.0 CODES AND STANDARDS

IS: 5290	Specification for Landing Valves
ANSI B16.5	Pipe Flanges and Flanged Fittings
ASTM A-105	Standard Specification for Carbon Steel Forgings for piping applications
NFPA 1963	Standard for Fire Hose Connections
6-52-0006	Standard specification for restriction orifice plates
7-52-0041	Orifice Plates and Flanges Dimensional Details

NOTE: - Latest Edition of all Codes and Standards shall be followed.

3.0 MATERIAL

The MOC of components shall be as the Data Sheet provided along with this specification in the Material Requisition.

4.0 DESCRIPTION

4.1 The hydrant shall be stand-post type which may of the following types (For details, refer Annexure-I)-

a. **Single Headed Hydrant –** The vertical post shall be of 75 mm diameter with one horizontal Landing Valve Single Outlet conforming to Normal Type landing valve as per Fig.1 of IS 5290 having flanged inlet and instantaneous female outlet as per Fig.2 of IS 5290. Refer Fig-A given in the Annexure-I

b. **2-Way Hydrant** - The vertical post shall be of 100 mm diameter with two horizontal hydrant arms, each of 75 mm diameter having independent Landing Valve Single Outlet conforming to Normal Type landing valve as per Fig.1 of IS 5290 having flanged inlet and instantaneous female outlet as per Fig.2 of IS 5290. Refer Fig-B given in the Annexure-I

c. **2-Way Hydrant with pumper connection** - The vertical post shall be of 150 mm diameter with two horizontal hydrant arms, each of 75 mm diameter having independent Landing Valve Single Outlet conforming to Normal Type landing valve as per Fig.1 of IS 5290 having flanged inlet and instantaneous female outlet as per Fig.2 of IS 5290. Also, one pumper connection, 4-inch outlet, non-threaded type fire department connection metal faced, without gasket as per NFPA 1963 with metallic blind cap with SS 304 chain. Refer Fig-C given in the Annexure-I

d. **4-Way Hydrant -** The vertical post shall be of 150 mm diameter with two horizontal hydrant arms, each of 100 mm diameter having 2 numbers of independent Landing Valve Single Outlet (on each am) conforming to Normal Type landing valve as per Fig.1 of IS

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5290 having flanged inlet and instantaneous female outlet as per Fig.2 of IS 5290 on each arm. Refer Fig-D given in the Annexure-I

e. **4-Way Hydrant with pumper connection -** The vertical post shall be of 150 mm diameter with two horizontal hydrant arms, each of 100 mm diameter having 2 numbers of independent Landing Valve Single Outlet conforming to Normal Type landing valve as per Fig.1 of IS 5290 having flanged inlet and instantaneous female outlet as per Fig.2 of IS 5290 on each arm. Also, one pumper connection, 4-inch outlet, non-threaded type fire department connection metal faced, without gasket as per NFPA 1963 with metallic blind cap with SS 304 chain. Refer Fig-E given in the Annexure-I

4.2 Outlet of the landing valve shall be provided with instantaneous female coupling as per Fig.2 of IS 5290 with blind cap as per Fig.5 of IS 5290 along with SS304 chain.

4.3 Landing Valve Single Head Outlet conforming to IS: 5290 shall have rated flow of 900 lpm at 7 kg/cm2g

4.5 All flanges for landing valve connection shall have all dimensions conforming to ANSI.B.16.5, 150 lbs rating, Flat Face, Slip On type. Base flange of stand post shall be as per job specific Piping Material Class as mentioned in datasheet.

4.6 Job specific requirements, if any shall be as per Data Sheet enclosed in Bid/ Requisition document.

4.7 Refer Annexure-I for scope details for supply of Hydrants

5.0 RESTRICTION ORIFICE

5.1 Restriction Orifice (RO) may be provided in the landing valves as per requisition requirement.

5.2 The pressure conditions like Inlet pressure, design pressure and pressure drop in the RO shall be as per the table attached with the data sheet of Hydrant.

5.3 The flow through the RO shall be 900 lpm.

5.4 The MOC of the RO shall be SS 316.

5.5 Refer standard specifications 6-52-0006 and standard 7-52-041 for fabrication of Restriction orifice plate.

5.6 The type of RO plate shall be Concentric Square Edge type with single stage pressure reduction.

5.7 The line ID shall be 3” as per the PMS

6.0 WORKMANSHIP AND FINISH

All parts shall have good workmanship and finish. All warps and sharp edges shall be removed. The waterways shall have smooth finish.

7.0 TESTING

Each hydrant assembly shall be satisfactorily tested for water tightness, hydrostatic test and flow test as per IS 5290.

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Hydrant assembly with Landing valves closed shall be satisfactorily tested and proved water tight, under a hydraulic pressure of 21.0 kg/cm². The pumper connection shall be kept closed during testing in case the same is provided on hydrant assembly.

8.0 PAINTING

The stand post and its arms shall be painted as specified in Job Specific Data Sheet attached with this specification.

9.0 MARKING

Each hydrant shall be clearly and permanently marked with the following:

a) Manufacturers name or trade mark.
b) Year & Month of Manufacture.
c) Batch Number
d) Purchaser name.
e) BIS certification marking on landing valve and couplings.

10.0 INSPECTION

Owner's / EIL's authorized representative or as mentioned in data sheet shall have access at all reasonable times to vendor's works where Stand Post Hydrants and Landing Valves are being manufactured and/or tested. Vendor shall arrange for all tests and inspection facilities for checking material, design and construction, hydraulic performance, workmanship, finish and hydrostatic testing. Any shortcoming pointed out shall be rectified to the satisfaction of the inspectors. All consumables i.e. water etc. shall be arranged by vendor at his own cost.

11.0 VENDOR's DRAWING AND DATA REQUIREMENT

Vendor shall furnish drawings for review, prior to fabrication of Hydrant assembly as per Vendor Data Requirement**.**

12.0 APPROVAL

Vendor shall furnish valid BIS certificate approval letter.

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ANNEXURE-I

(SUPPLY SCOPE FOR FIRE HYDRANTS)

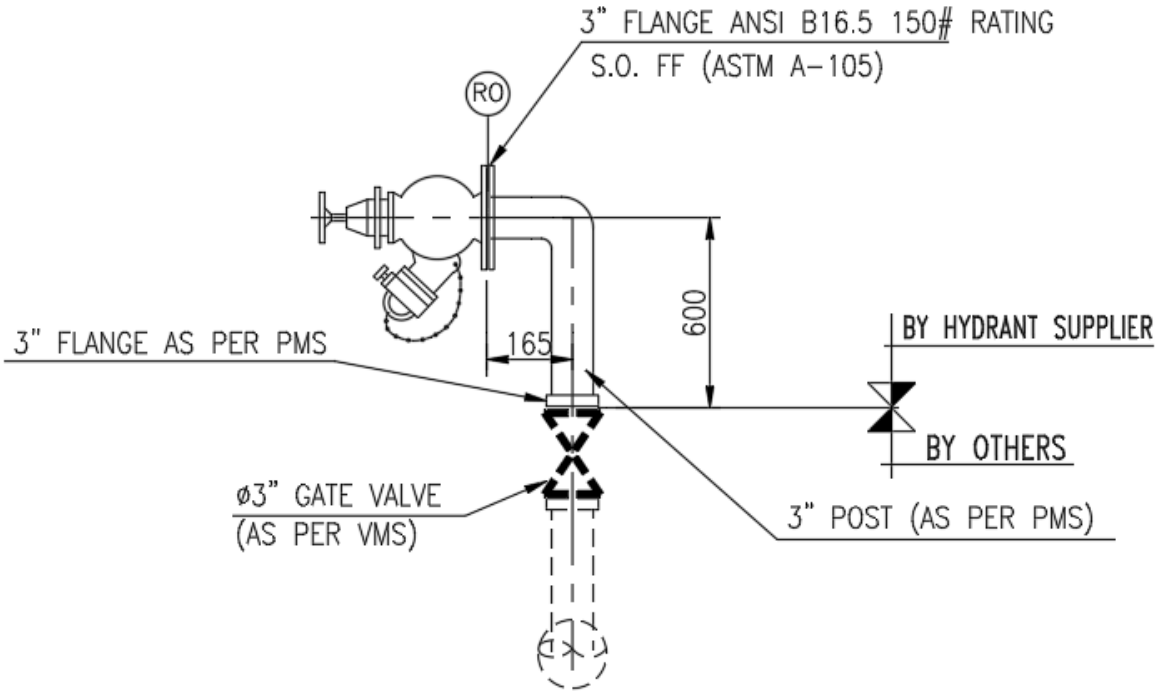


FIG A: SINGLE HEADED HYDRANT

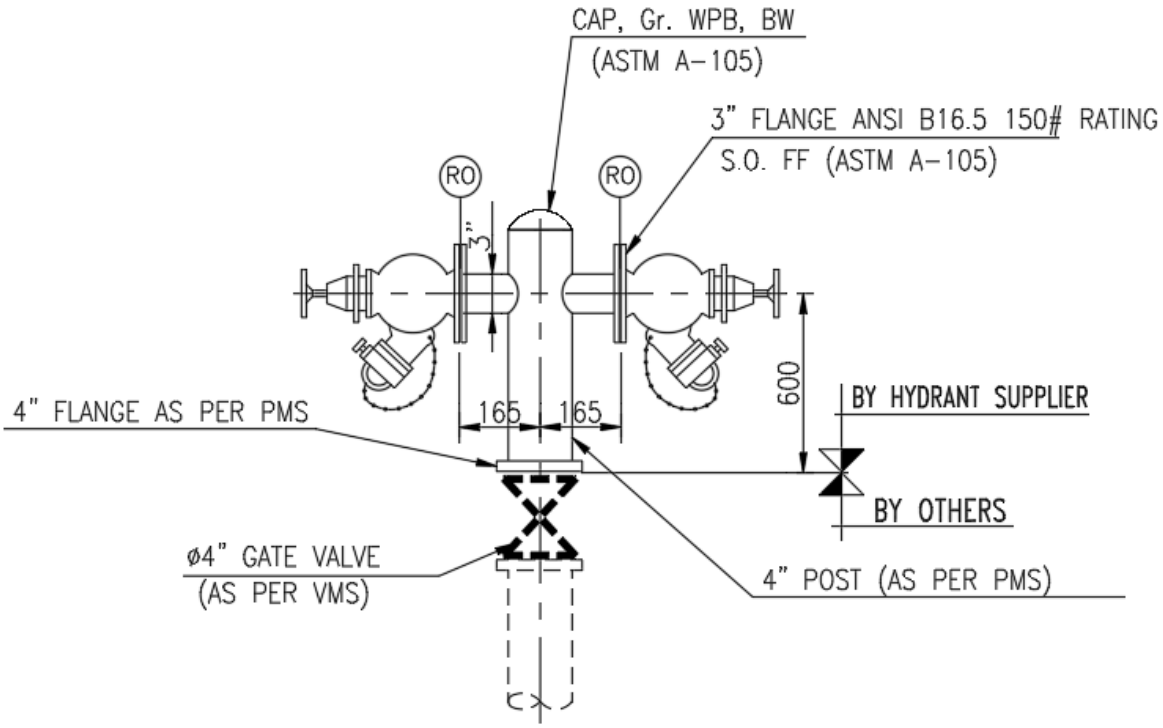


FIG B: 2-WAY HYDRANT

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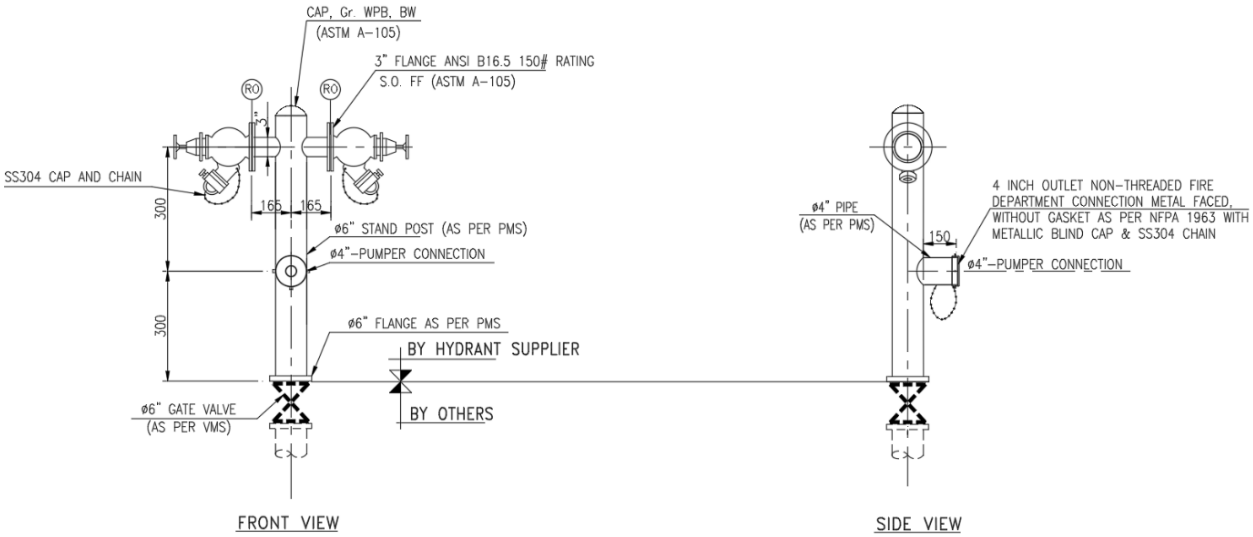


FIG C: 2-WAY HYDRANT WITH PUMPER CONNECTION

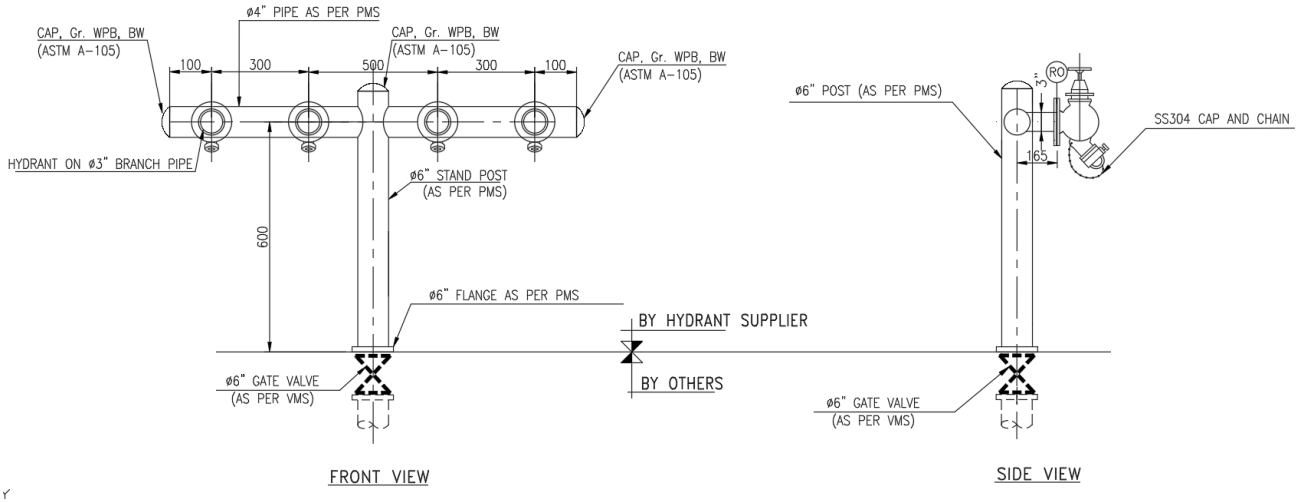


FIG D: 4-WAY HYDRANT

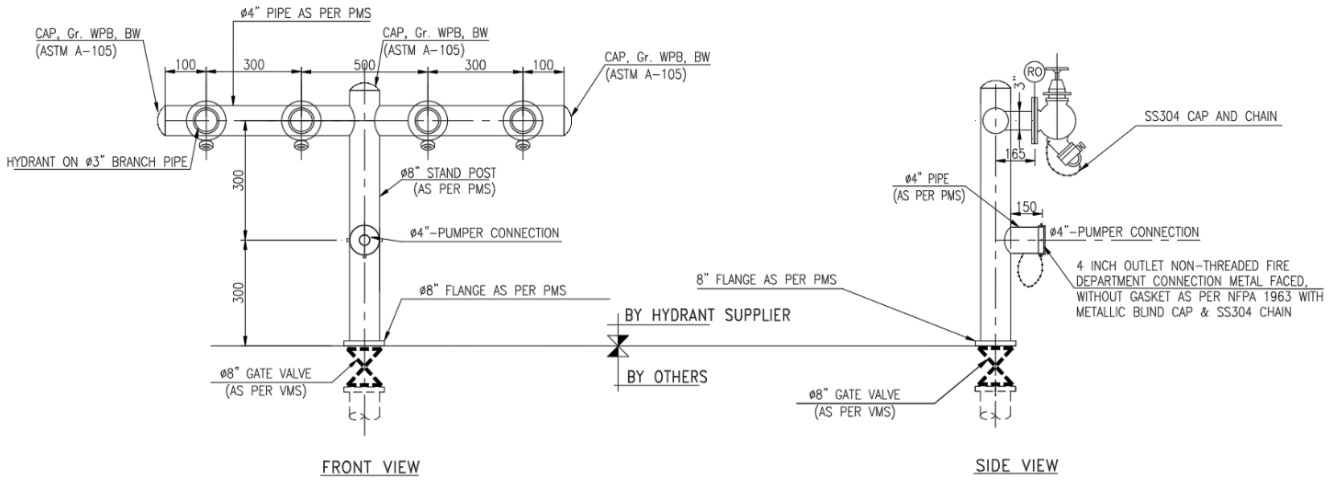


FIG E: 4-WAY HYDRANT WITH PUMPER CONNECTION

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STANDARD SPECIFICATION FOR FIRST AID HOSE REEL

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved By	
5	27.10.25	REVISED & ISSUED AS STD. SPEC.	NKP	GYAS	SK NASKAR	M.NANDI
4	26.06.18	REVISED & ISSUED AS STD. SPEC.	GAURAV SINGH	GYAS	RS	RKT
3	23.05.11	REVISED & REISSUED AS STD. SPEC	ALOK	RKS	RBB	DM
2	12.01.06	REVISED & REISSUED AS STD. SPEC	SKC	NK	VDS	VJN
1	21.11.96	REVISED & ISSUED AS STD. SPEC	NK	PCS	MMK	A SONI
0	31.03.82	ISSUED AS STD. SPEC.	RB	KP	HVR	RCPC

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ABBREVIATIONS:

IS : Indian Standard

General Civil Standards Committee

Convenor : Mr. Samir Kumar Naskar

Members:
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Mr. Gyasuddin
Mr. Dinesh Debbarma
Mr. Raj Kumar Singh
Mr. UC Pathak (Piping)
Mr. Charanjit Singh (Proj.)
Mr. Indrajit Neog (Const.)
Mr. Vikram Kumar Gupta (Structural)

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1.0 SCOPE

This specification covers the requirements regarding material, constructional details and test for Floor/Wall mounted First Aid Hose Reel, intended for installation within process units / buildings as emergency firefighting equipment.

Type _A -Wall mounting type to be used for mounting inside buildings on wet and dry riser. This can be directly mounted on the wall or custom-built cabinets for housing the hose -reel.

Type-B – Design shall be horizontal type hose reel-which can be mounted on custom built pedestals or in suitable position on fire engine.

2.0 CODES AND STANDARDS

IS : 884 First-Aid hose reel for fire-fighting.

NOTE: Latest Edition of all Codes and Standards shall be followed.

3.0 MATERIAL, CONSTRUCTION AND TEST

Material, Construction, tests and all other requirements shall conform to IS: 884, Type-A And Type B Hose Reel, except as mentioned in the Data Sheet of Hose Reel attached with Bids / Requisition.

4.0 SIZE

House reel tubing length shall be 30 m with internal bore 25 mm or as specified in data sheet.

5.0 HYDRAULIC PERFORMANCE

5.1 First Aid hose reel shall be capable of discharging not less than 44 lpm at the reel inlet pressure of 7 $kg/cm2_g$ +/- 0.1 $kg/cm2_g$ for 25mm size hose reel.

5.2 The horizontal range of water jet shall not be less than 6.0 m at the reel inlet pressure of 7 kg/cm2g.

6.0 MARKING

Each hose reel shall be clearly and permanently marked with the following information along with Purchaser's name.

a) Manufacturer's name or Trade Mark.
b) Year and month of Manufacture
c) Length and size of tube carried on hose reel.
d) Type of Reel.
e) BIS certification mark on house reel tubing
f) Batch number
g) Type of material.

7.0 INSPECTION AND TESTING

Owner's / EIL's authorized representative as mentioned in data sheet shall have access at all reasonable times to vendor's works where Hose Reels are being manufactured and/or tested. Vendor shall arrange for all tests and inspection facilities for checking material, design and construction, hydraulic performance, workmanship, finish and hydrostatic testing. Any shortcoming pointed out shall be rectified to the satisfaction of the inspectors. All consumables i.e. water etc. shall be arranged by vendor at his own cost.

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8.0 VENDOR's DRAWING AND DATA REQUIREMENT

Vendor shall furnish drawings and data for review, prior to fabrication of Hydrant assembly as per Vendor Data Requirement.

9.0 APPROVAL

Vendor shall furnish valid BIS certificate.

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STANDARD SPECIFICATION FOR STAND POST TYPE WATER MONITOR

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	25.08.18	REVISED & ISSUED AS STD. SPEC	GS	GYAS	RS	RKT
3	24.09.13	REVISED & ISSUED AS STD. SPEC	RBT	RKS	RBB	DM
2	12.01.06	REVISED & ISSUED AS STD. SPEC	SKC	NK	VDS	VJN
1	15.07.98	REVISED & ISSUED AS STD. SPEC	RC	NK	MMK	A SONI
0	09.09.88	ISSUED AS STD. SPEC.	NK	PCS	HVR	RCPC

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Abbreviations:

ANSI	:	American National Standards Institute
BIS	:	Beureau of Indian Standards
IS	:	Indian Standard
NB	:	Nominal Bore

Structural Standards Committee

Convenor: Mr. Rajanji Srivastava

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Mr. VK Panwar
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1.0 SCOPE

This specification covers the general requirements regarding Material, Design and Construction, Workmanship and Finish, Anticorrosive Treatment, Performance requirements, Tests, Painting, Accessories, Marking and Inspection for Stand Post Type Water Monitor.

2.0 CODES AND STANDARDS

IS: 8442 Functional requirement For Stand Post Type Water Monitor for Fire Fighting.

NOTE: Latest Edition of all Codes and Standards shall be followed.

3.0 DESIGN AND CONSTRUCTION

3.1 Design and Construction of Water Monitor shall conform to IS: 8442, except as mentioned in data sheet for Stand Post Type Water Monitor enclosed with Bid / Requisition document.

3.2 The Monitor shall be Aqua Fog, self-locking type and operated by a single person with the Horizontal range of 360° & vertical range of 135° (i.e. +90° to -45°).

3.3 The monitor shall be mounted on a 100 mm (4") N.B. Raised Face, Slip On type Flange with all dimensions conforming to ANSI B 16.5, 150 lbs rating.

3.4 Water nozzle shall be Non aspirating or aqua foam type with Jet and Fog arrangement.

3.5 The threaded end of the water nozzle shall be hexagonal to facilitate screwing of the nozzle on the water barrel with nozzle spanner.

3.6 Near the base flange a drain connection shall be provided with a 15 mm (½") NB drain valve at the end of pipe.

4.0 HYDRAULIC PERFORMANCE

Minimum Hydraulic performance of the monitor shall be as per clause 9.1 of IS 8442.

5.0 MATERIAL

All material for different parts of Water Monitor shall be per IS: 8442. Except as mentioned in data sheet for Stand Post Type Water Monitor enclosed with Bid/Requisition document.

6.0 WORKMANSHIP AND FINISH

Workmanship and finish, anticorrosive treatment, painting, Hydraulic performance, tests and accessories shall conform to IS: 8442, except as mentioned in data sheet for Stand Post Type Water Monitor enclosed with Bid/Requisition document.

7.0 MARKING

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

(a) Manufacturer's name or trademark
(b) Year of manufacture

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(c) Purchaser's name.
(d) Discharge Capacity in liters / minute.
(e) BIS & ISI certification mark.

8.0 INSPECTION

Owner's / EIL's authorized representative shall have access at all reasonable times to vendor's works where Monitors are being manufactured and/or tested. Vendor shall arrange for all tests and inspection facilities for checking material, design and construction, hydraulic performance, workmanship, finish and hydrostatic testing as per IS: 8442. Any shortcoming pointed out shall be rectified to the satisfaction of the inspectors. All consumables i.e. water etc. shall be arranged by vendor at his own cost.

9.0 DRAWINGS

Refer ANNEXURE -A for scope drawing for supply of monitor.

10.0 VENDOR DRAWING AND DATA REQUIREMENT

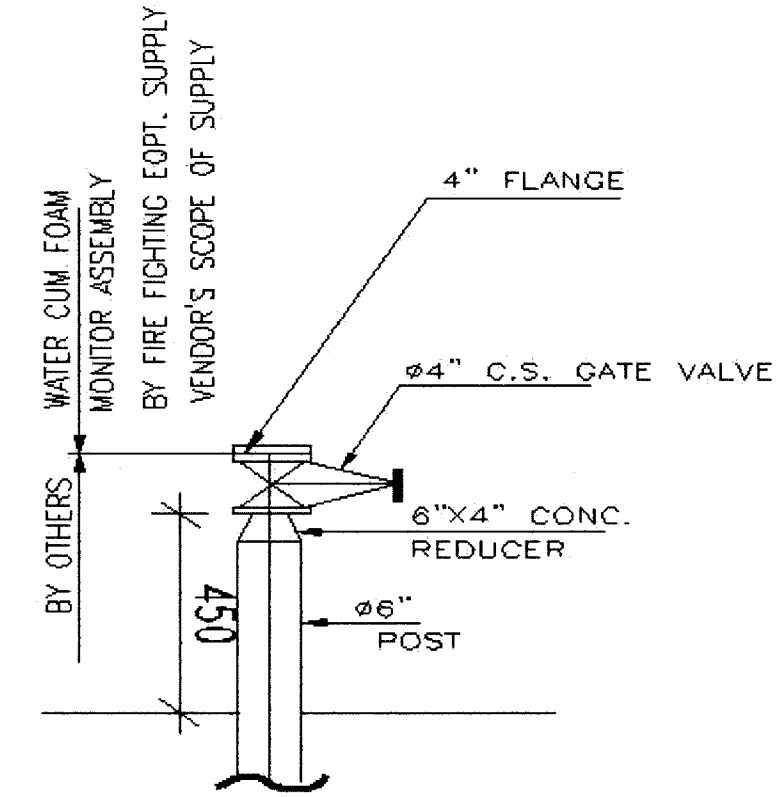
Vendor shall furnish drawings and data as per document for "Vendor drawings and Data Requirements".

11.0 APPROVAL

Vendor shall furnish BIS approval letter along with offer.

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ANNEXURE –A



WATER MONITOR

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जल एवम झाग युक्त मॉनिटर सिंगल बैरल टाइप हेतु मानक विनिर्देश (स्थिर और परिवरतनशील प्रवाह)

STANDARD SPECIFICATION FOR WATER CUM FOAM MONITOR SINGLE BARREL TYPE (FIXED & VARIABLE FLOW)

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved By	
5	26.06.18	REVISED & ISSUED AS STD. SPEC.	GAURAV SINGH	GYAS	RS	RKT
4	21.01.13	REVISED & ISSUED AS STD. SPEC	JAY KUMAR	RC	RBB	DM
3	30.07.07	REVISED & ISSUED AS STD. SPEC	RKS	NK	VDS	VC
2	12.01.06	REVISED & ISSUED AS STD. SPEC	SKC	NK	VDS	VJN
1	15.03.98	REVISED & ISSUED AS STD. SPEC	RB	PCS	MMK	A SONI
0	31.03.82	ISSUED AS STD. SPEC.	RB	KP	HVR	RCPC

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Abbreviations:

ANSI	American National Standards Institute
FM	Factory Mutual
"	Inch
IS	Indian Standard
kg/cm^2	Kilogram per Square Centimeter
lbs	Pounds
m	Meter
MS	Mild Steel
mm	Millimeter
m^3	Cubic Meter
NB	Nominal Bore
PVC	Poly -Vinyl Chloride
SS	Stainless Steel
UL	Underwriters Laboratory
VdS	Verband Der Sachversicherer

Structural Standards Committee

Convenor: Mr. Rajanji Srivastava

Members:
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Mr. VK Panwar
Mr. Samir Das
Mr. Amitabh Kishore
Mr. Gyasuddin
Mr. Charanjit Singh (Proj.)
Mr. Ravindra Kumar (Const.)

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1.0 SCOPE

This specification covers the general requirements regarding Material, Design and Construction, Workmanship and Finish, Anticorrosive Treatment, Performance requirements, Testing, Painting, Accessories, Marking and Inspection for Single Barrel, Stand Post Type Water cum Foam Monitor.

2.0 CODES AND STANDARDS

IS: 5	Colors For Ready Mix Paints and Enamels.
IS: 291	Machining Purposes- Specification.
IS: 1239-Part 1	MS Tubes, Tubulars and Other Wrought Steel Fittings-MS Tubes.
IS: 1239-Part 2	MS Tubes, Tubulars and Other Wrought Steel Fittings- Tubulars and Other Wrought Steel Fittings.
IS: 3203	Methods of Testing Local Thickness of Electroplated Coatings.
ANSI B16.5-	Pipe Flanges and Flanged Fittings.

NOTE: - Latest Edition of all Codes and Standards shall be followed.

3.0 DESIGN AND CONSTRUCTION

3.1 Design and Construction of Water cum Foam Monitor shall be single barrel type with fixed /variable flow and shall be UL / FM / Vds approved for discharge capacity as specified in data sheet, and shall comply with Data Sheet attached with Bids / Requisition

3.2 The Monitor shall be self-locking type and manually operated by a single person, with Non aspirating type Aqua Fog foam Nozzle.

3.3 Foam induction shall be by aqua powered foam inductor, (Jet Ratio Controller Pump) or self-inducting through pick up tube as specified in data sheet.
The foam induction system by aqua powered foam inductor shall be listed by UL/ FM/ Vds. Water operated foam proportioner shall be suitable for feeding foam concentrate from distance of 60 meters. The inlet and outlet of proportioner shall be provided with 63-mm male and female coupling. Foam induction hose of total 60m length shall be supplied along with end couplings of SS304. Foam solution induction hose shall be Type B delivery hose (Non-Percolating with elastomeric outer coating applied as reinforcement conforming IS 636) of size 63 mm long with ends couplings.
Foam inductor shall be provided behind the air intake chamber of foam maker in Foam Monitor. A flexible pick up tube of 3. length, having strainer at the inlet, shall be provided.
A foam concentrate valve shall be capable of inducing 3% to 6% foam compound.

3.4 Near the base flange a drain connection shall be provided with a 15 mm (½") NB drain valve at the end of pipe. The drain pipe shall be long enough to drain water away from the base flange.

4.0 MATERIAL

All material for different parts of Water cum Foam Monitor shall be as approved for UL / FM / Vds certification and the Water cum Foam Monitor assembly shall be supplied as per data sheet enclosed with Bid / Requisition document. Any conflict between specifications and data sheet, Data Sheet shall govern.

4.1 Pick up tube shall be made from PVC hose reinforced with high tensile steel wire helix manufactured as per ASTM D1785 schedule 80. Pick up tube shall be 3m long with dip Pipe made of SS316. Foam concentrate ball valve shall be of SS316.

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5.0 HYDRAULIC PERFORMANCE

FOAM MONITOR SINGLE BARREL TYPE				
FLOW RATE (US GPM)	**Minimum Horizontal Ranges at** 7 kg/cm^2 pressure for		**Minimum Vertical Ranges at** 7 kg/cm^2 pressure for	
	Water (m)	**Foam (m)**	**Water (m)**	**Foam(m)**
500GPM	50	45	17	15
750 GPM	52	50	17	15
1000GPM	60	55	20	18
2000 at 2000 GPM	80	75	25	22

Table1

Note: The minimum horizontal & vertical ranges for water and foam jets shall be as specified in **Table 1** at 7 kg/cm^2 pressure, with 30° & 45° nozzle angle respectively from horizontal plane in still weather condition except if specifically specified in the data sheet attached with the bid document / purchase document.
Monitor shall be tested for minimum two directions at 0 degrees and second reading at opposite direction i.e. 180 degrees apart as specified above and average reading shall be considered as horizontal throw of the monitor.

Vendor shall furnish the projectile curve for the monitor supplied showing horizontal and vertical throw for foam and water at angles 30, 45, 60, 75 degrees nozzle angle from horizontal plane for records with operational pressure at monitor base flange of 7/8/9/10 kg/ cm^2/.

5.5 Aqueous Film Forming Foam (AFFF) shall be used for testing of foam monitor for horizontal and vertical throws as specified.

6.0 WORKMANSHIP AND FINISH

6.1 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.

6.2 None of the joints shall be connected with permanent adhesive. No adhesive shall be used to arrest leaks or locking joint movement in threaded joints.

7.0 ANTICORROSIVE TREATMENT AND PAINTING

7.1 Monitor's steel parts shall be painted with luminous fire red colour, conforming to IS: 5, shade no.536, over 2 coats of Red Oxide Zinc Chromate primer or single coat of Aluminum paint. Nozzle shall be Yellow Epoxy painted. Copper Alloy parts shall be polished.

8.0 TESTING

8.1 Monitor shall be tested to fulfill hydraulic performance requirements as per clause 5.0 above and as per Data Sheet of Water cum Foam monitor attached with Bids / Requisition.

8.2 All the monitors shall be tested as follows:

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The entire assembly shall be subjected to hydraulic pressure of 23 kg/cm^2 and horizontal rotation shall be carried out 5 times and then vertical rotation up and down for 5 cycles for 5 minutes. During the test there shall be no leakage observed in any of the swiveled joints.

9.0 ACCESSORIES

9.1 The accessories shall include nozzle spanner.

10.0 MARKING

10.1 Each Monitor shall be clearly and permanently marked with the following:

(a) Manufacturer's name or trademark
(b) Year of manufacture
(c) Purchaser's name.
(d) Discharge Capacity in liters / minute.
(e) FM/UL/Vds listing marks.

11.0 INSPECTION

11.1 Owner's / EIL's authorized representative shall have access at all reasonable times to vendor's works where Monitors are being manufactured and/or tested. Vendor shall arrange for all tests and inspection facilities for checking material, design and construction, hydraulic performance, workmanship, finish and hydrostatic testing.

11.2 Verification of all the relevant document at shop before dispatch of the monitor.

11.3 Any shortcomings pointed out shall be rectified to the satisfaction of the inspectors. All consumables i.e. water and foam etc. shall be arranged by vendor at his own cost.

12.0 APPROVAL

12.1 Water cum foam monitor & nozzle along with foam induction mechanism shall be UL listed/ FM / Vds approved.

12.2 Vendor shall provide certified approved drawings / documents authenticated by UL / FM / Vds as documentary evidence along with bids.

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सुरक्षा शॉवर एवं आई वॉश हेतु मानक विनिर्देश

STANDARD SPECIFICATION FOR SAFETY SHOWER AND EYE WASH

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved By	
5	17.08.21	REVISED AND ISSUED AS STANDARD SPECIFICATION	GAURAV SINGH	GYAS	Anurag Sinha	SM
4	11.01.19	REVISED AND ISSUED AS STANDARD SPECIFICATION	GAURAV SINGH	GYAS	RS	RKT
3	17.07.12	REAFFIRMED AND ISSUED AS STANDARD SPECIFICATION	JAY KUMAR	RC	RBB	DM
2	11.09.06	REAFFIRMED AND ISSUED AS STANDARD SPECIFICATION.	DCB	UCJ	VDS	VC
1	02.06.97	REAFFIRMED AND ISSUED AS STANDARD SPECIFICATION	AK	PCS	MMK	AS

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Abbreviations:

GI	:	Galvanized Iron
IS	:	Indian Standard
Kg	:	Kilogram
LPM	:	Litre per minute
mm	:	Millimeter

Structural Standards Committee

Convener: Mr. Anurag Sinha

Members:
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Mr. VK Panwar
Mr. Samir Das
Mr. Amitabh Kishore
Mr. Gyasuddin
Mr. Charanjeet Singh (Projects)
Mr. Ravindra Kumar(Construction)

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1.0 SCOPE

This specification covers the general requirements regarding material, design, fabrication and acceptance tests for safety showers and Eye wash (combine unit).

2.0 CODES AND STANDARDS

IS: 1239	Mild steel tubes, tubular and other wrought steel fittings
IS: 10592	Specification for Industrial Emergency Shower, eye and face fountain and combination units.
Installation drawing	As per Vendor

3.0 DESIGN REQUIREMENT

3.1 It shall be as per IS : 10592.

3.2 The twin fountain head of eye wash unit shall give soft, controlled drenching of eye/face when the foot pedal is pressed.

3.3 Shower head should give uniform shower of water as soon as the chain/ pull rod is pulled.

3.4 Available inlet pressure shall not be less than 2.0 kg/cm^{2}g. In case available pressure is greater than 3.0 kg/cm^{2}g suitable Restriction Orifice shall be provided before safety shower and eye wash unit.

3.5 All steel parts shall be properly painted with 3 coats of anticorrosive paints.

3.6 Water supply pipe size shall be 40mm at inlet of combined equipment. Inlet connection shall generally be from top unless specified otherwise. Inlet connection shall be 1.5" flanged as per ASTM A105 (GALV.), 150FF.

3.7 Emergency shower head shall be capable of delivering a minimum of 76 lpm of water and each eye wash head shall be capable of delivering approximately 12 lpm.

4.0 MATERIAL OF CONSTRUCTION

Pipe	: GI heavy grade conforming to IS: 1239.
Pipe Fittings	: GI heavy grade conforming to IS: 1239 (II)/ CI conforming to IS:1879
Self closing Valve	: Gun Metal / Brass
Bowl for eyewash	: Stainless steel (SS 304)
Atomiser	: SS 304 with Copper head
Shower head	: C.P Brass or stainless steel(SS 304)
Foot Pedal	: M.S. with aluminium top
Spring	: M.S Galvanised
Pull chain	: M.S Galvanised

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5.0 INSPECTION AND TESTING

a) The whole assembly shall be tested for its hydraulic performance as per the requirements of IS 10592

b) EIL/Owner's representative shall have access at all reasonable times to the manufacturer's work in which safety shower/its components are being manufactured and/or tested.

6.0 MARKING

Combined unit shall be marked with ISI certification mark and other marking requirement as per IS 10592

7.0 VENDOR DATA REQUIREMENTS

7.1 Vendor shall furnish drawings and data as per VENDOR drawing and data requirements for approval prior to manufacturing.

7.2 Original transparencies after incorporating the as built information shall be got signed by the inspection engineer before submitting to EIL/OWNER for records.

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STANDARD SPECIFICATION FOR WATER SPRAY NOZZLE FOR COOLING

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
						Approved by
4	04 07 2019	REAFFIRMED AND ISSUED AS STD SPEC	AVM	AJS	RS	RKT
3	21 01 2013	REAFFIRMED AND ISSUED AS STD SPEC	J KUMAR	RC	RBB	DM
2	07 08 07	REVISED & ISSUED AS STD SPEC	RKS	RB	NK	VC
1	28 02 98	REVISED & ISSUED AS STD SPEC	VEDA	SM	MMK	A SONI
0	14 06 90	ISSUED AS STD SPEC	VDS	UCJ	RPB	RCPC

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Abbreviations:

ANSI	American National Standards Institute
FM	Factory Mutual
Gr.	Grade
IS	Indian Standard
$kg/cm^2 g$	Kilogram / Square Centimeter Gauge Pressure
lbs	Pound
LPCB	Loss Prevention Certification Board
lpm	Liters Per Minute
M	Meter
MS	Mild Steel
NFPA	National Fire Protection Association
OISD	Oil Industry Safety Directorate
Ph	Phosphorus
SS	Stainless Steel
TAC	Tariff Advisory Committee
UL	Underwriters Laboratory
VdS	Verband Der Sachversicherer

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1.0 SCOPE

This specification covers the general requirements of Codes and Standards, Material, Design, Fabrication and Acceptance tests for Medium and High Velocity Water Spray Nozzles supplied along with couplings for cooling of spheres, bullets, tanks and pumps which are exposed to radiant heat. The same shall also be used for cable cellars, cable galleries and transformers in electrical sub stations for fire suppression system.

2.0 CODES AND STANDARDS

a) **Material / Design Codes :**

IS: 291	Machining purposes
IS: 305	Aluminium bronze ingots and castings
IS: 318	Specification For Leaded Tin Bronze Ingots And Castings.
IS: 554	Pipe Threads where pressure Tight Joints are made on Threads - Dimensions, Tolerances and Designation
IS: 2768	Copper alloy strip for bullet envelope
IS: 7811	Phosphor bronze rods and bars
IS: 7814	Phosphor bronze sheet strip and foil
ANSI B16.11	Forged Steel Fittings, Socket-Welding and Threaded.
SS : 316	

b) **Reference Codes** :

TAC Manual

OISD Standards

NFPA

NOTE: Latest Edition of all Codes and Standards shall be followed

3.0 DESIGN REQUIREMENTS

a) The nozzle shall produce a 120° angle, uniform, full cone spray pattern, covering a circular area of about 3 metre diameter, when located about 0.60 M away from the vessel surface or any other angle as per the requirement of system design.

b) The water shall strike the vessel with low impact and minimum rebound.

c) Each nozzle shall have minimum orifice of 6mm and the flow through the nozzle shall be defined by nozzle constant "K- Factor". The flow of various design pressure shall be worked out by the formula :

$Q = K (P)^{0.5}$
Where Q = Flow through nozzle in lpm
K = Nozzle constant
P = Pressure in bar at inlet of nozzle.

Flow through nozzle shall be within ± 5%. Bidder shall provide K- Factor and spray angle at different orientation angle details along with bid.

d) Vendor shall furnish the performance test data for nozzle regarding variation in discharge rate and spray angle at different pressure varying from 1.4 kg/cm²g to 3.5 kg/cm²g.

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e) The nozzles shall be non-clogging type.

f) Inlet side of nozzle shall have tapered threads conforming to IS: 554.

g) MS Half coupling shall be of 3000 lbs rating, as per ANSI B 16.11.

h) Nozzle shall have a hexagonal or square shape on the out side, to facilitate screwing of the nozzle to female Half coupling, welded to the water ring.

i) Nozzles shall be fitted on the circumferential rings around vessels.

j) Water pressure available at the nozzle ring shall be varying between 1.40 kg/cm^{2}g to 3.50 kg/cm^{2}g for medium velocity spray nozzles.

k) Water pressure available at nozzle ring shall be varying between 2.8 kg/cm^{2}g to 5 kg/cm^{2}g for high velocity spray nozzles (projectors) in case of Indoor Transformers

l) Water pressure available at nozzle ring shall be varying between 3.5 kg/cm^{2}g to 5 kg/cm^{2}g for high velocity spray nozzles (projectors) in case of Outdoor Transformers

4.0 MATERIAL OF CONSTRUCTION

Spray nozzles shall be constructed of the following material :

4.1 For Non Saline Water supply

Body	:	Forged Brass to IS:291 Gr.I /SS:316
Deflector	:	Brass IS: 2768 / SS:316
Deflector Pin	:	Brass IS: 291 Gr-I / SS :316

4.2 For Sea Water supply

Body	:	Nickel Aluminium Bronze to IS:305
Deflector	:	Ph. Bronze to IS: 7814
Deflector Pin	:	Ph. Bronze to IS:7811

5.0 WORKMANSHIP AND FINISH

All nozzles shall have good workmanship and finish. All burrs and other irregularities shall be neatly removed.

6.0 ACCESSORIES

Vendor shall supply forged steel spanners for fixing the nozzles to the half couplings.

7.0 TESTING

Nozzles shall be tested by the vendor in presence of EIL/Owner's representative at his works for performance as required in Cl. No. 3.0.

8.0 MARKING

i) All the Nozzles shall have IS/ UL/ FM/ VdS / LPCB mark.

ii) K-Factor, spray angle and Manufacturer name /Trade mark.

Vendor shall furnish the required documents / certificates in this regards.

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9.0 INSPECTION

Owner's / EIL's authorised representative shall have access at all reasonable times to vendor's works where Water Spray Nozzle assemblies are being manufactured and/or tested. Vendor shall arrange for all tests and inspection facilities for checking material, design and construction, hydraulic performance, workmanship, finish and hydrostatic testing. Any shortcoming pointed out shall be rectified to the satisfaction of the inspectors.

10.0 VENDOR's DRAWING AND DATA REQUIREMENTS

Vendor shall furnish drawings and data as per "Vendor's drawings and Data Requirements" for approval prior to manufacturing.

11.0 APPROVALS

The water spray nozzles shall be UL / FM / VdS / LPCB approved.

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STANDARD SPECIFICATION FOR HOSE CABINET

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved By	
4	26.06.18	REVISED & ISSUED AS STD. SPEC.	GAURAV SINGH	GYAS	RS	RKT
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0	31.03.82	ISSUED AS STD. SPEC. RECOMPOSED IN AUG. 95	RB	-	HVR	-

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Abbreviations:

BIS	Bureau of Indian Standards
GI	Galvanised Iron
IS	Indian Standard
MS	Mild Steel
mm	Millimeter

Structural Standards Committee

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Mr. Charanjit Singh (Proj.)
Mr. Ravindra Kumar (Const.)

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1.0 SCOPE

1.1 This specification covers the general requirements regarding the Design requirement, Material, Construction, Painting and Marking of Hose cabinet and fire fighting equipments contained in the cabinets.

1.2 The Hose cabinet shall be supplied along with all the fire fighting equipments contained in it.

2.0 CODES AND STANDARDS

IS: 5	Colors for Ready Mix Paints and Enamels
IS: 636	Non-Percolating flexible fire fighting delivery hose
IS: 903	Fire Hose Delivery Couplings, Branch Pipe, Nozzles and Nozzle Spanner
IS: 2871	Branch pipe, universal, for fire fighting purposes

NOTE: Latest Edition of all Codes and Standards shall be followed.

3.0 DESIGN REQUIREMENTS

3.1 Hose cabinet shall be of two types, Type-I and Type-II, to accommodate delivery hose and jet nozzle with branch pipe or universal branch pipe.

3.2 Type I Hose Cabinet

3.2.1 It shall be suitable to accommodate one Type B firefighting delivery hose (Reinforced rubber lined, non-Percolating with elastomeric outer coating applied as reinforcement conforming IS 636) of size 63 mm 15 meter long with ends couplings, one jet nozzle with branch pipe or one universal branch pipe.

3.2.2 It shall be capable of being mounted on wall. Necessary hangers and bracket for hose, nozzle and branch pipe or universal branch pipe shall be provided, with the cabinet.

3.2.3 It shall be provided with single panel glass door

3.3 Type II Hose Cabinet

3.3.1 It shall be suitable to accommodate two Type B firefighting delivery hoses (Reinforced rubber lined, non-Percolating with elastomeric outer coating applied as reinforcement conforming IS 636) of size 63 mm, 15 meter long with end couplings, one jet nozzles with branch pipe and one universal branch pipes.

3.3.2 It shall be of self-supporting type, suitable for outside installation. Necessary hangers and brackets for hose, nozzle and branch pipe or universal branch pipe shall be provided within the cabinet.

3.3.3 It hall be provided with double panel glass door.

3.4 Both the types 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 key glass cover.

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4.0 MATERIAL

4.1 Cabinet shall be made of 18 gauge MS sheet suitably welded with single/double MS door frame glass covered. 3mm Glass with rubber gomet shall be securely fitted to the door frame in a standard manner.

4.2 Door shall be provided with standard handle Mortise type lock.

4.3 Hammer shall be of MS with GI chain.

4.4 Suitable size angle iron posts shall be provided to support type II cabinet.

4.5 Delivery hose shall be either of the following type

a) Type B Reinforced rubber lined hose to I.S. 636

4.6 End couplings, jet nozzle and branch pipe shall conform to I.S. 903.

4.7 Universal branch pipe shall conform to I.S. 2871.

5.0 PAINTING

The hose cabinet shall be painted with 3 coats of anticorrosive fire red paint conforming to shade no. 536 of IS: 5 from outside and white paint from inside. The paint shall conform to IS: 2932.

6.0 MARKING

6.1 Each cabinet shall be clearly and permanently marked with following.

a) The words Hose Cabinet-Type I or II
b) Instructions for use.

6.2 Each equipment in the cabinet shall be marked with BIS certification mark and purchaser's name.

7.0 TESTING

All equipments being supplied with Hose Cabinet shall be tested as per relevant IS test requirements.

8.0 INSPECTION

Owner's / EIL's authorised representative shall have access at all reasonable times to vendor's works where Hose Cabinets and equipments being supplied with Hose Cabinet, are being manufactured and/or tested. Vendor shall arrange for all tests and inspection facilities for checking material, design and construction, hydraulic performance, workmanship, finish and hydrostatic testing. Any shortcoming pointed out shall be rectified to the satisfaction of the inspectors.

9.0 VENDOR's DRAWING AND DATA REQUIREMENT

Vendor shall furnish drawings and data as per "Vendor's drawings and Data Requirements" for information and records.

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STANDARD SPECIFICATION FOR DELUGE VALVE SKID

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	21.08.23	REVISED AND ISSUED AS STD. SPEC.	GS	GYAS	SKN	S.MAZUMDAR
3	21.06.18	REVISED AND ISSUED AS STD. SPEC.	BP	DCB	RS	RK TRIVEDI
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1	01.07.99	REVISED AND ISSUED AS STD. SPEC.	PKT	PCS	MMK	ASONI
0	18.11.92	ISSUED AS STD. SPECIFICATION	SKC	RB	RPB	AS

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Abbreviations:

FM	:	Factory Mutual
IS	:	Indian Standard
lpm	:	Liters per minute
NFPA	:	National Fire Protection Association
SRR	:	Satellite Rack Room
SS	:	Stainless Steel
TAC	:	Tariff Advisory Committee
UL	:	Underwriters Laboratory
DV	:	Deluge Valve
DGFAP	:	Data Gathering and Fire Alarm Panel
F&G PLC	:	Fire & Gas Programmable Logic controller

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1.0 SCOPE

This specification describes design requirements, material of construction, performance and schematic details for deluge valve skid.

2.0 CODES AND STANDARDS

1. NFPA 13
2. NFPA 15
3. NFPA 72
4. Piping Material Specification
5. Job Specification for surface preparation and protective coating
6. 6-44-0012 Specification for fabrication and erection of piping
7. 6-44-0013 Specification for inspection, flushing and testing of piping systems
8. Job Specification for non-destructive examination requirement of piping
9. Job Specification for instrumentation items attached elsewhere

3.0 DESIGN REQUIREMENTS

3.1 A deluge valve skid shall broadly consist of following:

1. Deluge Valve Diaphragm Type
2. Dry pilot basic trim/ Hydraulic Detection, with test and alarm trim and electric release trim
   a. Restriction check valve
   b. Pressure gauge with gauge valve
   c. Emergency release station
   d. Positive drain actuator
   e. Swing check valve
   f. Solenoid valve
   g. Drip valve
   h. Alarm system
   i. Priming connection
   j. Detector pipe work manifold
   k. PT, PA, PG, switches
   l. Local control panel
   m. All instrumentation and erection material such as impulse tubes, pipes, valves, fittings, manifolds for instrumentation mounted on skid.
3. Piping with Matching flange
4. Inlet valve, outlet valve & Bypass valve
5. Cables, Cable glands and PCP shrouds for cables etc. Cables up to Junction Box shall be provided by vendor.
6. Earthing strips and earthing cables for earthing of all instrumentation
7. Insulation and painting of instruments and impulse lines as applicable
8. Any other installation material required for installation and commissioning of various instruments and system supplied by vendor.
9. Any additional instrument required in the opinion of vendor for meeting functional requirements, safe and efficient operation, which is not listed specifically in this document.

Schematic details for Deluge valve skid shall be of following types: (Refer Annexure – A,B C and D)

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1. Deluge Valve Scheme-1, Pneumatic Detection
2. Deluge Valve Scheme-2, Hydraulic Detection
3. Deluge Valve Scheme-3, Pneumatic Detection Security P&ID's
4. Deluge Valve Scheme-4, Hydraulic Detection for Transformers etc.

3.2 Size and working pressure of deluge valve shall be as under:

Size in inch (mm)	Working Pressure (kg/cm^2g)
2 (50)	7.0 to 13.5
3(80)	7.0 to 13.5
4(100)	7.0 to 13.5
6(150)	7.0 to 13.5
8(200)	7.0 to 13.5

3.3 The deluge valve shall be provided with solenoid operated release valve for remote operation in addition to automatic operation of deluge valve. The deluge valve and its accessories shall be provided as per the relevant area classification.

4.0 MATERIAL OF CONSTRUCTION

4.1 For non saline water service

Deluge Valve	
Body/ Housing & Cover	Cast Steel (ASTM A 216 WCB) / Ductile Iron (ASTM A 536-77 GRADE 65-45-12) / Cast iron to IS:210 Gr. FG 260
Seat, Clapper, Clamp Ring	Bronze
Diaphragm spindle and Hinged pin	SS 304
All piping, fittings, valves, strainers etc.	PMS CLASS of project
Skid	Carbon steel construction with provision of bolts for securing it firmly to foundation pedestal
Canopy	FRP (Canopy shall be provided over local control panel)

4.2 For saline water service, body shall be aluminum bronze. Test and drain valve, installation stop valve, outlet valve and check valve shall be cast steel with internal epoxy lining.

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5.0 CONSTRUCTION AND PERFORMANCE

Entire Deluge Valve assembly with all fittings and instrument including bypass valve and strainers shall be incorporated into a single self-contained skid, of appropriate size and strength.

5.1 The deluge valve unit shall be provided with a clack to keep the valve close through a diaphragm unit.

5.2 The deluge valve shall also be fitted with an integral test and drain manifold. It shall consist of 50mm test and drain valve and a drip plug.

5.3 The test valve shall allow water to flow through the deluge valve to drain during testing of deluge valve and to drain water from distribution pipe after fire. At open position, the valve clack shall be held against its seating by an internal compression spring of sufficient strength to keep it in closed position till the pressure acting on underside of it does not exceed approximately 0.5 kg/cm^2. The clack will open when pressure exceeds 0.5kg/cm^2g.

5.4 The drain valve shall drain all the water from the deluge valve body and the outlet connections during maintenance of the deluge valve. The drain pipe work is to be designed to periodically check the rate of flow available in the system to satisfy the requirements appropriate to the hazard class for which the deluge valve is provided. Flow measurement shall be checked with differential pressure.

Water operated alarm motor gang shall be connected to the test and drain valve so that it gives an alarm as the deluge valve opens.

5.5 In hydraulic detector network, tapping from fire water network shall be taken. Check valve, strainer and restricted orifice shall be provided in the detector network. Piping shall be as per relevant piping material specifications. Refer Annexure A, B, C and D for schematic details for deluge valve skid.

5.6 In addition to above, pressure transmitters on the detection and actuation piping, Solenoid operated valve on priming chamber drain line, push buttons and lamps as per attached schematics shall be provided as a minimum requirement. Alarm set values shall also be provided by vendor.

5.6.1 For schemes-1, 2 & 3 (e.g.. applications other than Transformer fire protection), Alarm values provided by vendor shall be configured in Purchaser's F&G PLC system. When fire occurs and deluge valve opens, the alarm shall be given in local control panel, control room and fire station. Deluge valve shall be operated automatically via detection system as well as through interlock of F&G PLC system. Provision shall also be kept to manually operate the solenoid valve through push buttons provided in the local control panel and from F&G console in the control room / fire station.

5.6.2 For scheme-4 (e.g.. Deluge system for transformer fire protection), Alarm values provided by vendor shall configured within the local control panel. When fire occurs and deluge valve opens, the alarm shall be provided in local control panel, DGFAP and fire station. Deluge valve shall be operated automatically via detection system equipped with QBDs. Provision shall also be kept to manually operate the solenoid valve through push buttons provided on local control panel.

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5.7 Installation of valve, check valve, strainer etc. required as per deluge valve schematic shall be as per the relevant piping material specification. In addition, following provisions shall be made:

Both the valves (u/s and d/s of deluge valve) must be strapped (not chained) and padlocked in open position at all normal times.

5.8 The deluge valve shall be tested for operation/ opening at set pressure and operation of the alarms at set pressures. Restricted orifice provided in QBD line shall be sized such that breakage of one quartzoid bulb will lead to pressure drop in line. Hence, lead to DV actuation.

5.9 For testing and setting of deluge valve, a priming valve and a vent valve shall be provided with deluge valve assembly. At all normal times and when testing the deluge valve according to various tests required, the body of the deluge valve shall remain full of water.

5.10 Pressure gauge shall be fitted immediately above the deluge valve on water supply line. Pressure gauges shall be provided for 1-15 Kg/cm^2 range.

5.11 The complete deluge valve skid assembly shall be of good workmanship and finish, and it shall be free from burrs and sharp edges. All waterways shall have smooth finish.

5.12 The deluge valve , inlet / outlet isolation valve, bypass valve shall be tested for a test pressure of 28.5kg/cm^{2}g.

6.0 APPROVALS

The deluge valve shall be UL/ FM approved.

7.0 INSPECTION AND MARKING

7.1 EIL or its authorised representatives/ third party inspection agency shall have access at all reasonable times, to the manufacturer's works where the deluge valve skid assemblies are being manufactured or being tested.

7.2 Deluge valve assembly shall be clearly and permanently marked with the purchaser's name, design and test pressure, UL/ FM approval.

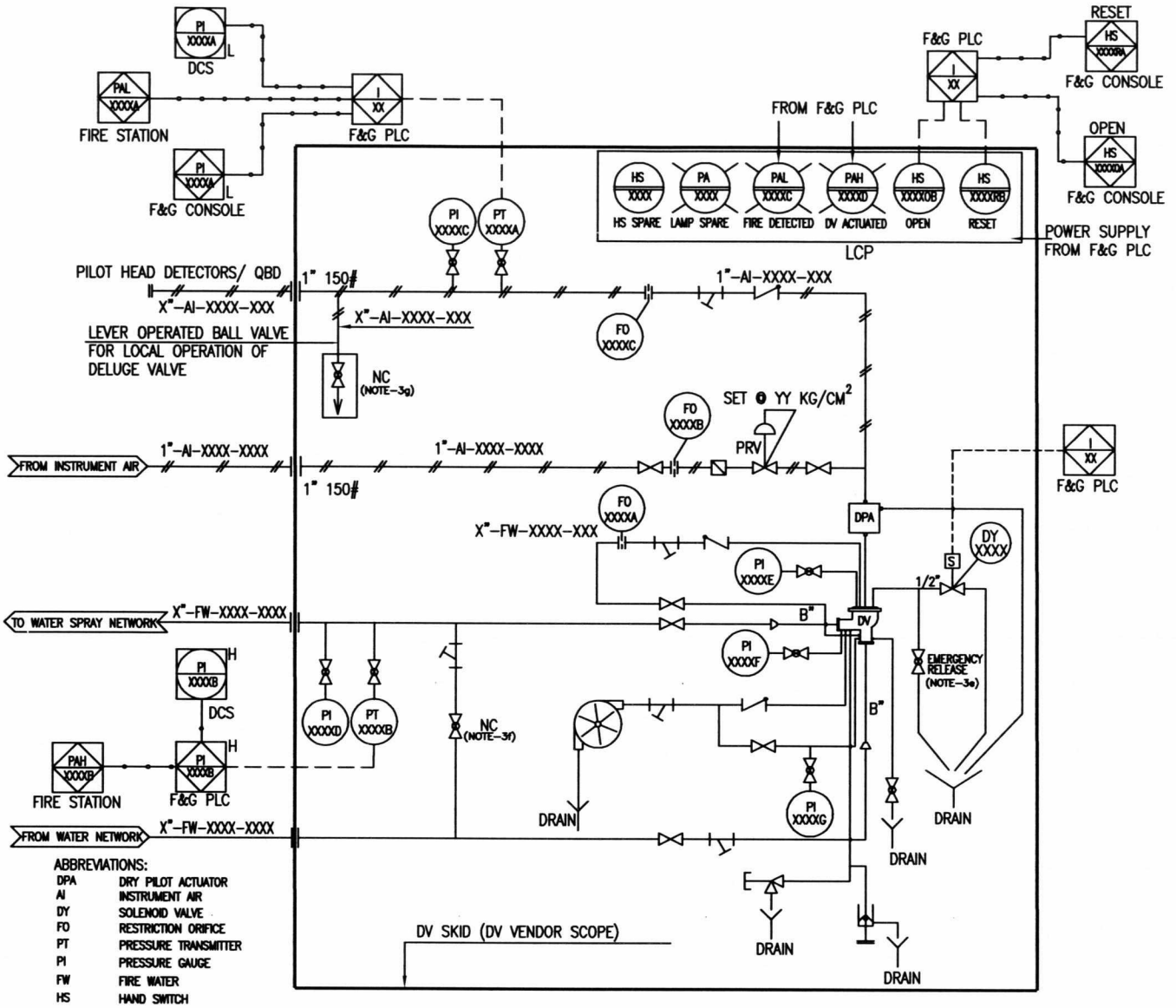
8.0 INFORMATION REQUIRED FROM VENDOR

Vendor Data Requirement shall be as per VDR document attached separately with the tender/MR document.

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Annexure-A : Deluge Valve Scheme-1(Pneumatic Detection)

DV skid nomenclature: A" X B" ([Fire water inlet and outlet size to DV skid] X [DV size])



ABBREVIATIONS:

DPA	DRY PILOT ACTUATOR
AI	INSTRUMENT AIR
DY	SOLENOID VALVE
FO	RESTRICTION ORIFICE
PT	PRESSURE TRANSMITTER
PI	PRESSURE GAUGE
FW	FIRE WATER
HS	HAND SWITCH
F&G PLC	FIRE & GAS PROGRAMMABLE LOGIC CONTROLLER
DV	DELUGE VALVE
PAL	PRESSURE ALARM LOW
PAH	PRESSURE ALARM HIGH
PRV	PRESSURE REGULATOR
NO	NORMALLY OPEN
NC	NORMALLY CLOSED
QBD	QUARTZOID BULB DETECTOR

CAUSE & EFFECT DIAGRAM:

CAUSE \ EFFECT	Action	Description	Deluge Valve SOV	Deluge Valve SOV	Reset	Fire Detected Lamp at LCP	ON	DV Actuated Lamp at LCP	ON
	Tag		DY-XXXX	DY-XXXX		1PAL-XXXXC		1PAH-XXXXD	
	No.		1	2	3		4		
			F&G PLC Action						

No.	Description	Tag no.	Signal Type	From	Condition				
1	Detection Line Pressure	PT-XXXXA	AI	Field	Low	X		X	
2	DV Actuation Line Pressure	PT-XXXXB	AI	Field	High				X
3	Open Soft hand switch at HMI	HS-XXXXOA	Soft	CR		X			
4	Reset Soft hand switch at HMI	HS-XXXXRA	Soft	CR			X		
5	Open Push Button at LCP	HS-XXXXOB	DI	Field	Close	X			
6	Reset Push Button at LCP	HS-XXXXRB	DI	Field	Close		X		

LEGENDS:

- FRANGIBLE BULB/ QBD
- REDUCER
- DV — DELUGE VALVE
- DRLV — DRIP VALVE
- PRV — PRESSURE REGULATOR
- FILTER
- DY — SOLENOID OPERATED VALVE (AUTO RESET)
- BALL VALVE
- GATE VALVE
- WATER MOTOR GONG (ALARM)
- NON RETURN VALVE
- DRAIN VALVE
- ANGLE VALVE
- STRAINER
- DPA — DRY PILOT ACTUATOR

SIGNALS & INDICATIONS

- PNEUMATIC LINE
- INSTRUMENT SIGNAL
- SOFT SIGNAL
- SOFT INDICATION
- XX — INTERLOCK
- LCP MOUNTED(LAMP)
- LCP MOUNTED

"YY" BY DELUGE VALVE SUPPLIER

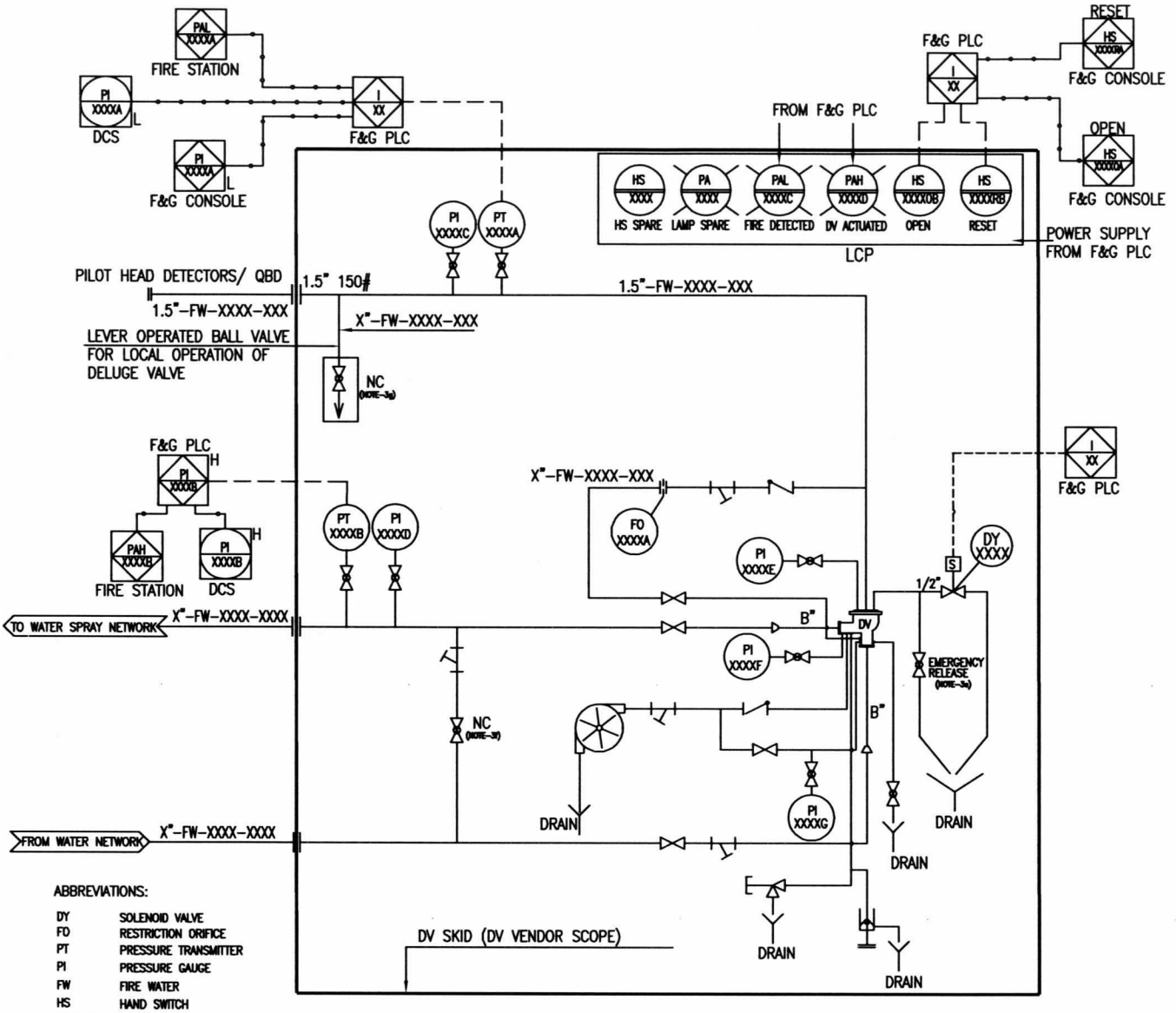
NOTES:

1. DURING NORMAL CONDITION INSTRUMENT AIR SUPPLY SHALL KEEP LINE PRESSURISED TO CLOSE THE DELUGE VALVE.
2. RESTRICTION ORIFICE PROVIDED IN QBD LINE SHALL BE SIZED SUCH THAT BREAKAGE OF ONE QUARTZOID BULB WILL LEAD TO PRESSURE DROP IN LINE CAUSING DV ACTUATION.
3. VARIOUS METHODS OF DV ACTUATION ARE AS UNDER:
   a. AUTOMATIC ACTUATION THROUGH PRESSURE DROP IN DETECTION LINE.
   b. AUTOMATIC ACTUATION THROUGH F&G INTERLOCK.
   c. MANUAL/LOCAL ACTUATION THROUGH HAND SWITCH PROVIDED IN LCP.
   d. REMOTE ACTUATION THROUGH SOFT HANDSWITCH IN F&G PLC CONSOLE.
   e. MANUAL/LOCAL ACTUATION THROUGH EMERGENCY RELEASE.
   f. MANUAL/LOCAL ACTUATION USING BYPASS VALVE.
   g. MANUAL/LOCAL ACTUATION USING DETECTION LINE DRAIN VALVE.

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Annexure-B : Deluge Valve Scheme-2(Hydraulic Detection)

DV skid nomenclature: A" X B" ([Fire water inlet and outlet size to DV skid] X [DV size])



ABBREVIATIONS:

DY	SOLENOID VALVE
FD	RESTRICTION ORIFICE
PT	PRESSURE TRANSMITTER
PI	PRESSURE GAUGE
FW	FIRE WATER
HS	HAND SWITCH
F&G PLC	FIRE & GAS PROGRAMMABLE LOGIC CONTROLLER
DV	DELUGE VALVE
PAL	PRESSURE ALARM LOW
PAH	PRESSURE ALARM HIGH
NO	NORMALLY OPEN
NC	NORMALLY CLOSED
QBD	QUARTZOID BULB DETECTOR

LEGENDS:

- FRANGIBLE BULB/ QBD
- REDUCER
- DV — DELUGE VALVE
- DRIP VALVE
- DY — SOLENOID OPERATED VALVE (AUTO RESET)
- BALL VALVE
- GATE VALVE
- WATER MOTOR GONG (ALARM)
- NON RETURN VALVE
- DRAIN VALVE
- ANGLE VALVE
- STRAINER

SIGNALS & INDICATIONS

- INSTRUMENT SIGNAL
- SOFT SIGNAL
- SOFT INDICATION
- XX — INTERLOCK
- LCP MOUNTED(LAMP)
- LCP MOUNTED

CAUSE & EFFECT DIAGRAM:

CAUSE \ EFFECT						Action	Open	Reset	ON	ON
						Description	Deluge Valve SOV	Deluge Valve SOV	Fire Detected Lamp at LCP	DV Actuated Lamp at LCP
						Tag	DY-XXXX	DY-XXXX	PAL-XXXXC	PAH-XXXXD
No.	Description	Tag no.	Signal Type	From	Condition	No.	1	2	3	4
							F&G PLC Action			
1	Detection Line Pressure	PT-XXXXA	AI	Field	Low		X		X	
2	DV Actuation Line Pressure	PT-XXXXB	AI	Field	High					X
3	Open Soft hand switch at HMI	HS-XXXXOA	Soft	CR			X			
4	Reset Soft hand switch at HMI	HS-XXXXRA	Soft	CR				X		
5	Open Push Button at LCP	HS-XXXXOB	DI	Field	Close		X			
6	Reset Push Button at LCP	HS-XXXXRB	DI	Field	Close			X		

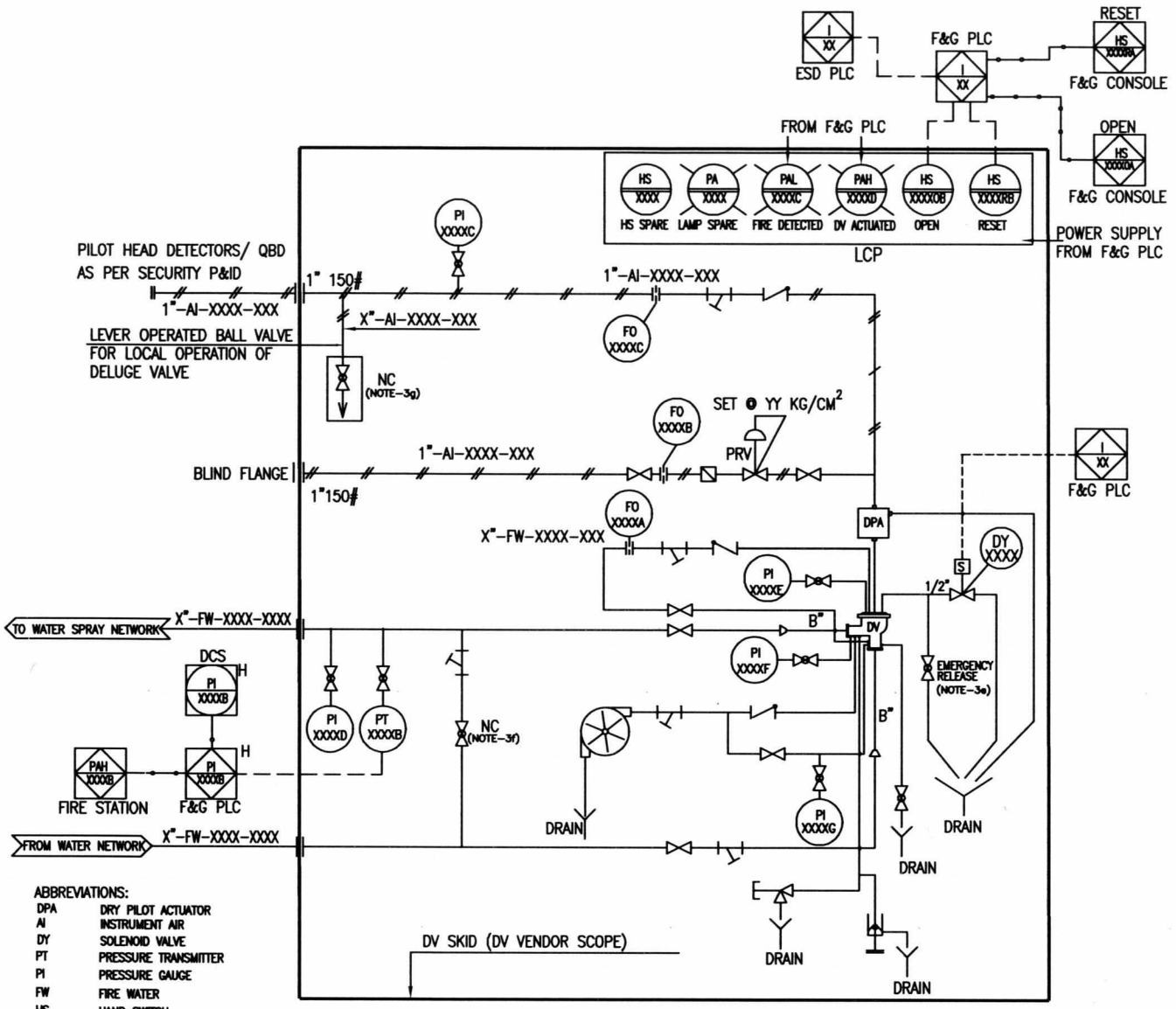
NOTES:

1. DURING NORMAL CONDITION FIRE WATER SUPPLY SHALL KEEP LINE PRESSURISED TO CLOSE THE DELUGE VALVE.
2. RESTRICTION ORIFICE PROVIDED IN QBD LINE SHALL BE SIZED SUCH THAT BREAKAGE OF ONE QUARTZOID BULB WILL LEAD TO PRESSURE DROP IN LINE CAUSING DV ACTUATION.
3. VARIOUS METHODS OF DV ACTUATION ARE AS UNDER:
   a. AUTOMATIC ACTUATION THROUGH PRESSURE DROP IN DETECTION LINE.
   b. AUTOMATIC ACTUATION THROUGH F&G INTERLOCK.
   c. MANUAL/LOCAL ACTUATION THROUGH HAND SWITCH PROVIDED IN LCP.
   d. REMOTE ACTUATION THROUGH SOFT HANDSWITCH IN F&G PLC CONSOLE.
   e. MANUAL/LOCAL ACTUATION THROUGH EMERGENCY RELEASE.
   f. MANUAL/LOCAL ACTUATION USING BYPASS VALVE.
   g. MANUAL/LOCAL ACTUATION USING DETECTION LINE DRAIN VALVE.

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Annexure-C : Deluge Valve Scheme-3(Pneumatic Detection Security P&ID's)

DV skid nomenclature: A" X B" ([Fire water inlet and outlet size to DV skid] X [DV size])



ABBREVIATIONS:

DPA	DRY PILOT ACTUATOR
AI	INSTRUMENT AIR
DY	SOLENOID VALVE
PT	PRESSURE TRANSMITTER
PI	PRESSURE GAUGE
FW	FIRE WATER
HS	HAND SWITCH
F&G PLC	FIRE & GAS PROGRAMMABLE LOGIC CONTROLLER
DV	DELUGE VALVE
PAL	PRESSURE ALARM LOW
PAH	PRESSURE ALARM HIGH
PRV	PRESSURE REGULATOR
QBD	QUARTZOID BULB DETECTOR

CAUSE & EFFECT DIAGRAM:

No.	Description	Tag no.	Signal Type	From	Condition	Type	No.	1	2	3	4
							Action	Open	Reset	ON	ON
							Description	Deluge Valve SOV	Deluge Valve SOV	Fire Detected Lamp at LCP	DV Actuated Lamp at LCP
							Tag	DY-XXXX	DY-XXXX	PAL-XXXXC	PAH-XXXXD
								F&G PLC Action			
1	Detection line Pressure transmitter(s)	##	AI	CR	Low	1ooN		x		x	
2	Trip from ESD on Manual Interlock actuation	XS-XXXX	DI	CR	Close			x			
3	DV Actuation Line Pressure	PT-XXXXB	AI	Field	High						x
4	Open Soft hand switch at HMI	HS-XXXXOA	Soft	CR				x			
5	Reset Soft hand switch at HMI	HS-XXXXRA	Soft	CR					x		
6	Open Push Button at LCP	HS-XXXXOB	DI	Field	Close			x			
6	Reset Push Button at LCP	HS-XXXXRB	DI	Field	Close				x		

Refer C&E of Security System P&ID.

LEGENDS:

- REDUCER
- DV — DELUGE VALVE
- DRV — DRIP VALVE
- DY — SOLENOID OPERATED VALVE (AUTO RESET)
- BALL VALVE
- GATE VALVE
- WATER MOTOR GONG (ALARM)
- ANGLE VALVE
- STRAINER
- DPA — DRY PILOT ACTUATOR
- NON RETURN VALVE
- PRV — PRESSURE REGULATOR
- FILTER

SIGNALS & INDICATIONS

- PNEUMATIC LINE
- INSTRUMENT SIGNAL
- SOFT SIGNAL
- SOFT INDICATION
- XX — INTERLOCK
- LCP MOUNTED(LAMP)
- LCP MOUNTED

"YY" BY DELUGE VALVE SUPPLIER

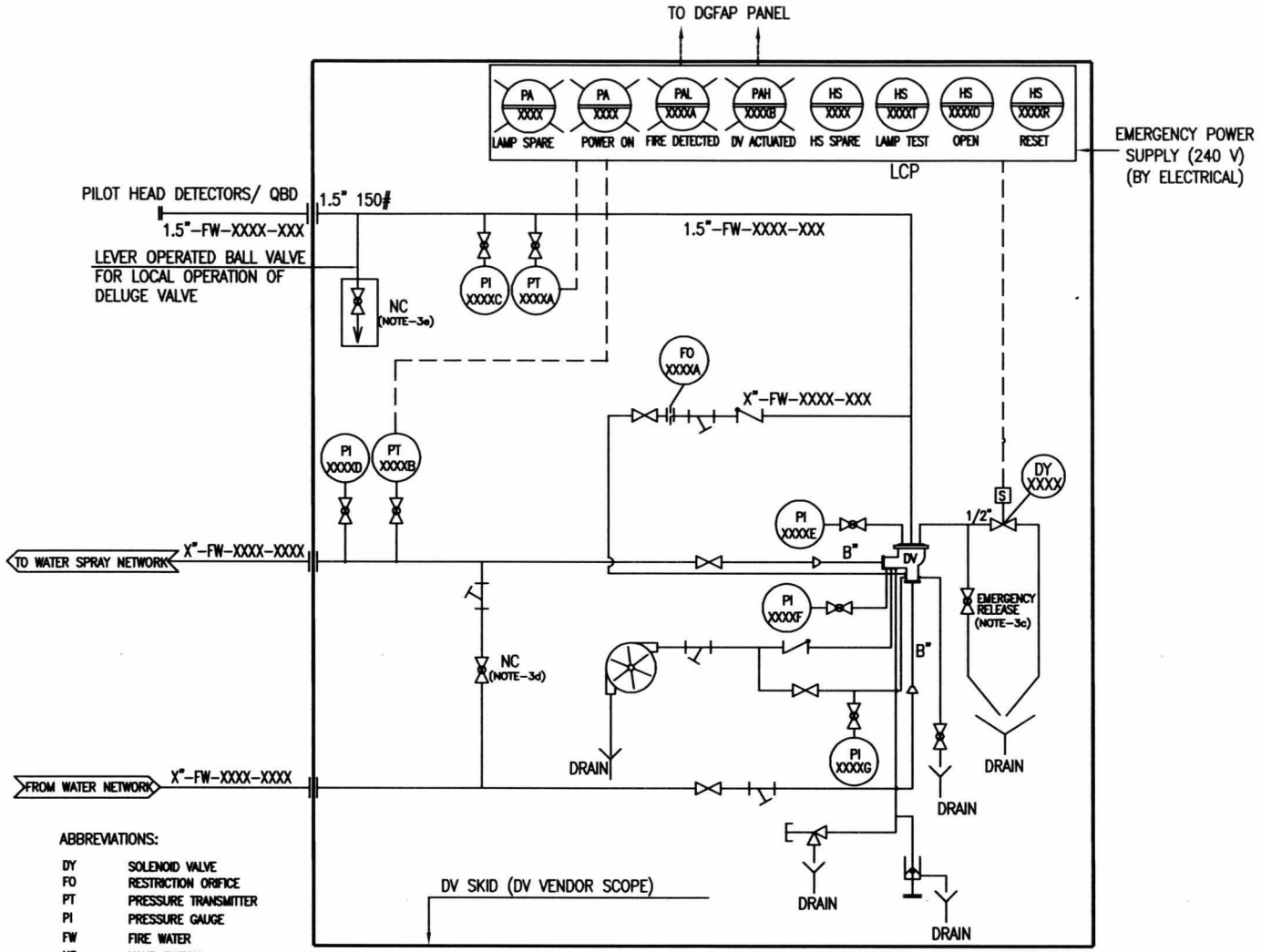
NOTES:

1. DURING NORMAL CONDITION INSTRUMENT AIR SUPPLY SHALL KEEP LINE PRESSURISED TO CLOSE THE DELUGE VALVE.
2. RESTRICTION ORIFICE PROVIDED IN QBD LINE SHALL BE SIZED SUCH THAT BREAKAGE OF ONE QUARTZOID BULB WILL LEAD TO PRESSURE DROP IN LINE CAUSING DV ACTUATION.
3. VARIOUS METHODS OF DV ACTUATION ARE AS UNDER:
   a. AUTOMATIC ACTUATION THROUGH PRESSURE DROP IN DETECTION LINE.
   b. AUTOMATIC ACTUATION THROUGH F&G INTERLOCK.
   c. MANUAL/LOCAL ACTUATION THROUGH HAND SWITCH PROVIDED IN LCP.
   d. REMOTE ACTUATION THROUGH SOFT HANDSWITCH IN F&G PLC CONSOLE.
   e. MANUAL/LOCAL ACTUATION THROUGH EMERGENCY RELEASE.
   f. MANUAL/LOCAL ACTUATION USING BYPASS VALVE.
   g. MANUAL/LOCAL ACTUATION USING DETECTION LINE DRAIN VALVE.
4. PRESSURE TRANSMITTER(S) ON THE DETECTION LINE ARE LOCATED OUTSIDE THE SCHEME. SAME SHALL BE CONNECTED TO ESD PLC AND FURTHER CONNECTED TO F&G PLC.
5. "OPEN DV" HAND SWITCH SHALL ACTUATE THE DELUGE VALVE ONLY.
6. "RESET DV" HAND SWITCH SHALL RESET THE DELUGE VALVE ONLY.

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Annexure-D: Deluge Valve Scheme-4(Hydraulic Detection for Transformers etc.)

DV skid nomenclature: A" X B" ([Fire water inlet and outlet size to DV skid] X [DV size])



ABBREVIATIONS:

DY	SOLENOID VALVE
FO	RESTRICTION ORIFICE
PT	PRESSURE TRANSMITTER
PI	PRESSURE GAUGE
FW	FIRE WATER
HS	HAND SWITCH
DGFAP	DATA GATHERING & FIRE ALARM PANEL
DV	DELUGE VALVE
PAL	PRESSURE ALARM LOW
PAH	PRESSURE ALARM HIGH
QBD	QUARTZOID BULB DETECTOR

CAUSE & EFFECT DIAGRAM:

No.	Description	Tag no.	Signal Type	From	Condition
1	Detection Line Pressure	PT-XXXXA	AI	Field	Low
2	DV Actuation Line Pressure	PT-XXXXB	AI	Field	High
3	Open Push Button at LCP	HS-XXXXO	DI	Field	Close
4	Reset Push Button at LCP	HS-XXXXR	DI	Field	Close
5	Test Push Button at LCP	HS-XXXXT	DI	Field	Close

Relay Logic Action						
Action	Open	Reset	ON	ON	Contact Close	Contact Close
Description	Deluge Valve SOV	Deluge Valve SOV	Fire Detected Lamp at LCP	DV Actuated Lamp at LCP	Fire Detected to DGFAP	DV Actuated to DGFAP
Tag	DY-XXXX	DY-XXXX	PAL-XXXXA	PAH-XXXXB	PAL-XXXXC	PAH-XXXXD
No.	1	2	3	4	5	6
1			X		X	
2				X		X
3	X					
4		X				
5			X	X		

LEGENDS:

- FRANGIBLE BULB/ QBD
- REDUCER
- DV — DELUGE VALVE
- DRIP VALVE
- S, DY — SOLENOID OPERATED VALVE (AUTO RESET)
- BALL VALVE
- GATE VALVE
- WATER MOTOR GONG (ALARM)
- NON RETURN VALVE
- DRAIN VALVE
- ANGLE VALVE
- STRAINER

SIGNALS & INDICATIONS

- INSTRUMENT SIGNAL
- LCP MOUNTED(LAMP)
- LCP MOUNTED

NOTES:

1. DURING NORMAL CONDITION FIRE WATER SUPPLY SHALL KEEP LINE PRESSURISED TO CLOSE THE DELUGE VALVE.
2. RESTRICTION ORIFICE PROVIDED IN QBD LINE SHALL BE SIZED SUCH THAT BREAKAGE OF ONE QUARTZOID BULB WILL LEAD TO PRESSURE DROP IN LINE CAUSING DV ACTUATION.
3. VARIOUS METHODS OF DV ACTUATION ARE AS UNDER:
   a. AUTOMATIC ACTUATION THROUGH PRESSURE DROP IN DETECTION LINE.
   b. MANUAL/LOCAL ACTUATION THROUGH HAND SWITCH PROVIDED IN LCP.
   c. MANUAL/LOCAL ACTUATION THROUGH EMERGENCY RELEASE.
   d. MANUAL/LOCAL ACTUATION USING BYPASS VALVE.
   e. MANUAL/LOCAL ACTUATION USING DETECTION LINE DRAIN VALVE.
4. OPEN & RESET SHALL BE SEPARATE CONTACTS & LATCHING SHALL BE DONE AT LCP.
5. PRESSING OF "LAMP TEST" HAND SWITCH SHALL ACTIVATE ALL LAMPS IN THE LCP.

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50 के०जी० तथा 75 के०जी० क्षमता के सूखा रसायन पाउडर अग्निशामक हेतु मानक विनिर्देश

STANDARD SPECIFICATION FOR 50 KG. & 75 KG. CAPACITY DRY CHEMICAL POWDER EXTINGUISHER

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved By	
4	24.08.18	REVISED & ISSUED AS STD. SPEC.	GAURAV SINGH	GYAS	RS	RKT
3	06.07.10	REVISED AND ISSUED AS STD. SPEC.	AS	RKS	RBB	ND
2	29.04.08	REVISED AND ISSUED AS STD. SPEC.	GAURAV	RKS	NK	VC
1	25.6.99	REVISED AND ISSUED AS STD. SPEC.	RC	PCS	MMK	AS
0	18.1.93	ISSUED AS STANDARD SPECIFICATION	RB	MMK	RPB	RNS

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Abbreviations:

DCP	DRY CHEMICAL POWDER
IS	INDIAN STANDARD
OISD	OIL INDUSTRY SAFETY DIRECTORATE
PESO	PETROLEUM EXPLOSIVE SAFETY ORGANISATION (Formerly known as CCOE)

Structural Standards Committee

Convenor: Mr. Rajanji Srivastava

Members:
Mr. Anurag Sinha
Mr. VK Panwar
Mr. Samir Das
Mr. Amitabh Kishore
Mr. Gyasuddin
Mr. Charanjit Singh (Proj.)
Mr. Ravindra Kumar (Const.)

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1.0 SCOPE

This specification lays down the requirements regarding material, shape, construction, chemical charges, anticorrosive treatment, painting, test, safety, reliability and performance for trolley mounted dry powder fire extinguishers of capacities 50 kg and 75 kg.

2.0 CODES AND STANDARDS

IS: 16018	Specification for performance and construction of wheeled fire Extinguisher
OISD-GDN-115	Guidelines on Fire Fighting, Equipment and Appliances in Petroleum Industry

Note: - Latest Edition of all standard documents shall be followed.

3.0 DESIGN REQUIREMENTS

3.1 Fire extinguisher shall be as per IS: 16018.

3.2 The method of expulsion of dry powder shall be by means of pressure produced from compressed or liquefied gas from gas cylinder attached to the body and suitably mounted on trolley.

3.3 Propellant for cartridge operated wheeled fire extinguisher shall be CO_2 gas type and having maximum dew point of -55°C.Gas cartridge shall conform to IS 4947 in all aspects.

3.4 Chemical content for Dry chemical powder used as extinguishing media shall cover more than 50% of Mono ammonium phosphates of total composition of the extinguishing powder, and shall comply with IS 14609, with maximum fill density as specified in IS: 16018.

3.5 The recommended capacity with filling tolerance/ Nominal charge of the dry powder extinguisher when filled for the various capacities shall be as under:

Nominal Size (Kg)	Dry Powder content (Kg. minimum.)
50	50 ±2% by mass
75	75±2% by mass

4.0 MATERIAL OF CONSTRUCTION

4.1 The material ~~of~~ for construction of various parts of Fire Extinguisher shall be as per IS: 16018.

4.2 The body shall be cylindrical made up of welded Low carbon steel (Mild steel) / stainless Steel. The welding of cylinder shall conforming to requirements of IS 9595.

4.3 All internal and external surface of the body shall be completely coated with an anti corrosive Material. Thickness of the coating shall be measured as per IS: 3203. Testing of anti-corrosive Treatment shall be complying with IS: 10658.

5.0 SAFETY CLIP

Safety Clip should be provided to prevent accidental actuation of piercing mechanism.

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6.0 COLOUR AND MARKING

Each extinguisher shall be painted fire red confirming to shade No. 536 of IS 5. Each extinguisher shall be clearly and permanently marked with the information specified in IS: 16018 along with the BIS certification mark, operating instruction and purchaser's name.

7.0 TESTING INSPECTION AND APPROVALS

Each fire extinguisher shall be complying with test requirement specified in IS: 16018
Wheeled fire extinguishers intended for use on class ABC fires shall be tested for 6A and 144B fire rating system as specified in IS 15683.

A clearance/approval certificate from the PESO, Nagpur shall be submitted for each gas cartridge supplied with the DCP extinguishers.

EIL or its authorised representatives shall have access at all reasonable times to the manufacturer's works where the extinguishers are being manufactured or being tested.

8.0 INFORMATION REQUIRED FROM VENDOR

8.1 The vendor shall furnish the following information along with the offer and for approval prior to fabrication.

- General arrangement of trolley mounted extinguisher showing plan and elevation.
- Fabrication details and plate thickness calculation for pressure vessel.
- Catalogues for all bought out items with Model No. If any.

8.2 Following information shall be furnished by the vendor along with the supply of extinguisher:

- Instruction book(s) - Instruction book(s) for guidance of the user including both the operating and normal maintenance procedures shall be supplied. The book(s) shall include an itemized and illustrated part list/spare parts list giving reference number of all the wearing parts.
- Duly approved final drawings listed in clause 8.1.
- A clearance/approval certificate from PESO as described in clause 7.

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मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION
CIVIL AND STRUCTURAL WORKS

सामान्य परिधि
GENERAL SCOPE

Rev No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	28.02.2025	REVISED AND REISSUED AS SPECIFICATION	RGA	VIKRAM	AS	MN
5	04.07.2019	REAFFIRMED AND REISSUED AS SPECIFICATION	AVM	AJS	RS	RKT
4	28.03.2013	REAFFIRMED AND REISSUED AS SPECIFICATION	AJS	RS	PKM	DM
3	26.02.2008	REAFFIRMED AND REISSUED AS SPECIFICATION	PKB	PKM	VK	VC
2	08.06.2001	REAFFIRMED AND REISSUED AS SPECIFICATION	DPN	RPM	SCJ	MI
1	02.03.1994	ISSUED AS STD. SPECIFICATION		HM	GPL	AS

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Abbreviations:

IS : Indian Standards

Structural Standards Committee:

Convenor: Mr. Anurag Sinha

Members:
Mr. Virender Goel
Mr. Deepak Agrawal
Ms. Alpana Srivastava
Dr. Sudip Paul
Mr. Charanjit Singh (Projects)
Mr. Indrajit Neog (Construction)
Ms. Papia Mandal
Mr. Vikram Kumar Gupta

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1. These specifications establish and define the material and constructional requirements for CIVIL and STRUCTURAL WORKS.

2. Methods of measurements are indicated in these specifications; however, if not specified, latest revision of IS 1200 shall be applicable.

3. Providing and operating all necessary measuring and testing devices/ equipments including all materials and consumables are included in the scope of work. No separate measurement or payment for testing the quality of work and materials shall be made; rates quoted for various items shall be deemed to include the cost of such tests which are required to ensure achievement of specified quality.

4. All materials shall be of standard quality, manufactured by renowned concerns conforming to Indian Standards or equivalent, and shall have IS mark as far as possible unless otherwise approved by the Engineer-in-Charge. Wherever Vendor List is attached in the Tender document, the same shall be followed. The Contractor shall get all materials approved by the Engineer-in-Charge prior to procurement and use. The Contractor shall furnish manufacturer's certificates for the materials supplied by him when asked for. Further to that he shall get the materials tested from an approved test house if asked for by the Engineer-in- Charge. The cost for all the tests and test certificates for the material procured by the Contractor shall be borne by the Contractor. No separate payment shall be made for the testing. The Engineer-in-Charge shall have the right to determine whether all or any of the materials are suitable. Any materials procured or brought to site and not conforming to specifications and satisfaction of the Engineer-in-Charge shall be rejected and the Contractor shall have to remove the same immediately from site at his own expense and without any claim for compensation due to such rejection.

5. Wherever referred to in the tender document, only the latest version of BIS Specifications, Codes of Practice, etc. shall be applicable.

6. Wherever the Contractor executes civil and structural works involving buildings, equipment foundations, supporting structures, pipe racks, etc., the following works are deemed to have been included in the quoted rates for various works.

   - Marking of centre lines of foundations etc.
   - Establishing layout and levels of foundations and superstructure etc., including establishment of reference lines, bench marks on various floors, platforms etc.
   - General upkeep of the construction site, till completion of works and handing over.
   - Preparation of BBS.
   - Preparation of Fabrication drawings and getting approval from Engineer-in-Charge after incorporating all the comments.
   - Preparation of "As-Built" scheme of civil-structural drawings indicating constructed details including levels, centre lines, layouts, member sizes, MTO etc. complete.

7. The provisions of Schedule of Rates, specifications and drawings shall be read in conjunction with each other and in case of conflict amongst them, clarification shall be obtained from the Engineer-in-Charge whose decision shall be final and binding. However, the following procedure may generally be followed:

   - Description of items in schedule of rates shall be followed when provisions therein are different from those in specifications.

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- Where the description of item does not call for some specific requirement but the same is given in specifications, the specifications shall be followed in addition to the requirement given in description of item.

- Where drawings call for requirements different from or additional to those given in item description and specifications, the decision of the Engineer-in-Charge shall be obtained as to what shall be followed.

- All relevant General notes and Safety notes shall be followed

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मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

सामग्री
MATERIALS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
7	13.03.25	UPDATED & REISSUED	MI	AJS	ANURAG SINHA	M. NANDI
6	25.02.21	UPDATED & REISSUED	TK	AJS	AS	S.MAZUMDAR
5	16.05.16	UPDATED & REISSUED	MK	AJS	RS	R.NANDA
4	21.08.14	UPDATED & REISSUED	ASR	AS	PKM	S.CHANDA
3	19.06.09	REAFFIRMED & REISSUED	AS	SCH	VINAY KUMAR	N. DUARI
2	18.02.00	UPDATED & REISSUED	DPN	SKP	SC JAIN	A. SONI

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Abbreviations:

API	:	American Petroleum Institute
ASTM	:	American Society for Testing & Materials
BIS	:	Bureau of Indian Standards
BS	:	British Standard
C&D Waste	:	Construction and Demolition Waste
DIN	:	Deutsches Institut' für Normung
EC	:	Emulsifiable Concentrate
IS	:	Indian Standards
PCC	:	Plain Cement Concrete
PVC	:	Poly Vinyl Chloride
RA	:	Recycled Aggregates
RCA	:	Recycled Concrete Aggregates
RCC	:	Reinforced Cement Concrete

Structural Standards Committee

Convenor: **Mr. Anurag Sinha**

Members:
Mr. Virender Goel
Mr. Deepak Agrawal
Ms. Alpana Srivastava
Dr. Sudip Paul
Ms. Papia Mandal
Mr. Vikram Kumar Gupta
Mr. Charanjit Singh (Projects)
Mr. Indrajit Neog (Construction)

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1.0 SCOPE

1.1 This specification establishes and defines the requirements of various materials to be used in Civil and Structural works.

1.2 Whenever any reference to BIS Codes is made, the same shall be taken as the latest revision (with all amendments issued thereto) as on the date of submission of the bid.

1.3 Apart from the BIS Codes mentioned in particular in the various clauses of this specification, all other relevant codes related to specific job under consideration regarding quality, tests, testing and/ or inspection procedures shall be applicable. Reference to some of the Codes in the various clauses of this specification does not limit or restrict the scope of applicability of other referred or relevant codes.

1.4 In case of any variation/contradiction between the provision of BIS Codes and this specification, the provision given in this specification shall be followed.

1.5 All materials shall be of standard quality and shall be procured from renowned sources/ manufacturers approved by the Engineer-in-Charge. It shall be the responsibility of the Contractor, to get all materials/ manufacturers approved by the Engineer-in-Charge prior to procurement and placement of order.

1.6 Whenever called for by the Engineer-in-Charge all tests of the materials as specified by the relevant BIS Codes shall be carried out by the Contractor in an approved laboratory and test reports duly authenticated by the laboratory, shall be submitted to the Engineer-in-Charge for his approval. If so desired by the Engineer-in-Charge, tests shall be conducted in the presence of the Engineer-in-Charge or his authorized nominee.

1.7 Quality and acceptability of materials not covered under this specification shall be governed by the relevant BIS Codes. In case BIS code is not available for the particular material, other codes e.g. BS or DIN or API/ ASTM shall be considered. The decision of Engineer-in-Charge, in this regard, shall be final and binding on the Contractor.

1.8 Whenever asked for, the Contractor shall submit representative samples of materials to the Engineer-in-Charge for his inspection and approval. Approval of any sample does not necessarily exempt the Contractor from submitting necessary test reports for the approved material, as per the specification/relevant BIS Codes.

1.9 The Contractor shall submit manufacturer's test reports on quality and suitability of any material procured from them and their recommendation on storage, application, workmanship etc. for the intended use. Submission of manufacturer's test reports does not restrict the Engineer-in-Charge from asking fresh test results from an approved laboratory of the actual material supplied from an approved manufacturer/ source at any stage of execution of work.

1.10 All costs relating to or arising out of carrying out the tests and submission of test reports and or samples to the Engineer-in-Charge for his approval during the entire tenure of the work shall be borne by the contractor and included in the quoted rates.

1.11 Materials for approval shall be separately stored and marked, as directed by the Engineer-in-Charge and shall not be used in the works till these are approved.

1.12 All rejected materials shall be immediately removed from the site by the Contractor at his own cost.

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2.0 REFERENCES

As mentioned in the respective clauses.

3.0 WATER

3.1 Water used in construction for all civil & structural works shall be clean and free from injurious amount of oil, acids, alkalies, organic matters or other harmful substances which may be deleterious to concrete, masonry or steel. The pH value of water sample shall be not less than 6. Potable water shall be considered satisfactory. Underground water can also be used with the prior approval of Engineer-in-Charge, if it meets all the requirements of IS 456.

3.2 Tests on water samples shall be carried out in accordance with IS 3025 and they shall fulfill all the guidelines and requirements given in IS 456.

3.3 The Engineer-in-Charge may require the Contractor to prove, that the concrete prepared with water, proposed to be used, shall have average 28 days compressive strength not lower than 90% of the strength of concrete prepared with distilled water.

3.4 The Engineer-in-Charge may require the Contractor to get the water tested from an approved laboratory before starting the construction work and in case the water contains any oil/ organic matter or an excess of acid, alkalies or any injurious amount of salts etc., beyond the permissible maximum limits given in IS 456, the Engineer-in-Charge may refuse to permit its use. In case the water is supplied by the owner, contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense. In case there is any change in source of water, water samples shall be tested again to meet the specified requirements.

3.5 Water shall be stored in tin barrels, steel tanks or water-tight reservoirs made with bricks / stone or reinforced concrete. Brick/ stone masonry reservoirs shall have RCC base slab and shall be plastered inside, with 1 part of cement and 4 parts of sand and finished with neat cement punning. These reservoirs shall be of sufficient capacity to meet the water requirement, at any stage of construction.

3.6 Water for curing shall be of the same quality as used for concreting and masonry works. Sea water shall not be used for preparation of cement mortar, concrete as well as for curing of plain/reinforced concrete and masonry works. Sea water shall not be used for hydrotesting and checking the leakage of liquid retaining structures also.

4.0 AGGREGATE

4.1 General

4.1.1 Coarse and fine aggregates for Civil and Structural Works shall conform in all respects to IS 383 (Specification for coarse and fine aggregate for concrete). Aggregates shall consist of naturally occurring (crushed or uncrushed) stones, gravel and sand or a combination thereof or manufactured aggregates produced from other than natural sources. These shall be chemically inert, hard, strong, dense durable, clear and free from veins, adherent coatings, injurious amount of disintegrated pieces, alkalies, free lime, vegetable matter and other deleterious substances such as iron pyrites, coal, lignite, mica, shale, sea shells etc. Naturally occurring aggregates shall be obtained from an approved source known to produce the same satisfactorily.

Manufactured aggregates shall consist of Iron and Steel slag aggregates, Copper slag aggregates or aggregates made from Construction & Demolition (C&D) waste such as Recycled Aggregates (RA) and Recycled Concrete Aggregates (RCA). RA shall comprise of waste from concrete, brick, tiles, stone, etc. and RCA shall be derived from concrete after requisite processing. Extent of utilization of manufactured aggregates in RCC and PCC works shall be as per Table-1 of IS 383.

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4.1.2 Source and type of aggregates shall be got approved by the Engineer-in-Charge prior to procurement. Change in source and type of aggregates, at later stage, shall not be generally permitted; but under specific circumstances, Engineer-in-Charge can allow a change in source and type of aggregate. Contractor shall produce necessary test certificates from approved laboratories regarding the quality and suitability of the proposed aggregates and submit fresh mix design for approval of the Engineer-in-Charge. Any such change, if permitted by the Engineer-in-Charge, shall be without any time and cost implication to the owner.

4.1.3 Aggregates which may chemically react with alkalies of cement or might cause corrosion of the reinforcement, shall not be used. If so desired by the Engineer-in-Charge, the Contractor shall carry out alkali reactivity tests and submit the results to him for approval.

4.1.4 The maximum quantities of deleterious materials in the aggregates as determined in accordance with IS 2386 - Part II (Methods of Test for aggregates for concrete), shall not exceed the limits defined in IS 383. No special test is required to prove the absence of such deleterious matters if the aggregates are from a known source with satisfactory prior data on the properties of concrete made with them. In case of newly developed quarry sites, the contractor shall submit necessary test results as per IS 383 and IS 2386 to the Engineer-in-Charge prior to his acceptance and approval. The method of Sampling shall be in accordance with the requirements given in IS 2430.

4.1.5 Coarse and fine aggregates shall be batched separately. All-in-aggregate shall be used only where specifically permitted by the Engineer-in-Charge.

Separate sieve analysis and grading curves shall be prepared by the Contractor for any/ all batches of coarse and fine aggregates, and submitted to the Engineer-in- Charge, whenever asked for, to ensure conformity with those submitted along with the mix design.

4.1.6 Whenever required by Engineer-in-Charge, the aggregates (coarse/ fine) shall be washed and/ or sieved by the contractor before use in the works to obtain clean and graded aggregate at no extra cost to the owner.

4.1.7 Aggregates not in conformity with the specifications shall be rejected and the Contractor shall immediately remove them from the site of work.

4.2 Coarse Aggregates

4.2.1 Coarse aggregates are the aggregates, which are retained on 4.75 mm BIS Sieve. It shall have a specific gravity not less than 2.6 (saturated surface dry basis).

The grading of the aggregates shall be as per IS 383 or as required by the mix design, to obtain densest possible concrete. For this purpose, the contractor shall submit to the Engineer-in-Charge at least three sets of mix design and test results, each with different gradings of coarse aggregates, proposed to be used. The Engineer-in-Charge may allow "All-in-aggregates" to be used provided they satisfy the requirements of IS 383.

4.2.2 Coarse aggregates may be obtained from

a) Uncrushed gravel or stone which results from natural disintegration of rock

b) Crushed gravel or stone which results from crushing of gravel or hard stone

c) Partially crushed gravel or stone which results from blending of (a) and (b) above

d) Manufactured from other than natural sources, by processing materials, using thermal or other processes such as separation, washing, crushing and scrubbing. Manufactured coarse

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aggregate may be RCA or RA processed from C&D waste and may be supplied as single sized or graded.

4.3 Fine Aggregates

4.3.1 Fine aggregates are the aggregates which pass through 4.75 mm BIS sieve but not more than ten percent (10%) pass through 150 micron BIS sieve. These shall comply with the requirements of grading zones I, II and III of IS 383. Fine aggregates conforming to grade zone IV shall not be used for reinforced concrete works.

Sand from sea shores, creeks or river banks affected by tides, shall not be used for filling or concrete works.

4.3.2 Fine aggregates shall consist of

a) Natural Sand : Fine aggregate resulting from natural disintegration of rock and which has been deposited by streams or glacial agencies. This may also be called as uncrushed sand.

b) Crushed Sand –
   i) Crushed Stone Sand : Fine aggregate produced by crushing hard stone
   ii) Crushed Gravel Sand : Fine aggregate produced by crushing natural gravel

c) Mixed Sand : Fine aggregate produced by blending natural sand and crushed stone sand or crushed gravel sand in suitable proportions.

d) Manufactured Fine Aggregate : Fine aggregate manufactured from other than natural sources, by processing materials, using thermal or other processes such as separation, washing, crushing and scrubbing. Manufactured fine aggregate may be RCA processed from C&D waste.

4.4 Sampling and Testing

The Contractor shall carry out all tests including mix designs of concrete, at his own expense, at the start of work as well as during any stage of construction as required by the Engineer-in-Charge. Test shall be carried out in accordance with IS 516 - Methods of test for strength of concrete and IS 2386 - Methods of test for aggregates for concrete. Testing shall be carried out from laboratories approved by the Engineer- in-Charge. The method of sampling shall be in accordance with the requirements given in IS 2430.

4.5 Storage of Aggregates

4.5.1 Storage of all types of aggregates at site of work shall be at contractor's expense and risk and shall be stored as specified in IS 4082. Aggregates shall in no case be stored near to the excavated earth or directly over ground surface.

4.5.2 The Contractor shall maintain sufficient quantities of aggregates, near to the place of work, required for the continuity of the work. Each type and grade of aggregate shall be stored separately on hard, firm surface having adequate slope for drainage of water.

4.5.3 Aggregates delivered at site in wet condition or becoming wet due to rain or any other means, shall not be used for atleast 24 hours. The Contractor shall obtain prior approval of the Engineer-in-charge for the use of such aggregates and shall adjust the water content in accordance with IS 2386 to achieve the desired mix. In the absence of test results, and to allow variation in mass of aggregates and water content on account of moisture content, the

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Contractor can make suitable adjustment in the masses as per IS 456, for preparation of nominal mix concrete only.

5.0 SAND

5.1 Sand for Masonry Mortars

5.1.1 The sand shall consist of natural sand, crushed stone sand or crushed gravel sand or a combination of any of these. The sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain the amount of clay, silt and fine dust more than specified in IS 2116.

5.1.2 The sand shall not contain any harmful impurities such as iron pyrites, alkalis, salts, coal or other organic impurities, mica, shale or similar laminated materials, soft fragments, sea shells in such form or in such quantities as to affect adversely the hardening, strength or durability of the mortar.

5.1.3 Unless found satisfactory as a result of further tests as may be specified by the Engineer-in-Charge, or unless evidence of such performance is offered which is satisfactory to him, the maximum quantities of clay, fine silt, fine dust and organic impurities in the sand, when tested in accordance with IS 2386, shall not be more than 5% by mass in natural sand, or crushed gravel sand or crushed stone sand. For organic impurities, when determined in accordance with IS 2386, colour of the liquid shall be lighter than that indicated by the standard solution specified in IS 2386.

5.1.4 **Grading of Sand**

The particle size grading of sand for use in mortars shall be within the limits as specified below:

GRADING OF SAND FOR USE IN MASONRY MORTARS

IS SIEVE DESIGNATION IS 460 (PART I)	PERCENTAGE PASSING BY MASS	REF. TO METHOD OF
4.75 mm	100	IS 2386 (Part I)
2.36 mm	90 to 100	
1.18 mm	70 to 100	
600 micron	40 to 100	
300 micron	5 to 70	
150 micron	0 to 15	

In case of a sand whose grading falls outside the specified limits due to excess or deficiency of coarse or fine particles, this shall be processed to comply with the standard by screening through a suitably sized sieve and/or blending with required quantities of suitable sizes of natural sand particles or crushed stone screenings which are by themselves unsuitable. Based on test results and in the light of practical experience with the use of local materials, deviation in grading of sand may be considered by the Engineer-in-Charge. The various sizes of particles of which the sand is composed shall be uniformly distributed throughout the mass.

5.1.5 **Sampling and Testing**

The method of sampling shall be in accordance with IS 2430. The amount of material required for each test shall be as specified in relevant parts of IS 2386. Any test which the engineer-in-charge may require in connection with this, shall be carried out in accordance with the relevant parts of IS 2386.

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If further confirmation as to the satisfactory nature of the material is required, compressive test on cement mortar cubes (1:6) may be made in accordance with IS 2250 using the supplied material in place of standard sand and the strength value so obtained shall be compared with that of another mortar made with a sand of acceptable and comparable quality.

5.2 Sand for Filling

Sand for filling shall meet the requirements of IS 383 and shall be natural sand, hard, strong, free from any organic and deleterious materials. Any sand proposed for filling, shall be used only after it is approved by the Engineer-in-Charge. Sand obtained from sea shores, creeks or river banks affected by tides, shall not be used for filling. Fine aggregates suitable for concreting works shall be suitable for filling also. No sand below grading zone-III as per IS 383 shall be allowed for filling.

6.0 CEMENT

Cement to be used for civil and structural works shall be one of the following. Specific requirement for the type of cement to be used shall be as shown in the drawings or as specified in the contract or as directed by the Engineer-in-Charge.

- Specification for 33/43/53 grade ordinary portland cement — IS 269
- Specification for portland slag cement — IS 455
- Specification for Portland pozzolana cement (fly ash based) — IS 1489 Pt.1
- Specification for Portland pozzolana cement (calcined clay based) — IS 1489 Pt.2
- Specification for Masonry Cement — IS 3466
- Specification for high alumina cement for structural use — IS 6452
- Specification for rapid hardening portland cement — IS 8041
- Specification for Sulphate Resisting Portland cement — IS 12330

6.1 Storage at Site

6.1.1 The storage of cement (lifted from the Owner's godown or procured by the Contractor himself) at the site of work shall be at contractor's expense and risk and shall meet the requirements of IS 4082. The cement shall be stored above ground in a suitable weather tight building or godown and in such a manner as to permit easy access for proper inspection and also to prevent deterioration due to moisture. In the event of any damage occurring to the quality of cement due to faulty storage or on account of negligence on the part of the contractor, such damages shall be borne by the contractor himself.

6.1.2 All approved cement shall be arranged in batches with type, brand and date of receipt flagged on them. A maximum of eight bags shall be stacked one over the other. Cement bags shall be used in the same order as received from the manufacturer/ owner. The contractor shall maintain a register, on day-to-day basis, giving the details of the receipt/ consumption, source of supply and type of cement etc. The register shall always be accessible to the Engineer-in-Charge for verification.

6.2 Tests after Delivery

Each consignment of cement supplied by Owner or contractor, shall, after delivery at site and at the discretion of the Engineer-in-Charge, be subjected to any or all of the tests and analyses, required by the relevant Indian Standard Codes. In case the cement is supplied by the owner, the contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense. The contractor shall carry out and bear the cost of all tests and

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analyses required to ensure quality of cement before using in actual works, irrespective of the fact whether the cement is supplied by the Owner or procured by him.

6.3 Rejection

The Engineer-in-Charge may reject at his discretion any cement, notwithstanding the manufacturer's certificate or failing to meet the requirements of relevant BIS Codes for testing of cement. He may similarly reject any cement which has deteriorated owing to inadequate protection from moisture or due to intrusion of foreign matter or any other cause. Any cement which is considered defective, shall not be used and shall be promptly removed from the site by the contractor.

7.0 STEEL

7.1 General

All steel bars, sections, plates, and other miscellaneous steel materials, etc shall be free from loose mill scales, rust as well as oil, mud, paint or other coatings. The materials, construction specifications such as dimensions, shape, weight, tolerances, testing etc, for all materials covered under this section, shall conform to respective BIS Codes. Steel sections shall be conforming to IS 808 or IS 12778.

7.2 Reinforcement Bars

Reinforcement bars, to be used for civil and structural works shall be one of the following or in combination thereof.

- Mild Steel and Medium Tensile Steel Bars and Hard-Drawn Steel Wire for Concrete Reinforcement — IS 432
- Specification for hard drawn steel wire fabric for concrete reinforcement — IS 1566
- Specification for plain hard-drawn steel wire for prestressed concrete. — IS 1785
- Specification for High strength deformed steel bars and wires for concrete reinforcement. — IS 1786
- Specification for indented wire for prestressed concrete. — IS 6003
- Specification for fusion bonded epoxy coated reinforcing bars — IS 13620

7.3 Structural Steel

Structural steel to be used for general structural purposes shall be one of the following or in combination thereof.

Structural steel sections shall conform to following BIS Codes:

- Steel tubes for structural purposes. — IS 1161
- Mild Steel Tubes, tubulars and other wrought steel fittings. — IS 1239
- Steel for general structural purposes (Grade A/BR/B0). — IS 2062
- Hollow steel sections for structural use. — IS 4923

7.4 Miscellaneous Steel Materials

Miscellaneous steel materials shall be conforming to the following BIS Codes.

- Expanded Metal Steel Sheets for General purposes. — IS 412
- Mild steel bars of anchor bolts, rungs, metal inserts, grating etc.) — IS 2062
- Hexagonal head bolts, screws & nuts of product grade C. — IS 1363

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- Cold formed light gauge structural steel sections. IS 811
- Technical supply conditions for threaded steel fasteners. IS 1367
- Plain washers IS 2016
- Steel wire ropes for general engineering purposes IS 2266
- Thimbles for wire ropes. IS 2315
- Bulldog grips. IS 2361
- Mild Steel Tubes, tubulars and other wrought steel fillings. (For Hand rail tubular sections). IS 1239
- Drop forged sockets for wire ropes for general engineering purposes. IS 2485
- Steel chequered plates. IS 3502
- Hexagonal bolts and nuts (M42 to M150). IS 3138
- High Strength Structural Bolts IS 3757
- High Strength Bolts IS 4000

7.4.1 Anchor Bolts

Material for Anchor Bolts such as MS bars, washers, nuts, pipe sleeves and plates etc. shall be as per relevant BIS Codes mentioned above.

7.5 Storage

The storage of all materials at site of work shall be at the contractor's expense and risk and shall be done as per the requirements given in IS 4082. The contractor shall maintain the proper records of receipt/consumption. The records shall always be accessible to the Engineer-in-Charge for verification.

The reinforcement bars, structural steel sections and other miscellaneous steel materials etc, shall be stored in such a way as to avoid and prevent deterioration, corrosion, bending, twisting and wrapping. In case of any damage occurring to the material on account of faulty storage or negligence by the contractor, same shall be borne by the contractor himself.

7.6 Tests after Delivery

Materials supplied by the Owner or Contractor, shall, after delivery at site and at the discretion of Engineer-in-Charge, be subjected to any or all of the tests, required by the relevant BIS Codes. The Contractor shall carry out and bear the cost of such tests irrespective of the fact whether the material is procured by the Owner or the contractor. In case steel is supplied by the Owner, the Contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense.

7.7 Rejection

The Engineer-in-charge may reject at his discretion any material, not withstanding the manufacturer's certificate or failing to meet the requirements of relevant BIS Codes for testing of materials. He may similarly reject any material, which has deteriorated or corroded etc., due to improper storage, handling or transport. Defective materials shall not be used and removed from the site by the contractor at his own expense.

8.0 BRICK

8.1 General

All Bricks used for masonry works shall conform to the requirements of following BIS Codes:

- Common Burnt Clay Bricks- Specifications IS 1077

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- Pulverized Fuel Ash Cement Bricks- Specifications IS 16720
- Pulverized Fuel Lime Ash Bricks- Specifications IS 12894
- Burnt Clay Fly Ash Bricks- Specifications IS 13757

8.1.1 Common Burnt Clay Bricks

Bricks for masonry works shall conform to IS 1077 - Specification for common burnt clay building bricks and shall be of class 5.0 (with minimum compressive strength of 5.0 N/mm^2). Specific requirement for any other class of bricks shall be as shown in drawings or as described in the contract for a particular site or type of work. Physical requirements, quality, dimensions, tolerances etc. of common burnt clay building bricks shall conform to the requirements of IS 1077.

Bricks shall be hand - moulded or machine moulded and shall be made from suitable soils. The bricks shall have smooth rectangular faces with sharp corners and shall be well burnt, sound, hard, tough and uniform in colour. These shall be free from cracks, chips, flaws, stone or humps of any kind.

8.1.2 Pulverized Fuel Ash Cement Bricks

Pulverized fuel ash-cement bricks shall conform to IS 16720. The bricks shall be sound, free from visible cracks and uniform in shape and colour. The brick shall have total pulverized fuel ash content not less than 35 percent of the mass of bricks. Pulverized fuel ash shall conform to IS 3812 (Part 1) or IS 3812 (Part 2).

8.1.3 Fly Ash Lime Bricks (FALG Bricks)

The Fly Ash Lime Bricks (FALG Bricks) shall conform to IS 12894. Visually the bricks shall be sound, compact and uniform in shape free from visible cracks, warpage, flaws and organic matter. Fly ash shall conform to IS 3812.

8.1.4 Burnt Clay Fly Ash Bricks

The burnt clay fly ash bricks shall conform to IS 13757. The bricks shall be sound, compact and uniform in shape and colour. Bricks shall have smooth rectangular faces with sharp and square corners. The bricks shall be free from visible cracks, flaws, warpage, nodules of free lime and organic matter, the bricks shall be hand or machine moulded. The bricks shall have frog of 100 mm in length 40 mm width and 10 to 20 mm deep on one of its flat sides. If made by extrusion process may not be provided with frogs. Fly Ash shall conform to grade I or grade II of IS 3812.

8.1.5 Mechanized Autoclave Fly Ash Lime Brick

These bricks shall be machine moulded and prepared in plant by appropriate proportion of fly ash and lime. The autoclave fly ash bricks shall conform to IS 12894. Visually, the bricks shall be sound, compact and uniform shape, free from visible cracks, warpage and organic matters. The brick shall be solid with or without frog, and of 100/80 mm in length, 40 mm width and 10 to 20 mm deep one of its flat side as per IS 12894. The brick shall have smooth rectangular faces with sharp corners and shall be uniform in shape and colour. Fly ash shall conform to IS 3812 and lime shall conform to class 'C' hydrated lime of IS 712.

8.2 Tests after Delivery

The Contractor shall take samples of each type of brick as directed by the Engineer-in-Charge as per the requirements of IS 5454 and tests shall be carried out as per IS 3495. The cost for carrying out any or all the tests, shall be borne by the Contractor. The bricks, when tested, as

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per IS 3495 shall have a minimum average compressive strength, as given in the Code, for a particular class of brick. Water absorption shall not be more than 20% by its dry weight, when soaked in cold water for 24 hours.

Brick samples so approved, shall be deposited with the Engineer-in-Charge. All subsequent deliveries shall be upto the standards of the approved samples.

8.3 Stacking of Bricks

Bricks shall be stored at site as per the requirements given in IS 4082 and shall not be dumped at site. They shall be unloaded from trucks to a place on a levelled surface near to the work site. They shall be stacked in regular tiers even as they are unloaded, to minimise breakages and defacement of bricks. The supply of bricks shall be so arranged that as far as possible, at least two days' requirements of bricks are available at site at any time. Bricks, of different class & types, shall be stacked separately.

8.4 Local Bricks/ Class 3.5 Bricks.

Where shown on drawings, locally available bricks of non modular size (230 mm x 110 mm x 70 mm) in place of bricks of modular size (190 mm x 90 mm x 90 mm) can be used in case the bricks satisfy the other requirements of respective BIS codes. Minimum compressive strength of these bricks shall not be less than 3.5 N/mm^2.

8.5 Concrete Block Masonry

Concrete Block Masonry shall be as per EIL Specification No. 6-68-0016.

9.0 STONE

9.1 General

All Stones used for masonry works shall conform to the requirements of following BIS Codes.

- Method of identification of natural building stones. IS 1123
- Recommendations for dimensions and workmanship of natural building stones for masonry work. IS 1127
- Recommendations for dressing of natural building stones. IS 1129

9.2 Quality of Stones

Stones shall be of approved quality, hard, dense, strong, sound, durable, clean and uniform in colour. They shall also be free from veins, adherent coatings, injurious amount of alkalies, vegetable matters and other deleterious substances such as iron pyrites, coal, lignite, mica, sea shells etc. Unless otherwise approved, stones from one single quarry shall be used for any one work. The strength of stones should be adequate to carry the imposed load and shall meet all the requirements of IS 1905, taking into account the appropriate crushing strength of stone and type of the mortar used. The percentage of water absorption, when tested in accordance with IS 1124, shall not exceed 5 percent.

Stones normally used, shall be small enough to be lifted and placed by hand. The length of the stone shall not exceed 3 times the height. Width of stone on base shall not be less than 150 mm and in no case exceed $3/4^{th}$ thickness of the wall. Height of the stone shall not be more than 300 mm.

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9.3 Unloading/Stacking

The stones shall be unloaded from the trucks to a site near to the place of work as defined in IS 4082 and shall be stacked on a firm ground having adequate stope for drainage. The supply of stones shall be so arranged that as far as possible, at least two days' requirements of stone are available at site at any time.

10.0 ADMIXTURES

10.1 General Requirements for Admixtures

10.1.1 All concrete admixtures shall in general comply with the following BIS Codes unless otherwise stipulated in this specification.

- Specification for integral cement water proofing compounds. IS 2645
- Specification for other admixtures for concrete. IS 9103

10.1.2 Generally, admixtures shall have ISI certification marks. However, even in case of BIS certified admixtures, Engineer-in-Charge may require the Contractor to carry out and submit any or all the tests (as specified in relevant BIS Codes), from BIS approved laboratories, over and above the manufacturer's test certificate, before giving his final approval.

In case, admixtures certified by BIS are not available, the contractor shall submit to the Engineer-in-Charge the type and/or proprietary brand of the admixture from only reputed manufacturers along with necessary test certificates from BIS recognized/ BIS approved laboratories or any other document directed by Engineer-in-Charge for the latter's final approval. In such cases, names of at least two manufacturers shall be submitted to the Engineer-in-Charge for his selection. In case, both the names are rejected, the contractor shall submit a fresh list of two manufacturers for approval by the Engineer-in-Charge.

The Engineer-in-Charge may direct the contractor to submit test results as required by IS 2645 or IS 9103 for any admixture proposed to be used in the concrete in any approved laboratory at his discretion at any stage of the work. The cost of any/all tests required to satisfy compliance with this specification shall be borne by the Contractor.

In case of non-availability of any BIS code for testing and acceptability criteria, relevant American, British or German Code shall be applicable.

10.1.3 Prior approval of the Engineer-in-Charge shall be obtained while using water reducing admixtures in the concrete (PCC/ RCC) or mortar. Other type of admixtures such as accelerating admixtures, retarding admixtures or air entraining admixtures, shall not be used unless specified on the design drawings or prior approval taken from the design approving authority. Once approved, utmost care shall be exercised at site by the Contractor to maintain the consistency in the quality of admixture and the concrete/ mortar so produced.

10.1.4 The suitability and effectiveness of any admixture shall be verified by trial with the designed concrete mixes using cement, aggregates together with any other materials to be actually used in the works as per the direction of Engineer-in-Charge. If two or more admixtures are to be used simultaneously in the same concrete mix, the Contractor must submit necessary test results from an approved laboratory to show their interaction and compatibility. Any/all tests specified in BIS Codes shall be carried out only with the type of material and mix design, to be actually used in the work site.

10.1.5 No admixture shall impair the durability of the concrete nor combine with the ingredients to form harmful compounds nor increase the risk of corrosion of reinforcement. Use of admixtures shall not reduce the dry density of concrete. Once the proportion of admixture has

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been established, strict check shall be maintained not to alter the proportions of ingredients and water-cement ratio of the Design Mix during execution.

10.1.6 The chloride contents in admixtures shall not exceed 2% by mass of the admixture or 0.03% by mass of the cement.

10.1.7 Admixtures which do not meet the requirements stipulated in this specification shall be rejected and shall not be used.

10.2 Water Proofing Compounds

10.2.1 Water proofing compounds shall be mixed with cement only.

10.2.2 The permeability of the specimen with the admixture shall be less than half of the permeability with similar specimen without the use of these compounds. These compounds shall be used in such proportion as recommended by manufacturer but in no case it shall exceed 3% by weight of cement.

10.2.3 The initial setting time of the cement with the use of these compounds shall not be less than 30 minutes and final setting time shall not be more than 10 hours. Test shall be carried out in accordance with IS 4031.

10.2.4 Compressive strength of specimen at 3 days shall not be less than 160 kg/sq.cm nor 80% of the 3 days compressive strength of mortar cubes prepared with same cement and sand only, whichever is higher. Similarly compressive strength at 7 days shall not be less than 220 kg/sq.cm nor less than 80% of the 7 days compressive strength prepared with the same cement and sand only, whichever is higher. The test to determine the compressive strength shall conform to IS 4031.

10.3 Concrete Penetrating Corrosion Inhibiting Admixture shall be as per EIL Specification No. 6-68-0017.

11.0 WATER BARS (WATER STOPS)

11.1 PVC water bars shall be used in reinforced concrete construction of liquid retaining structures or any other structure to safeguard them from hydrostatic pressure and water leakage and any relative movement between two parts of the structure due to thermal loading shrinkage or differential movement of foundations. Wherever desired or shown in the drawings, they shall be used at expansion/contraction/construction joints. These shall be pre-formed and shall provide a permanent water tight seal along the entire joint in the poured concrete structures. These shall also be flexible enough to withstand deflection/displacements at joints arising due to variation of temperatures or settlement of foundations. The minimum thickness of water bar shall be as shown on drawings or described in the schedule of rates and unless otherwise mentioned, these shall be able to withstand a water head of at least 12 meters.

11.2 Performance requirements of PVC water bars shall meet the requirements of IS 12200. These shall be of approved make and of ribbed/ serrated/ plane type with a bulb at the centre. The thickness and width of water bars shall be as per schedule of rates/ drawings but in no case the thickness shall be less than 5 mm and width less than 150 mm. The joining of the water bars shall be carried out by vulcanising strictly as per the manufacturer's specifications. Lapped joints shall not be allowed under any circumstances.

12.0 BITUMEN/BITUMINOUS MATERIALS

Bitumen to be used for various types of work shall meet all the requirements of relevant BIS Codes as given below:

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- Specification of Paving Bitumen IS 73
- Specification for bitumen mastic for flooring IS 1195
- Specification for Bitumen felts for water proofing and damp proofing IS 1322
- Specification for Bituminous compounds for water proofing and caulking purposes IS 1834
- Specification for preformed fillers for expansion joint in concrete pavements and structures IS 1838
- Specification for bitumen mastic for use in water proofing of roofs IS 3037
- Specification for bitumen primer for use in water proofing and damp proofing IS 3384
- Specification for Bitumen Mastic for Tanking and Damp proofing IS 5871
- Specification for Glass fibre base coal tar pitch & bitumen felts IS 7193
- Code of practice for damp proofing using bitumen mastic IS 7198
- Specification for bitumen Mastic, Anti-Static and electrically conducting grade IS 8374

The type and grade shall be as shown on the drawings or as indicated in schedule of quantities or as directed by Engineer-in-Charge. Tests and acceptable criteria shall be as per relevant BIS Codes.

13.0 PVC PIPES

PVC Pipes shall conform to the requirements of IS 4985.

14.0 WOOD/ TIMBER

14.1 Wood recommended for platforms of cold vessels or below cold vessels/ exchangers shall be hard and shall be of group A, grade I, and shall have safe permissible stress of 7 N/mm^2 in compression, perpendicular to grains on outside location as per IS 883. General characteristics like durability, treatability etc. shall conform to IS 883 and IS 3629.

14.2 Timber required to be used for formwork shall be fairly dry before use. It should maintain its shape during the use and even when it comes into contact with moisture from the concrete. Storage of Wood/Timber shall be as per the requirements of IS 4082.

For proper identification and selection of suitable timber for formwork, following codes shall be referred.

- Classification of commercial timbers and their zonal distribution IS 399
- Specification for ballies for general purposes. IS 3337
- Specification for Ply wood for concrete shuttering work. IS 4990

15.0 EPOXY COMPOUNDS

Refer EIL Specification No. 6-68-0056.

16.0 PAINT

16.1 Refer EIL Specification No. 6-79-0020 or the job specification whichever applicable.

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17.0 ANTITERMITE COMPOUNDS

17.1 Following chemicals as per IS 6313 (Part 2 & 3) shall be used for treatment of soil for protection of buildings against attack by subterranean termites:

S.No.	Chemical	Relevant Standard	Dosage* (Chemical Emulsion)
1	Chlorpyrifos 20% Emulsifiable Concentrate (EC)	IS 8944	250ml in 5 litre water 50ml in 1 litre water
2	Imidacloprid 30.5% Suspension Concentrate (SC)	IS 16131	10.5ml in 5 litre water 2.1ml in 1 litre water
3	Bifenthrin 2.5% Emulsifiable Concentrate (EC)	IS 15936	100ml in 5 litre water 20ml in 1 litre water

(*Dosage as specified above or as per Manufacturer's recommendation, whichever is stringent)

18.0 POLYSULPHIDE SEALANTS

Polysulphide Sealants shall conform to IS 12118 and be of approved make. Test conditions and requirements shall be as given in the above referred BIS code.

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मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

मिट्टी का कार्य

EARTHWORK

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	18.03.21	REVISED & REISSUED	TK	AJS	AS	SM
5	21.08.14	REVISED & REISSUED	AJS	AS	PKM	SC
4	19.06.09	REVISED & REISSUED	AS	SCH	VINAY KUMAR	N. DUARI
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2	AUG'94	UPDATED & REISSUED	-	H MATHUR	GP LAHIRI	A. SONI

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Abbreviations:

CNS : Cohesive Non Swelling

Structural Standards Committee

Convenor : Mr. Anurag Sinha

Members:
Mr. C Damodaran
Mr. V.K.Panwar
Mr. Samir Das
Mr. Amitabh Kishore
Mr. Gyasuddin
Mr. Charanjit Singh (Projects)
Mr. Ravindra Kumar (Constn.)

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1.0 SCOPE

This specification deals with earth work in excavation and filling.

2.0 CLASSIFICATION OF SOIL

2.1 Ordinary Soil

2.1.1 Soft Soil/ Loose Soil

Generally any soil which yields to the ordinary application of pick and shovel, or to phawra, rake or other ordinary digging implements such as:

a) Sand, gravel, loam, clay, mud, black cotton soil
b) Vegetables or organic soil, turf, peats, soft shale or loose murrum
c) Mud concrete below ground level
d) Any mixture of soil mentioned above.

2.1.2 Hard/ Dense Soil

Generally any soil, which requires close application of picks or jumpers or scarifier and rippers to loosen the same, such as:

i) Stiff heavy clay, hard shale or compact murrum requiring grafting tool and/ or pick and shovel
ii) Shingle and river or nallah bed boulders
iii) Soling of roads, paths etc. and hard core
iv) Macadam surface of any description (water bound, grouted tarmac etc.)
v) Lime concrete, stone masonry in lime or cement mortar below ground level
vi) Soft conglomerate when the stone can be detached from the matrix with picks and shovels

2.2 Soft Rock

This is fissured/ disintegrated rocky strata, boulders (volume more than 0.028 m^3 and less than 0.400 m^3) and also which cannot be quarried/ excavated by using above manual tools but can be quarried/ excavated manually by using crow bars is classified as soft rock. Soft rock shall include all kinds of stiff and stratified rock, such as shales, thinly bedded phillites, laterite hard conglomerate, lime stone, sand stone and unreinforced cement concrete below ground level. Soft rock may be quarried or split with crow bar or picks and can also be excavated by rippers, dozers and other mechanical equipment, but without the aid of blasting. If required and permitted, light blasting may be restored to, for loosening the materials, but this will not, in any way entitle the material to be classified as "Hard Rock".

2.3 Hard Rock

2.3.1 Hard Rock (Not Requiring Blasting)

This shall include all types of hard and compact rock, having closely spaced fissures or joints, on account of which blasting is not considered necessary and shall not be resorted unless permitted by the Engineer-in charge.

2.3.2 Hard Rock (Requiring General Blasting)

This shall include all types of hard and compact rock occurring in unfissured masses or similar foundations, boulders (volume more than 0.4 m^3) for excavation in which blasting is

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considered necessary such as quartzite, granite, basalt stones, reinforced cement concrete (reinforcement to be cut through but not separated from concrete) below ground level and the like.

2.3.3 **Hard Rock (Requiring Controlled Blasting (Explosive/ Non-explosive)**

This type of excavation becomes necessary when excavation is done in formations, mentioned in Clause 2.3.2, in the vicinity of existing foundations/ structures. Mode of blasting shall be decided by Engineer-in-Charge, keeping in view the sensitivity of structures.

2.3.4 **Hard Rock (Blasting Prohibited)**

Hard rock requiring blasting as described in clause 2.3.2 above, but where blasting is prohibited for any reason and excavation has to be carried out by chiseling, wedging, pneumatic/ hydraulic/ electro-mechanical breaking by using splitter or by chemical means or any other agreed method.

The use of excavation shall not be considered as a reason for classification under hard rock requiring blasting unless clearly found necessary in the opinion of Engineer-in-Charge.

3.0 BACKFILLING MATERIAL

3.1 Suitable Materials:

3.1.1 Back filling suitable material shall be approved by the Engineer-in-charge. Additionally, they shall be free from refuse, large stones or rocks or other material which might prevent proper compaction or cause the compacted fill or embankment to perform inadequately or to have insufficient stability or bearing capacity for the superimposed loads to which it is likely to be subjected.

3.1.2 Back filling of excavation in trenches, foundations and elsewhere shall consist of one of the following materials as shown on drawing, or directed by the Engineer-in-charge.

i) Soil
ii) Selected earth from heaps or brought from borrow areas.

In case i) or ii) are not available, the Engineer-in-charge may approve use of any of the following:

iii) Stone/ Gravel
iv) Sand
v) CNS material.

3.1.3 The material shall be free from refuse, debris, roots, hard lumps and any other foreign organic material.

3.2 Unsuitable Materials

Unsuitable material shall include particles in excess of 75 mm size and that which is:

a) Organic material, logs, stumps and perishable materials.
b) Material susceptible to spontaneous combustion
c) Materials with undefined properties
d) Materials having a moisture content greater than the maximum specified
e) Building rubble and domestic and industrial wastes
f) Soils and rock susceptible to deterioration/ change of their properties.

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g) Clay, silt and other loose or soft soils not in accordance with compaction criteria.
h) Dredged material
i) Material containing gypsum or other soluble salts.

4.0 SETTING OUT

4.1 The Contractor shall be responsible for the true and proper setting out of the work in relation to original points, ***lines**** and ***levels**** of reference and for the correctness of the levels, dimensions and alignment of all parts of the work. If at any time during progress of the work any error appears or arises in the position of level, dimension, or alignment of part of the work, the Contractor at his own expense shall rectify such errors to the satisfaction of the Engineer-in-Charge. The checking of any line or level by the Engineer-in-Charge shall not in any way relieve the Contractor of his responsibilities.

4.1.1 Tolerances*

The grade shall be properly shaped to the required elevations and parallel to the required surface. The elevation of any point and the line of any edge or center of the earthworks shall conform to that shown on the drawings within the tolerances stated below:

	Tolerances from True Level	Tolerances from True Line
Basic Grading	- 25 mm	- 75 mm
Embankments	+75 mm - 0	+75 mm - 75 mm

4.2 The Contractor shall lay out and construct one or more permanent bench marks in some central place before the start of the work, from which all important levels for the excavations will be set.

These permanent bench marks shall consist of masonry pillars with top neatly plastered and leveled as per the directions of the Engineer-in-Charge. Bench marks shall be well connected with triangular grid system or any other bench mark approved by the Engineer-in-Charge.

5.0 EARTHWORK IN EXCAVATION

5.1 Excavation shall be carried out in any material met on the site to the lines, levels and contours shown on the detailed drawings and the Contractor shall remove all excavated materials to spoil heaps on site or transport for use in filling on the site or stack them for reuse as directed.

5.2 Excavated material shall not be deposited within 1.5 m from the top edge of the excavation.

5.3 The sides of the excavation may be cut sloping, or shored and strutted to hold the face of earth as per site requirements and as directed by the Engineer-in- Charge.

5.4 Foundation pits/ trenches shall not be excavated to the full depth unless construction is imminent. The last 15 cm depth of the excavation shall not be done until concreting work is imminent. The full depth may at the discretion of the Engineer-in-Charge be excavated and the bed covered with a 50 mm (minimum) thick (or as indicated on drawing) layer of lean concrete 1:5:10 mix (1 cement : 5 coarse sand : 10 crushed stone aggregate) or as specified in schedule of rates/ shown on drawing, after watering if required, and consolidating the bed.

5.5 If the bottom of any excavation has been left exposed by the Contractor and in the opinion of the Engineer-in-Charge, that has become badly affected by the atmosphere or by water, then the Contractor shall remove such portions of the deteriorated material as the Engineer-

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in-Charge may direct and shall make good with lean concrete 1:5:10 mix (1 cement : 5 coarse sand : 10 crushed stone aggregate). All expenses for such additional concrete and excavation shall be borne by the Contractor.

5.6 Where excavation is made in excess of the depth required, the Contractor shall, at his own expense, fill upto required level with lean concrete 1:5:10 mix (1 cement : 5 coarse Sand : 10 crushed stone aggregates) or as decided by Engineer-in-Charge.

5.7 The Contractor shall provide suitable drainage arrangement to prevent surface water from any source entering the foundation pits at his own cost.

5.8 The Contractor shall make all arrangements for dewatering during excavation and subsequent works, the accumulated water from any source (including subsoil water) in the excavated pits/trenches and keeping the excavated pits/ trenches dry for subsequent works.

5.9 The Contractor shall make necessary arrangements for lighting, fencing and other suitable measures for protection against risk of accidents due to open excavation.

5.10 Where the excavation is to be carried out below the foundation level of an adjacent structure, the precaution to be taken such as under pinning, shoring and strutting etc. shall be determined by the Engineer- in-Charge. No excavation shall be done unless such precautionary measures are carried out as per directions of the Engineer-in-Charge. The payment for such precautionary measures shall, however, be made separately.

5.11 Loose or soft bed ground encountered in excavation at the required depth shall on the Engineers-in-Charge's instructions be excavated to a firm bed and difference made up to the required level with lean concrete 1:5:10 mix (1 cement : 5 coarse Sand : 10 crushed stone aggregates).

5.12 In those cases where during excavation, side slips occur for reasons not attributable to the Contractor (e.g. side slips which take place on their own but not due to surcharge of earth kept near the edge of excavation and cracking of excavation top strata due to clay drying out leading to collapse of excavation sides), the Engineer-in-Charge shall admit payment at his discretion.

5.13 Any obstacle encountered during excavation shall be reported immediately to the Engineer-in-Charge and shall be dealt with as instructed by him. Removal of buried pipes or cables shall not be done without prior permission of the Engineer-in-Charge and the Contractor shall provide all measures to protect the same. Cost of such protective measures are deemed to be included in the rates for various items of excavation.

5.14 The Contractor shall not undertake any concreting in foundation until the excavation pit/trench is approved by the Engineer-in-Charge.

5.15 The specification for earth work shall also apply to excavation in rock in general.

5.16 In case of hard rock requiring blasting, the provisions mentioned below shall be strictly followed.

5.16.1 **General**

Where hard rock is met with and blasting operations are considered necessary, the Contractor shall intimate about the same to the Engineer-in-Charge, and obtain his approval in writing for resorting to blasting operation.

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The Contractor shall obtain license from the district authorities for undertaking blasting work as well as for obtaining and storing the explosive as per the Explosive Rules 2008, corrected upto date. He shall purchase the explosives, fuses, detonators etc. only from a licensed dealer. He shall be responsible for the safe custody and proper accounting of the explosive materials. The Engineer-in-Charge or his authorised representative shall have the access to check the Contractor's store of explosive and his accounts.

In case where explosives are required to be transported and stored at site, relevant clauses of the Explosive Rules, 2008 as amended subsequently, shall apply.

The Contractor shall be responsible for any accident to workmen, public or property, due to blasting operations.

5.16.2 **Precautions**

Blasting operations shall be carried out under the careful supervision of a responsible authorised and licensed blaster of the Contractor (referred subsequently as "blaster" only) during specified hours, as approved in writing by the Engineer-in-Charge. The blaster shall be fully conversant with the rules of blasting.

Proper precautions for safety of persons shall be taken. Red flags shall be prominently displayed around the area to be blasted and all the people on the work except those who actually light the fuses, shall withdraw to a safe distance of not less than 200 m from the blast. Precautions as per Explosive Rules 2008 with amendment shall be followed.

5.16.3 **Fuses**

All fuses shall be cut to the lengths required before being inserted into the holes. Joints in fuses shall be avoided. Where these are unavoidable, a semicircular niche shall be cut in one piece of fuse about 2 cm. deep from the end and the end of other piece inserted into this niche, and the two pieces then wrapped together with a string. All joints exposed to dampness shall be wrapped with rubber tape. Fuse and detonators shall be kept separated from the explosives.

5.16.4 **Blasting with Gun Powder**

Blasting shall normally be done with gun powder. Dynamite, gelatine or any other high explosive shall only be used in special cases with the written permission of the Engineer-in-Charge.

In case of blasting with gun powder, the position of all bore holes to be drilled shall be marked out in circles with white paint. The bore holes shall be jumped or drilled in the rock face. The depth of bore hole shall be about the same as that of the line of least resistance and its size shall be such that the cartridges can easily pass down to the bottom. The bore holes must be dried before being charged and these shall be inspected by the Contractor's agent.

Gun powder may be used in the form of pellet blasting cartridges or as powder or granules. Cartridges are provided with tapered central hole. One end of fuse is passed through the narrow end of the hole and a sufficient length of the fuse is doubled back so that when the fuse is pulled, it is held tight in the tapered hole of the cartridge. Other cartridges are then inserted in the fuse to make up the required charge. The cartridge along with the fuse is lowered down in the bore hole, placed in position and gently filled and pressed home with dry hay or turf. The rest of the bore shall then be filled with dry clay, which shall be tamped with copper or brass rod until it becomes compact. Care shall be taken to avoid any possibility of an air space around the fuse. The safety fuses shall be taken to the required distance so as to allow the blasting to take place after the person lighting the fuse has withdrawn to a safe distance.

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Where gun powder is used in the form of powder or granules it shall be introduced in the bore hole by means of funnel or copper tube. The bore holes shall be loaded with two thirds of the quantity of charge required, and safety fuse then directly introduced over the charge. Remaining one third charge shall then be introduced, and gently filled and pressed home with dry hay or turf. The rest of the bore hole shall be filled with dry clay in the same way as for cartridges, and the safety fuse taken to the required distance.

The charges shall be fired by igniting the fuse. The number of charges to be fired and the actual number of shots heard, shall be compared, and the Contractor's blaster shall satisfy himself by examination that all the charges have exploded, before workmen are permitted to approach the site. The charge which has not exploded, shall not be permitted to be withdrawn. The tamping and charge shall be flooded with water and the holes marked with a red cross (X) over it. Another hole shall be jumped at a distance of about 45 cm from the old hole and fired in the usual way. This operation shall be continued, till the original and any subsequent unfired charges are exploded.

5.16.5 **Blasting with Dynamite or any other High Explosive**

In case of blasting with dynamite or any other high explosive the position of all bore holes to be drilled shall be marked out in circle with white paint. These shall be inspected by the Contractor's blaster. Bore holes shall be of a size that the cartridge can easily pass down. After the drilling operation, the blaster shall re-inspect the holes to see that the holes marked out by him have been drilled. The Blaster shall then prepare all charges necessary for the bore holes. The bore holes shall be thoroughly cleaned before a cartridge is inserted. Wooden tamping rods (not pointed but cylindrical throughout) shall be used, in charging holes. Metal rods shall never be used for tamping. One cartridge shall be first placed in the bore hole, gently pressed and not rammed down. Other cartridges shall then be added as may be required to make up the necessary charge for the bore hole. The top most cartridge shall be connected to the detonator which shall in turn be connected to the safety fuse of required length.

The maximum of eight (8) bore holes shall be loaded and fired on each occasion. The charges shall be fired successively and not simultaneously.

Immediately before firing a blast, due warning shall be given and the blaster shall see that all persons have retired to a place of safety. The safety fuses of the charged holes shall be ignited in the presence of the blaster, who shall see that all the fuses are properly ignited.

Careful count shall be kept by him and others of each blast as it explodes. After the blast the blaster shall inspect the work and ascertain that all the charged holes have been exploded. In case of misfired holes, the Blaster shall inspect the same after half an hour and mark red crosses (X) over the holes. During this interval of half an hour, no body shall approach the misfired holes. None of the drillers shall work near such holes, until one of the two following operations has been done by the blaster.

a) Either the Contractor's blaster shall very carefully (when the tamping is of damp clay) extract the tamping with a wooden scraper and withdraw the fuse, primer and detonator, after which a fresh detonator, primer and fuse shall be placed in the misfired holes and fired.

OR

b) The hole shall be cleaned for 30 cm of tamping and its direction ascertained by placing a stick in the hole. Another hole shall then be drilled 15 cm away and parallel to it. This hole shall be charged and fired. The misfired hole should also explode along with the new one.

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Before leaving the work, the blaster of one shift shall inform another blaster relieving him for the next shift, of any cases of misfire, and shall point out their positions denoted by red crosses and also state the action, if any, to be taken in the matter.

The Engineer-in-Charge shall also be informed by the blaster of all cases of misfire, their causes and steps taken in that connection.

5.16.6 **Controlled Blasting (Explosive/ Non-explosive)**

Whenever required by the Engineer-in-Charge, rock blasting shall be carefully controlled so that vibrations generated during the blasting do not cause damage to the buildings and installation around. Similarly, the rock pieces should not fly off and endanger the buildings and installations around. Apart from the general precautions mentioned in the preceding paragraphs, following protective measures and limits for use of explosive are suggested as guidelines. Bidders are requested to carefully check the site conditions and submit details of the scheme they propose to adopt for controlling the blast.

Following protective measures shall be adopted while carrying out blasting operations.

The hole shall be covered with mild steel plate of minimum 12 mm thickness.

Reinforcement rod mesh not less than 20 mm dia. at 150 mm centre in both directions shall be placed over the steel plates.

Steel plate and reinforcement shall be inspected after every blasting operation and all twists shall be removed before reuse to the satisfaction of the Engineer-in-Charge.

Sand filled bags of 6 to 8 layers shall be placed over the mesh suitably covering the whole region under blasting operation.

The thickness of covering plate and the kind of dead weight is to be duly approved by the Engineer-in-Charge.

5.16.7 Hard rock requiring blasting as described under Clause 2.3.2 above, but where blasting is prohibited for any reason(s), breaking up of rock can be done by using Splitter and/or chemical substances of approved manufacturer mixed in an appropriate proportion. The method involves drilling holes into rock and then inserting Splitter (hydraulic/ pneumatic/ electro-mechanical) or injecting Chemical solvents into the holes. The breaking-up of rock takes place in a controlled fashion without much noise and spark. Any other method as agreed with Engineer-in-Charge may also be used.

5.17 Excavation in areas where existing under ground cables are envisaged, to be carried out carefully by manual means taking proper safety precautions.

The earth work machinery be deployed after ensuring from the trial pits that no cable is crossing the proposed area of excavation.

5.18 Payment (applicable for item rate tenders only)

5.18.1 The payment clause shall be operated only if the earthwork is to be measured separately as per relevant tender item.

5.18.2 Payment for earth work in excavation shall be made on cubic meter (m^3) basis on the measurement of volume of pit/ trench of excavation with working space as per relevant Indian Standards (IS:1200) and slopes/ steppings as permitted by the Engineer-in-Charge. The rate shall include cost of all the operations of blasting with explosives & accessories, making of all

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arrangements for dewatering the accumulated water from any source in the excavated pit or trench, removal and disposal of surplus excavated soil within a lead of 100 m from construction areas. The rate shall also include setting out and line out work required for the excavation.

5.18.3 The following works shall not be measured separately and allowance for the same shall be deemed to have been made in the description of main item:

a) Setting out works, profiles, etc.;
b) Site clearance, such as cleaning grass and vegetation;
c) Unauthorized battering or benching of excavation;
d) Forming (or leaving 'dead men' or 'tell-tales' in borrow pits and their removal after measurements;
e) Forming (or leaving) steps in sides of deep excavation and their removal after measurements;
f) Excavation for insertion of planking and strutting;
g) Unless otherwise specified, removing slips or falls in excavations;
h) Bailing out or pumping of water in excavation from rains;
i) Bailing out or pumping of water in excavation from sub-soil water, and
j) Slinging or supporting pipes, electric cables, etc, met during excavation.

5.18.4 Special pumping other than what is included in 5.18.3 (h and i) and well point dewatering where resorted to, shall each be measured separately, unless otherwise stated, in Kilo Watt Hour against separate specific provision(s) made for the purpose.

5.18.5 The Contractor shall intimate to the Engineer-in-Charge as soon as different classification of soils are met with. The measurements of various soil classifications then shall be worked out by either of the following alternatives in the order of their decreasing importance.

a) Joint levels shall be taken as to the levels of different soil classifications and volume worked out on the basis of levels only.

b) Where levels of different strata cannot be clearly marked and defined, the Contractor shall stack different soils of various classifications separately for measurement purpose and then dispose it off.

c) If the quantum of work involved in (b) above is extensively large & time consuming, then the total area may be divided into various zones and reasonably representative samples as in (b) above may be taken and quantities of soils of various classifications finalized for the entire zone based on the representative.

If soil of any classification other than that specified in the Schedule of Rates is met with during excavation, the decision of the Engineer-in-Charge as to the classification of soil, levels of the strata of different classifications and their location shall be binding.

In above case, the total quantity of excavation shall be computed from the measurement of the pit/ trench excavated. The hard rock and soft rock shall be measured separately from the relevant stacks and each shall be reduced by fifty percent for voids, and paid under the relevant items. The balance, that is the total quantity of excavation minus the reduced (for voids) quantity of excavation for rocks shall be paid as soft/ hard soil as per the direction of the Engineer-in-Charge (However, the maximum payment shall be limited to the volume of the excavated pit/ trench as approved by Engineer-in-Charge).

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6.0 SHORING AND STRUTTING

6.1 The shoring and strutting of the sides to withhold the face of excavation pits/trenches shall be done when approved or directed by the Engineer-in-Charge.

6.2 The shoring shall be of close or open timbering type or by Sheet Piling, Soldier Piling, etc. depending upon the site requirements and as directed by the Engineer-in-Charge whose decision shall be final and binding as to the type of shoring to be used.

6.3 The arrangement of the shoring and strutting shall be sound and safe and shall be got approved from the Engineer-in-Charge before installation. The approval shall not absolve the Contractor of his responsibilities of safety and any other requirements of the contract.

6.4 The shoring and strutting shall be kept in position till all the relevant work in the excavated area is completed and approved. It shall be dismantled and removed only after the permission to do so is obtained from the Engineer-in-Charge.

6.5 Sheet Piling

The contractor shall design, supply and install hot rolled steel sheet piles including all associated structural steel members viz. waler & runner beams, strut, cross ties, vertical members, guide frames, suitable interlocks, suitable corner sections, splicing & cutting of sheet piling. The contractor shall also apply recommended sealant for complete water tightness (as required) and ensure pre-drilling for installation into bedrock (as necessary), etc. as per site conditions.

The contractor shall mobilize/ demobilize all necessary tools & tackles, hammer (vibratory/ impact), crane(s) etc., shifting plant/ machinery and carryout all ancillary works (as required) and ensure subsequent removal of entire arrangement after completion of works.

6.6 Payment (applicable for item rate tenders only)

Payment for shoring and strutting by close and open timbering shall be made on square meter (m^2) basis as separate items. In both the cases, the measurement shall be done on the basis of the surface area of the sides of the excavation actually shored and strutted.

The rate shall include all labour, materials, erection of the poling boards, wales, struts, ballies etc., fixing and keeping the same in position as required, dismantling and removing the same after the work is over as directed.

Payment for shoring and strutting by sheet piling shall be made on the basis of shoring area of sheet pile exposed after complete excavation.

The rate shall include all labour, design, supply and installation of hot rolled steel sheet piles including all associated structural steel members, application of recommended sealant, pre-drilling for installation into bedrock etc., mobilization/ demobilization of all necessary tools & tackles, hammer, crane(s) etc., shifting plant/ machinery & all ancillary works, fixing and keeping the sheet piling in position, dismantling and removing the same after the work is over, etc. all complete as directed by the Engineer-in-Charge.

No extra payment shall be made for cost of extraction and replacement for installing of sheet pile deviating the specification or rejected by Engineer-in-charge. Extracted sheet piles shall be contractor's property and contractor shall remove the same from site without any extra cost to client.

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7.0 BACK FILLING AROUND FOUNDATIONS AND IN PLINTH

7.1 Back filling around completed foundations, structures, trenches and in plinth shall be done to the lines and levels shown on the drawings including any trimming of the surfaces, as may be necessary. This shall be done with selected and approved earth from excavation or otherwise with suitable materials described under Clause 3.1 as directed by the Engineer-in-Charge. Where sufficient suitable material is not available from the excavation, the Engineer-in-Charge may direct to import suitable earth from other sources. The filling shall be done in layers of thickness not exceeding 15 cm with watering, rolling and ramming by manual methods/ mechanical compactors to grade and level as shown on drawings to obtain 90% laboratory maximum dry density.

7.2 The Contractor shall not commence filling in and around any work until it has been permitted by the Engineer-in-Charge.

7.3 Backfilling around liquid retaining structures and pipes shall be done only after approval of the Engineer-in-Charge is obtained.

7.4 **Payment (applicable for item rate tenders only)**

Payment for backfilling with earth shall be based on volume in cubic meters (m^3) of consolidated fill. This volume shall be derived from the difference between the volume of excavation and the structure or trenches as the case may be. The rate shall include cost of extracting suitable approved earth from available excavated soil from spoil heaps within a lead of 100 m, placing, watering, rolling, ramming compacting in layers, trimming and dressing finished surface and disposal of surplus material upto a lead of 100 m.

However, backfilling done with materials other than earth shall be paid separately under relevant items.

8.0 TRANSPORTATION OF SURPLUS EARTH

8.1 Surplus earth and soil from excavation shall be removed from construction area to the area demarcated by the Engineer-in-Charge.

8.2 **Payment (applicable for item rate tenders only)**

8.2.1 Payment shall be made only for the lead beyond initial 100 m from construction area. Rate shall include re-excavation, loading, transportation, dumping, stacking or spreading (as per directions of the Engineer-in-Charge) the surplus earth and the soil in the area demarcated by the Engineer-in-Charge. Payment shall be made on cubic metre (m^3) basis on the difference of measurements of the volume of the excavated pits and the measurement of the back filling. Quantity generated due to voids in back filled volume of earth shall also be removed by the Contractor at no extra cost and this disposal of earth shall not be measured and paid under any item.

8.2.2 In exceptional circumstances the Engineer-in-Charge may direct the Contractor to remove surplus earth, concrete debris or any other waste material from site to the areas of disposal on the basis of truck measurement. In such cases volume of material shall be calculated on the basis of truck volume reduced by 30% for voids in case of soft/hard soils and 50% for soft/ hard rock. All other provisions of disposal such as spreading, levelling, grading shall apply in this case also.

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9.0 PROTECTION OF PROPERTY AND PERSONNEL

9.1 The Contractor shall protect all active utility lines shown on the drawings or encountered during the excavation. If he damages those lines, the Contractor shall repair or replace them. If existing utilities interfere with his work, the Contractor shall inform to the Engineer-in-charge and secure written instructions for further action.

9.2 The Contractor shall barricade open holes and depressions which he creates or exposes as part of this, and he shall post warning signs and lights on property adjacent to or with public access. He shall operate warning lights during hours from dusk to dawn each day and as otherwise required for safety.

9.3 The Contractor shall protect structures, utilities, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by his operations.

9.4 The Contractor shall plan and execute all aspects of the earthwork so that the safety of personnel, the work and adjacent property is guaranteed and such that a minimum of inconvenience is caused.

10.0 CLEAN UP

Upon completion of work, the Contractor shall leave the project site clear of debris and surplus materials off plant limits in a manner meeting all location authority requirements.

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मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

सादा एवं प्रबलित सीमेंट कंक्रीट

PLAIN AND REINFORCED CEMENT CONCRETE

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
8	07 DEC 22	UPDATED & REVISED	DK	DA	AS	SM
7	29h JAN 16	UPDATED & REISSUED	AJS	AS	RS	SC
6	15th DEC 14	UPDATED & REISSUED	SP	AS	PKM	SC
5	28th DEC 12	UPDATED & REISSUED	CDS	AJS	PKM SC	DM
4	23rd NOV 07	UPDATED & REISSUED	YPC	PKM	VK	VC
3	APR,01	UPDATED & REISSUED	RPM7097	SCS	SCJ1151	MI

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Abbreviations:

ACI	:	American Concrete Institute
ASTM	:	American Society for Testing and Materials
BS	:	British Standards
GI	:	Galvanized Iron
IS	:	Indian Standard
ISO	:	International Organization for Standardization
PVC	:	PolyVinyl Chloride
RCC	:	Reinforced Cement Concrete
SCC	:	Self Compacting Concrete
SWG	:	Standard Wire Gauge

Structural Standards Committee

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Mr. Deepak Agrawal
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1.0 SCOPE

This specification is applicable for Concrete Grade up to M60 and establishes the requirements of materials, mix proportioning, placing, curing, etc. of all types of cast-in-situ and precast concrete (ref. section 1.6) used in foundations, underground and above ground structures, floors, pavements etc. Any special requirements as shown or noted on the drawings shall supersede the provisions of this specification.

1.1 Reference Codes and Specifications

Apart from this specification, construction of plain and reinforced concrete works shall be in accordance with the Indian Standard Code of Practice for "Plain and Reinforced Concrete" IS 456 along with all amendments till date and other relevant codes mentioned therein.

1.2 For Liquid Retaining Structures, EIL Specification No. 6-68-0005 shall be applicable.

1.3 For Structural Steel works, EIL Specification No. 6-68-0006 & 0008 shall be applicable.

1.4 For Bipolar Concrete Penetrating Corrosion Inhibiting Admixture, EIL Specification No. 6-68-0017 shall be applicable.

1.5 For Self Compacting Concrete, EIL Specification No. 6-68-0019 shall be applicable.

1.6 For precast concrete manufacturing refer EIL Specification No. 6-68-0014.

1.7 In case of conflict between the clauses mentioned in this specification and those in the Bureau of Indian Standards (BIS), this specification shall govern.

2.0 MATERIALS

2.1 Materials for concrete viz cement, Pozzolanas, Fly Ash, Ground Granulated Blast Furnace Slag, Sand, Coarse aggregate, Water, etc. shall be as described in EIL Specification No.6-68-0002.

2.2 Materials for all reinforcements, embedment, inserts, water bars etc. shall conform to EIL Specification 6-68-0002.

2.3 Materials to be used as additive to concrete shall conform to EIL specification 6-68-0002 & 6-68-0017.

3.0 GRADES OF CONCRETE

Characteristic Compressive strength for different grades of concrete shall be as per Table-1.

TABLE – 1
GRADES OF CONCRETE

Group	Grade Designation	Specified Characteristic Compressive Strength of 150 mm cube at 28 days (N/mm^2)
Ordinary Concrete	M10 M 15 M 20	10 15 20

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TABLE – 1 (CONT.)
GRADES OF CONCRETE

Group	Grade Designation	Specified Characteristic Compressive Strength of 150 mm cube at 28 days (N/mm^2)
Standard Concrete	M 25	25
	M 30	30
	M 35	35
	M 40	40
	M 45	45
	M 50	50
	M 55	55
High Strength Concrete	M 60	60

Note: The characteristic strength is defined as the strength of material below which not more than five (5) percent of the test results are expected to fall.

4.0 TYPE OF CONCRETE MIX

4.1 Unless otherwise noted on drawings, all lean/plain concrete shall be of Nominal Mix type and reinforced concrete shall be of Design Mix type.

4.2 Nominal Mix Concrete

This concrete shall be made (without preliminary tests) by adopting nominal concrete mix with proportions of materials as specified in Table 9 of IS 456.

4.3 Design Mix Concrete

The mix shall be designed as per IS: 10262 in an approved laboratory to produce the grade of concrete having the required workability and characteristic strength not less than appropriate values given in Table-1. The target mean strength of concrete mix shall be equal to the characteristic strength plus 1.65 times the standard deviation.

As long as the quality of materials does not change, a mix design done earlier but not prior to one year may be considered adequate for later work. However, in case the source & quality of materials changes or there is a break in the continuity of construction, the Engineer-In-Charge shall ask for a new design mix.

Irrespective of the grade of concrete required to be produced as per characteristic strength criteria, the minimum cement content and maximum water cement ratio in the design concrete shall be strictly maintained as stipulated in Table 5 of IS 456.

5.0 CONCRETE MIX PROPORTIONING

Proportioning, as used in this specification, shall mean the process of determining the proportions of the various ingredients to be used to produce concrete of the required workability when fresh/green and strength, durability & surface finish, when hardened. The following information shall be collected prior to design of the concrete mix:

a) Grade designation.
b) Type of cement.
c) Maximum nominal size of aggregate.
d) Minimum cement content.
e) Maximum water cement ratio
f) Workability requirements.

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g) Exposure condition as per Table 3 & Table 4 of IS 456
h) Maximum temperature of concrete at the time of placing.
i) Method of Placing.

The Engineer-in-Charge shall verify the strength of the concrete mix, before giving his sanction of its use. However, this does not absolve the Contractor of his responsibility as regards achieving the prescribed strength of the mix. If during the execution of the work, cube tests show lower strengths than required, the Engineer-in-Charge shall order fresh trial mixes to be made by the Contractor. No claim to alter the rates of concrete work shall be entertained due to such changes in mix variations. Any variation in cement consumption shall be taken into consideration for material reconciliation. Preliminary mix designs shall be established well ahead of start of work.

5.1 Maximum Density

Suitable proportions of sand and the different sizes of coarse aggregates for each grade of concrete shall be selected to give as nearly as practicable the maximum density as per clause 10.2.3 of IS 456. This shall be determined by mathematical means, laboratory tests, field trials and suitable changes in aggregate gradation. The contractor shall ensure the same to the satisfaction of Engineer-in-Charge.

5.2 Consistency

The concrete shall have a consistency such that it shall be workable in the required position and when properly vibrated it flows around reinforcing steel, all embedded fixtures, etc.

5.3 Workability

"Workability of Concrete" shall be as per clause 7 of IS 456.

5.4 Durability

For achieving sufficiently durable concrete, strong, dense aggregates, low water-cement ratio and adequate cement content shall always be used. Workability of concrete shall be such that concrete can be completely compacted with the means available. Leak-proof formwork shall be used so as to ensure no loss of cement-slurry during pouring and compaction. Cover to reinforcement shall be uniform. Concrete mix design shall always take into account the type of cement, minimum cement content irrespective of the type of cement and maximum water cement ratio and minimum grade of concrete conforming to environmental exposure conditions (refer Table 3 of IS 456) as given in Table 5 of IS: 456.

Generally, following types of cement shall be used for Plain and Reinforced concrete works:

a) 43/ 53 Grade Ordinary Portland Cement conforming to IS 269.
b) Rapid hardening Portland Cement conforming to IS 8041.
c) Portland Slag Cement conforming to IS 455.
d) Portland Pozzolana Cement(fly ash based) conforming to IS 1489(Part 1)
e) Portland Pozzolana Cement (calcined clay based) conforming to IS 1489(Part-2).
f) Sulphate Resisting Portland Cement conforming to IS 12330

Sulphate Resisting Portland Cement shall be used only for specific requirements depending on environmental and process exposure conditions to which the structures may be subjected to like high Sulphate concentrations, processes involving Sulphur handling etc.

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5.4.1 Water Cement Ratio

Once a mix, including its water cement ratio, has been determined and approved for use by the Engineer-in-Charge, that water cement ratio shall be maintained. The Contractor shall determine the water content of the aggregates frequently as the work progresses, and the amount of mixing water shall be adjusted so as to maintain the approved water cement ratio. Maximum water-cement ratio shall be as per Table 5 of IS 456 for different exposure condition.

The minimum cement content as mentioned in Table 5 of IS 456 shall be adjusted for aggregates other than 20 mm nominal maximum size as defined in Table 6 of IS 456.

For maximum cement content refer Cl.8.2.4.2 of IS 456.

5.4.2 Where specified, Bipolar concrete penetrating corrosion inhibiting Admixture in reinforced concrete as per EIL specification No. 6-68-0017 shall be used for protecting the reinforcement from corrosion.

5.5 Limits to Deleterious Constituents

Careful selection of the mix and the constituent materials shall be made to limit the presence of deleterious constituents in concrete. The total acid soluble chloride content calculated from the mix proportion and the measured chloride content of each of the constituents shall not exceed 0.6 kg/m^3 at the time of placing of concrete. The total water soluble Sulphate content of the concrete mix shall not exceed 4 percent by mass of the cement in the mix.

6.0 BATCHING

Refer clause 10.2 of IS 456.

7.0 CONCRETE MIXING

7.1 Ready Mixed Concrete supplied by Ready Mixed Concrete Plants or from on/off-site batching plants (IS 4926) shall be used for structural concrete.

All records and charts for the batching and mixing operations shall be prepared and maintained by the contractor in accordance with IS 4926 or as per the instructions of Engineer-in-Charge.

In case Ready Mixed Concrete is not available, the mixing of concrete shall be strictly carried out in an approved type of mechanical concrete mixer. The mixer shall be fitted with water measuring devices. The mixing shall be continued until there is a uniform distribution of the material and the mass is uniform in colour and consistency. If there is segregation after unloading from the mixer, the concrete shall be remixed.

7.2 Mixer

7.2.1 Mechanical Mixers shall comply with IS 1791 and 12119 and shall be maintained in satisfactory operating condition. These shall be used only for producing lean/ plain concrete and/ or nominal mix concrete wherever permitted.

7.2.2 Mixing Time

Mixing time shall be as indicated in the following Table-2. Excessive mixing requiring additions of water shall not be permitted. Time shall start when all solid materials are poured in the revolving mixer drum, provided that all of the mixing water shall be introduced before one-fourth of the mixing time has elapsed. The Engineer-in-Charge may, however, direct a change in the mixing time, if he considers such a change necessary.

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TABLE-2

MINIMUM MIXING TIME FOR MIXERS

Capacity of mixer	Minimum mixing time
2 m^3 or less	2 minutes
Above 2 m^3	3 minutes or as recommended by the mixer manufacturer.

7.3 Hand Mixing

Hand mixing of concrete shall not be permitted. However, for non-critical applications namely foundations for crossovers, isolated operating platforms etc., using concrete upto grade M20 and located at far away isolated places, this may be permitted by the Engineer-in-charge as a special case. Mixing shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. No extra payment shall be made to the Contractor for mixing by hand or for using extra cement due to hand mixing.

7.4 Additives

Additive in concrete shall be used only with the prior approval of the Engineer-in-Charge and shall comply with Cl. 5.5 of IS 456. Any additive used for obtaining proper workability or leak proofness of concrete or repair/rendering works of concrete due to non-conformance to the specifications, shall not be measured and paid for. All costs relating to such usage shall be borne by the Contractor.

8.0 TRANSPORTATION, PLACING AND COMPACTION

8.1 General

The entire concrete placing programme including transportation arrangements, deployment of equipment, layout, proposed procedures and methods, shall be submitted to the Engineer-in-Charge 24 hours prior to concreting for approval. No concreting shall be placed until his approval has been received. Approval of the Engineer-in-Charge for pouring concrete shall be taken as 'conveyed', when the concrete pour card is signed by him.

8.1.1 Chuting

The use of long troughs, chutes and pipes for conveying concrete from the mixer to the forms shall be permitted only on written authorization from the Engineer-in-Charge. In case an inferior quality of concrete is produced by the use of such conveyors, the Engineer-in-Charge may order discontinuance of their use and the substitution of a satisfactory method of placing the concrete. Open troughs and chutes shall be equipped with baffles and be in short lengths to avoid segregation. Chutes shall be designed so that the concrete is, to some extent, remixed at the lower end by passing down through a funnel shaped pipe or drop chute. Alternatively, they shall discharge into a storage hopper from which the concrete shall be transported to the point of placing by wheel barrows or other means. Where drop chutes are used, a sufficient number of these must be provided, so that the concrete discharged from the chute is not required to flow laterally more than 1.0 metre. Where a drop chute is swung from the vertical, the bottom two sections must be maintained in a vertical position to avoid segregation. The addition of water at any point in the system of transportation, to facilitate the movement of concrete shall not be permitted. All chutes, troughs and pipes, shall be kept clean and free from coatings of hardened concrete by thoroughly flushing them with water after each run; water used for flushing shall be discharged clear of the structure.

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8.1.2 Vibrators

8.1.2.1 Concrete shall be compacted with mechanical vibrating equipment supplemented, if necessary to obtain consolidation, by hand spreading, rodding and tamping. The vibrators shall be of immersion type with operational frequency ranging between 8,000 to 12,000 vibrations per minute. All vibrators shall comply with IS 2505. Screed board concrete vibrators or concreting vibrating tables or form vibrators conforming to IS 2506, 2514 and 4656 respectively shall be used where specifically required and directed by Engineer-in-Charge.

8.1.2.2 Immersion type vibrators shall be inserted in a vertical position at intervals of about 600 mm, depending upon the mix, the equipment used, and experience on work. The vibrators shall be withdrawn slowly. The spacing shall provide some overlapping of the area vibrated at each insertion. In no case shall vibrators be used to transport concrete inside the forms. Over vibration or under vibration shall not be permitted as both are harmful. Hand tamping in some cases may be allowed subject to the approval of the Engineer-in-Charge.

8.1.2.3 In placing concrete in layers which are advancing horizontally as the work progresses, great care shall be exercised to ensure adequate vibration, bonding and moulding of the concrete between the succeeding batches.

8.1.2.4 The vibrator shall penetrate the layer being placed and also penetrate the layer below while the under layer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.

8.1.2.5 Care shall be taken to prevent contact of vibrators against all embedded reinforcing steel or inserts. Vibrators shall not be allowed to come in contact with forms.

8.1.2.6 The use of form vibrators shall not be permitted for compaction of in-situ concrete without specific authorization of the Engineer-in-Charge.

8.1.2.7 The use of surface vibrators of screed board type shall not be permitted for consolidation of concrete under ordinary conditions. However, for thin slabs (of thickness less than 200 mm) surface vibration by such vibrators may be permitted, upon approval of the Engineer-in-Charge.

8.1.2.8 Whenever vibration has to be applied externally, the design of formwork and the disposition of vibrators shall be carefully planned to ensure efficient compaction and to avoid surface blemishes.

8.2 Transportation

8.2.1 All concrete shall be conveyed from the mixer to the place of final deposit such as formwork as rapidly as possible using suitable buckets, dumpers, pumps, transit mixers containers or conveyors which shall be mortar leak tight. Care shall be taken to prevent the segregation or loss of the ingredients and maintaining the required workability. For structural concrete produced from Ready Mixed Concrete/ Batching Plants, concrete shall be transported from the plants to the sites only by transit mixers and Delivery Ticket for each delivery of concrete shall be maintained by the contractor.

8.2.2 During hot or cold weather, concrete shall be transported in deep containers. Other suitable methods to reduce the loss of water by evaporation in hot weather and heat loss in cold weather may also be adopted. All equipment used for transporting and placing of concrete shall be maintained in clean condition. All buckets, hoppers, chutes, dumpers and other equipment shall be thoroughly cleaned after each use.

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8.3 Placing and Compaction

8.3.1 Before placing concrete, all soil surfaces upon which or against which concrete is to be placed shall be well compacted and free from standing water, mud or debris. Soft or yielding soil shall be removed and replaced, with lean concrete or with selected soils/sand and compacted to the density as directed by Engineer-in-Charge. The surface of absorptive soil (against which concrete is to be placed) shall be moistened thoroughly so that moisture is not drawn from the freshly placed concrete. Similarly, for concrete to be placed on formworks, all chippings, shavings and sawdust etc. shall be removed from the interior of the forms before the concrete is placed.

8.3.2 Concrete shall not be placed until the formwork, the placement of reinforcing steel, embedded parts; pockets etc. have been inspected and approved by the Engineer- in-Charge. Any accumulated water on the surface of the bedding layer shall be removed by suitable means before start of placement. No concrete shall be placed on a water covered surface.

8.3.3 Concrete shall be discharged by vertical drop only and the drop height shall not normally exceed 1.5 metre throughout all stages of delivery until the concrete comes to rest in forms. However, drop height can be relaxed by the Engineer-in-Charge as per the provisions given under Cl. 8.1.1. For continuous concreting operation windows of suitable size shall be kept in the formwork or chutes shall be used to avoid segregation of concrete.

8.3.4 Concrete shall be deposited as near as practicable in its final position to avoid rehandling. Concrete shall be placed in successive horizontal layers. The bucket loads, or other units of deposit, shall be placed progressively along the face of the layer with such over-lap as will facilitate spreading the layer of uniform depth and texture with a minimum of hand shoveling. Any tendency to segregation shall be corrected by shovelling coarse aggregates into mortar rather than mortar on the coarse aggregates. Such a tendency for segregation shall be corrected by redesign of mix, change in process or other means, as directed by the Engineer-in-Charge.

8.3.5 All struts, stays and braces (serving temporarily to hold the forms in correct shape and alignment pending the placing of concrete at their locations) shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These shall not be buried in the concrete. Concrete shall be thoroughly compacted with vibrators and fully worked around the reinforcement, embedded fixtures and into corners of formwork before setting commences and shall not be subsequently disturbed. Methods of placing shall be such as to preclude segregation and avoid displacement of reinforcement or formwork. The formation of stone-pockets or mortar bondage in corners and against face forms shall not be permitted. Should these occur, they shall be dug out, reformed and refilled to sufficient depth and shape for thorough bonding as directed by the Engineer-in-Charge. Care shall be taken to avoid displacement of reinforcement and embedded inserts or movement of formwork.

8.3.6 Unless otherwise approved, concrete shall be placed in single operation to the full thickness of foundation rafts, slabs, beams and similar members. Concrete shall be placed continuously until completion of the part of the work between approved construction joints or as directed by the Engineer-in-Charge.

8.3.7 The method of placing and compaction employed in any particular section of the work shall be to the entire satisfaction of the Engineer-in-Charge.

8.3.8 During hot weather (atmospheric temperature above 40 degree Celsius) or cold weather (atmospheric temperature below 5 degree Celsius, the concreting shall be done as per the procedure set out in IS 7861).

8.3.9 Concrete that has set standing and becomes stiffened shall not be used in the work.

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8.3.10 Continuous Concreting

Where called out on the drawings, continuous concreting shall be done in a single operation as per the requirements of IS 456 and IS 2974. Sufficient "Windows" shall be left in the formwork for pouring & compaction of concrete and inspection. These windows shall be fixed tight once the level of concrete reaches their levels.

8.3.11 Concreting under special conditions

a) Work in extreme weather conditions during hot or cold weather, the concreting shall be done as per procedure set out in IS 7861(Part 1) or IS 7861 (Part2).

b) Under water concreting shall be as per clause 14.2 of IS 456.

8.4 Items Embedded in Concrete

8.4.1 Concreting shall not be started unless the electrical conduits, pipes, fixtures etc., wherever required, are laid by the concerned agency. The Contractor shall afford all the facilities and maintain co-ordination of work with other agencies engaged in electrical and such other works as directed by the Engineer-in-Charge.

8.4.2 Before concreting, the Contractor shall provide, fabricate and lay in proper position all metal inserts, anchor bolts, pipes etc. (which are required to be embedded in concrete members) as per relevant drawings and directions of Engineer-In-Charge.

8.4.3 All embedment, inserts etc. shall be fully held and secured in their respective positions by the concerned agencies to the entire satisfaction of Engineer-in-Charge so as to avoid any dislocation or displacement during the concreting operations. The Contractor shall take all possible care during concreting to maintain these embedment/inserts in their exact locations.

9.0 CONSTRUCTION JOINTS

9.1 Construction joints shall be provided in position as shown or described on the drawings or as directed by the Engineer-in-Charge. Such joints shall be kept to the minimum. These shall be straight and at right angles to the direction of main reinforcement and shall be placed at accessible locations to permit cleaning out of laitance, cement slurry and unsound concrete.

9.2 In a column, the joint shall be formed about 100 mm to 150 mm below the lowest soffit of the beams framing into it. Concrete in a beam and slab shall be placed throughout without a joint but if the provision of a joint is unavoidable, the joint shall be vertical and located within 1/3 to 1/4 of the span, unless otherwise shown on the drawings.

9.3 When stopping the concrete on a vertical plane in slabs and beams, an approved stop board shall be placed with necessary slots for reinforcement bars. The construction joints shall be keyed by providing a triangular or trapezoidal fillet nailed on the stop board. Inclined joints shall not be permitted. Any concrete flowing through the joints of stop board shall be removed soon after the initial set. When concrete is stopped on a horizontal plane, the surface shall be roughened and cleaned after the initial set and a triangular or trapezoidal groove shall be provided for keying with the new concrete later.

9.4 When the work has to be resumed on a surface which has hardened, such surface shall be cleared of any foreign materials and roughened to expose the tips of the coarse aggregate. This may be done by manual chipping of concrete, with a high pressure water jet or by any other appropriate means as per Engineer-in-Charge's directions. It shall then be swept clean and thoroughly washed and wetted before any new concrete is poured. Any set mortar or concrete sticking to the exposed reinforcing rods in and around such joints shall be thoroughly removed. The reinforcements shall be wire brushed and washed just before

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pouring any cement slurry or mortar. For vertical joints neat cement slurry shall be applied on the surface before it is dry. For horizontal joints the surface shall be covered with a layer of mortar about 10 to 15 mm thick composed of cement and sand in the same ratio as the cement and sand in concrete mix. This layer of cement slurry or mortar shall be freshly mixed and applied immediately before placing new concrete.

9.5 Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of particles of aggregate. The surface shall be thoroughly wetted and all free water removed. The surface shall then be coated with neat cement slurry. On this surface layer of concrete not exceeding 150 mm in thickness shall first be placed and shall be well rammed against old work, particular attention being paid to corners and close spots; work thereafter shall proceed in normal way.

10.0 SEPARATION JOINT

10.1 Separation joint shall be obtained by using an approved Alkathene sheet stuck on the surface against which concrete shall be placed. Adequate care shall be taken to cause no damage to the sheet.

11.0 EXPANSION JOINTS/ISOLATION JOINT

11.1 Expansion/ Isolation joints in structures shall be formed in the positions and to the shapes shown in the relevant drawings. Joints shall be filled with joint filling material as stipulated in the drawings/schedule of rates. Isolation joints shall be provided around all equipment foundations, columns, pedestals, trenches etc. on grade.

12.0 WATER STOPS

PVC water stops as per EIL Specification No. 6-68-0002 for materials shall be accurately cut, fitted and integrally joined as per manufacturer's specifications to provide a continuous, watertight diaphragm at all points.

The water stops shall be located and embedded at expansion/contraction/ construction joints as indicated in the drawings or directed by the Engineer-in-Charge.

Adequate provision shall be made for the support and protection of water stops during the progress of the work. Damaged water stops shall be replaced and/or repaired as directed.

13.0 PROTECTION OF FRESHLY LAID CONCRETE

13.1 Newly placed concrete shall be protected, by approved means, from rain, sun and wind. Concrete placed below the ground level shall be protected from falling earth during and after placing. Surface shall be kept free from contact with such ground or with water draining from such ground during placing of concrete for a period of at least 3 days, unless otherwise directed by the Engineer-in-Charge. The ground water around newly poured concrete shall be kept to an approved level by pumping or other approved means of drainage and adequate steps shall be taken to prevent floatation and flooding. Steps shall be taken to protect immature concrete from damage by debris, loading, vibration, abrasion, mixing with deleterious materials that may, in the opinion of the Engineer-in-Charge, impair the strength and/or durability of the concrete.

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14.0 CURING

14.1 Concrete shall be cured by keeping it continuously moist wet for the specified period of time to ensure complete hydration of cement and its hardening. Curing shall be started after 8 hours of placement of concrete in normal weather, and in hot weather after 4 hours. The water used for curing shall be of the same quality as that used for making of concrete.

Curing shall be assured by use of an ample water supply under pressure in pipes, with all necessary appliances such as hose, sprinklers etc. A layer of sacking, canvas, hessian, or other approved material, which will hold moisture for long periods and prevent loss of moisture from the concrete, shall be used as covering. Type of covering which would stain, disfigure or damage the concrete, during and after the curing period, shall not be used. Only approved covering shall be used for curing.

Exposed surfaces of concrete shall be maintained continuously in a damp or wet condition for at least the first 7 days after placing of concrete.

The Contractor shall have all equipment and materials required for curing on hand and ready to use before concrete is placed.

For curing the concrete in pavements, floors, flat roofs or other level surfaces, the ponding method of curing shall be used. For the first 24 hours after concreting, the concrete shall be cured by use of wet sacking, canvas, hessian etc. The minimum water depth of 25 mm for ponding shall be maintained. The method of containing the ponded water shall be approved by the Engineer-in-Charge. The ponded areas shall be kept continuously filled with water, and leaks, if any, shall be promptly repaired. Areas cured by ponding method shall be cleared of all debris and foreign materials after curing period is over.

Alternatively, membrane curing may be used in lieu of moist curing with the permission of the Engineer-in-Charge. Such compounds shall be applied to all exposed surfaces of the concrete by spraying or brushing as soon as possible after the concrete has set. Minimum film thickness of such curing compounds shall be as per the recommendation of the manufacturer so as to obtain an efficiency of 90% as specified by BS-8110. This film of curing compound shall be fully removed from the concrete surface after the curing period specified earlier. Engineer-in-Charge may not allow curing by curing compounds for those surfaces where use of curing compound may be detrimental to application of future finishes over the concrete. Impermeable membranes such as polyethylene sheeting closely covering the concrete surface may also be used.

14.2 For concretes containing Portland pozzolana cement or Portland slag cement, the curing period as given in Cl. 14.1 shall be doubled. Curing by ponding shall, however, commence after the first 24 hours of concreting.

15.0 FIELD TESTS

15.1 Materials Testing

15.1.1 Aggregates

Grading test on fine and coarse aggregates shall be carried out as per IS 2386 at intervals specified by the Engineer-in-Charge.

The mandatory tests and their frequencies shall be done as given in Table-3A & 3B below:

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TABLE – 3A
(For Concrete prepared at site by using Mechanical mixers)

MANDATORY TESTS ON SAND & STONE AGGREGATES

S. No	MATERIAL	TEST	FIELD / LAB TEST	MIN. QTY OF MATERIAL/ WORK FOR CARRYING OUT TEST	FREQUENCY OF TESTING*
1.	Sand	(a) Bulking of sand	Field Test	20 m^3	Every 20 m^3 or part thereof or more frequently as decided by the Engineer-in-Charge
		(b) Silt content	Field Test	20 m^3	
		(c) Particle size distribution	Field or Lab as decided by the Engineer-in-Charge	40 m^3	1) Every 40 m^3 of fine aggregate/sand required in RCC works only 2) Every 80 m^3 of fine aggregate/ sand required for other items
2.	Stone aggregate	a) Percentage of soft or deleterious materials	General visual inspection, laboratory test where required by Engineer -in-Charge or as specified	As required by Engineer-in-Charge	For all quantities
		b) Particle size distribution	Field or lab. as required by Engineer-in-Charge	45 m^3	For every 45 m^3 or part thereof as decided by Engineer-in-Charge
		c)Ten percent Fine value	Laboratory	45 m^3	Initial test and subsequent test as & when required by Engineer-in-Charge

* Fresh testing is mandatory whenever there is change in Source of materials.

TABLE – 3B
(Refer Cl. 4.4 & 4.6.1 of IS 4926)

(For Ready Mixed Concrete supplied by Ready Mixed Concrete Plants or from on/off-site Batching Plants)

MATERIALS TESTING REQUIREMENTS

S. No	AGGREGATE PROPERTY/ PARAMETER	TYPE OF AGGREGATE	ASSESSMENT OF TYPICAL PROPERTIES AND HIGH TEST RATE*	NORMAL MONITORING AND LOW TEST RATE*	REQUIREMENT FOR NORMAL MONITORING AND LOW TEST RATE
1.	**Grading**	Sand/Fine	Weekly	Monthly	Last 8 results conform to IS 383 or representative values
		Coarse-Single sized/ Graded	Weekly	Monthly	
2.	**Particle density** -Oven Dry -Saturated Surface Dry -Apparent	All Types	Weekly	3 Monthly	Last 4 results ±0.04 percent
3.	**Absorption**	All Types	Weekly	3 Monthly	Last 4 results ±0.04 percent

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S. No	AGGREGATE PROPERTY/ PARAMETER	TYPE OF AGGREGATE	ASSESSMENT OF TYPICAL PROPERTIES AND HIGH TEST RATE*	NORMAL MONITORING AND LOW TEST RATE*	REQUIREMENT FOR NORMAL MONITORING AND LOW TEST RATE
4.	**Bulk Density** - Loose - Compacted	All Types	Monthly	6 Monthly	Last 4 results ± 75kg/m³
5.	**Fines(Silt) Content**	Sand	Weekly	Monthly	Last 10 results <75 percent maximum allowed
		Coarse	Monthly	3 Monthly	
6.	**Aggregate Impact Value**	Coarse	As specified	As specified	-
7.	**10 % Fines**	Coarse	Yearly	Yearly	-
8.	**Flakiness**	Coarse	2 Weekly	6 Monthly	Last 3 results conform to standard
9.	**Chloride Content**	All Types	Weekly	6 Monthly	Last 3 results < 0.01 percent
10.	**Aggregate Abrasion Value** (Los Angeles Method)	Coarse	-	Yearly/ Source Change	-
11.	**Soundness**	Fine and Coarse	-	Yearly/ Source Change	-
12.	**Potential Alkali Aggregate Reactivity Including Petrography**	Fine and Coarse	-	5 Yearly/ Source Change	-
13.	**Petrographic Description** (General)	All Types	-	5 Yearly	-

***Note** : The high or low test rates apply in accordance with the following conditions:

a) High test rate
   i) To establish the typical characteristics of an aggregate, and
   ii) When significant changes in properties occur outside the tolerances for low test rates given.

b) Low test rate
   i) When the typical characteristics of the aggregate have been established, and
   ii) When subsequent tests lie within the tolerances for low test rates given

15.1.2 Water

The minimum testing frequencies shall be as follows:

SOURCE	PARAMETERS	FREQUENCY	REQUIEMENT
Non mains water (Untreated water extracted from wells, ponds, lakes, rivers, underground, etc.)	p^H value, Chloride ion content, Sulphate content and any other parameter in accordance with IS 456	Initially every week for first 6 weeks (average of test results to be taken) and then at 3-monthly interval	Need further investigation in case significant deviation observed in test results of 3-monthly interval samples from the original 6 weeks average
Mains water (Treated water supplied through piped network)	Same as above	Annual basis once all tests for source are satisfactory	In case Chloride content > 0.01%, testing frequency shall be reduced to 3 months

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15.2 Compaction Factor Test /Slump Test of Concrete

15.2.1 For structural quality concrete (excluding pavements, flooring etc.) at least one Slump Test shall be made for every compressive strength test carried out. More frequent tests shall be made if there is a distinct change in working conditions or if required by the Engineer-in-Charge.

In case of Ready Mixed Concrete, provisions of IS 4926 shall be followed.

15.2.2 For structural quality concrete for pavements & floorings, measurement of workability shall be by determination of compacting factor. Value of compacting factor of 0.75 to 0.8 shall generally be acceptable.

15.3 Strength Test of Concrete

15.3.1 Samples from fresh concrete shall be taken as per IS 1199 and cubes shall be made, cured and tested at 28 days in accordance with IS 516.

15.3.2 In order to get a relatively quicker idea of the quality of concrete, optional tests on beams for modulus of rupture at 72±2 hours or at 7 days, or compressive strength tests at 7 days may be carried out in addition to 28 days compressive strength tests. For this purpose, the values shall be arrived at based on actual testing. In all cases, the 28 days compressive strength specified in Table-1 shall alone be the criterion for acceptance or rejection of the concrete in accordance with clause 15.3.9.

15.3.3 Sampling Procedure

A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested that is, the sampling should be spread over the entire period of concreting and cover all mixing units.

15.3.4 Frequency of Sampling

The minimum frequency of sampling of concrete for each grade shall be in accordance with Table-4.

TABLE – 4
(Refer Cl. 15.2.2 of IS 456)

FREQUENCY OF CONCRETE SAMPLING

Quantity of concrete in the work (m^3)	Number of samples
1-5	1
6-15	2
16-30	3
31-50	4
51 & above	4 plus one additional sample for each additional 50m^3 or part thereof.

At least one sample shall be taken from each shift.

When concrete is produced at continuous production units such as ready mixed concrete/ batching plants, atleast one sample shall be taken for every 50m^3 of concrete or after every 50 batches, whichever occurs at a greater frequency or as decided by the Engineer-in-Charge. Samples shall be avoided from the first and the last cubic metre of concrete mix in a lot.

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15.3.5 Test Specimen

Three test specimens shall be made for each sample for testing at 28 days. Additional cubes may be required for various purposes such as to determine the strength of concrete at 7 days or at the time of striking the formwork or to check the testing error. Additional samples may also be required for testing samples cured by accelerated methods as described in IS 9013. The specimen shall be tested as described in IS 516.

15.3.6 Identification mark on concrete test cubes:

The following numbering system shall be adopted on each 150 mm cube:

First line: ZZ	(Alpha code assigned by the Engineer -in-Charge to the Contractor for a particular contract starting with AA and progressing to AB, AC and so on).
Second line: XXXX	(Unique integer in ascending order starting from 1).
Third line: DD-MM-YY	(Date of casting of cube)

15.3.7 Test Results of Sample

The test results of the sample shall be the average of the strength of three specimens. The individual variation should not be more than ± 15 percent of the average. If more, the test results of the sample shall be considered invalid.

15.3.8 Standard Deviation

Standard deviation for each grade of concrete shall be calculated separately.

Standard deviation based on test results of samples:

a) The total number of test samples required to constitute an acceptable record for calculation of standard deviation shall be not less than 30. Attempts shall be made to obtain the 30 samples, as early as possible, when a mix is used for the first time.

b) For design of mix in the first instance, the value of standard deviation given in Table 8 of IS 456, Amendment No. 4 may be assumed.

c) As soon as sufficient results of samples are available, actual calculated standard deviation shall be used and the mix design shall be revised/ updated. However, when adequate past records for a similar grade exist and justify to the designer a value of standard deviation different from that shown in Table 8 of IS 456, Amendment No. 4, it shall be permissible to use that value.

d) For additional requirement on standard deviation refer clause 9.2.4 of IS 456.

15.3.9 Acceptance Criteria

15.3.9.1 Compressive Strength

The concrete shall be deemed to comply with the strength requirement when both the conditions as given in col. 2 & col.3 of Table-5 for that particular grade of concrete are simultaneously met. For working out standard deviation compressive test result of date wise serially logged 30 sample test result shall be used.

15.3.9.2 Flexural Strength

The concrete shall be deemed to comply with flexural strength requirements when both the following conditions are simultaneously met:

a) The mean strength determined from any group of four consecutive test results exceeds the specified characteristic strength by at least 0.3 N/mm².

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