9.3.5.5 All post order documents shall be submitted / approved through EIL VDM portal.

9.3.5.6 Final documentation shall be submitted in hard copy and soft (CDs/ DVDs) in addition to submission through EIL VDM portal. The number of prints and/or reproducible required to be submitted by vendor are specified in Purchaser's inquiry/order.

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डोजिंग पैकेज (स्किड माउंटिड) हेतु मानक विनिर्देश

STANDARD SPECIFICATION FOR DOSING PACKAGES (SKID MOUNTED)

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
2	30.12.2025	REVISED AND ISSUED AS STANDARD SPECIFICATION	TP	JSD/TK	NK	MN
1	09.02.2021	REVISED AND ISSUED AS STANDARD SPECIFICATION	MK	AM	NK	SM
0	03.07.2014	ISSUED AS STANDARD SPECIFICATION	SKK	AM	DB / AKN	SC

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Abbreviations:

ANSI : American National Standard Institute

API : American Petroleum Institute

ASTM : American Society for Testing and Materials

ASME : American Society for Mechanical Engineers

EC : Experience Criteria

HART : Highway Addressable Remote Transducer

NPSHA: Net Positive Suction Head Available

NPSHR: Net Positive Suction Head Required

PWHT : Post Weld Heat Treatment

PTR : Proven Track Record

VDM : Vendor Document Management

VDR : Vendor Data Requirements

B/L : Battery Limit

P&ID : Piping and Instrumentation Diagram

PMS : Piping Material Specification

VMS : Valve Material Specification

eDMS : Electronic Document Management System

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1.0 GENERAL

1.1 Scope

This specification describes the minimum requirements for engineering, manufacture, packaging, shop inspection & testing and supply of Skid Mounted Dosing Packages.

The Dosing package(s) shall be used to dose metered quantity of chemicals as per the requirements specified in the process data sheets, process P&IDs and other specifications forming part of inquiry document.

1.2 Conflicting Requirements

In case of conflict between this specification and the attendant data sheets, job specifications (if any) and other attached specification the following order of precedence shall govern:

1. Process Data Sheet / P&IDs / Process Package
2. Mechanical Data Sheets.
3. Job Specifications/scope of work (if any)
4. This specification
5. Other standards & specifications
6. Other referred codes and standards

The editions of referenced publication that are in effect at the time of inquiry or at a date specified in the inquiry documents shall be applicable.

In case of any ambiguity in the above documents, the vendor/supplier shall seek clarification from the owner/purchaser and the decision of the owner/purchaser shall be final and binding.

2.0 CODES AND STANDARDS

a) **Codes, Standards and Regulations**

The following codes and standards-latest edition (as applicable) shall apply. In case any additional codes and standards are mentioned in the list of attachments, the same shall also be applicable.

Code	Title
API 675	Positive Displacement Pumps-Controlled Volume
ASME Section VIII Div.1	Rules for Construction of Pressure Vessels
ASME Sec. II A	Ferrous Material Specification
ASME Sec. II C	Specifications for Welding Rods, Electrodes, and Filler Metals
ASME Sec. II D	Material Properties
ASME Sec. V	Non Destructive Examination
ASME Sec. IX	Welding and Brazing Qualifications
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B16.47	Large Diameter Steel Flanges
ASME B16.20	Metallic Gaskets for Pipe Flanges
ASME B 16.21	Non -Metallic Gaskets for Pipe Flanges
ASME B 31.3	Process Piping
IS 4049 (Part-II)	Specification for Formed Ends for Vessels

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Code	Title
API 650	Welded Tanks for Oil Storage
IS : 803	Code of Practice for Design, Fabrication, Erection of Vertical Mild Steel Cylindrical Welded Oil Storage Tanks
IS 4682	Code of Practice for Lining Vessels & Equipments for Chemical Process

Other international standards may be acceptable subject to their being equivalent or superior backed by proven track record for the application and prior approval of the Company.

b) **Standard Specifications**

Standards	Title
6-41-0021	Standard Specifications for Positive Displacement Pumps Controlled Volume
6-81-0052	Inspection and test plan for Pump Reciprocating (Controlled Volume)
6-78-0001	Specification for Quality Management System Requirements from Bidders
6-78-0003	Specification for Documentation Requirements from Suppliers
6-51-0064	Specification for energy efficient medium voltage induction motors
6-51-0006	Specification for Flameproof Control Stations
6-81-1064	Inspection and test plan for energy efficient medium voltage motors
6-81-1006	Inspection & Test Plan for Flame Proof Control Stations
7-12-0001	Vessel Tolerances
7-12-0002	Support for Horizontal Vessel
7-12-0004	Skirt Base Details
7-12-0006	Angle Leg Support
7-12-0007	Pipe Leg Support
7-12-0008	Bracket Support for Vertical Vessels
7-12-0009	Manhole with Hinged Cover
7-12-0010	Manhole with Davit
7-12-0013	Nozzle Reinforcement and Projection
7-12-0015	Standard Bolt Hole Orientation
7-12-0018	Internal Flanges
7-12-0024	Lifting Lug Top Head Type
7-12-0026	Earthing Lug
7-13-0001	Earth Connections

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Standards	Title
7-13-0002	Anchor Chair
7-13-0006	Level Indicator Supports
7-13-0007	Gauge Hatch with Cover
7-13-0010	Cage Ladder for Fixed Roof Tank
7-68-0509	Steel Ladder Joint Details
7-68-0663	Structural Arrangement of Cone Roof – (2.5 M < Dia < 6.0 M)
7-68-0680	Roof Structure for Cone Roof Tank, Joint Details (Dia <=40 M)
7-68-0681	Roof Structure for Cone Roof Tanks Central Drum (Detail B).
7-68-0682	Cone Roof Structure Schematic Joint Details & Central Drum.
6-26-0001	Standard Specification for Mechanical Agitators

Following project specifications attached elsewhere in the bid package are referenced to and made a part of this specification. In case any additional standard specifications are mentioned in the list of attachments, the same shall also be applicable

3.0 EXPERIENCE CRITERIA

3.1 Dosing Skid-Supplier/Packager

3.1.1 The Supplier of the Dosing Package (Skid Mounted) shall be a packager of Dosing Packages (Skid Mounted) with API 675 Pumps and shall be the Single Point Responsibility Vendor (SPRV) of the complete Dosing Package (Skid Mounted).

3.1.2 The vendor shall have designed, engineered, packaged, tested and supplied, in the last Ten (10) years, at least ONE (1) unit of Dosing Package (Skid Mounted) similar in terms of skid size & weight, fluid/chemical handled, capacity of dosing vessels/tanks and type, capacity & capacity control method of metering pumps (API 675), from the proposed manufacturing plant, with minimum operating experience of one year, as on bid due date.

3.1.3 The vendor shall complete the Experience Record Proforma enclosed with the inquiry document to amply prove that the offered Dosing Package (Skid Mounted) meets the above experience requirement furnishing details of skid size & weight, fluid/chemical handled, capacity of dosing vessels/tanks, type, capacity & capacity control method of metering pumps etc., as applicable in the format. In addition, manufacturer's catalogue and general reference list for Dosing Package (Skid Mounted) shall also be furnished along with the proposal.

3.2 Positive Displacement Pumps (Controlled Volume)

3.2.1 Pumps shall be procured from CONSULTANT /OWNER approved vendor list.

3.2.2 The Experience Criteria (EC) as specified in the Standard Specification for Positive Displacement Pumps (Controlled Volume) [Spec.# 6-41-0021], shall be met for the offered model of pump.

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3.3 Static Equipment

3.3.1 Vessel/Tank shall be procured from CONSULTANT /OWNER approved vendor list.

In case, Package vendor fabricates the vessel/tank on his own or sources it from his approved sub-supplier, following experience criteria shall be met:
Vendor shall have fabricated and supplied at least one number vessel/tank of similar material of construction, dimensions and thickness in the last ten (10) years.

Reference list for the similar supplied vessel/tank shall be provided to establish experience of fabrication of similar vessels/tank.

3.3.2 Mixers/Agitators shall be procured from CONSULTANT /OWNER approved vendor list.

In case, Package vendor manufactures the Mixers/Agitators on his own or sources it from his approved sub-supplier, following experience criteria shall be met:
Vendor shall have manufactured and supplied at least one number Mixer/Agitator of similar material of construction, dimensions and operating speed in the last ten (10) years.

Reference list for the similar supplied Mixers/Agitators shall be provided to establish experience of manufacture of similar Mixers/Agitators.

3.4 Vendor may procure material/equipment from any of CONSULTANT /OWNER approved vendors. However current validity of vendor approval & their approved product range and the conditions imposed while according vendor approval as per the approved letter shall be verified by the vendor before the placement of order.

4.0 SCOPE OF SUPPLY/WORK

Package vendor scope has been defined broadly in document “Scope of Supply”. However, vendor shall refer the entire enquiry specification for complete vendor’s scope of supply/work.

5.0 BASIC DESIGN

5.1 General

5.1.1 The Process datasheets and P&IDs shall be referred to, for operating conditions.

5.1.2 The equipment shall be suitable for outdoor (without-roof) installation.

5.1.3 All controls shall operate in a fail-safe mode.

5.1.4 All Electrical Devices and instruments shall meet the requirements for the specified area classification in which they are installed.

5.2 Positive Displacement Pumps (Controlled Volume)

5.2.1 Pumps shall be designed, manufactured and tested in accordance with API Std. 675 and as modified as per the attached EIL Standard specification no. 6-41-0021.

5.2.2 Maximum allowable working pressure (MAWP) & temperature of the equipment shall not be less than the design pressure & temperature specified in the data sheet nor less than those specified in specifications, codes & standards.

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5.2.3 The dosing package vendor shall calculate the acceleration head for each pump item, based on the system configuration. Calculations for Acceleration head & NPSHR shall be furnished. The dosing package vendor shall ensure that NPSHA is greater than "Acceleration Head + NPSHR" by a margin of at least 1.0 meter, either by proper selection of pump speed or by proper valve design or else by providing a suction side Pulsation dampener.

5.2.4 Pulsation dampeners shall be provided as per pump data sheets and P&ID.

a) The suction side pulsation dampener (if provided) shall be as per the following details:

Design Code:	ASME Sec. VIII Div.I
Allowable pulsation level:	± 3%
Material of construction:	As per applicable Piping Material Specification (PMS) indicated in P&IDs
Type of pulsation dampener:	Inverted Bottle, Direct Contact type.

b) The discharge side pulsation dampener (if provided) shall be as per the following details:

Design Code:	ASME Sec. VIII Div.I
Allowable pulsation level:	± 3%
Material of construction:	As per applicable Piping Material Specification (PMS) indicated in P&IDs
Type of pulsation dampener:	Inverted Bottle, Direct Contact type/Bladder Type.

c) Note: In case Discharge Pulsation dampeners are of bladder type with gas charging, bidder shall provide a gas charging kit which should include pressure gauge, pressure regulator etc. Unless otherwise specified, one number gas charging kit shall be supplied against each order.

5.2.5 All coupling and exposed rotating parts shall be provided with suitable guards of non-sparking type.

5.3 Drum Unloading Pump and Connecting Hoses

5.3.1 Drum unloading pumps shall be of "Air Operated Double Diaphragm (AODD)" type and shall be as per manufacturer's standard.

5.3.2 Typical data sheet(s) for AODD pumps is enclosed with the inquiry document. The dosing package vendor is advised to refer the inquiry specifications and completely fill-up the same with operating data and data related to construction, performance of pump & submit the same during detailed engineering stage. Technical literature, manufacturer's standard performance curve, Plant air consumption data etc. for the AODD pumps shall also be submitted for purchaser's review during detailed engineering stage.

5.3.3 The drum unloading pumps wherever specified shall be of portable type, driven pneumatically i.e.by plant air.

5.3.4 These pumps shall be used for transfer of chemicals to the dosing vessel/tank from the chemical drum / barrel (By Purchaser) (standard capacity of 200 litres). Pumps shall be selected for a transfer rate of minimum1000 litres per hour.

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5.3.5 For connecting the plant air supply to the air inlet side of each drum unloading pumps, air inlet shall be provided with an air dryer requiring no electric power, air filter cum regulator with pressure gauge, bleed type master air valve, pressure relief valve & flexible hoses. The air outlet shall be equipped with air discharge muffler.

5.3.6 For transferring the chemical from the drum/barrel to the dosing tank/vessel through drum unloading pump, flexible metallic hose with quick coupling connection (suitable for handling the particular chemical) with liquid filter, shall be provided in the inlet line. The outlet line should also be provided with a flexible metallic hose with quick coupling connection,(suitable for handling the particular chemical) check valve, isolation valve and a flanged connection which can be connected to the nozzle on the dosing vessel / tank.

5.3.7 The pump shall be provided with a suitable adapter such that it can fit on the top of chemical drum. Liquid inlet, outlet and air inlet connections of the pump shall be suitable for fitting the respective flexible metallic hoses.

5.3.8 The drum unloading pump shall be procured from a reputed AODD pump manufacturer having proven experience for similar services. The dosing package vendor shall furnish, AODD pump manufacturer's general reference list for the proposed pump model during detailed engineering.

5.4 Calibration Pot / Graduated Cylinder

Unless otherwise specified, calibration pot / graduated cylinders shall be provided for calibration of each controlled volume pump as specified in the Scope of supply. For multi head pumps, separate calibration cylinders or necessary piping arrangement with isolation valves shall be provided so that flow through each head can be calibrated. This requirement shall govern over and above the P&ID.

5.5 Skid

5.5.1 The skid shall be designed and built to ensure that all the equipment along with accessories, local control station(s) and piping are located and mounted suitably for ease of operation and maintenance.

5.5.2 All the components of a particular chemical dosing package shall be assembled & mounted on the skid, and shall be duly interconnected with piping & power/control cabling. The inlet and outlet connections for purchaser’s interface shall be terminated at the skid edge with flanges of the specified sizes & ratings. The local control station(s) & the junction box(es) for instrumentation shall be located at the edge of skid.

5.5.3 The skid shall be suitable for four point lift & shall be provided with lifting lugs.

5.5.4 The skid shall be provided with cable trays for routing of purchaser’s power / control cables.

5.6 Static Equipment

5.6.1 Mixers/ Agitators

5.6.1.1 The Vendor/Supplier shall furnish the Filled in Mixer Data sheet in the format provided after award of contract.

5.6.1.2 Unless otherwise specified, all mixers/agitators shall be provided with dry running mechanical vapor seals (cartridge type).

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5.6.2 **Design**

5.6.2.1 **Pressure Vessels**

5.6.2.1.1 Minimum Wall Thickness

Vessel shell and heads shall have minimum wall thicknesses calculated with Design pressure and temperature, in accordance with the codes, but in no case, shall the thickness be less than the criteria indicated below:

a) For Carbon steel vessels: 6mm (including corrosion allowance not exceeding 3.0 mm), but not less than that calculated as per below formula :

For Vessels with Diameter less than 2400 mm,

Wall Thickness = {(Dia./1000) + 1.5+ C.A.}

For Vessels with Diameter 2400 mm & above,

Wall thickness = {(Dia/1000) + 2.5+ C.A.}

b) For Stainless Steel vessels: 3 mm, but not less than that calculated as per following for Vessels with Diameter more than 1500 mm

Wall thickness= {(Dia/1000) + 2.5}

5.6.2.1.2 Design Pressure

Design pressure shall be calculated as per the following, unless otherwise specified elsewhere in the package:

a) Design pressure shall be the highest of the following:

- Maximum operating pressure (kg/cm2g) x 1.1
- Maximum operating pressure + 2.0 kg/cm2
- 3.5 kg/cm2g

b) Design pressure at any lower point is to be determined by adding the maximum operating liquid head and any gradient within the vessel.

c) Vessel operating under vacuum (or partial vacuum) shall be designed for differential external pressure of 1.055 Kg/cm2.

5.6.2.1.3 Design Temperature

Design temperature shall be calculated as per the following, unless otherwise specified elsewhere in the package:

a) For Vessels operating at 0° C and over, the design temperature shall be operating temperature plus 15° C. However, design temperature shall not be less than 65°C.

b) For Vessels operating below 0° C, design temperature shall be lowest operating temperature.

c) Minimum Design Metal Temperature (MDMT) shall be lower of minimum atmospheric temperature and minimum temperature envisaged during operation.

5.6.2.1.4 Corrosion Allowance

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Minimum Corrosion allowance for Carbon steel vessels shall be 3.0 mm, unless otherwise specified elsewhere in the package.

All internals shall be designed for full load condition. For Welded internals, twice the corrosion allowance shall be considered. For Removable internal parts, single corrosion allowance shall be considered. All bolted internals shall be provided with SS bolts and two nuts.

5.6.2.1.5 Vessels shall be designed as per ASME Sec. VIII Div. 1 (latest edition including latest addenda in accordance with design data enclosed with the package). All Design calculations shall be carried out considering all loads for erection, operation and hydro test condition.

5.6.2.2 **Storage Tanks**

5.6.2.2.1 Any pressurized tank (irrespective of diameter) and atmospheric storage tanks (diameter more than 2.0 m) shall be designed and fabricated as per API 650 code. However, small atmospheric tanks can be designed& fabricated as per manufacturer's standard & good engineering practice.

5.6.2.2.2 All internals shall be designed for full load condition. For Welded internals, twice the corrosion allowance shall be considered. For Removable internal parts, single corrosion allowance shall be considered. All bolted internals shall be provided with SS bolts and two nuts.

5.6.2.2.3 The Corrosion allowance for Tanks shall be as given in respective Tank data sheets attached with the bid package. Otherwise, it shall be determined by its intended service conditions and service life.

5.6.3 **Fabrication**

5.6.3.1 Materials

Materials of various pressure parts of equipment shall be selected as follows for general industrial condition/services, unless otherwise specified in respective Process data sheets. Minimum grade for Stainless Steel shall be SS 304.

Plates	:	SA 516 Gr. 60/70 (for CS vessels)/ IS 2062 Gr. B (for CS tanks)/ SS 304 (for SS Vessels/Tanks)

SA 516 Gr.60 for Caustic/Sour/Amine service tanks & vessels

Forgings	:	SA 105/SA 182 F 304
Pipes	:	SA 106 Gr. B/SA 312 TP 304
External bolting	:	SA 193 Gr. B7/ SA 194 Gr. 2H
Gasket	:	As per PMS

MOC of internals shall be as per respective Process Data Sheets attached with the bid package.

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5.6.3.2 CS Plates used shall conform to the latest issue of specification SA-20 with additional requirements mentioned herein.

a) Only normalized plates free from injurious defects with workmanlike finish shall be used. Reconditioning/repair of plates by welding shall not be permitted.

b) One product analysis of each heat shall be carried out and reported. Chemical analysis shall be as per applicable specifications with carbon content not exceeding 0.23%.

Additionally, one of following requirements for carbon equivalents (Ceq) based on heat analysis shall be satisfied.

$$Ceq = C + Mn/6 < 0.42 \quad ...(1)$$
$$Ceq = C + Mn/6+(Cr + Mo + V)/5+(Cu+Ni)/15 < 0.43 \quad ...(2)$$

Equation -(1) shall be used when applicable material specify C and Mn only.
Equation -(2) is applicable for restricted chemistry requirements or for supplementary requirements of S19 & S21 of specification SA-20.

SS plates shall conform to Specification SA 480 with additional requirements mentioned herein:

a) All plates shall be hot rolled, pickled & shall have No. 1 finish on both sides with reference to Specification SA-480. In addition, all stabilized grades of SS (SS 347, SS 321 etc.) shall be given stabilization heat treatment.

b) Unless otherwise specified; plates, pipes, forgings & fittings representative of each heat shall be subjected to Inter granular corrosion tests as per ASTM A262 practice E for all 300 series material. The bend test specimen shall be examined at a magnification of 200X.

5.6.3.3 Heads

a) All Carbon steel cold formed dished heads or knuckles shall be stress relieved. Hot formed dished ends or knuckles which have not been uniformly heated in the normalizing range in the final stages of manufacturing shall be normalized. When completed vessel involves PWHT, heat treatment intended above for cold formed dished heads or knuckles is not applicable.

b) Cold formed dished ends of SS vessels shall not be solution annealed unless any of the following condition exists:
- Specifically called for any Equipment/service.
- Hardness value after forming exceeds 235 BHN.
- Nominal thickness of plate is 16 mm or above.

c) Hot formed dished ends of SS vessels shall be solution annealed.

d) Whenever Heat treatment on Stainless Steel is carried out, it shall be followed by micro etching test & IGC test as per ASTM A 262 practice E unless otherwise specified to ascertain suitability & effectiveness of Solution annealing. The bend test specimen shall be examined at a magnification of 200X.

5.6.3.4 Material Certificates shall conform to EN 10204 Type 3.1 and shall be submitted to EIL/Owner/Third party.

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5.6.3.5 Material of construction (MOC) of the Mixers shall be compatible with the process service applicable.

5.6.3.6 Pipes for nozzles shall conform to API 5L, IS: 1978, A-53 or A-106. For Caustic, Sour and Amine services, all nozzle pipes shall be A-106. Pipes for nozzle & heating coil shall be of seamless quality. SS tanks shall have SS nozzles of compatible grade.

5.6.3.7 All Vessels/ Tanks shall be provided with lifting lugs.

5.6.3.8 Unless otherwise specified, Bottom plate slope shall be 1:50 from the centre of the tank towards the shell.

5.6.3.9 For vessels, all Nozzle Flanges shall be of Weld Neck type. For Caustic, Sour and Amine services all nozzle flanges shall be WN type in Vessels as well as Tanks.

5.6.3.10 Nozzles upto 50 mm NB size shall be stiffened with 2 numbers of 40 mm wide x 6 mm thick stiffeners welded at 90 apart.

5.6.3.11 Rolling direction of plate for shell shall be lengthwise.

5.6.3.12 All Tanks shall be provided with Vent connection, level indicators & earthing connections. A gauge hatch with cover for gauging & sampling purpose is to be provided on the tank, if specified on the Tank datasheet

5.6.3.13 All vessels shall be transported to site in single piece.

5.6.3.14 Roof Supporting Structure for Storage Tanks, if provided internally, shall be protected with proper primer and painting as per the provisions of painting specification, as these structures are designed without corrosion allowance.

5.6.4 **Tolerances**

5.6.4.1 Equipments tolerances shall be as per attached Standards/applicable code.

5.6.5 **Cleaning and Painting**

5.6.5.1 Vessels shall be cleaned internally to remove scale, rust, dirt, foreign material by wire brushing.

5.6.5.2 All external surfaces shall be cleaned, primed and painted in accordance with painting specification for specified environment.

5.6.5.3 SS surfaces both inside & outside shall be pickled & passivated in accordance with Specification ASTM 380 after hydro test.

5.7 Piping

5.7.1 **Piping Design Codes**

The design and engineering shall conform to the following standards as applicable:

- ASME B 31.3 "Process Piping"
- IBR " Indian Boiler regulations"

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5.7.2 **Piping Design Basis**

5.7.2.1 Preferred level of bottom of piping from skid top shall be 500 mm.

5.7.2.2 Minimum level of overhead piping shall be such that clear 2.2 M headroom is available below pipe/insulation/supports.

5.7.2.3 All hydrocarbon vents to atmosphere should be vented at minimum 3 meters above the nearest operating platform, existing within a radius of 12 meters. A 3/8" diameter weep hole in the tail pipe for drainage to safe location at low point of line shall be provided. All steam vents to atmosphere should be vented at minimum 3 meters above the nearest operating platform, existing within a radius of 8 meters. A 3/8" diameter weep hole in the tail pipe for drainage at low point of line shall be provided.

5.7.2.4 All PSVs and Control valves discharging to flare header shall be located close to and above flare header for maintaining free draining requirement. PSVs and control valve assembly along with prefabricated spools, valves, flanges, gaskets and bolts shall be supplied loose by vendor for installation by owner. Size of PSV inlet line shall be decided considering far away location of the PSV.

5.7.2.5 Hydrostatic test, Leak test, Non destructive Examination shall be carried out as per applicable piping design codes.

5.7.2.6 Hydrostatic Vents and Drains shall be provided at High Point and Low points respectively as per PMS and or good engineering practice.

5.7.2.7 Piping systems shall be adequately flexible to cater for thermal expansion/contraction under start-up, operating and shut down conditions to ensure that the stresses and loads do not exceed the values permitted in the applicable code.

5.7.2.8 All instruments and valves requiring attention during normal operation shall be conveniently operable.

5.7.2.9 Adequate space shall be provided for removal of equipment components for routine maintenance.

5.7.3 **Pipe Support Design Basis**

All piping shall be adequately supported, guided or anchored so as to prevent undue vibration, deflection/expansion or loads on connected equipment and leakage at flanged joints. Piping at valves and equipments such as pumps, requiring periodic maintenance, shall be supported in such a way so that the valves and Equipments can be removed with a minimum necessity of installing temporary pipe supports.

5.7.4 **Piping Material Specification/ Valve Material Specification**

The job piping material specification as applicable to incoming and outgoing lines is provided. Vendor shall follow these piping classes if shown in P&IDs. Basic details for valves are provided in the Piping Material Specification. Detail Valve material specification shall be provided to the successful bidder. In case of variation in material/components from this specification it shall be the responsibility of the vendor to ensure suitability and establish equivalence of proposed material.

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5.7.5 **Battery Limit**

All incoming and outgoing Piping shall be terminated by the vendor at one location with isolation valves/flanges as per the approved P &Ids. B/L interface orientation shall be finalized during detail engineering. Battery Limit Drawing shall indicate exact location, levels and scope of package piping for all incoming and outgoing lines. All piping at Battery Limit shall be anchored.

5.7.6 **Painting**

The protective paint system shall be provided to protect external surface of uninsulated low alloy steel and carbon steel piping and equipments and insulated surface of low alloy steel, carbon steel and stainless steel piping and equipments. The painting system shall be suitable for the type of environment where package unit is to be installed.

5.7.7 **Welding**

Welding procedure qualification, welder's qualification, all welding work, equipment for welding, heat treatment, other auxiliary functions and the welding personnel shall meet the requirements of the accepted national/international standards and practices.

5.8 Electrical

5.8.1 Following minimum electrical facilities shall be provided by Vendor on local control station:

a) Start
b) Stop
c) Field ammeter, as required.

Selector switch shall be provided, as required, as per P&ID & operational requirements. The interlocking between the MCC feeder and field equipment shall be arranged in Local Control Station by the Vendor.

5.8.2 All motors shall have a enclosure protection Ex-d with efficiency class IE-3 as per IS 12615-2011/IEC 60034-30and shall meet the requirements of IS/IEC 60079-1 & 60079-0.

5.8.3 All the 415 Volts supply feeders, to feed Dosing Pumps & Agitator Motors shall be arranged by Purchaser. kW rating of motors for Dosing System shall be decided by Bidder for the starting and running conditions specified in pump/ agitator datasheet. Vendor to furnish Motor List, indicating kW rating, enabling Purchaser to provide MCC with required number & rating of feeders as per the format mentioned in the Job Specification-Electrical for Dosing Package.

5.8.4 The power & control cables from Purchaser's MCC to individual motor & local control stations, shall be supplied, laid & terminated by the Purchaser. However, Vendor shall supply all cable glands and lugs, as required. All cable glands shall be flameproof Ex (d) double-compression type of Ni-plated Brass. The cable-lugs shall be of tinned Copper and crimping type. Exact size of Purchaser-supplied power and control cables shall be finalised during detail engineering. Provisions, as required, in Vendor's equipment for termination of the same, shall be made accordingly without any cost & time implications to Owner.

5.8.5 Purchaser's power cables will be 1100V grade, Copper or Aluminum conductor, XLPE or PVC insulated, PVC extruded inner sheath, armoured with overall FRLS PVC sheath.

5.8.6 Purchaser's control cables will be 1100V grade, Copper conductor, overall shielded, twisted pair, XLPE/ PVC insulated, armoured with overall FRLS PVC sheath.

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5.8.7 Cable size for motor space heater shall be 3 x 2.5 mm² with Cu Conductor, 3/4-inch entry.

5.8.8 The cable trenches/ trays from sub-station to battery limit of individual package shall be in the scope of Purchaser. Cable trays on Dosing Skids shall be provided by Vendor, as required, for routing of Purchaser-supplied power & control cables within skid.

5.8.9 Earthing of all package equipments within the skid shall be done by the bidder. Earth terminals shall be provided on skid for connection by Purchaser to main plant earth grid.

5.8.10 Earthing shall be carried-out as per standard IS: 3043. All hardware for earthing shall be hot dip galvanized @ 610 gm/m2. GI Earth Plate shall be provided and all non-current carrying parts of electrical apparatus, vessels and skid structure shall be bonded with this GI earth plate. Purchaser shall connect earth plate with main plant earth network. Sizes of earth conductors to be used shall be as per Job Specification-Electrical for Dosing Package.

5.8.11 All the equipment, indigenous and imported, shall have a valid statutory approval of PESO/CCOE towards explosion protection and copies of the same (PESO/CCOE approvals) shall be furnished during detailed engineering stage.

5.8.12 All local control stations shall be flameproof Ex (d) type.

5.8.13 For project specific requirement, Bidder shall refer Job Specification-Electrical for Dosing Package

5.8.14 In case of any conflict between various requirements/ parameters, the most stringent one shall be applicable.

5.9 Instrumentation and Controls

5.9.1 **General**

5.9.1.1 All electronic field instruments shall be certified for installation in hazardous area classification of Location as per Job specification sheet. Instrument shall also be weatherproof to IP-65 as a minimum. For environmental conditions, refer elsewhere in the package.

5.9.1.2 SS Tag plate shall be provided for all instruments.

5.9.1.3 The instrumentation selected for the package shall be rugged in design and must be well proven for use in similar applications. Items of Prototype design or items of experimental nature or design undergoing testing etc. shall not be selected and supplied by bidder. The instruments as being offered / supplied should have been operating satisfactorily in hydrocarbon industry like Refinery, Petrochemical and Gas Processing Plant for a period of minimum 6 months on the bid due date under similar conditions as specified in purchasers datasheet.

5.9.1.4 Bidder shall supply 10% subject to minimum 1 no. of each type of instrument installation materials such as fittings, valves, tubes, etc. as loose supply. Prices for these spares shall be included in the base price.

5.9.1.5 Bidder shall supply instruments from EIL approved vendors. For items not appearing in approved vendor list, bidder shall furnish proposed sub-vendor list for purchaser's approval.

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5.9.1.6 For Caustic and NACE services, minimum wetted parts/ Sensor material shall be SS316L against SS316 material indicated in respective instrument specifications.

5.9.2 **Instrument Specifications**

5.9.2.1 Transmitters

a) The SMART transmitter shall be two wire microprocessor based type and it shall incorporate a non-volatile memory which shall store complete configuration data of transmitter and sensor characterization. All necessary signal conversions, including conversion to produce output with the required protocol shall be carried out in the transmitter electronics. The configuration data of the instruments shall be stored in a non-volatile memory such that this remains unchanged because of power fluctuations or power off condition. In case vendor standard instrument has battery backed RAM, bidder to ensure that battery drain alarm is provided as diagnostic maintenance message. Transmitter body material shall be metallic. Integral output LCD display shall be provided for all transmitters.

b) SMART Transmitters shall be able to communicate to Universal Hand Held communicator (HHC Model no. : HART 475 or equivalent model, not in Vendor's scope). In case any of transmitter is not able to accept commands from HHC, vendor shall supply suitable intrinsically safe dust proof hand held configurator (one no. suitable for HART transmitters) with complete license and upgrade packing rechargeable battery charger and other accessories suitable for the specified area classification along with suitable carry case for easy mobility.

c) When HART protocol is specified, the following features must be ensured;

i) It shall allow multi masters (two for example, primary and secondary) for configuration, calibration, diagnostics and maintenance. The primary could be the control system or host computer and the secondary could be the hand-held communicator.

ii) It shall be capable of implementing universal commands from either of these locations.

iii) All HART transmitters shall be configurable for under current and over current.

iv) All HART transmitters shall be compliant to NAMUR NE 43 recommendations.

d) The Overall rangeability shall be 1:100 for Normal transmitters with calibrated accuracy of ± 0.065%of span. The Overall rangeability shall be 1:100 for Diaphragm seal transmitters with calibrated accuracy of ± 0.2% of span.

e) Transmitter shall also run complete diagnostic subroutines and shall provide diagnostic alarm messages for sensor as well as transmitter healthiness. In the event of detection of failure, the output shall be driven to a predefined value, which shall be field configurable.

f) The over-range/ static pressure protection of the transmitter shall be 130% of maximum operating range.

5.9.2.2 Level Instruments standpipe philosophy

5.9.2.2.1 Standpipe shall be used for clean, non-viscous and non-crystallizing services for installation of level instruments on vessels/ equipments if more than 4 nozzles are required

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for level instruments on a vessel. Standpipe shall also be used wherever shown in Licensor's drawings. Size of standpipe shall be 2" minimum.

5.9.2.2.2 Maximum number of nozzles allowable on standpipe is as follows:

a) 8 with no displacer / guided wave radar type level instrument on standpipe.
b) 6 with displacer/ guided wave radar type level instrument on standpipe

5.9.2.3 Level Gauge

a) Level gauges shall be steel armored reflex or transparent type with body and cover material of forged carbon steel as a minimum and shall have tempered borosilicate glass with asbestos free gasket. Transparent type of gauges shall be provided with integral illuminators operating at 230V, 50 Hz supply and suitable for electrical area classification. All gauge glasses must have a rating equal to or more than the vessel design pressure and temperature. SS Calibrated scale shall be provided with scale graduations in mm.

b) Reflex type will be used for clean and colorless liquids, except liquids level interface. Transparent type will be used on acid, caustic, dirty or viscous, coloured liquids and liquid interface. Transparent type with Mica or Kel-F shields shall be used for treated water, boiler and condensate services, and for corrosive liquids, which will attack glass.

c) The visible range of level gauge shall be selected to cover the complete operating level as well as measuring range of the other level instruments provided for the same purpose.

In general, the visible length of the level gauges shall be 220, 470, 720, 980, 1230 mm. In any case, the maximum visibility length shall not exceed 1500 mm for a single gauge.

d) For level gauging in very viscous liquids, liquids with crystals and high pressure rating (600# and above), float operated magnetic gauges with 2" (50 mm) flanged end connections, shall be used. C to C length of single magnetic level gauge shall not be more than 2500mm.The float and chamber material of magnetic level gauge shall be non magnetic type. Float chamber (or cage) shall be provided with ¾"flanged end vent and drain connections. The design shall also facilitate float removal.

5.9.2.4 Level Transmitter

a) Guided Wave Radar type instruments with external chamber and side-side connections, complete with isolation valves, vent and drain details shall be used for level measurement upto 2400 mm. In general, Guided Wave Radar instruments shall be used with C-C lengths of 356 mm, 813 mm & 1219 mm etc.

b) Guided Wave Radar instrument shall have $\pm$ 3mm accuracy.

c) Differential pressure transmitter shall be used for level instruments above 2400 mm, for services requiring purge or where liquid might boil in external portion.

d) Differential Pressure transmitters for use on corrosive or fouling service shall generally be diaphragm with extended filled capillary type. Flush or extended diaphragm type differential pressure transmitter shall be considered for special applications only. Diaphragm material shall normally be stainless steel or any other special alloy.

e) Transmitters shall also meet the requirements specified in clause no. 5.9.2.1 as applicable.

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5.9.2.5 Pressure Gauges

a) Pressure gauges shall be weatherproof with dial size of 150 mm and shall have features like screwed bezels, externally adjustable zero, over range protection (at least 130% of max. operating pressure), blowout discs and Shatter proof glass window. Pressure gauge sensing element shall be of SS 316 and movement & Case of SS 304, as a minimum.

b) Pressure gauge dial shall be white, non-rusting plastic with black figures. The dial face shall be marked with pressure element material. Pointers shall have micrometer adjustment.

c) Pressure gauge shall have 1/2" NPT (M) bottom connection.

d) Pressure gauge shall have an accuracy of ± 1% of URV (Upper Range Value).

e) Ranges shall be so specified that the gauge normally operates in the middle third of the scale and shall conform to IS-3624 standard dials, wherever possible. Pressure gauge with design pressure more than 130% of range shall be provided with Gauge saver. The material of construction of gauge saver shall be same as socket material or superior.

f) Diaphragm seals, filled type or mechanical type shall be provided where plugging of the element may occur or where suitable material is not available in highly corrosive services. When chemical seals are required, they shall be of the clean out type with flushing connection.

g) Pressure gauges shall be weather proof to IP-55 as per IS/IEC-60529 as a minimum. Pressure gauge case material shall be minimum SS304.

h) The pressure sensing element shall be bourdon, diaphragm or bellows depending upon process conditions.

5.9.2.6 Pressure Transmitter

a) Pressure transmitter shall have electronic state-of-art capacitance or any other type of sensor meeting all functional specifications. Body & Element material for transmitters shall be SS316, as a minimum, and shall be able to withstand over pressure of at least 30% of range or maximum working pressure whichever is higher.

b) All transmitters shall have an integral LCD display. Remote mounted meters may be provided if required in addition.

c) Threaded end connections shall be NPT as per ANSI B 1.20.1. Flanged end connections shall be as per ANSI B 16.5.

d) Diaphragm seal element with capillary shall be used for congealing, corrosive and highly viscous services.

e) Transmitters shall also meet the requirements specified in clause no. 6.9.2.1 as applicable.

f) Pressure transmitters used for diaphragm rupture detection shall have dedicated instrument isolation valve in addition to manifold.

5.9.2.7 Pressure Relief Valve & Rupture Disc

a) All pressure relieving devices shall be designed in accordance with ASME code for 'Boilers and Pressure Vessels', API-521. Pressure Relief Valve shall meet relief valve requirements as defined in API RP-520 (Part-I & II) and in API-526.

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b) Pressure relief valves shall be full nozzle full lift type except for thermal relief valves which shall be modified nozzle type. Type of Pressure relief valve such as Conventional, bellows & pilot shall be decided by vendor based on process parameters such as set pressure, back pressure, etc.

c) Percentage Accumulation shall be 10% for Pressure Relief Valve and 10% / 25% (as per process requirement) for Thermal relief Valve.

d) Body materials shall be as per piping material specification. Nozzle and disc material shall be SS 316 as a minimum with machined SS guide and spindle. Whenever semi nozzle designs are unavoidable, body material shall be at least same as nozzle and disc material.

e) Spring material shall be selected as per operating conditions. Normally it shall be Cadmium / Nickel / Zinc / Aluminum plated Carbon Steel.

f) Pressure Relief Valve shall have flanged connections for sizes 1" and above and shall have screwed connection for sizes 3/4" and below. Thermal Relief Valve shall have screwed connection with 0.38 cm2 orifice size and inlet outlet shall be of 3/4" NPT(M) X 1" NPT(F) sizes.

g) Rupture discs shall be reverse buckling type, in general and shall be supplied in pre-torqued holder assembly, mounted between standard ANSI flanges. Disc material shall be compatible with the vessel contents and shall be consistent with the bursting requirements. Disc shall be supplied with tell-tale assembly.

h) The bursting tolerance of the rupture disc shall be 5% of the specified bursting pressure or less.

i) Vendor shall supply three nos. spare discs along with each Rupture disc assembly ordered.

5.9.2.8 Variable Area Flowmeter (Rotameter) and Transmitter

a) Variable area flow meters or rotameters shall be as per ISA-RP 16.1, 16.2, 16.3, 16.4, 16.5 and 16.6. Rotameter shall be of flanged body construction.

b) Rotameter shall be of metal tube type with local indication.

c) The material for tube & float shall be SS 316 as a minimum (or better material as per piping material specification).

d) The packing material shall be PTFE if the liquid temperature is below 230 C. For temperatures above 230 C, packing shall be of GRAFOIL.

e) Rotameter shall have an accuracy of minimum ± 2% FSD.

f) Rotameter transmitter shall be SMART type with HART protocol with integral LCD display. Rotameter transmitters shall be intrinsically safe,4-20mA two wire type capable of operation on 24VDC power supply with a load capacity not less than 600 ohms.

5.9.2.9 Orifice Plates and Flanges

a) Flow measurement shall normally be carried out by using thin, square-edge concentric orifices plate mounted between a pair of weld-neck type orifice flanges with flange taps. The minimum pressure rating of flanges shall be 300 lb ANSI. Where D, D/2 taps are required, the ratings of the orifice flanges shall be same as that of the pipe class. Flanged end connections shall be as per ASME B16.5

b) Eccentric type of orifice plates shall be used for specific applications, like dual phase.

c) Segmental type shall be used for specific applications.

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d) Quadrant edge or conical entrance orifice plates shall be used for services with low Reynolds number.

e) Orifice Plate material shall be SS 316 as a minimum or better

f) Each Orifice Plate shall have an integral handle, which shall, upon assembly with flanges, extend to a distance of 50 mm. with following information punched on it:

- Tag Number.
- Nominal flange size in inches and rating in pounds.
- Plate and flange material to ASTM specifications.
- Bore dia in mm.

g) Sizing of orifice plate shall be carried out in accordance with ISO-5167(latest edition).

5.9.2.10 Restriction Orifice Plates

a) The material of the orifice plates shall be normally SS 316, as a minimum. Flange material & rating shall be as per piping specification.

b) Sizing of orifice plate shall be carried out in accordance with ISO-5167 (Latest Edition).

c) Each Orifice Plate shall have an integral handle, which shall, upon assembly with flanges, extend to a distance of 50 mm beyond flange edge with Tag no., nominal pipe size in inches, rating in psi and material of plate punched on it.

d) Thickness of the orifice plate shall be calculated to meet the service condition requirement. Minimum thickness shall be 3.18mm.

5.9.2.11 Self Actuated Pressure Control Valve

a) Body material shall be as per piping material specification. Trim material shall be Stainless Steel SS 316 as a minimum. Actuator shall be diaphragm type and diaphragm material shall be Stainless Steel as a minimum.

b) All pressure parts shall be designed to withstand maximum shut off pressure.

c) Valve shall have flanged connections for sizes 1" and above and shall have screwed connection for sizes 3/4" and below.

d) The line pressure sensing for the self actuated control valve/regulator shall be internal, in general.

e) The set pressure of the self actuated control valve shall be adjustable throughout each spring range externally. A locking mechanism shall be provided to avoid inadvertent set point adjustment.

f) Flow direction shall be clearly stamped or cast on the valve/regulator body to ensure correct installation.

5.9.2.12 Temperature Gauge

a) Local temperature gauges shall be in general bimetallic type. The temperature bulb shall be of stainless steel construction. The case of bimetallic type temperature gauges shall be all angles rotatable type. The gauge movement material shall be of stainless steel, as a minimum.

b) Temperature gauges shall have accuracy of ± 1 % of URV (Upper Range Value). All local temperature gauges shall have 150 mm dial size. The bulb size shall be selected to suit the Thermowell.

c) All gauges shall be of weatherproof construction to IP 55 as a minimum.

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d) Thermometer stem adjustable gland with union connection and bushing shall be suitable for 1/2" NPTF connection.

e) The temperature gauges shall be provided with 1½" flanged thermowell with ½" NPT (F) connection for temperature gauges. .

f) Zero adjustment screw for temperature gauge shall be external type.

g) Unless otherwise specified, the temperature gauge shall have an over range protection of at least 130% of specified range or maximum working temperature, whichever is higher.

5.9.2.13 Thermowell

a) Thermowells and flanges shall be minimum of 316 SS or better material to suit the service conditions. Pressure rating of flanges shall be as per respective piping specification. Thermowell shall be fabricated from bar-stock.

b) Immersion length of Thermowells for different line sizes shall be as follows:-

Line Size	Immersion length (U)
4" to 6"	280 mm
From 8 "to 20"	320 mm
>20" & Vessels/columns	400 mm

c) Immersion length is based on 200 mm length between flange face and inner well of pipe. In vessels, where fouling with vessel internals is expected, the immersion length shall be suitably modified. The minimum line size shall be of 4" for installation of Temperature element. Any pipe of less than 4"nominal bore shall be blown to 4"size to install thermowell.

5.9.2.14 Control Valves

a) Control valves shall normally be Globe type single seated or double seated. For clean services, guiding shall be top and bottom/ cage type. For highly viscous services, cage guiding shall be avoided.

b) Flanged control valves shall be used. Body material, body rating and flange rating, shall be as per piping specifications as a minimum. Minimum control valve body size shall be 1" in general. Reduced trims can also be considered.

c) Trim characteristics shall be equal percentage type unless required otherwise. Anti-cavitation trim shall be selected wherever cavitation is expected in the valve. Control valve body and flange rating shall be minimum 300#.

d) Noise from control valve during operation shall be limited to OSHA specified level or better. The maximum allowable noise is 85 dBA SPL (Sound Pressure Level). Low noise trim shall be considered where noise level exceeds maximum limit.

e) Valve seat leakage shall be as per ANSI/FCI 70.2 and shall be selected with due consideration to meet the requirement. Minimum class IV leakage shall be provided.

f) Flanged bolted type gland packing boxes shall be used. Packing shall normally be PTFE on liquid and gas service up to 200ºC (design). For high temperature application (above 200 ºC (design) temperature, grafoil or equivalent gasket suitable for the specified service shall be provided. Asbestos based packing material shall not be used.

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g) Material used for trim shall be minimum 316 SS, with guide bushing of hardened stainless steel like 440 C, 17-4 PH, etc. upto a pressure drop of 10 kg/cm2. Stellited trims shall be provided for higher pressure drops (more than 10 kg/cm2) and wherever required to meet service conditions.

h) Valve actuator shall be pneumatic spring opposed diaphragm type, in general. Piston type actuators may be used for very high shut off pressure requirements. Additional equipment necessary to meet fail safe condition shall also be included in case double acting piston type actuator is selected. In either case, actuator shall be able to withstand maximum shut-off pressure (1.5 times of design pressure) with the minimum instrument air pressure specified. The actuator shall be painted as below:

- Direct action (open on air failure) valves - Green color.
- Reverse acting (close on air failure) valve - Yellow color.

i) Control valve positioner shall be Smart type with HART protocol (latest version). The positioner shall be provided with necessary hardware/ software for maintenance, diagnostics, programming etc.

j) Positioner output shall include but not limited to actual valve stem travel, input current, actuator pressure, travel direction, accumulated travel, cycle counter etc.

k) Positioner shall provide diagnostic information such as Valve signature data with seat load, bench set and valve friction, dynamic error and dynamic linearity of control valve, diagnostic graphics with adequate resolution. When mounted on control valve, the factory valve signature test report shall be provided.

l) All control valve supplied by bidder must comply with fugitive emission requirements as per leakage class-C of ISO-15848-1(Latest edition).

5.9.3 **Installation Requirement**

5.9.3.1 Bidder shall ensure and supply all erection hardwares required for the installation of complete instrumentation items which form part of the package unit. This includes items like instrument valves and manifolds, mounting accessories, impulse piping, tubing, pipe/tube fittings, canopies for instruments, identification tags etc. as a minimum.

5.9.3.2 All instruments shall be provided with isolation, vent / drain and equalizing arrangement.

5.9.3.3 Instrument connection sizes shall be as follows:

a) On Vessel/ Equipment- 2”

b) On Pipe - ¾” NPT for direct type. 1.5” flanged for Diaphragm seal type and thermowells.

6.0 INSPECTION AND TESTING

6.1 All Equipments shall be subjected to inspection by EIL/Owner /Third party. The Inspector shall have free access to the Contractor/Vendor's shop/work site. The Contractor/Vendor shall provide all facilities like tools and tackles, instruments and personnel to inspector. All the Inspection shall be carried out in accordance with the relevant Codes & requirements of Drawings & Specifications. Approval of Inspector shall in no way relieve the Contractor/Vendor of his responsibility for proper execution of work. Manufacturer’s Quality Assurance (QA) plans shall be submitted for Owner / Consultant or his authorized inspection agency’s approval before taking up manufacturing.

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6.2 The Inspection shall include but not be limited to:

a) Examination of materials of construction.

b) Welding procedure and Welder's qualification tests.

c) Various non-destructive tests like radiography etc. as per code.

d) Checking of dimensions

e) Pressure testing and certification etc.

f) Hardness testing

6.3 Wherever specified in code, dye penetrant/magnetic particle examination shall be carried out on the welds. Spot radiography shall be minimum requirement for all Equipments. Extent of radiography and acceptance criteria shall be as per the relevant provisions of the code.

6.4 All nozzles fabricated from plate, irrespective of thickness, shall be 100% radiographed.

6.5 The inner fillet of bottom or annular plate to shell weld shall be leak tested with penetrating oil after removal of slag prior to welding of outside fillet weld.

6.6 After completion, tank shall be hydrostatically tested by filling water and all weld joints shall be hammered and inspected for any leakage. In case of any defect it shall be repaired and retested as per the instructions of Inspector.

6.7 Equipments under Caustic, Amine & Sour (H_2S) service shall essentially be PWHT. The Hardness of the PM, Weld & HAZ shall be limited to 200 BHN in such cases.

6.8 It shall be the responsibility of Contractor/Vendor to prepare a Detailed Inspection and Test plan as per applicable Code and Specifications and get the same reviewed by EIL/Owner/Third party prior to execution of work.

6.9 Fittings, valves, instruments, other accessories like electric motor etc. shall be duly tested and manufacturer's test certificates shall be furnished.

6.10 Any other tests as per the Process Data Sheet / EIL standard / applicable codes shall also be performed.

Following "Witness" inspection & tests shall be carried out for the completely assembled chemical dosing package:

- Dimensional Inspection
- Cleanliness
- Hydro test / Pneumatic Leak test of assembled piping / joints

The dosing package vendor shall further note that "Witness" inspection is also specified for certain equipment i.e. controlled volume pumps, Mechanical Agitators etc. in the respective equipment data sheets which shall also be carried out.

Vendor shall provide test/ calibration/ inspection certificates of all the instrument items under dosing package scope for purchaser's review/ record

7.0 COMMISSIONING SPARE PARTS

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The vendor shall include in his scope of supply, spares required for erection and commissioning of the dosing package (inclusive of mechanical, electrical and instrumentation spares). List for the same shall be furnished by the dosing package vendor along with the bid.

If however, any additional spare is consumed during erection and commissioning, over and above the quoted erection and commissioning spares, the same shall be provided free of cost by the dosing package vendor.

8.0 RECOMMENDED SPARE PARTS FOR TWO YEARS NORMAL OPERATION

8.1 The vendor shall furnish a quotation for spare parts required for two years normal operation as per the equipment manufacturer's recommendation along with unit rates for the package (inclusive of mechanical, electrical and instrumentation spares).

8.2 The recommended spares for two years operation for each rating and type of motor shall include the following as a minimum:

a. Bearings for DE & NDE

b. Cooling fan

c. Terminal block

d. Terminal box cover with screws.

9.0 SPECIAL TOOLS/TACKLES

Any special tools and tackles required for erection, site assembly and maintenance of dosing package (inclusive of mechanical, electrical and instrumentation spares) shall be included in the dosing package vendor's scope of supply.

An itemized list of special tools/tackles included in the scope of supply, shall be furnished along with the bid.

10.0 EQUIPMENT LAYOUT

Vendor shall furnish the tentative equipment layout for dosing package(s) along with the bid. If any tentative skid size/layout is enclosed with the inquiry document vendor shall ensure that the proposed dosing package skid is accommodated within the space allocated for the specified dosing package

11.0 VENDOR DATA AND DRAWINGS

11.1 PROPOSALS

The vendor's proposals shall as a minimum include all data sheets, drawings and documents listed under "WITH BID" in the enclosed Vendor Data Requirements.

11.2 CONTRACT DATA

11.2.1 General

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11.2.1.1 Drawings and data as required after purchase order has been specified in Vendor Data Requirements. Vendor to note that the drawing/ document descriptions/titles as given in the Vendor Data Requirement are generic in nature. It is possible that against one drawing/ document specified there are several drawings to be furnished by the vendor or vice-versa. Vendor shall complete & forward a document "DOCUMENT CONTROL INDEX" to the purchaser (Destination & contact person as per order).
This document shall list out in consolidated form all drawings and documents required by purchaser (As specified in Data Sheets, Specifications and Vendor Data Requirements enclosed with the order).
Against each drawing/document vendor shall indicate the vendor's drawing numbers, titles, Rev. No., category (whether for information or approval) and schedule of submission.
This shall be the first document to be submitted by vendor within two weeks of order.
No drawing shall be taken up for review till DCI for the inquiry/order is finalized by the vendor.

11.2.1.2 All drawings and data shall have a title block (in addition to vendor's standard title block) which shall as a minimum contain the following contract information:
i) Purchaser's and Consultant's Corporate Name
ii) Project Name.
iii) Client / Customer's Name.
iv) Equipment Name and Item No.
v) Purchase Order No.
vi) Purchase Requisition No.
Title Block on drawings shall be placed on the lower right hand corner.

11.2.1.3 All vendor data/drawings/documents shall be in English Language and in Metric Systems.

11.2.1.4 Data specified in the VDR document is the minimum requirements of Purchaser. Any additional document/data required or requested by Purchaser for engineering or construction shall also be made available by the vendor.

11.2.1.5 Whether or not specified, the vendor shall furnish the following, before shipment:
- A supplementary list of spare parts other than those included in his original proposal. The supplementary list shall include recommended spare parts, cross-sectional or assembly type drawings, parts numbers, materials, prices and delivery period. The vendor shall forward this supplementary list to the purchaser promptly after receipt of the reviewed drawings and in time to permit order and delivery of parts before field startup.
- A parts list for all equipment supplied. The list shall include pattern, stock, or production drawing numbers and materials of construction. The list shall completely identify each part so that the purchaser may determine the interchangeability of the parts with other equipment furnished by the same manufacturer. Standard purchased items shall be identified by the original manufacturer's name and part number.
- At least 8 weeks before shipment, the vendor shall submit his preservation, packaging and shipping procedures to the purchaser's for his information.

11.2.2 **Drawings**

11.2.2.1 Drawing review shall be through eDMS/ VDOCS in soft as per the details provided elsewhere in the inquiry document.

11.2.2.2 The purchaser's review of the vendor's drawings shall not constitute permission to deviate from any requirements in the purchase order/specifications unless specifically agreed upon in writing. After the drawings have been reviewed, the vendor shall furnish certified copies in the quantity specified in VDR.

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11.2.2.3 Drawings/documents with following titles shall contain as a minimum the following information:

a) **General Arrangement Drawing**

A general arrangement drawing shall indicate:

i) Outline dimensions (minimum three views) (All principal dimensions).

ii) Location (in all three planes), size, type, rating and identification of all purchaser's interface connections including those of vents, drains lubricating oil, cooling water, steam & Electrical/Instrumentation.

iii) Weight of each equipment/assembly/component.

iv) The weight & location of center of gravity of the heaviest equipment/assembly/components that must be handled for erection.

v) Identification and weight, dimensions of the heaviest equipment/assembly / subassembly /component required to be handled for maintenance.

vi) Maintenance clearances and dismantling clearances.

vii) Layout of auxiliary equipment and operating platform.

viii) A list of reference drawings if any.

ix) A list of any special weather-protection and climatic features.

b) **Foundation Drawing**

A foundation drawing shall indicate complete information required for foundation design by purchaser including the following:

i) Foundation bolt sizes & pipe sleeve details and pocket sizes & locations.

ii) Grouting thickness and other necessary technical details.

iii) Static weight of each independently grouted item and location of center of gravity of each item in all three planes.

iv) Weight distribution for each bolt/sub sole-plate location and total static weight.

v) Dynamic loads, if any, caused due to various items grouted independently. (The cause of generation of such loads shall also be indicated).

vi) The direction and magnitude of unbalance forces and moments (with their phase angles) generated by the out of balance of the rotating / moving parts of the machine at the relevant operating conditions. [These loads and their locations are to be given in all three planes. These shall be utilised for computing the amplitudes of vibration of the foundation].

vii) Maximum permissible amplitude of vibration on the foundation at the base level. (The location of the points on the foundation base where such amplitudes are not to be exceeded shall be given in all three planes). The reference of relevant code, if any, shall also be indicated.

viii) Total mass of static parts.

ix) Total mass of reciprocating parts

x) Suggested dynamic factor and ratio of weight of foundation to weight of skid/ equipment.

xi) Scope of Supply of the Foundation Bolts (unless otherwise specified, by vendor).

c) **P&I Diagrams (with Bill of Materials)**

Vendor shall furnish **P&I** Diagrams along with Bill of Materials of each system in the vendor's scope of supply or specified in the order. **P&I** Diagram shall indicate the system details, location of various auxiliaries, instruments, controls and safety devices as required. Line sizes, piping class, valve sizes and class shall be clearly marked on the P&ID. Vendor's scope and purchaser's scope shall be clearly demarcated. Each item shall be identified by an item No./item tag no., which shall correspond to the item no. shown on the bill of materials. The bill of materials shall include items number, normal value, set value, range, quantity per unit, make and other specifications as applicable.

Legends adopted shall be indicated either at the bottom of drawing or on a separate drawing.

The legends shall be as per ISA.

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d) **Data Sheet**

The Vendor shall provide completely filled in data sheets first for "as purchased" and then for "as built". This shall be done by the vendor correcting and filling out the data sheets and submitting copies to the purchaser.

e) **Technical Data Manual/Mechanical Catalogues**

Technical Data Manual/Mechanical Catalogue is a compilation of "as built" drawings and data, manufacturing and test records, installation, operating and maintenance instructions.

The vendor shall furnish the required number of Technical Data Manual/Mechanical Catalogues for the equipment, any auxiliaries and instruments that the vendor is providing. The Technical Data Manual/Mechanical Catalogue shall include the following documents as a minimum:

i. All drawings and data as listed in the vendor data requirements.

ii. All manufacturing, inspection and test data and records.

iii. Installation and Instruction Manual

The vendor shall provide sufficient written instructions, including a cross-reference list of all drawings, to enable the purchaser to correctly install the skid and prepare the equipment for start-up. It shall also contain the following information:

(a) Instructions for erecting, piping, aligning.

(b) Pre-commissioning/commissioning/functional test procedures and acceptance criterion.

iv. Operation and Maintenance Manual

This manual shall provide sufficient written instructions and data to enable purchaser to correctly operate and maintain the equipment ordered.

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STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	28.03.25	REVISED AND ISSUED AS STANDARD SPECIFICATION	PK	SH	GB	MN
5	31.12.19	REVISED AND ISSUED AS STANDARD SPECIFICATION	PK	SH	MI	RKT
4	30.07.14	REVISED AND ISSUED AS STANDARD SPECIFICATION	SH	AK	RN ATD	SC
3	31.03.09	REVISED AND ISSUED AS STANDARD SPECIFICATION	RN	VKB	SC	ND
2	05.06.03	PMI REQT. INCLUDED AND ISSUED AS STANDARD SPECIFICATION	RN	DM	BN	SKG

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Abbreviations:

A.S.	:	Alloy Steel
ASME	:	American Society of Mechanical Engineers
C.I.	:	Cast Iron
C.S.	:	Carbon Steel
IBR	:	Indian Boiler Regulations
LTCS	:	Low Temperature Carbon Steel
NACE	:	National Association of Corrosion Engineers
NB	:	Nominal Bore
NDT	:	Non Destructive Testing
P&ID	:	Piping and Instrumentation Diagram
PMI	:	Positive Material Identification
S.S.	:	Stainless Steel

Piping Standards Committee

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1.0 SCOPE

This specification covers general requirements of fabrication and erection of above ground and trench piping systems at site. The specification covers the scope of work of Contractor, basis of work to be carried out by Contractor and standards, specifications and normal practice to be followed during fabrication and erection by the Contractor.

2.0 SCOPE OF WORK OF CONTRACTOR

Generally the scope of work of Contractor shall include the following:

2.1 Transportation of required piping materials (as described in Cl.2.1.1), pipe support (material as described in Cl. 2.3) and all other necessary piping materials from Owner's storage point or Contractor's storage point (in case of Contractor's scope of supply) to work site/shop including raising store requisitions for issue of materials in the prescribed format & maintaining an account of the materials received from Owner's stores.

2.1.1 Piping materials include the following but not limited to the same.

a. Pipes (All sizes and schedule)

b. Flanges (All sizes, types & Pressure ratings).

c. Fittings (All sizes, types and schedule)

d. Valves (All sizes, types and Ratings)

e. Gaskets (All sizes, types & Ratings)

f. Bolts, Nuts or M/C Bolts (All types)

g. Expansion Joint/Bellows (All types)

h. Specialty items like online filters, ejectors, sample coolers, steam traps, strainers, air traps, springs, silencers, snubbers, steam and condensate manifolds, injection nozzles, MOVs, sight glass, spray nozzles, integrated steam traps, hoses, hose couplings, etc.

i. Online instruments like control valve, orifice flange, rotameter, safety valves, restriction orifice, rupture disc, de-super heaters, corrosion probes, annubar, magnetic flow meter, ultrasonic flow meter, Coriolis mass flow meters, venturi PG/PT/ Flow transmitter, ejectors, static mixers, flame arrestors, thermal flow switches, pre-fabricated hook-ups etc.

j. Shut Down Valves with and without fire box.

2.2 Shop & field fabrication and erection of piping in accordance with documents listed under Cl.3.0 i.e. 'BASIS OF WORK' including erection of all piping materials enumerated above.

2.3 Fabrication and erection of pipe supports like shoe, saddle, guide, stops, anchors, clips, cradles, hangers, turn-buckles, supporting fixtures, bracket cantilevers, struts, tee-posts including erection of spring supports, sway braces, dummy pipes, corrosion pads/protection shields, low friction pads, clamps, special support, expansion bellows, steam and condensate manifolds supports etc. Corrosion Pads/Protection shields, stiffeners and stiffening rings, if not covered in the specifications/standards, shall be of the same material as of parent pipes.

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2.4 Site fabrication of Piping items

Site fabrication of Piping items shall include but not be limited to the following

2.4.1 Fabrication of piping specials like special radius bends, reducers, mitres etc.

2.4.2 Fabrication of plain and threaded nipples from pipes as required during erection.

2.4.3 Fabrication of swage nipples as and when required.

2.4.4 Fabrication of odd angle elbow like 60°, 30° or any other angle from 90°/45° elbows as and when required.

2.4.5 Fabrication of flange, reducing flange, blind flange, spectacle blinds as and when required.

2.4.6 Fabrication of stub-in connection with or without reinforcement.

2.4.7 Grinding of edges of pipes, fittings, flanges etc. to match mating edges of uneven/different thickness wherever required.

2.4.8 Fabrication of circular pipe for steam rings, fire water lines, utility lines.

2.4.9 Threading of all small bore piping as per piping material specifications.

2.4.10 Drilling on blind flange for inserting / joining small bore lines.

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

2.4.12 Equipment nozzle reinforcement with pads, jacket & stiffeners wherever required.

2.4.13 Fabrication of injection nozzles as per details provided wherever required.

2.4.14 Fabrication of chain operation arrangement for valves, wherever required. All material required for this modification shall be supplied by Contractor.

2.4.15 Fabrication and erection in position of funnels required for OWS/ SS/ Condensate blow down system as per direction of Engineer-in-charge.

2.4.16 Grinding/ finishing of uneven surfaces/ joints after welding. Internal grinding of welds of orifice flanges to render smooth surface.

2.4.17 Tapping and drilling of holes in flanges, blind flanges etc. for making piping connections, providing jack screws in tapped and drilled holes, if required.

2.4.18 Providing bird screens at the outlet of lines open to atmosphere.

2.5 Modifications like providing additional cleats, extension of stem of valve, locking arrangement of valves etc. as and when required. Seal welding of plugs in orifice flange excess tappings, threaded drain plugs provided in valves as per direction of Engineer in charge.

2.6 Piping isometrics for main process/utility lines shall be provided to the Contractor for Units.

Preparation of miscellaneous small bore isometrics with bill of materials for process and utility lines (up to 1½" size) like instruments & pump flushing / cooling, sample connection, purging, pump casing vents & drains, pump base plate drains, control valve drains / vent to flare, instrument drains & vents, steam tracing (non-IBR) from steam supply stations up to

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condensate recovery station, and lines specified as field routed within the Unit battery limit as and when required are in Contractor's scope of work. Approval for these isometrics prepared by the Contractor shall be taken from Engineer-in-charge before erection.

Small bore piping isometrics given by Owner shall be rechecked by Contractor before erection and installation.

2.7 Obtaining approval for drawings prepared by Contractor from statutory authority, if required. Contractor shall also arrange all necessary permits for hot work etc.

2.8 Spun concrete lining of the inside of pipes 3" NB & above including fittings and flanges as required in accordance with specification.

2.9 Rubber lining inside pipes, fittings, flanges as and when required, in accordance with specification.

2.10 Radiography, stress relieving, dye penetration, magnetic particle test etc. as required in specification.

2.11 Performing PMI using alloy analyzers as per 'Standard Specification for Positive Material Identification at Construction Sites, 6-82-0002'.

2.12 Casting of concrete pedestals and Fabrication and erection of small structures/ platforms for pipe supports and valve operation / attending some instruments, spectacle blinds etc., providing brackets, modification / extension of platforms, providing additional platforms / ladders for improving / providing accessibility.

2.13 Providing insert plates with anchor fasteners in concrete structures / paved floors. Cutting and repair of platform gratings around pipe openings and providing suitable members for support under the platform grating.

2.14 Making material reconciliation statement and return of Owner's supply left over materials to Owner's storage.

2.15 Flushing and testing of all piping systems as per standard specification for inspection, flushing and testing of piping systems (Specification No. 6-44-0013). The accessories required for blinding the line like flange, blind flange, gasket (all sizes, type and rating), stud-bolts, flexible hoses etc. are to be arranged by the Contractor. During flushing the discharged water / air shall be drained / routed as directed by the Engineer – In Charge.

2.16 Contractor shall prepare welding specifications for all weld joints where dissimilar welding will be performed, and obtain approval from EIL.

2.17 Contractor to ensure meeting all requirements for carrying out work in shutdown/running plant.

2.18 Pickling (as and when applicable) as per Job specification(s) for chemical cleaning of CS suction piping of compressors, SS Piping, Weldments etc, as applicable.

2.19 Chemical Cleaning/ Hydro jet cleaning as per marked-up P&IDs with supply of chemicals, consumables, DM water, equipments, boilers, coupons, tools & tackles and other testing equipments required for the same.

2.20 For Offsites, only Piping General Arrangement drawings shall be issued. Isometrics, if required, shall be prepared by the Contractor.

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3.0 BASIS FOR WORK

3.1 The complete piping work shall be carried out in accordance with the following:

3.1.1 "Approved for Construction" drawings and sketches issued by EIL to the Contractor - Plans and/or Isometrics.

3.1.2 "Approved for Construction" drawings and sketches issued by Turn-key bidders to the Contractor - Plans and/or Isometrics.

3.1.3 Approved Process Licensor's standards and specifications.

3.1.4 Drawings, sketches and documents prepared by Contractor duly approved by Engineer-in-Charge (such as isometrics of small bore piping and offsite piping etc.).

3.1.6 EIL specifications/documents as below:

a. Process and Instrument Diagram.

b. Job Piping Materials Specification (****-6-44-0005). **** denotes job number.

c. Piping support, engineering standards.

d. Line list

e. Piping support indices (only in offsite), if supports are not shown in plan.

f. Job specification of Non-destructive Requirement of Piping (****-6-44-0016)

g. Job Welding Specification Charts for Piping Classes (****-6-77-0005)

h. Job Welding specification for fabrication of piping (****-6-77-0001).

i. Any other EIL or OTHER specifications attached with Piping Material Specification or special condition of contract (such as standard for cement lining of pipe, standard of jacketed piping, standard for steam tracing, Dimensional Tolerances etc.)

j. Standard specification for positive material identification (PMI) at construction sites, 6-82-0002

k. Standard Spec for application of torque & hydraulic bolt tension for flange joints (6-76-0002) and its addendum, if any.

3.1.7 Following codes, standards and regulations

a.	ASME B 31.3	:	Process Piping
b.	ASME Sec. VIII	:	Code for unfired pressure vessel.
c.	IBR Regulations		
d.	ASME Sec. IX	:	Qualification standard for welding and brazing procedures, welders, brazers and welding and brazing operators.

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e. NACE Std. : Code for Sour Services material requirements MR-0175/MR0103/Job spec(NACE), as applicable

Note : All codes referred shall be latest edition, at the time of award of contract.

3.2 Deviations

Where a deviation from the "Basis of Work" and approved job procedure described above is required or where the basis of work does not cover a particular situation, the matter shall be brought to the notice of Engineer-in-Charge and the work carried out only after obtaining written approval from him in each case.

4.0 FABRICATION

4.1 Piping Material

Pipe, pipe fittings, flanges, valves, gaskets, studs bolts etc. used in a given piping system shall be strictly as per the "Piping Material Specification" for the "Pipe Class" specified for that system. To ensure the above requirement, all piping material supplied by the Owner / Contractor shall have proper identification marks as per relevant standards / EIL specifications / Licensors specification. Contractor shall provide identification marks on left over pipe lengths wherever marked up pipe lengths have been fabricated/erected. Material- traceability is to be maintained for A.S., S.S., NACE, LTCS, material for Hydrogen service and other exotic materials by way of transferring heat number, etc. (hard punching) as per approved procedure. This shall be in addition to colour coding for all piping materials to avoid mix-up.

For the purpose of common understanding the construction job procedure, to be submitted by the Contractor, shall include proposal for

- Maximizing prefabrication, inspection and testing at fabrication shop with minimum field joints.

- Positive material identification, handling, storage & preservation.

4.2 Dimensional Tolerances

Dimensional tolerances for piping fabrication shall be as per EIL Standard No. 7-44-0486. The Contractor shall be responsible for working to the dimensions shown on the drawings. However, the Contractor shall bear in mind that there may be variations between the dimensions shown in the drawing and those actually existing at site due to minor variations in the location of equipments, inserts, structures etc. Isometrics, if supplied may have the field welds marked on them. However, it is the responsibility of the Contractor to provide adequate number of field welds. Wherever errors / omissions/ mismatches occur in drawings and Bills of Materials it shall be the Contractor's responsibility to notify the Engineer-in-Charge prior to fabrication or erection.

4.3 IBR Piping

4.3.1 Contractor shall obtain approval for the piping systems falling under purview of IBR from the statutory Indian Boiler Regulations (IBR) authority of the state where the plant is situated. The Owner shall provide documentation for the IBR System. The Contractor shall carry out the fabrications, erection and testing of this piping as per requirements of Indian Boiler Regulations and to the entire satisfaction of the local Boiler Inspector. The Contractor shall also get the approval of IBR inspector for all fabrication and testing done by him at his own cost. All certificates of approval shall be in proper IBR forms.

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4.3.2 IBR Package for residual, field routed and site modified steam lines shall be prepared by the Contractor. IBR approval for the same shall be in Contractor's scope, at his own cost.

4.4 Pipe Joints

The piping class of each line specifies the type of pipe joints to be adopted. In general, joining of lines 2" and above in process and utility piping shall be accomplished by butt-welds. Joining of lines 1-1/2" and below shall be by socket welding/butt welding/threaded joints as specified in "Piping Material Specifications". However, in piping 1-1/2" and below where socket welding/ threaded joints are specified butt - welds may be used with the approval of Engineer-in-Charge for pipe to pipe joining in long runs of piping. This is only applicable for non-galvanized piping without lining.

Flange joints shall be used at connections to Vessels, Equipment's, Valves and where required for ease of erection and maintenance as indicated in drawings.

4.5 Butt Welded and Socket Welded Piping

End preparation, alignment and fit-up of pipe pieces to be welded, welding, pre-heating, post-heating and heat treatment shall be as described in the Job welding specification (****-6-77-0005) and NDT specification (****-6-44-0016).

4.6 Screwed Piping

In general, Galvanized piping shall have threads as per IS:554 or ANSI B2.1 NPT as required to match threads on fittings, valves etc. All other piping shall have threads as per ANSI B2.1, tapered unless specified otherwise.

Threads shall be clean cut, without any burrs or stripping and the ends shall be reamed. Threading of pipes shall be done preferably after bending, forging or heat treating operations. If this is not possible, threads shall be gauge checked and chased after welding heat treatment etc.

During assembly of threaded joints, all threads of pipes and fittings shall be thoroughly cleaned of cuttings, dirt, oil or any other foreign matter. The male threads shall be coated with thread sealant and the joint tightened sufficiently for the threads to seize and give a leakproof joint. Threaded joints to be seal-welded shall be cleaned of all foreign matter, including sealant and made up to full thread engagement before seal welding.

It is the responsibility of the contractor to ensure leak proof joints and to maintain good workmanship handling or making threads during assembly.

4.7 Flange Connections

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

Wherever jack screws are to be provided, drilling and tapping for the jack screws in the flange, shall be done as per EIL Standard before welding it to the pipe.

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4.8 Branch Connections

Branch connections shall be as indicated in the piping material specifications. For end preparation, alignment, spacing, fit-up and welding of branch connections refer welding specifications. Templates shall be used wherever required to ensure accurate cutting and proper fit-up.

For all branch connections accomplished either by pipe to pipe connections or by using forged tees the rates quoted for piping shall be inclusive of this work.

Reinforcement pads shall be provided wherever indicated in drawings/ specifications etc. Reinforcement pads shall be pneumatically tested at 1.05 kg/cm2g with soap solution. This test shall be carried out before hydrostatic testing.

4.9 Bending

Bending shall be as per ASME B31.3 except that corrugated or creased bends shall not be used.

Cold bends for lines 1-1/2" and below, with a bend radius of 5 times the nominal diameter shall be used as required in place of elbows wherever allowed by piping specifications. Bending of pipes 2" and above may be required in some cases like that for headers around heaters, reactors etc.

The completed bend shall have a smooth surface, free from cracks, buckles, wrinkles, bulges, flat spots and other serious defects. They shall be true to dimensions. The flattening of a bend, as measured by the difference between the maximum and minimum diameters at any cross-section, shall not exceed 8% and 3% of the nominal outside diameter, for internal and external pressure respectively.

4.10 Forging and Forming

Forging and forming of small bore fittings, like reducing nipples for piping 1-1/2" and below, shall be as per ASME B 31.3.

4.11 Mitre Bends and Fabricated Reducers

The specific application of welded mitre bends and fabricated reducers shall be governed by the Piping Material Specifications. Reducers shall be fabricated as per directions of Engineer-in-Charge. The radiographic requirements shall be as per Material Specifications for process and utility systems and NDT Specification for steam piping under IBR, radiographic requirements of IBR shall be complied with.

4.12 Cutting and Trimming of Standard Fittings & Pipes

Components like pipes, elbows, couplings, half-couplings etc. shall be cut / trimmed / edge prepared wherever required to meet fabrication and erection requirements, as per drawings and instructions of Engineer-in-Charge. Nipples as required shall be prepared from straight length piping.

4.13 Galvanized Piping

Galvanized carbon steel piping shall be completely cold worked, so as not to damage galvanized surfaces. This piping involves only threaded joints and additional external threading on pipes may be required to be done as per requirement.

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4.14 Jacketed Piping

The Jacketing shall be done in accordance with EIL Specification or Licensors specification as suggested in material specification or special condition of contract.

Pre-assembly of jacketed elements to the maximum extent possible shall be accomplished at shop by Contractor. Position of jump-over and nozzles on the jacket pipes, fittings etc. shall be marked according to pipe disposition and those shall be prefabricated to avoid damaging of inner pipe and obstruction of jacket space. However, valves, flow glasses, in line instruments or even fittings shall be supplied as jacketed.

4.15 Shop Fabrication / Prefabrication

The purpose of shop fabrication or pre-fabrication is to minimize work during erection to the extent possible. Piping spool, after fabrication, shall be stacked with proper identification marks, so as facilitate their withdrawal at any time during erection. During this period all flange (gasket contact faces) and threads shall be adequately fabricated by coating with removable rust preventive. Care shall also be taken to avoid any physical damage to flange faces and threads.

4.16 Miscellaneous

4.16.1 Contractor shall fabricate miscellaneous elements like flash pot, seal pot, sample cooler, supporting elements like turn-buckles, extension of spindles and interlocking arrangement of valves, operating platforms as required by Engineer-in-Charge.

4.16.2 Spun Concrete Lining

The work of inside spun concrete lining of pipes and specials of diameter 3" and above shall be done as per material specifications and special condition contract.

4.16.3 Fabrication of pipes from plate

Pipes shall be fabricated at site as and when required as per the specifications and the actual Piping Material Specification.

5.0 ERECTION

5.1 Cleaning of Piping before Erection

Before erection all pre-fabricated spool pieces, pipes, fittings etc. shall be cleaned inside and outside by suitable means. The cleaning process shall include removal of all foreign matter such as scale, sand, weld spatter chips etc. by wire brushes, cleaning tools etc. and blowing with compressed air/or flushing out with water. Special cleaning requirements for some services, if any, shall be as specified in the piping material specification or isometric or line list. S.S jacketed piping requiring pickling shall be pickled to remove oxidation and discolouring due to welding.

5.2 Piping Routing

No deviations from the piping route indicated in drawings shall be permitted without the consent of Engineer-in-Charge.

Pipe to pipe, pipe to structure / equipments distances / clearances as shown in the drawings shall be strictly followed as these clearances may be required for the free expansion of piping

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/ equipment. No deviations from these clearances shall be permissible without the approval of Engineer-in-Charge.

In case of fouling of a line with other piping, structure, equipment etc. the matter shall be brought to the notice of Engineer-in-Charge and corrective action shall be taken as per his instructions.

5.3 Cold Pull

Wherever cold pull is specified, the Contractor shall maintain the necessary gap, as indicated in the drawing. Confirmation in writing shall be obtained by the Contractor from the Engineer-in-Charge, certifying that the gap between the pipes is as indicated in the drawing, before drawing the cold pull. Stress relieving shall be performed before removing the gadgets for cold pulling.

5.4 Slopes

Slopes specified for various lines in the drawings / P&ID shall be maintained by the Contractor. Corrective action shall be taken by the Contractor in consultation with Engineer-in-Charge wherever the Contractor is not able to maintain the specified slope.

5.5 Expansion Joints / Bellows

Installation of Expansion Joints/Bellows shall be as follows:

5.5.1 All Expansion joints / Bellows shall be installed in accordance with the specification and installation drawings, supplied to the Contractor.

5.5.2 a. Upon receipt, the Contractor shall remove the Expansion Joints/ Bellows from the case(s) and check for any damage occurred during transit.

b. The Contractor shall bring to the notice of the Engineer-in- Charge any damage done to the bellows / corrugations, hinges, tie-rods, flanges/ weld ends etc.

c. Each Expansion Joint / Bellow shall be blown free of dust / foreign matter with compressed air or cleaned with a piece of cloth.

5.5.3 a. For handling and installation of Expansion Joints, great care shall be taken while aligning. An Expansion Joints shall never be slinged from bellows corrugations/ external shrouds, tie / rods, angles.

b. An Expansion Joints / Bellow shall preferably be slinged from the end pipes / flanges or on the middle pipe.

5.5.4 a. All Expansion Joints shall be delivered to the Contractor at "Installation length", maintained by means of shipping rods, angles welded to the flanges or weld ends or by wooden or metallic stops.

b. Expansion Joints stop blocks shall be carefully removed after hydrostatic testing. Angles welded to the flanges or weld ends shall be trimmed by saw as per manufacturer's instructions and the flanges or weld ends shall be ground smooth.

5.5.5 a. The pipe ends in which the Expansion Joint is to be installed shall be perfectly aligned or shall have specified lateral deflection as noted on the relevant drawings.

b. The pipe ends / flanges shall be spaced at a distance specified in the drawings.

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5.5.6 The Expansion Joint shall be placed between the mating pipe ends / flanges and shall be tack welded/bolted. The mating pipes shall again be checked for correct alignment.

5.5.7 Butt-welding shall be carried out at each end of the expansion joint. For flanged Expansion Joint, the mating flanges shall be bolted.

5.5.8 After the Expansion Joint is installed the Contractor shall ensure that the mating pipes and Expansion Joints are in correct alignment and that the pipes are well supported and guided.

5.5.9 The Expansion Joint shall not have any lateral deflection. The Contractor shall maintain parallelism of restraining rings or bellows convolutions.

5.5.10 Precautions

a. For carrying out welding, earthing lead shall not be attached with the Expansion Joint.

b. The Expansion bellow shall be protected from arc weld spot and welding spatter.

c. Hydrostatic Testing of the system having Expansion Joint shall be performed with shipping lugs in position. These lugs shall be removed after testing and certification is over.

5.6 Flange Connections

While fitting up mating flanges, care shall be exercised to properly align the pipes and to check the flanges for trueness, so that faces of the flanges can be pulled together, without inducing any stresses in the pipes and the equipment nozzles. Extra care shall be taken for flange connections to pumps, turbines, compressors, cold boxes, air coolers etc. The flange connections to these equipments shall be checked for misalignment, excessive gap etc. after the final alignment of the equipment is over. The joint shall be made up after obtaining approval of Engineer-in-Charge.

Hydraulic bolt tensioning & torque tensioning shall be performed on flange joints as per the requirements specified in "Standard Specification for application of Torque & Hydraulic Bolt Tension for flange joints," 6-76-0002 and its addendum, if any.

Temporary protective covers shall be retained on all flange connections of pumps, turbines, compressors and other similar equipments, until the piping is finally connected, so as to avoid any foreign material from entering these equipments.

The assembly of a flange joint shall be done in such a way that the gasket between these flange faces is uniformly compressed. To achieve this, the bolts shall be tightened in a proper sequence. All bolts shall extend completely through their nuts but not more than 1/4".

Steel to C.I. flange joints, if any, shall be made up with extreme care, tightening the bolts uniformly after bringing flange flush with gaskets with accurate pattern and lateral alignment.

5.7 Vents and Drains

High point vents and low point drains shall be provided as per the instructions of Engineer-in-Charge, even if these are not shown in the drawings. The details of vents and drains shall be as per piping material specifications / job standards.

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5.8 Valves

Valves shall be installed with spindle / actuator orientation / position as shown in the layout drawings. In case of any difficulty in doing this or if the spindle orientation / position is not shown in the drawings, the Engineer-in-Charge shall be consulted and work done as per his instructions. Care shall be exercised to ensure that globe valves, check valves, and other uni-directional valves are installed with the "Flow direction arrow "on the valve body pointing in the correct direction. If the direction of the arrow is not marked on such valves, this shall be done in the presence of Engineer-in-Charge before installation.

Fabrication of stem extensions, locking arrangements, interlocking arrangements of valves (if called for) and change in orientation of spindles (if required as per site conditions) shall be carried out as per drawings/ instructions of Engineer-in-Charge.

5.9 Instruments

Installation of in-line instruments such as control valve, orifice flange, rotameter, safety valves, restriction orifice, rupture disc, de-super heaters, corrosion probes, annubar, magnetic flow meter, ultrasonic flow meter, Coriolis mass flow meters, venturi PG/PT/ Flow transmitter, ejectors, etc. and Shut Down Valves with fireboxes shall form a part of piping erection work.

Fabrication and erection of piping upto first block valve / nozzle / flange for installation of offline Instruments for measurement of level, pressure, temperature, flow etc. shall also form part of piping construction work. The limits of piping and instrumentation work will be shown in drawings / standards / specifications. Orientations / locations of take-offs for temperature, pressure, flow, level connections etc. shown in drawings shall be maintained.

Flushing and testing of piping systems which include instruments mentioned above and the precautions to be taken are covered in flushing, testing and inspection of piping (EIL Spec. 6-44-0013). Care shall be exercised and adequate precautions taken to avoid damage and entry foreign matter into instruments during transportation, installation, testing etc.

5.10 Line Mounted Equipments / Items

Installation of line mounted items like filters, strainers, steam traps, air traps, desuperheaters, ejectors, samples coolers, mixers, flame arrestors, sight glasses etc including their supporting arrangements shall form part of piping erection work.

5.11 Bolts and Nuts

The Contractor shall apply molycoat grease mixed with graphite powder (unless otherwise specified in piping classes) all bolts and nuts during storage, after erection and wherever flange connections are broken and made-up for any purpose whatsoever. The grease and graphite powder shall be supplied by the Contractor within the rates for piping work.

5.12 Pipe Supports

Pipe supports are designed and located to effectively sustain the weight and thermal effects of the piping system and to prevent its vibrations. Location and design of pipe supports will be shown in drawings for lines 2" NB & above. For lines 1½"NB & below Contractor shall locate and design pipe supports in line with EIL Stds. In case of IBR Lines 1½"NB & below only indicative supporting shall be provided & detailing of such supports is in Contractor's scope. Contractor shall obtain approval of Engineer - in - Charge on drawings prepared by Contractor, before erection. However, any extra supports desired by Engineer-in-Charge shall also be installed. Upon issue of drawings contractor to prepare BOM for support members in

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contractor's scope for procurement action. Pipe shall be erected along with the primary support to the maximum extent to minimize works at height.

No pipe shoe / cradle shall be offset unless specifically shown in the drawings.

Hanger rods shall be installed inclined in a direction opposite to the direction in which the pipe move during expansion.

Piping (including small bore) shall not be supported directly from gratings of platforms including equipment platforms.

Preset pins of all spring supports shall be removed only after hydrostatic testing and insulation is over. Springs shall be checked for the range of movement and adjusted if necessary to obtain the correct positioning in cold condition. These shall be subsequently adjusted to hot setting in operating condition. The following points shall be checked after installation, with the Engineer-in-Charge and necessary confirmation in writing obtained certifying that:

- All restraints have been installed correctly.
- Clearances have been maintained as per support drawings.
- Insulation does not restrict thermal expansion.
- All temporary tack welds provided during erection have been fully removed.
- All welded supports have been fully welded.

5.13 Dismantling and Modifications

Dismantling/ modification of erected piping shall be carried out, if required for routing of lines as per revised Isometrics. All necessary clearances have to be taken by contractor from Engineer-in- charge.

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STANDARD SPECIFICATION FOR INSPECTION, FLUSHING AND TESTING OF PIPING SYSTEMS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	28.09.23	REVISED & ISSUED AS STANDARD SPECIFICATION	ABA	SH	GB	SM
5	31.07.18	REAFFIRMED&ISSUED AS STANDARD SPECIFICATION	PK	SH	MI	RKT
4	01.07.13	REVISED & ISSUED AS STANDARD SPECIFICATION	UK	SH	RN ATD	DM
3	27.08.07	REVISED & ISSUED AS STANDARD SPECIFICATION	RN	ATD	DM	VC
2	05.06.03	PMI REQT. INCLUDED AND ISSUED AS STANDARD SPECIFICATION	RN	DM	BN	SKG

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Abbreviations:

ASME	:	The American Society of Mechanical Engineers
IBR	:	Indian Boiler Regulations
PMI	:	Positive Material Identification
ppm	:	Parts per million
SS	:	Stainless Steel

Piping Standards Committee

Convenor: Mr. G. Balaji

Members :
Mr. Udayan Chakravarty
Mr. Rameshwar Prasad
Mr. K. Anjaneyulu (SMED)
Mr. Rajesh Chitara (SMMS)
Mr. S.C. Maity (Structural)
Mr. Harsh Vardhan (Projects)
Mr. P.K. Rai (Construction)

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1.0 SCOPE

This specification covers the general requirements for inspection, flushing and testing of piping systems. However, testing of steam lines falling under IBR shall also be governed by Indian Boiler Regulations.

Flushing and testing of all piping systems shall be witnessed by the Engineer-In-Charge.

2.0 REFERENCES

ASME B31.3	:	Process Piping
IBR	:	Indian Boiler Regulations
6-82-0002	:	Standard Specification for Positive Material Identification (PMI) at Construction Sites

3.0 INSPECTION

During various stages and after completion of fabrication and erection, the piping system shall be inspected by the Engineer-In-Charge to ensure that:

- Proper piping material has been used.
- PMI has been performed as per EIL specification '6-82-0002'.
- Piping has been erected as per drawings and instructions of Engineer-In-Charge.
- All supports have been installed correctly.
- Test preparations mentioned in this specification have been carried out.

4.0 FLUSHING

Flushing of all lines shall be done before pressure testing.

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

Required pressure for water flushing shall meet the fire hydrant pressure or utility water pressure. For air flushing, the line/system shall be pressurized by compressed air at the required pressure which shall be 3.5kg/cm^{2}g maximum. The pressure shall then be released by quick opening of a valve, already in line or installed temporarily for this purpose. This procedure shall be repeated as many times as required till the inside of the pipe is fully cleaned.

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

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

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

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

During flushing discharged water/air shall be drained to the place directed by the Engineer-In-Charge. If necessary, proper temporary drainage shall be provided by the contractor.

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

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

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

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

Records in triplicate shall be prepared and submitted by the contractor for each piping system for the flushing done in the proforma provided/approved by the Engineer-in-Charge.

5.0 PRESSURE TESTING

Pressure testing, in general shall be as per clause 345 of ASME B31.3, unless otherwise specified, herein. Lines carrying highly hazardous/poisonous fluids must have a sensitive leak test. For IBR lines, 'IBR Regulations' shall also be followed.

5.1 Extent of Testing

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

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

Pumps, compressors and other rotary equipment shall not be subjected to field test pressure.

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

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

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

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

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

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

5.2 General Requirements / Test Preparation for Testing

Testing shall be carried out with permanent gaskets installed unless specified otherwise or instructed by the Engineer-in-Charge.

No pressure test shall be carried out against closed valve unless approved by the Engineer-in-Charge

The Engineer-in-Charge shall be notified in advance by the Contractor, of the testing sequence and programme, to enable him to be present for witnessing the test. The Contractor shall be fully responsible for making arrangements with the local boiler inspector to witness the tests for steam lines falling under IBR. IBR certificates for these tests shall be obtained in the relevant IBR forms and furnished to the Engineer-in-Charge.

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

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

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

All joints welded, screwed or flanged shall be left uninsulated and exposed for examination during the test. Before pressurizing the lines, each weld joint shall be cleaned by wire brush to free it from rust and any other foreign matter. All joints may be primed and painted prior to leak testing unless they are subject to sensitive leak test or testing with soap solution (e.g., reinforcement pads and lines to be pneumatically tested, etc.).

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

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

Pressure gauges used in testing shall be installed as close as possible to the lowest point in the piping system to be tested, to avoid overstressing of any of the lower portions of the system.

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For longer lines and vertical lines, two or more pressure gauges shall be installed at locations decided by the Engineer-in-Charge.

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

- Whenever possible pressurize up-stream side of valve.
- Replace the valve by a temporary spool and reinstall the valve after testing.
- Provide blind on valve flanges and test the upstream and downstream of the line separately and remove the blind after testing. At these flanges, temporary gaskets shall be provided during testing and shall be replaced by permanent gaskets subsequently.
- For check valves in lines 1½" and below flapper or seat shall be removed during testing (if possible). After completion of testing the flapper/seat shall be refitted.

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

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

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

For jacketed pipes testing of core pipes shall be done on individual pieces where the pipe is continuously jacketed, before it is jacketed. The outer jacket shall be tested separately as a system. For piping with discontinuous jacketing the core pipe and the jacket shall be tested as separate continuous systems.

5.3 Testing Media, Test Pressure and Test Pressure Gauges

5.3.1 Testing Media

In general all pressure tests shall be hydrostatic using iron free water, which is clean and free of silt. Test fluid temperature shall be min. 5 °C. Maximum chloride content in water for hydrostatic testing for SS piping shall be 15- 20 ppm.

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

If operating fluid in the line is much lighter than testing fluid, the additional weight of testing fluid may render piping supports (as designed) inadequate. This will call for additional temporary supports. The typical examples are flare and vapor lines. It is preferable that hydrostatic testing is avoided in such systems and instead pneumatic testing may be specified.

Where air/water tests are undesirable, substitute fluids such as gas oil, kerosene, methanol etc. shall be used as the testing medium, with due consideration to the hazards involved. These test fluids shall be specified in the line list given to the contractor.

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5.3.2 Test Pressure

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

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

- Test pressure required as per line list.
- Maximum allowable pressure for the material of construction of piping.

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

5.3.3 Test Pressure Gauge

All gauges used for field testing shall have suitable range so that the test pressure of various systems falls in 35% to 65% of gauge scale range. Pressure gage dial shall be minimum of 150 mm. Size of Bourdon shall not be less than 75% of nominal diameter of dial range. Gauge shall be of a good quality and in first class working condition.

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

5.4 Testing Procedure

5.4.1 Hydrostatic Test

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

Pressure shall be applied only after the system / line is ready and approved by the Engineer-in-charge.

Pressure shall be applied by means of a suitable test pump or other pressure source which shall be isolated from the system as soon as test pressure is reached and stabilized in the system.

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

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

Test pressure shall be maintained for a sufficient length of time not less than 10minutes. Test pressure shall be released only after physical checking of all the joints and attachments are completed, to permit thorough inspection of all joints and connections for leakage or signs of failure. Any joint found leaking during a pressure test shall be retested to the specified pressure after repair.

The pump and the piping system to be tested are to be provided with separate pressure indicating test gauges.

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

5.4.2 Pneumatic Test

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

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

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

5.5 Completion of Testing

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

All vents shall be opened before the system is to be drained and shall remain open till all draining is complete, so as to prevent formation of vacuum in the system. After draining, lines / systems shall be dried by air. In services like dry air, ethylene etc., small traces of water can cause problem. For such lines hot air drying is to be done after hydro-test.

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

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

5.6 Test Records

Records in triplicate shall be prepared and submitted by the contractor for each piping system, for the pressure test done in the proforma provided/approved by the Engineer-in-Charge. Records shall also be submitted for the PMI undertaken as per EIL Std. Specification No. 6-82-0002.

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TECHNICAL NOTES FOR PIPES

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
8	18.06.24	REVISED AND ISSUED AS STANDARD SPECIFICATION	PK	SH	GB	MN
7	16.01.20	REVISED AND ISSUED AS STANDARD SPECIFICATION	PK	SH	MI	RKT
6	25.09.14	REVISED AND ISSUED AS STANDARD SPECIFICATION	SH	AK	RN	ATD
5	31.12.13	REVISED AND ISSUED AS STANDARD SPECIFICATION	UK	SH	AK	RN
4	04.07.08	REVISED AND ISSUED AS STANDARD SPECIFICATION	RN	SC	DM	VC

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Abbreviations:

ANSI	:	American National Standards Institute
API	:	American Petroleum Institute
ASME	:	American Society of Mechanical Engineers
ASTM	:	American Society for Testing & Materials
BHN	:	Brinell Hardness Number
BIS	:	Bureau of Indian Standards
E.FS.W	:	Electric Fusion Weld
E.R.W	:	Electric Resistance Weld
HAZ	:	Heat Affected Zone
HIC	:	Hydrogen Induced Cracking
IBR	:	Indian Boiler Regulations
IGC	:	Inter Granular Corrosion
IS	:	Indian Standard
LT	:	Low Temperature
MR	:	Material Requisition
NACE MR	:	National Association of Corrosion Engineers : Material Requirement
NB	:	Nominal Bore
NPT	:	Nominal Pipe Thread
PMI	:	Positive Material Identification
PR	:	Purchase Requisition
SMYS	:	Specified Minimum Yield Strength
SS	:	Stainless Steel

Piping Standards Committee

Convenor: Mr. G. Balaji

Members :
Mr. Udayan Chakravarty
Mr. Rameshwar Prasad
Mr. K. Anjaneyulu (SMED)
Mr. Rajesh Chitara (SMMS)
Dr. Sudip Paul (Structural)
Mr. Harsh Vardhan (Projects)
Mr. P.K. Rai (Construction)

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1.0 GENERAL

1.1 All pipes and their dimensions, tolerances, chemical composition, physical properties, heat treatment, hydrostatic test and other testing and marking requirements shall conform to the latest codes and standards specified in the material requisition (MR). In case of any conflict amongst documents attached with the MR, the most stringent shall govern and Owner's/ EIL decision shall be final in this regard.

Supplier shall strictly comply with MR/PR stipulations and no deviations shall be permitted. Post Order Concession/Deviation as mentioned in Cl. 5.17 of Specification for Quality Management System Requirements from Bidders (6-78-0001) is not applicable.

1.2 Testing

1.2.1 Test reports shall be supplied for all mandatory tests as per the applicable material specifications. Test reports shall also be furnished for any supplementary tests as specified in the MR & Clauses 1.11 & 1.12.

1.2.2 Material test certificates (physical property, chemical composition & heat treatment report including Chart) shall also be furnished for the pipes supplied.

1.2.3 PMI shall be performed as per the scope and procedures as defined in the spec for PMI at Supplier's Works (6-81-0001).

1.2.4 Refer to specification nos. 6-81-0002 and 6-81-0003 for Inspection & Test plans for welded pipes and seamless pipes respectively.

1.3 Manufacturing Processes

1.3.1 Steel made by acid Bessemer process shall not be acceptable.

1.3.2 All longitudinally welded pipes should employ only automatic welding.

1.4 Pipe shall be supplied in single or double random length of 4 to 7 and 7 to 14 meters respectively.

1.5 a. Seamless and E.R.W. pipes shall not have any circumferential seam joint in a random length. However, in case of E.Fs.W pipe, in one random length one welded circumferential seam of same quality as longitudinal weld is permitted. This weld shall be at least 2.5 m from either end. The longitudinal seams of the two portions shall be staggered by 90°. Single random length in such cases shall be 5 to 7 m.

b. Unless otherwise mentioned in the respective material code, E.Fs.W pipes < 36" shall not have more than one longitudinal seam joint and E.Fs.W pipes ≥ 36" shall not have more than two longitudinal seam joints.

1.6 Pipes with screwed ends shall have NPT external taper pipe threads conforming to ASME/ANSI B1.20.1.

1.7 Pipe with beveled ends shall be in accordance with ASME B16.25. Weld contours shall be as follows:

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Material	Wall Thickness	Weld Contour
Carbon Steel (Except Low Temp. Carbon Steel)	Up to 22 mm	Figure 2 Type A
	> 22 mm	Figure 3 Type A
Alloy Steel, Stainless Steel & Low Temp. Carbon Steel	Up to 10 mm	Figure 4
	> 10 mm & Up to 25 mm	Figure 5 Type A
	> 25 mm	Figure 6 Type A

1.8 Galvanized pipes shall be coated with zinc by hot dip process conforming to IS 4736 for pipes to Indian Standards and ASTM A53 for pipes to ASTM Standards.

1.9 All austenitic stainless steel pipes shall be supplied in solution annealed condition. All types of 321 or 347 stainless steel pipes shall be in a stabilized heat treated condition. Stabilizing heat treatment shall be carried out subsequent to the normal solution annealing. Soaking time & holding temp. for stabilizing heat treatment shall be 4 hrs & 900°C respectively.

1.10 For welded Carbon steel pipes wherever heat treatment is specified, hardness of weld and HAZ shall be 200 BHN (max.). For welded Alloy steel pipes, maximum hardness of weld and HAZ after heat treatment shall be as per relevant ASTM material specification unless otherwise specified. In addition, for 9Cr-1Mo-V(P91) pipes, a minimum hardness of 190BHN shall also be ensured.

1.11 I.G.C. Test for Stainless Steels

1.11.1 For all austenitic stainless steel pipes inter-granular corrosion test shall have to be conducted as per following:

ASTM A262 Practice "B" with acceptance criteria of "60 mils/year (max.)".

OR

ASTM A262 Practice E : The bent specimen shall be examined under 20X magnification. The acceptance criteria is that there will be no crack or fissure in the bent specimen. The bent specimen shall also be subjected to metallographic examination at 250X magnification to ensure no crack or fissure. The photograph of the bent specimen along with comments shall be submitted for review.

1.11.2 When specifically asked for in MR for high temperature application of some grades of austenitic stainless steel (eg.SS 309, 310, 316, 316H etc.) ASTM A262 Practice "C" with acceptance criteria of "15 mils/year (max.)" shall have to be conducted.

1.11.3 For the IGC test as described in 1.11.1 & 1.11.2, two sets of samples shall be drawn from each solution annealing lot; one set corresponding to highest carbon content and the other set corresponding to the highest pipe thickness.

1.12 All welded pipes indicated as 'CRYO' & 'LT' in MR shall be impact tested per requirement & acceptance criteria of ASME B31.3. The impact test temperature shall be -196°C & -45°C for stainless steel and carbon steel respectively unless specifically mentioned otherwise in MR.

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1.13 NACE/HIC Requirements

1.13.1. Pipes under "NACE" category and those designated as "HIC1" shall meet the requirements given in NACE MR-0103 unless mentioned otherwise.

1.13.2. Pipes made from plates and designated as "HIC1" shall meet the HIC requirements of EIL specification 6-79-0013 unless mentioned otherwise.

1.14 Specified heat treatment for carbon steel and alloy steel and solution annealing for stainless steel pipes shall be carried out after weld repairs. Number of weld repairs at the same spot shall be restricted to maximum two by approved repair procedure.

1.15 For black or galvanized pipes to IS 1239, the minimum percentage of elongation shall be 20%.

1.16 All 1Cr-½Mo and 1¼Cr-½Mo seamless pipes shall be normalised and tempered.

1.17 For all welded alloy steel pipes with mandatory requirement of heat treatment and radiography, radiography shall be performed after heat treatment.

1.18 For Hydrogen service pipes following special requirements shall also be met:

1.18.1. All carbon steel pipes having wall thickness 9.53 mm (0.375") and above shall be normalised. Cold drawn pipes shall be normalised after the final cold draw pass for all thicknesses.

1.18.2. All alloy steel (Cr-Mo) pipes shall be normalised and tempered. The normalising and tempering shall be a separate heating operation and not a part of the hot forming operation. The maximum room temperature tensile strength shall be 100,000 psig.

1.18.3. For carbon steel Pipes, hardness of weld and HAZ shall be 200 BHN (max.). For alloy steel Pipes, hardness of weld and HAZ shall be 225 BHN (max.).

1.18.4. For all Carbon steel and Alloy steel pipes with wall thickness over 20 mm, Charpy-V Notch impact testing shall be carried out in accordance with paragraph UG-84 of ASME Section VIII, Div-1 for weld metal and base metal from the thickest item per heat of material and per heat treating batch. Impact test specimen shall be in complete heat treated condition and accordance with ASTM A370. Impact energies at 0°Celsius shall average greater than 27J (20 ft-lb) per set of three specimens, with a minimum of 20J (15 ft-lb).

1.19 For dual grades of SS where specified, chemical composition and mechanical properties of both grades specified shall be ensured.

2.0 IBR PIPES

2.1 IBR Documentation

2.1.1 Pipes under purview of IBR shall be accompanied with IBR certificate original in Form III-A duly approved and countersigned by IBR authority/local authority empowered by the Central Boiler Board of India (Photocopy of the original certificate duly attested by the local boiler inspector where the supplier is located is the minimum requirement for acceptance) .

2.1.2 For materials 1¼Cr - ½Mo (ASTM A335 Gr.P11 / A691 Gr.1¼Cr), 2¼Cr - 1Mo (ASTM A335 Gr.P22 / A691 Gr.2¼Cr) & 9Cr -1Mo-V (A335 Gr.P91/A691 Gr.91), Form III-A approved by IBR shall include the tabulation of Et, Sc & Sr values for the entire temperature range given below. Et, Sc & Sr values shall be such that throughout the temperature range.

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$$\left.\begin{array}{ll} E_t / 1.5 & \geq \\ S_r / 1.5 & \geq \\ S_c & \geq \end{array}\right| S_A$$

where ,

S_A : Allowable stress at the working metal temperature.
E_t : Yield point (0.2% proof stress at the working metal temperature)
S_c : The average stress to produce elongation of 1%(creep) in 100000 hrs at the working metal temperature.
S_r : The average stress to produce rupture in 100000 hrs at the working metal temperature and in no case more than 1.33 times the lowest stress to produce rupture at this temperature.

S_A (psi)												
Temp(°F) Material	500	600	650	700	750	800	850	900	950	1000	1050	1100
A335 Gr.P11	16200	15700	15400	15100	14800	14400	14000	13600	9300	6300	4200	2800
A691 Gr.1¼Cr	18900	18300	18000	17600	17200	16800	16400	13700	9300	6300	4200	2800
A335 Gr.P22 / A691 Gr.2¼Cr	17900	17900	17900	17900	17900	17700	17100	13600	10800	8000	5700	3800
A335 Gr.P91/ A691 Gr.91	28100	27700	27300	26700	25900	24900	23700	22300	20700	18000	14000	10300

Note : S_A values shall be as per the latest edition of ASME B31.3 prevailing.

2.2 For carbon steel pipes under IBR the chemical composition shall conform to the following:

Carbon (max) : 0.25%
Others (S, P, Mn) : As prescribed in IBR.

The chemical composition as indicated in this clause is not applicable for pipes other than IBR services.

3.0 ACCEPTABLE DEVIATIONS

3.1 Pipes to IS 3589 Gr.410 are acceptable in place of IS 3589 Gr.330.

3.2 Pipes of Grades SS317 of corresponding material are acceptable in place of Grades SS316 or SS316(2.5 Mo min.).

3.3 Pipes of Grades SS317L of corresponding material are acceptable in place of Grades SS316L or SS316L(2.5Mo min.).

3.4 Seamless pipes are acceptable in place of welded pipes except in the case of welded SS321/SS321H pipes with nominal thickness greater than 9.53mm.

3.5 Dual Grade SS304/304L conforming to all chemical composition requirements of SS304L and mechanical properties of SS304 is acceptable in place of SS304L or SS304 grades. Any specific additional requirements given in the MR shall also be complied.

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3.6 Dual Grade SS316/316L conforming to all chemical composition requirements of SS316L and mechanical properties of SS316 is acceptable in place of SS316L or SS316 grades. Any specific additional requirements given in the MR shall also be complied.

4.0 HYDROSTATIC TEST

4.1 All pipes shall be hydrostatically tested.

4.2 The mill test pressure shall be as follows:

4.2.1 Seamless, E.R.W. & Spiral Welded

a) Carbon Steel

Material Std.	Test Pressure Std.
ASTM A106 Gr.B	ASTM A530
API 5L Gr.B, Seamless	API 5L
API 5L, E.R.W.	API 5L
API 5L, Spiral	API 5L
ASTM A333 Gr.3 & 6, Seamless	ASTM A530
ASTM A333 Gr.3 & 6, E.R.W.	ASTM A530

b) Seamless Alloy Steel

Material Std.	Test Pressure Std.
ASTM A335 Gr.P1, P12, P11, P22, P5, P9	ASTM A530
ASTM A268 TP 405, TP410	ASTM A530

c) Seamless Stainless Steel

Material Std.	Test Pressure Std.
ASTM A312 Gr.TP 304, 304L, 304H, 316, 316L, 316H, 321, 347	ASTM A999

d) Seamless Nickel Alloy

Material Std.	Test Pressure Std.
ASTM B161 UNS N02200	ASTM B161
ASTM B165 UNS N04400	ASTM B165
ASTM B167 UNS N06600	ASTM B167
ASTM B444 UNS N06625	ASTM B444
ASTM B407 UNS N08800	ASTM B407
ASTM B423 UNS N08825	ASTM B423

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e) Welded Nickel Alloy

Material Std.	Test Pressure Std.
ASTM B725 UNS N02200, N04400	ASTM B725
ASTM B517 UNS N06600	ASTM B517
ASTM B443/B474 UNS N06625	ASTM B474
ASTM B424/B474 UNS N08825	ASTM B474
ASTM B514 UNS N08800	ASTM B514

4.2.2 Electric Fusion Welded

a) Carbon Steel & Alloy Steel E.FS.W (16" & above)

Material Std.	Test Pressure Std.
API 5L Gr.B ASTM A671 Gr.CC65, 70 (Cl.32) ASTM A672 Gr.C60, 65, 70 (Cl.12,22) ASTM A671 Gr.CF60, 65, 66, 70 (Cl.32) ASTM A691 Gr.½Cr, 1Cr, 1¼Cr, 2¼Cr, 5Cr, 9Cr (Cl.42)	P = 2ST/D S = 90% of SMYS Except for API 5L Gr.B S = 85% of SMYS For API 5L Gr.B T = Nominal Wall Thickness D = O.D of Pipe

b) Stainless Steel E.FS.W (2" to 6")

The hydrostatic test pressure in kg/cm^2 for the following materials shall be as given below :

Material Gr.1 :ASTM A312 TP 304 / 304H / 316 / 316H / 321 / 347 welded.
Material Gr.2 :ASTM A312 TP 304L / 316L welded.

Size	Pipe Schedule : 10S		Pipe Schedule : 40S		Pipe Schedule : 80S	
	Material Gr. 1	Material Gr.2	Material Gr.1	Material Gr.2	Material Gr.1	Material Gr.2
2"	100	80	155	130	230	190
3"	80	60	155	130	230	190
4"	80	50	155	130	230	190
6"	65	35	90	75	155	130

c) Stainless Steel E.FS.W (8" and above).

Material Std.	Test Pressure Std.
ASTM A358 TP 304L, 304, 304H, 316L, 316, 316H, 321, 347 (Classes 1, 3 & 4)	P = 2ST/D S = 85% of SMYS T = Nominal Wall Thickness D = O.D of Pipe
ASTM A358 TP 304L, 304, 304H, 316L, 316, 316H, 321, 347 (Classes 2 & 5)	P = 2ST/D S = 72% of SMYS T = Nominal Wall Thickness D = O.D of Pipe

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4.2.3 Carbon Steel Pipes to BIS Standards

Material Std.	Test Pressure Std.
IS 1239	IS 1239
IS 3589	IS 3589

4.3 Hydrostatic pressure testing shall be performed using iron free water, which is clean and free of silt. Test fluid temperature shall be min. 5 °C. Maximum chloride content in water for hydrostatic testing for SS piping shall be 50 ppm.

5.0 MARKING AND DESPATCH

5.1 All pipes shall be marked in accordance with the applicable codes, standards and specifications. In addition the purchase order number, the item code & special conditions like "IBR", "CRYO", "NACE", "H2" etc. shall also be marked.

5.2 Pipes under "IBR","CRYO", "NACE" & "H2" shall be painted with one circumferential stripe of colour red, light purple brown, canary yellow & white respectively for easy identification. Width of stripe shall be 12mm for pipe sizes less than 3" and 25mm for pipes 3" and above.

5.3 Paint or ink for marking shall not contain any harmful metal or metallic salts such as zinc, lead or copper which cause corrosive attack on heating.

5.4 Pipes shall be dry, clean and free from moisture, dirt and loose foreign materials of any kind.

5.5 Pipes shall be protected from rust & corrosion.

5.6 Rust preventive used on machined surfaces to be welded shall be easily removable with a petroleum solvent and the same shall not be harmful to welding.

5.7 Both ends of the pipe shall be protected with the following material:

Plain end	:	Plastic cap
Bevel end	:	Wood, Metal or plastic cover
Threaded end	:	Metal or plastic threaded cap

5.8 Pipes may be provided with plastic push-fit type end caps/ steel caps without belt wire.

5.9 Steel end protectors to be used on galvanized pipes shall be galvanized. Plastic caps can also be used as end protectors for galvanised pipe ends.

5.10 If pipes are loaded in stacked condition for transport, then they shall be secured suitably to ensure that they can be safely transported without damage and unloaded safely.

6.0 REFERENCES

6.1 6-81-0001: Specification for Positive Material Identification (PMI) at Supplier's Works.

6.2 6-81-0002: Inspection & test plan for welded pipes.

6.3 6-81-0003: Inspection & test plan for seamless pipes.

6.4 6-79-0013: Material requirements for carbon steel components used in sour service for petroleum refinery environments

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TECHNICAL NOTES FOR VALVES

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
9	09.07.24	REVISED AND ISSUED AS STANDARD SPECIFICATION	PK	SH	GB	MN
8	15.02.23	REVISED AND ISSUED AS STANDARD SPECIFICATION	PK	SH	GB	SM
7	13.07.17	REVISED AND ISSUED AS STANDARD SPECIFICATION	PK	SH	MI	RN
6	04.08.10	REVISED AND ISSUED AS STANDARD SPECIFICATION	RN	ATD	SC	
5	04.07.08	REVISED AND ISSUED AS STANDARD SPECIFICATION	RN	SC	DM	VC
4	15.11.00	REVISED AND ISSUED AS STANDARD SPECIFICATION	RN	BRB	NS	MI

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Abbreviations:

AARH	:	Arithmetic Average Roughness Height
API	:	American Petroleum Institute
ASME	:	American Society of Mechanical Engineers
ASTM	:	American Society for Testing & Materials
BGO	:	Bevel Gear Operator
BHN	:	Brinnel Hardness Number
BIS	:	Bureau of Indian Standards
BS	:	British Standard
BVIS	:	Bureau Veritas Industrial Services
BW	:	Butt Weld
CAT	:	Category
CEIL	:	Certification Engineers International Limited
CS	:	Carbon Steel
DFT	:	Dry Film Thickness
DNV	:	Det Norske Veritas
DP	:	Dye-Penetrant
eDMS	:	Electronic Document Management System
IBR	:	Indian Boiler Regulations
IGC	:	Inter Granular Corrosion
IS	:	Indian Standard
ISO	:	International Organisation for Standardisation
LC	:	Lock Closed
LO	:	Lock Open
LT	:	Low Temperature
LTCS	:	Low Temperature Carbon Steel
MOV	:	Motor Operated Valve
MP	:	Magnetic Particle
MR	:	Material Requisition
NACE	:	National Association for Corrosion engineers
NDT	:	Non Destructive Testing
NPT	:	National Pipe Thread
PMI	:	Positive Material Identification
PO	:	Purchase Order
PR	:	Purchase Requisition
Ra	:	Roughness average
RFQ	:	Request for Quotation
SCRD	:	Screwed
SS	:	Stainless Steel
SW	:	Socket Weld
TUV	:	Technischer Überwachungsverein
WAFL	:	Lugged Wafer Type

Piping Standards Committee

Convenor: Mr. G. Balaji

Members:
Mr. Udayan Chakravarty
Mr. Rameshwar Prasad
Mr. K. Anjaneyulu (SMED)
Mr. Rajesh Chitara (SMMS)
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1.0 GENERAL

1.1 Vendor shall supply valves in accordance with the valve specification sheets along with auxiliaries, if any, such as gear operator, bypasses, drains, locking etc. wherever specified in the specification sheets, subject notes and other enclosures to the material requisition (MR).

1.2 Vendor shall quote in strict accordance with the valve data / specification sheets, subject technical notes and all other enclosures to the MR. For 'Cat-I valves', no deviations whatsoever shall be accepted. For Cat-II Valves, if exceptions/ deviations become absolutely must, the same shall be requested as explained in clause 2.3.6 giving reasons for seeking such exceptions/ deviations. In case Post order concessions/ deviations are unavoidable, the request must be made by BIDDER through online system of EIL eDMS in accordance with 6-78-0001.

1.3 All codes and standards for manufacture, testing, inspection etc. shall be of latest editions as on issue date of RFQ.

1.4 In case of any conflict amongst documents attached with the MR, the most stringent shall govern and Owner's/ EIL decision shall be final in this regard.

2.0 DOCUMENTATION

2.1 All document submissions to EIL shall be through EIL eDMS.

2.2 For 'Cat-I' valves, no documents shall be submitted with the offer.

2.3 For 'Cat-II' valves, vendor shall submit the following documents with the offer:

2.3.1 Manufacturer's complete descriptive and illustrative catalogue / literature.

2.3.2 Detailed dimensioned cross section drawing with parts / material lists, weight etc.

2.3.3 Drawings for valves with accessories like gear operator, hydraulic / pneumatic operator, motor, extension bonnet, extended stems with stands, bypass etc. giving major salient dimensions and weights.

2.3.4 One copy of the valve specification sheets signed as "Accepted" by the manufacturer. Deviations, if any shall be marked as applicable on the valve specification sheet.

2.3.5 If the valve is regretted or has no deviation, the manufacturer shall write clearly on valve specification sheets as "Regret" or "No Deviation".

2.3.6 If there is any deviation, the same shall be listed clausewise.

2.3.7 On failure to submit documents as specified in clauses 2.3.1 to 2.3.6 above, the offer is likely to be rejected.

2.4 The following documents shall be submitted through eDMS of EIL after placement of the order:

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2.4.1 For Cat-I valves of size 2" and above where end-to-end/ face-to-face dimensions are to manufacturers' standards, detailed dimensioned cross section drawing with parts, materials, weight, etc. shall be submitted for records/ information.

2.4.2 For 'Cat-II' valves, Vendor shall submit for review drawings mentioned in clauses 2.3.2 & 2.3.3 before start of manufacture. No other drawings shall be submitted for review unless otherwise mentioned in MR.

2.4.3 Test report shall be supplied for all mandatory tests as per the applicable code. Test reports shall also be furnished for any supplementary tests as specified in clauses 3.13, 3.14 & 3.15.

2.4.4 Material test certificates (physical properties, chemical composition & heat treatment report including Chart) of the pressure containing parts shall be furnished for the valves supplied. Material test certificates for the other parts shall also be furnished for verification during inspection.

2.5 In addition to submissions through EIL eDMS, Catalogues/Drawings shall be in submitted in hard copies (6 sets) and soft copies (2 CDs/DVDs) along with delivery for Purchaser's record for all categories/types of valves.

3.0 DESIGN AND CONSTRUCTION

3.1 Valve shall be designed, manufactured, tested, inspected and marked as per the manufacturing standards, design codes and standards indicated in the respective valve specification sheets. Any conflict between the requisition, enclosures, specification sheets and referred standards/ codes shall be brought to the notice of the purchaser for clarifications and resolution, before proceeding with the manufacture. The purchaser's decision shall be final and binding to the vendor. The drawings submitted for review shall not include any deviations except as communicated in writing in Deviation permits. The Drawings shall be reviewed only for design and construction features.

3.2 All flanged valves shall have flanges integral (except forged valves) with the valve body. Flange face finish shall be normally specified in the valve specification sheet as 125 AARH etc. The interpretation for range of face finish shall be as follows:

Stock Finish	:	1000 μ in AARH max.
125 AARH	:	Serrations with 125 to 250 μ in AARH
63 AARH	:	32 to 63 μ in AARH

3.3 For all weld end valves with bevel end as per ASME B16.25, the contour of bevel shall be as follows:

Material	Wall Thickness	Weld Contour
Carbon Steel (Except Low Temp. Carbon Steel)	Upto 22 mm	Figure 2 Type A
	> 22 mm	Figure 3 Type A
Alloy Steel, Stainless Steel & Low Temp. Carbon Steel	Upto 10 mm	Figure 4
	> 10 mm & Upto 25 mm	Figure 5 Type A
	> 25 mm	Figure 6 Type A

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Valve ends shall match thickness of the connecting pipe. Sloping of inside contour of valves shall be done wherever necessary to achieve this.

3.4 For flanged valves with ring joint flanges the hardness shall be as follows:

Flange Material	Min. Hardness of Groove (BHN)
Carbon Steel	140
1% Cr to 5% Cr, 9% Cr	150
9Cr-1Mo-V	190
Type 304, 316, 321, 347	160
Type 304L, 316L	150
Inconel UNS N06625	220
Incoloy UNS N08825	210
Duplex SS UNS S32205, UNS S31803	250

3.5 Following requirements for check valves shall be met over and above the valve specification sheet requirements:

3.5.1 Unless specified otherwise in the data sheet all check valves 3" & above (except in Class 900, Class 1500 & Class 2500 rating) shall have a drain boss at location "G" (Refer Fig.No.1 of ASME B16.34) where pocket is formed in valve body. A tapped drain hole with plug shall be provided as per ASME B16.34. Threads shall be as per ASME B1.20.1 (Taper) NPT.

3.5.2 For heavy check valves, provisions shall be available for lifting by way of lugs, eye bolts and other such standard devices.

3.6 If an overlay weld-deposit is used for the body seat ring seating surface, the corrosion resistance of the seat ring base material shall be at least equal to the corrosion resistance of the material of the shell.

3.7 Following valve bypass requirements shall be met:

3.7.1 By-pass requirement for Gate valves shall be as follows unless otherwise mentioned.

ASME 150 Class	On sizes 26" and above
ASME 300 Class	On sizes 16" and above
ASME 600 Class	On sizes 6" and above
ASME 900 Class	On sizes 4" and above
ASME 1500 Class	On sizes 4" and above
ASME 2500 Class	On sizes 3" and above

3.7.2 The by-pass piping arrangement shall be such that clearance between main valve body and by-pass assembly shall be the minimum possible for layout reasons. Vendor shall follow the sketch enclosed in Specification No. 6-44-0052-A1.

3.7.3 By-pass valve shall be a globe valve. The sizes shall be as under:

On main valve ≤ 4" : 1/2"

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On main valve 6" to 8" : 3/4"
On main valve 10"& above : 1"

By-pass piping shall be of same metallurgy as main valve. The by-pass piping, fittings and valve tag numbers shall be as specified in Specification No. 6-44-0052-A2. In case details of by-pass arrangement for any Valve tag number is missing, Vendor shall bring the same to notice of EIL and provide by-pass as per details specified. Bends are not acceptable in place of elbows except in the location specified in 6-44-0052-A1.

3.7.4 Vendor shall supply the by-pass valve duly tested and fitted to the main valve with proper supporting from the main valve body, as required. Valves with by-pass shall have the direction of flow marked on the bypass valve only. By-pass attachment to the main valve body shall not be screwed. All fillet welds for by-pass installation shall be 100% examined by DP/MP test and Butt-weld joints shall be 100% examined by radiography.

3.8 Valve body / bonnet shall be forged / cast as specified. Forgings are acceptable in place of casting but not vice-versa.

3.9 Stem shall be forged or machined from forged / rolled bar. No casting is permitted. However, integral stem of cast material is acceptable for Plug valves.

3.10 Stelliting / hardfacing by deposition, shall be minimum 1.6 mm.

3.11 Renewable seat rings shall be seal welded for valves of size 3" and above to prevent loosening in service.

3.12 For Low Temperature & Cryogenic valve requirements, refer Specification. No. 6-44-0052-A3 unless otherwise specified.

3.13 For Hydrogen service valve requirements, refer Specification. No. 6-44-0052-A4 unless otherwise specified.

3.14 Valves under 'NACE' category shall meet the requirements specified in MR-0103 unless otherwise specified.

3.15 For all austenitic stainless steel valves Inter Granular Corrosion (IGC) test shall be conducted as per the following:

3.15.1 ASTM A262 Practice 'B' with acceptance criteria of '60 mils/year (max.)' for all materials - forged, rolled, wrought and casting.

Or

ASTM A262 Practice 'E' with acceptance criteria of 'No cracks as observed from 20X magnification' for all materials other than castings. 'Microscopic structure to be observed from 250X magnification' in addition.

3.15.2 When specifically asked for in MR for high temperature application of some grades of austenitic stainless steel (eg. SS309, 310, 316, 316H etc.) ASTM A262 Practice 'C' with acceptance criteria of '15 mils/year (max.)' shall be conducted.

3.15.3 For the IGC test as described in Clauses 3.15.1 & 3.15.2, two sets of samples shall be drawn from each solution annealing lot. One set shall correspond to the highest Carbon content and the other to the highest pressure rating. When testing is conducted as per practice 'E', photograph of the microscopic structure shall be submitted for record.

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3.16 All types of 321 or 347 stainless steel valves shall be in a stabilised heat treated condition. Stabilising heat treatment shall be carried out subsequent to the normal solution annealing. Soaking temperature and holding time for stabilising heat treatment shall be 900°C and 4 hours respectively.

3.17 Spiral wound bonnet gaskets are to be provided with inner/outer ring except when encapsulated gaskets type body-bonnet joints are employed. Outer ring may be avoided in case of non-circular spiral wound gasket used in Class 150 valve provided the outermost layer of spiral touches the bolts ascertaining the centering.

3.18 All Stainless Steel Castings shall be solution heat treated.

3.19 Only normalized and tempered material shall be used in the following specifications:

Castings : A217 Gr.WC1, A217 Gr.WC4, A217 Gr.WC5, A217 Gr.WC6, A217 Gr.WC9, A217 Gr.C5, A217 Gr.C12

Forgings : A182 Gr.F11 Cl.2, A182 Gr.F12 Cl.2

3.20 Ball / Plug / Butterfly Valves

3.20.1 As a prequalification, fire safe test as per API 607 / API 6FA / BS EN ISO 10497 (Supersedes BS 6755 Part II) shall be carried out on soft seated ball, plug & butterfly valves and also on lubricated plug valves. The test shall be witnessed and certified by a third party inspection agency like Lloyds, BVIS, DNV, TUV or EIL/ CEIL unless otherwise specified. The vendor has to submit test certificate for the particular design of the valve offered, if fire safe design is required as per the Valve Material Specification sheet.

3.20.2 Each valve shall be supplied with a lever / wrench except for gear operated / motor operated valves.

3.20.3 Soft-seated ball, plug & butterfly valves shall be supplied with antistatic devices.

3.20.4 BW / SW end ball valves shall have a 100 mm long seamless pipe nipple welded to each end of the valve. Nipples are to be welded prior to assembling soft seats / seals. Specifications of the nipples shall be as indicated in the MR.

3.20.5 The ball of ball valve shall not protrude outside the end flanges of valve.

3.20.6 Ball valves shall be of floating ball/trunnion mounted type as per following:

Class 150	8" & below	Floating ball
	10" & above	Trunnion mounted
Class 300	4" & below	Floating ball
	6" & above	Trunnion mounted
Class 600 & above	1.5" & below	Floating ball
	2" & above	Trunnion mounted

3.20.7 Unless otherwise specified in the data sheets, bore of all reduced bore ball valves shall be limited to one size lower than the nominal bore.

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3.20.8 In case of ball valves, the ball shall have a cylindrical bore and shall be of solid construction except in the case of rising stem ball valves or where otherwise specified.

3.21 Motor Operated Valves:

3.21.1 The MOVs are to be installed in an open area and the actuators shall be suitable for all weather conditions. The testing of complete assemblies of MOVs along with the actuators shall be done by the supplier at his works.

3.21.2 Vendor shall be solely responsible for selection of suitable actuators & actuator control system. Vendor shall be single point responsible for the complete system (i.e. valves, actuators, actuators control system etc.).

3.21.3 Valve with motorized actuators shall be suitable for installation in horizontal/vertical lines.

3.21.4 All MOVs shall be provided with hand wheel for manual operation.

3.22 In case flange dimension standard / Butt weld end thickness have not been specified in Valve Material Specification attached with the MR, Vendor to obtain the same from EIL and supply strictly in line with specifications.

3.23 Yoke material shall be same as bonnet material where maximum temperature specified is more than 427°C.

3.24 Face to Face / End to End Dimensions of Valves:

The Face to Face dimensions for Flanged valves and End to End Dimensions for Butt Welded Valves shall be strictly as given below unless otherwise specified in the VMS sheet. Valves with Face-to-Face/End-to-End dimensions as per Manufacturers' Standards are acceptable only where not covered in the Dimension Standards listed below.

3.24.1 Gate Valves:

Type	Face-to-Face/End-to-End Dimension
Flanged End	Dimension 'A' for Solid Wedge & Double Disc Gate Valves as per ASME B16.10
Butt Welding End	Dimension 'B' for Short Pattern Gate Valves up to the sizes covered in ASME B16.10. For sizes not covered under Short Pattern, Dimension 'B' for Long Pattern Gate Valves as per ASME B16.10 shall be followed.

3.24.2 Globe Valves:

Type	Face-to-Face/End-to-End Dimension
Flanged End	Dimension 'A' for Globe Valves as per ASME B16.10
Butt Welding End	Dimension 'B' for Short Pattern Globe Valves up to the sizes covered in ASME B16.10. For sizes not covered under Short pattern, Dimension 'B' for Long Pattern Globe Valves as per ASME B16.10 shall be followed.

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3.24.3 Check Valves:

Type	Face-to-Face/End-to-End Dimension
Flanged End Swing Check	Dimension 'A' for Swing Check Valves as per ASME B16.10
Butt Welding End Swing Check	Dimension 'B' for Short Pattern Swing Check Valves up to the sizes covered in ASME B16.10. For sizes not covered under short pattern, Dimension 'B' for Long Pattern Swing Check Valves as per ASME B16.10 shall be followed.
Lugged/Double Flanged Dual Plate Check Valves	As per API 594

3.24.4 Ball Valves:

The face-to-face dimensions of all ball valves shall be same as those of gate valves of the corresponding ASME Class rating as given in Clause 3.24.1 (except 10" onwards in Class 150 where the face-to-face dimensions shall be as per ASME B16.10 long pattern).

3.24.5 Plug Valves:

Class Rating	Face-to-Face Dimension
Class 150	Short Pattern as per ASME B16.10 up to 12" Venturi Pattern as per ASME B16.10 for above 12"
Class 300 & 600	Short Pattern as per ASME B16.10 up to 4" Venturi Pattern as per ASME B16.10 for above 4"

3.24.6 Butterfly Valves:

The face to face dimensions for butterfly valves shall be as per BS EN 558/API 609. For Class 150 Butterfly valves, Series 13 shall be followed and for Class 300 Butterfly valves, Series 14 shall be followed, unless otherwise specified.

3.25 In addition to all types of BW/SW ball valves, any other type of soft seated BW / SW end valve shall have a 100 mm long seamless pipe nipple welded to each end of the valve. Nipples are to be welded prior to assembling soft seats / seals. Specifications of the nipples shall be as indicated in the MR.

3.26 All Butt welds shall be 100% radiographed and all socket welds shall be 100% DP/MP tested.

3.27 Fugitive Emission Requirements:

Unless otherwise mentioned in VMS sheet, all valves with stem packing shall comply with the fugitive emission requirements detailed below as a pre-qualification.

3.27.1 Gate valves as per API-600 and all Gate/Globe valves as per API-602 shall comply with fugitive emission requirements of API 624.

Gate valves of Class rating 900 & above, Gate valves of size 26" & above and Globe valves of size 2" & above or valves where API-624 is not applicable due to non-graphite stem packing material, shall comply with Fugitive emission requirement of ISO-15848-1.

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3.27.2 Quarter turn valves shall comply with Fugitive emission requirement of API 641.Quarter turn valves where API-641 is not applicable due to non-graphite stem packing material, shall comply with Fugitive emission requirement of ISO-15848-1.

3.27.3 As a prequalification, Fugitive emission type test as per Cl. 3.27.1 & 3.27.2 above shall have been carried out and the test shall have been witnessed and certified by a third party inspection agency like Lloyds, BVIS, DNV, TUV or EIL/ CEIL unless otherwise specified. The vendor has to submit test certificate covering the entire range of valves to be supplied.

Vendors who do not have Fugitive emission type test certificate covering the range of valves to be supplied, shall conduct the requisite test within 12 weeks from the date of purchase order or within contractual delivery date, whichever is earlier.

In case of non-conductance of Fugitive emission type test(s) within time frame specified above or failure in the test(s) conducted after receipt of order, the owner reserves the right to invoke any of the provisions of the purchase order including cancellation of the purchase order at the risk and cost of vendor.

3.28 Valves specified as LO (Lock open) and LC (Lock closed) shall be supplied with suitable arrangement for locking in open as well as in closed position. Lock is included in vendor's scope of supply.

3.29 For Lugged Wafer Type (WAFL) Butterfly Valves, lug shall be provided for each bolt.

3.30 For butterfly valves, where bolting for tapped hole in body is being supplied by Vendor and diameter of the bolting is more than or equal to 1", the bolting supplied shall be studs to ASME B18.2.1 with two nuts.

3.31 For Gate and Globe valves, the stem surface area in contact with the packing shall have a surface finish, Ra, of 0.80μm (32μin.) or smoother, unless otherwise specified.

4.0 OPERATION

4.1 Gear operation shall be provided as under as a minimum, unless otherwise specified:

Valve Type	Class	Size Requiring Gear-Operator
Gate Valve, Globe Valve & Diaphragm Valve	150 Class	12" and larger
	300 Class	12" and larger
	600 Class	10" and larger
	900 Class	6" and larger
	1500 Class	3" and larger
	2500 Class	3" and larger
Ball Valve / Plug Valve (Other than pressure balance plug valves)	150 Class	6" and larger
	300 Class	6" and larger
	600 Class	4" and larger
Ball Valve / Plug Valve (Other than pressure balance plug valves)	900 Class	3" and larger
	1500 Class	3" and larger
Butterfly Valve	150, 300 Class	6" and larger

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For sizes lower than these ranges, hand wheel / lever / wrench shall be provided. For pressure balance plug valves manufacturer's recommendation shall be acceptable provided the requirements specified in clause 4.6 are met.

4.2 Gear operator shall be provided, with position indicators for open / close positions and with limit stops. (Limit stops are not applicable for gate valves). Gear box shall be fully encased and weather proof.

4.3 Where gear operator is not called for as per Clause 4.1 but vendor recommends a gear operator, the same shall be highlighted.

4.4 Gear operator shall be so designed as to operate effectively with the differential pressure across the closed valve equal to the cold non-shock pressure rating.

4.5 Ball, plug and butterfly valves, shall have "Open" position indicators with limit stops.

4.6 Hand-wheel diameter shall not exceed 750mm and lever length shall not exceed 500mm on either side. Effort to operate shall not exceed 35 Kg at hand-wheel periphery. However, failing to meet the above requirements, vendor shall offer gear operated valve and quote as per clause 4.3.

5.0 INSPECTION AND TESTING

5.1 Every valve shall be subjected to all the mandatory tests and checks called in the respective codes / data sheet by EIL inspection or any third party as approved by the purchaser. For IBR valves refer clause 7.0.

5.2 Every valve, its components and auxiliaries must be subjected to all the mandatory tests and checks called for in the respective codes, data sheets etc. by the manufacturer.

5.3 Though the extent of inspection shall be as under, exact extent with hold points shall be decided by EIL regional inspection office and recorded in the form of inspection plan. In case of third party inspection, the inspection plan shall be approved by the purchaser.

Forged Valves:

1. Visual and dimensional inspection.
2. Review of material test certificates.
3. Any mandatory or supplementary test.
4. Hydrostatic test on 10% valves selected on random basis.
5. Strip check is required for 1% of total ordered quantity of Gate & Globe valves (min. 1 No.) for each Valve sheet no., however, strip check is not required for CS/ Brass/ Bronze material valves with 13% Cr/ Brass/ Bronze trims.
6. Type test certificate for Fugitive Emissions as per Cl. 3.27.3.
7. Positive Material Identification
8. Type test certificates for cryogenic & Fire safe test to be submitted.

Cast Steel Valves:

1. Visual inspection with acceptance standards as per MSS SP-55 and dimensional inspection.
2. Review of material test certificates.

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3. Review of radiographs and radiographic reports or any other NDT tests wherever applicable as per data sheet.
4. Any mandatory or supplementary test.
5. Hydrostatic test 100% for body, 10% other test.
6. Strip check is required for 1% of total ordered quantity of Gate & Globe valves (min. 1 No.) for each Valve sheet no., however, strip check is not required for CS/ Brass/ Bronze material valves with 13% Cr/ Brass/ Bronze trims.
7. Type test certificate for Fugitive Emissions as per Cl. 3.27.3.
8. Positive Material Identification
9. Type test certificates for cryogenic & Fire safe test to be submitted.

Samples for strip check shall be selected at random and shall generally be in the highest size in the lot.

5.4 In case of motor operated or actuator operated valves, functional / operational checks as per the requirements of the specifications shall be made on each valve.

6.0 RADIOGRAPHY OF CAST VALVES

6.1 Valve castings shall undergo radiographic examination as specified below.

Material	Rating	Size Range	Radiography
All	Class 150	24" and below	NIL**
		26" and above*	100%
	Class 300	16" and below	NIL**
		18" and above	100%
	Class 600& above	All sizes	100%

* No radiography is required for valves of size 26" and above in cooling water service.

**For sizes 24" & below in Class 150 and 16" & below in Class 300, radiography percentage if specifically mentioned in individual valve material spec sheet shall govern.

Radiography specified as random 10% or 20% etc. in the respective valve data sheet implies 10% or 20% etc. of number of valves ordered against each item number with a minimum of one valve against each item.

6.2 Radiography procedure, areas of casting to be radiographed shall be as per ASME B16.34 and acceptance criteria shall be as per ASME B16.34. However for areas of casting to be radiographed for types of valves not covered in ASME B16.34, vendor shall radiograph castings in line with ASME B16.34.

6.3 For random radiography wherever specified in individual data sheets, the sampling shall be per size of the quantity ordered for each foundry.

6.4 Radiography wherever specified in the data sheets or as per clause 6.1 shall be done by X-ray / γ-ray to get the required sensitivity.

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7.0 IBR CERTIFICATION

7.1 For valves described "IBR", valves shall be in accordance with the latest IBR (Indian Boiler Regulation) including the requirements specified in the specification.

7.2 For SW / BW end carbon steel valves under IBR, the chemical composition shall conform to the following:

Carbon (Max)	:	0.25%
Others (S, P, Mn)	:	As per IBR

7.3 Valves coming under the purview of "IBR" (Indian Boiler Regulations) shall each be individually accompanied by IBR certificate original in Form III-C duly approved by IBR authority / local authority empowered by the Central Boiler Board of India. Photocopy of original certificate duly attested by the local boiler inspector where the supplier is located is the minimum requirement for acceptance.

7.4 All "IBR" valves shall be painted red in body-bonnet / body-cover joint.

8.0 MARKING

8.1 Valve markings, symbols, abbreviations etc. shall be in accordance with MSS-SP-25 or the standard referred in specification sheet as applicable. Vendor's name, valve rating, material designation, nominal size, direction of flow (if any) etc. shall be integral on the body.

8.2 Each valve shall have a corrosion resistant tag giving size, valve tag / code no., securely attached to the valve body.

8.3 Paint or ink for marking shall not contain any harmful metal or metal salts such as zinc, lead or copper which cause corrosive attack on heating.

8.4 Carbon Steel / Alloy Steel valves shall be painted with one coat of inorganic zinc silicate (minimum DFT 65 to 75 microns).

9.0 DESPATCH

9.1 Valve shall be dry, clean and free from moisture, dirt and loose foreign materials of any kind.

9.2 Valves shall be protected from rust, corrosion and any mechanical damage during transportation, shipment and storage.

9.3 Rust preventive on machined surfaces to be welded shall be easily removable with a petroleum solvent or shall not be harmful to welding.

9.4 Each end of valve shall be protected with the following materials:

Flange Face	:	Wood or Plastic Cover
Bevelled End	:	Wood or Plastic Cover
SW & SCRD. End	:	Plastic Cap

9.5 End protectors of wood / plastic to be used on flange faces shall be attached by at least three bolts and shall not be smaller than the outside diameter of the flange. However, plastic caps for SW & SCRD end valves shall be press fit type.

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9.6 End protectors to be used on bevelled end shall be securely and tightly attached.

9.7 For special service valves additional requirement for despatch shall be as prescribed in data sheet.

10.0 ATTACHMENTS

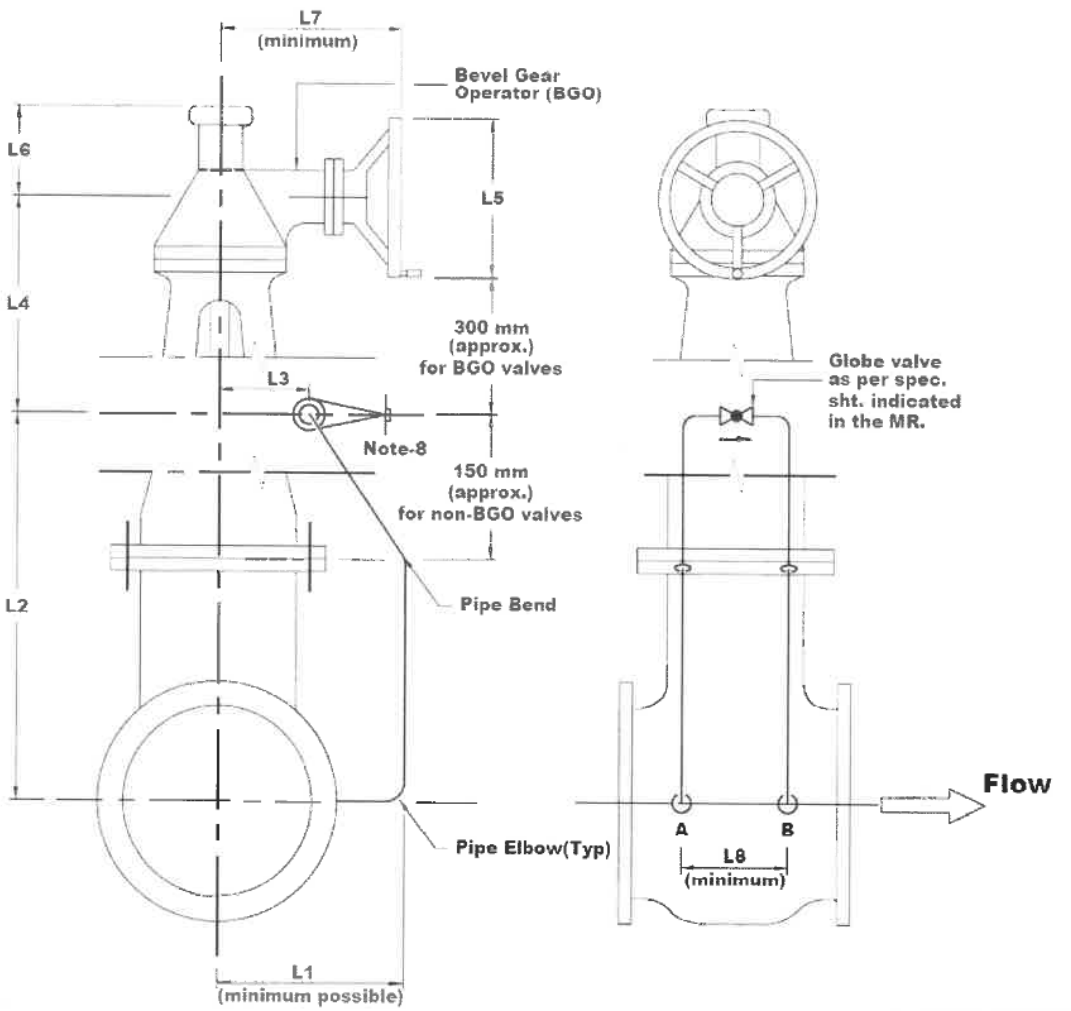
6-44-0052-A1	:	Bypass Piping Arrangement
6-44-0052-A2	:	Specifications for Bypass Piping, Fittings and Valves
6-44-0052-A3	:	Special Requirements for Low Temperature and Cryogenic Valves
6-44-0052-A4	:	Special Requirements for Hydrogen Service Valves

11.0 REFERENCES

6-78-0001	:	Specification for Quality management system requirements from bidders
6-78-0003	:	Specification for documentation requirements from suppliers
6-81-0001	:	Specification for Positive Material Identification (PMI) at Supplier's Works
6-81-0004	:	Inspection and Test plan for Valves

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BYPASS PIPING ARRANGEMENT



NOTES:

1. The orientation & location of handwheel of bevel gear operator & the bypass arrangement shall be strictly as per this sketch.
2. The bypass connection ends including connection to boss in main valve body shall be socket welded upto 600# and butt welded for 900# and above rating.
3. The bypass arrangement shall be properly clamped to & supported by the body of the main valve.
4. Basic design of bypass shall be to MSS-SP-45.
5. Material of bypass pipe & 90° elbows shall be same or equivalent to the body material as indicated in Specification No. 6-44-0052-A2.
6. This sketch is applicable for both BGO & NON-BGO Valves.
7. Vendor shall furnish dimensions L1 to L8.
8. Stem shall not be horizontal in the case of CRYO Valves.

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SPECIFICATIONS FOR BYPASS PIPING, FITTINGS AND VALVES

Class (Main Valve Sht.no.)	Pipe	Fittings	Bypass Valve Sht.no.	Remarks
A1A(51301), A3A(51321), A39A (51321), A9A(51301), A11A(51301), A33A(51301), B1A(51401), B9A(51401), D1A(51501), D9A (51501)	ASTM A106 Gr.B (SMLS) 0.5"-1.5": S160	ASTM A105 0.5"-1.5": SW 6000#	52001	
A6A(51301), B6A(51401)	ASTM A106 Gr.B (SMLS) 0.5"-0.5" : XXS 0.75"-1.5": S160	ASTM A105 0.5"-0.5" : SW 9000# 0.75"-1.5": SW 6000#	52001	
A13A(51301), B13A(51401)	ASTM A106 Gr.B (SMLS) 0.5"-1.5" : XXS	ASTM A105 0.5"-1.5" : SW 9000#	52001	
A2A(51302), B2A(51402), D2A (51502)	ASTM A106 Gr.B (SMLS)- IBR 0.5"-0.75": S160 1.0"-1.5" : XS	ASTM A105 - IBR 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52002	
A4A (51303), B4A (51403), D4A (51503)	ASTM A333 Gr.6 (SMLS)- LT 0.5"-0.75": S160 1.0"-1.5" : XS	ASTM A350Gr.LF2CL.1-LT 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52003	
B5A (51404), D5A (51504)	ASTM A106 Gr.B (SMLS) -H2 0.5"-0.75": S160 1.0"-1.5": XS	ASTM A105 - H2 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52004	Note-1
A7A (51307)	ASTM A106 Gr.B (SMLS) 0.5"-0.75" : S160 1.0"-1.5": XS	ASTM A105 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52007	
A16A (51311), B16A (51411), D16A (51511)	ASTM A106 Gr.B (SMLS) - NACE 0.5"-0.75" : XXS 1.0"-1.5": S160	ASTM A105 - NACE 0.5"-0.75" : SW 9000# 1.0"-1.5": SW 6000#	52011	Note-1
A19A (51313), B19A (51413), D19A (51513)	ASTM A106 Gr.B (SMLS) 0.5"-1.5" : S160	ASTM A105 0.5"-1.5": SW 6000#	52013	Note-1
E1A (51601), F1A (51701)	ASTM A106 Gr.B (SMLS) 0.5"-1.5" : S160	ASTM A234 Gr.WPB/ ASTM A105 0.5"-1.5" : BW, S160	52101	
E2A (51602), F2A (51702)	ASTM A106 Gr.B (SMLS) - IBR 0.5"-1.5" : S160	ASTM A234 Gr.WPB/ ASTM A105 - IBR 0.5"-1.5" : BW, S160	52102	
E5A (51604), F5A (51704)	ASTM A106 Gr.B (SMLS) - H2 0.5"-1.5" : S160	ASTM A234 Gr.WPB/ ASTM A105 - H2 0.5"-1.5" : BW, S160	52104	Note-1
E9A (51605), F9A (51705)	ASTM A106 Gr.B (SMLS) 0.5"-1.5" : SCH XXS	ASTM A234 Gr.WPB/ ASTM A105 0.5"-1.5" : BW, SCH XXS	52105	

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Class (Main Valve Sht.no.)	Pipe	Fittings	Bypass Valve Sht.no.	Remarks
E19A (51613), F19A (51713)	ASTM A106 Gr.B (SMLS) 0.5"-1.5" : SCH XXS	ASTM A234 Gr.WPB/ ASTM A105 0.5"-1.5" : BW, SCH XXS	52113	Note-1
A5Y (51384), A33Y (51384)	ASTM A106 Gr.B (SMLS) 0.5"-0.75" : S160 1.0"-1.5": XS	ASTM A105 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52085	
B1D (51430), D1D (51530)	ASTM A335Gr.P11(SMLS) 0.5"-0.75" : S160 1.0"-1.5": XS	ASTM A182 Gr.F11Cl.2 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52030	
D2D (51531)	ASTM A335Gr.P11 (SMLS) - IBR 0.5"-0.75" : S160 1.0"-1.5": XS	ASTM A182 Gr.F11Cl.2 - IBR 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52031	Note-1
B5D (51432), D5D (51532)	ASTM 335Gr.P11(SMLS)- H2 0.5"-0.75" : S160 1.0"-1.5": XS	ASTM A182 Gr.F11Cl.2 - H2 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52032	Note-1
B1E (51433)	ASTM A335Gr.P22(SMLS) 0.5"-0.75" : S160 1.0"-1.5": XS	ASTM A182 Gr.F22Cl.3 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52033	
D5E (51534)	ASTM A335Gr.P22(SMLS) - H2 0.5"-0.75" : S160 1.0"-1.5": XS	ASTM A182 Gr.F22Cl.3 - H2 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52034	Note-1
A4F (51336), B4F (51436)	ASTM A335 Gr.P5(SMLS) 0.5"-0.75" : S160 1.0"-1.5": XS	ASTM A182 Gr.F5 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52036	Note-1
B3F (51436)	ASTM A335 Gr.P5(SMLS) 0.5"-1.5" : XXS	ASTM A182 Gr.F5 0.5"-1.5" : SW 9000#	52036	Note-1
A4G (51339), B4G (51439)	ASTM A335 Gr.P9(SMLS) 0.5"-0.75" : S160 1.0"-1.5": XS	ASTM A182 Gr.F9 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52039	Note-1
F2D (51731)	ASTM A335 Gr.P11 (SMLS) - IBR 0.5"-1.5" : S160	ASTM A234Gr.WP11Cl.1/ A182 Gr.F11Cl.2 - IBR 0.5"-1.5" : BW, S160	52131	Note-1
F2G (517GG)	ASTM A335 Gr.P91 (SMLS) - IBR 0.5"-0.75" : S160 1.0"-1.5": XS	ASTM A234Gr.WP91/ A182 Gr.F91 - IBR 0.5"-0.75" : S160 1.0"-1.5": XS	52140	Note-1
G2G (518GG)	ASTM A335 Gr.P91 (SMLS) - IBR 0.5"-1.0" : S160 1.5"-1.5": XXS	ASTM A234Gr.WP91/ A182 Gr.F91 - IBR 0.5"-1.0" : S160 1.5"-1.5": XXS	52240	Note-1
E5E (51634)	ASTM A335 Gr.P22(SMLS) - H2 0.5"-0.75" : S160 1.0"-1.5": XS	ASTM A234Gr.WP22Cl.1/ A182 Gr.F22Cl.3 - H2 0.5"-0.75" : BW, S160 1.0"-1.5" : BW, XS	52134	Note-1

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Class (Main Valve Sht.no.)	Pipe	Fittings	Bypass Valve Sht.no.	Remarks
A1K (51345), A3K (51345), B1K (51445), D1K (51545)	ASTM A312TP304(SMLS) 0.5"-0.75" : 80S 1.0"-1.5": 40S	ASTM A182 Gr.F304 0.5"-1.5" : SW 3000#	52045	
A2K (51346), B2K (51446), D2K (51546)	ASTM A312TP304(SMLS) - CRYO 0.5"-0.75" : 80S 1.0"-1.5": 40S	ASTM A182 Gr.F304 - CRYO 0.5"-1.5" : SW 3000#	52046	
B4K (51448), B5K (51448)	ASTM A312TP304H(SMLS) 0.5"-1.5" : 80S	ASTM A182 Gr.F304H 0.5"-1.5": SW 3000#	52048	
A6K (51350), A11K (51350), B6K (51450)	ASTMA312TP304L(SMLS) 0.5"-0.75" : 80S 1.0"-1.5": 40S	ASTM A182 Gr.F304L 0.5"-1.5": SW 3000#	52050	
A1M (51361), B1M (51461)	ASTM A312 TP316(SMLS) 0.5"-0.75" : 80S 1.0"-1.5": 40S	ASTM A182 Gr.F316 0.5"-1.5": SW 3000#	52061	
B5M (51462)	ASTMA312TP316H(SMLS) - H2 0.5"-0.75" : 80S 1.0"-1.5": 40S	ASTM A182 Gr.F316H - H2 0.5"-1.5": SW 3000#	52062	
B3M (51463)	ASTM A312 TP321(SMLS) 0.5"-0.75" : 80S 1.0"-1.5": 40S	ASTM A182 Gr.F321 0.5"-1.5": SW 3000#	52063	
A1N (51366), B1N (51466)	ASTMA312TP316L(SMLS) 0.5"-0.75" : 80S 1.0"-1.5": 40S	ASTM A182 Gr.F316L 0.5"-1.5": SW 3000#	52066	
B6N (51471)	ASTM A312 TP316L (SMLS) 0.5"-0.75" : 80S 1.0"-1.5": 40S	ASTM A182 Gr.F316L 0.5"0.5"-1.5": SW 3000#	52071	

In case specifications for bypass of any specific VMS sheets are not available in the MR, Vendor to obtain the same from EIL and supply strictly in line with specifications.

Notes:

1. All welded joints shall be post weld heat treated. Procedure for Post weld heat treatment shall be in accordance with ASME B31.3.

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SPECIAL REQUIREMENTS FOR LOW TEMPERATURE & CRYOGENIC VALVES

1.0 SCOPE

All valves of Low Temperature Carbon Steel (LTCS) and all grades of austenitic SS (CRYO) material are categorized as cryogenic valves. All these valves shall have extended bonnet. The bonnet extension shall be as per VMS sheets (BS 6364/ BS EN ISO 28921-1) except check valves.

2.0 QUALIFICATION CRITERIA

For Limited Enquiries (Non NIT enquiries)

2.1 Vendors who satisfy both the requirements given below shall be considered qualified :

a. Vendor should be enlisted with EIL for any cryogenic valve irrespective of type, size, rating and metallurgy

b. Vendors should be enlisted with EIL for the same type, material, size and rating of non-cryogenic/cryogenic valve as the cryogenic valve quoted for

2.2 Qualified Vendors who do not have cryogenic test reports covering the range of Cryogenic valves quoted for, shall conduct cryogenic test per clauses 3.0 within 12 weeks from the date of purchase order.

2.3 Clauses 2.1 and 2.2 of this Annexure shall be read in conjunction.

3.0 CRYOGENIC TEST

3.1 Vendors to furnish copies of cryogenic test certificate for tests as per details given below:

3.1.1 Test shall be as per VMS sheets (BS 6364/ BS EN ISO 28921-2).

3.1.2 Test temperature, unless specifically called for otherwise in the individual MR, shall be -45°C for LTCS and -196°C for all grades of austenitic stainless steel.

3.1.3 Tests carried out on a particular size of one type of valve, pressure rating and material shall qualify all sizes equal to and below the test valve size for the same type, pressure rating and material. In case of austenitic SS any one grade would qualify for all other grades of austenitic SS.

3.1.4 Tests should have been witnessed and certified by any third party inspection agencies like M/s Lloyd, BV, DNV, TUV or EIL/ CEIL.

3.1.5 Test conducted previously and witnessed by inspection agencies listed above shall be considered acceptable and need not be repeated.

3.2 Post Order Testing Procedure

3.2.1. Before conducting post order testing, vendor shall obtain approval for the following from TPIA:

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a. Test procedure and Schematic of test rig with complete details as per standard specified in VMS sheet (BS 6364/ BS EN ISO 28921-2).

b. Cross-section drawing of the valve with material of construction.

3.2.2. Test has to be conducted irrespective of the service on largest size for each type of valve and for each material and class rating. Vendor shall offer one, two or three valves for selection of test valve by inspector depending upon whether quantity of largest valve in the order is one, two or three and more than three respectively.

In the event of failure of the test valve to meet the specification requirements, the vendor shall conduct test on two more valves. These two valves which pass test successfully, are of lower size, then the qualification will be valid only to sizes upto which test has been conducted successfully.

3.2.3. In case of non-conductance of cryogenic test(s) within 12 weeks or failure in the test(s) conducted after receipt of order, the owner reserves the right to invoke any of the provisions of the purchase order including cancellation of the purchase order at the risk and cost of vendor.

4.0 Bonnet extension, wherever specified in the valve sheet shall be for "non cold box application" unless otherwise specified in the MR. Even if not called for in VMS, valves indicated as "LT" or "CRYO" shall be supplied with bonnet extension.
If the valves are supplied in accordance with BS EN ISO 28921-1, Bonnet extension in LT service shall be as per values specified for -51 Deg.C to -109 Deg.C.

5.0 Bonnet and Gland extension joints shall be of butt welded/integrally cast construction.

6.0 Repair welding procedure for austenitic stainless steel valves in "CRYO" service shall have to be qualified for impact test as per ASME B31.3. Minimum acceptable impact energy shall be 20 J or lateral expansion of 0.38 mm at temperature of -196°C.

7.0 Wherever impact test of SS studs / nuts is called for in the data sheet, the impact value shall be 27 J at the intended service temperature specified in the data sheets.

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SPECIAL REQUIREMENTS FOR HYDROGEN SERVICE

1.0 GENERAL

1.1 These requirements are applicable for valves used in Hydrogen service. These are in addition to the requirements described in "Technical Notes for Valves" Spec. No. 6-44-0052, and shall be read in conjunction with this specification.

1.2 All cast valve flanges & bodies with flange rating of Class 900 or greater shall be examined in accordance with paragraphs 7.2 through 7.5 of Appendix-VII of ASME SEC-VIII, DIV.1, regardless of casting quality factor.

1.3 Body / bonnet / cover joints & stuffing box of all valves shall have low emission. One valve per metallurgy, per rating, per size shall be helium leak tested as per ASME Sec.V, Subsection A, Article 10 (Detector Probe Technique), Appendix IV at a minimum of 25% of the allowable (rated) cold working pressure. Selection of valves for helium leak test shall be at random. Test duration shall be as follows:

Test Duration in Minutes					
Nominal Size	Pressure Class				
	Upto 300	600	800 & 900	1500	2500
Upto 2"	3	6	9	12	12
3" to 6"	6	9	12	15	18
8" to 16"	9	9	12	15	18
18" to 24"	9	12	15	18	21

The valve shall show no leakage. No leakage is defined as a total leakage rate of less than 0.0001 ml/s of helium.

2.0 Only normalized and tempered material shall be used in the following specifications:

Castings : A217 Gr.WC1, A217 Gr.WC4, A217 Gr.WC5, A217 Gr.WC6, A217 Gr.WC9, A217 Gr.C5, A217 Gr.C12

Forgings : A182 Gr.F11 Cl.2

3.0 CS & AS VALVES

3.1 Bend test and Magnetic Particle inspection of the entire surface of body and bonnet casting shall be in accordance with ASTM A217. Supplementary requirement S3 & S4 evaluation of magnetic particle, inspection shall be in accordance with MSS-SP-53 except that no linear discontinuities shall be allowed.

3.2 The Brinell hardness of heat treated casting shall not exceed 200 BHN for carbon steel & 225 BHN for alloy steel.

3.3 Repair to defective casting shall be outlined in writing to the purchaser before repair starts. Repair method to be approved prior to welding.

3.4 Casting shall be preheated to a minimum of 400°F prior to welding and all Chromium-Molybdenum alloys shall be postweld heat treated after welding is complete. Stress relieving is essential for welds.

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3.5 Carbon steel shall be normalised and alloy steels shall be normalised & tempered.

3.6 Dye Penetrant test of welds shall be in accordance with ASTM B165 Procedure B-2. Interpretation as per Appendix-8 of ASME-VIII Div.1.

3.7 The tensile stress for AS shall be less than 100,000 psi.

3.8 Charpy V-notch impact testing is to be done for valve material (average 20 ft-lb for set of 3 [minimum value 15 ft-lb] at 30°F).

3.9 For radiography and acceptance criteria for valve castings, refer Cl. 4.2.

4.0 SS VALVES

4.1 Valve casting shall be in solution heat treated and pickled condition.

4.2 Critical body and bonnet casing section typically defined by ASME B16.34 shall be radiographed and shall meet ASTM E446 (upto 2" thick) Category A, B & CA Level 2, Category CB, OC & CD Level 3, Category D, B & F Level 0. For wall thickness 2" to 4.5" comparable plates of ASTM E186 shall be used. ASTM E94 and ASTM E142 shall be used for recommended practice & controlling quality of radiography as guide. The entire surface of all castings shall be dye-penetrant inspected after pickling.

4.3 Repair Welds shall be 100% radiographed and evaluated in accordance with paragraph 344.5 of ASME B31.3 with a minimum casting quality factor of 0.95. Dye Penetration test shall be as per ASTM E165 Procedure B-2, Interpretation as per Appendix-8 of ASME-VIII Div.1.

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फ्लैंजों, स्पैक्टेकल ब्लाइंडों एवं ड्रिप रिंगों के लिए तकनीकी टिप्पणियाँ

TECHNICAL NOTES FOR FLANGES, SPECTACLE BLINDS AND DRIP RINGS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
8	15.03.24	REVISED & ISSUED AS STD SPECIFICATION	PK	SH	GB	MN
7	16.01.20	REVISED & ISSUED AS STD SPECIFICATION	PK	SH	MI	RKT
6	25.09.14	REVISED & ISSUED AS STD SPECIFICATION	UK	SH	AK RN	SC
5	31.12.13	REVISED & ISSUED AS STD SPECIFICATION	UK	SH	AK RN	SC
4	04.07.08	REVISED & ISSUED AS STD SPECIFICATION	RN	SC	DM	VC

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Abbreviations:

AARH	:	Arithmetic Average Roughness Height
ANSI	:	American National Standards Institute
API	:	American Petroleum Institute
ASME	:	American Society of Mechanical Engineers
ASTM	:	American Society for Testing & Materials
AWWA	:	American Water Works Association
BHN	:	Brinell Hardness Number
HIC	:	Hydrogen Induced Cracking
IBR	:	Indian Boiler Regulations
IGC	:	Inter Granular Corrosion
IS	:	Indian Standard
MR	:	Material Requisition
MSS	:	Manufacturer's Standardization Society
NACE MR	:	National Association of Corrosion Engineers : Material Requirement
PMI	:	Positive Material Identification

Piping Standards Committee

Convenor: Mr. G. Balaji

Members :
Mr. Udayan Chakravarty
Mr. Rameshwar Prasad
Mr. K. Anjaneyulu (SMED)
Mr. Rajesh Chitara (SMMS)
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1.0 GENERAL

1.1 All items, their dimensions, tolerances, chemical composition, physical properties, heat treatment and testing etc. shall conform to the latest codes and standards specified in the requisition. In case of any conflict amongst documents attached with the MR, the most stringent shall govern and Owner's/ EIL decision shall be final in this regard.

Supplier shall strictly comply with MR/PR stipulations and no deviations shall be permitted. Post Order Concession/Deviation as mentioned in Cl. 5.17 of Specification for Quality Management System Requirements from Bidders (6-78-0001) is not applicable.

1.2 Testing

1.2.1 Test reports shall be supplied for all mandatory tests as per the relevant material specifications/ MR. Test reports shall also be furnished for any supplementary tests as specified in the requisition & Clauses 1.11, 1.12 & 1.15.

1.2.2 Material test certificates (physical property, chemical composition & heat treatment report including Chart) shall also be furnished for the flanges supplied.

1.2.3 Positive Material Identification (PMI) shall be performed as per the scope and procedures as defined in the 'Specification for Positive Material Identification (PMI) at Supplier's Works' (No. 6-81-0001).

1.2.4 Refer to specification no. 6-81-0006 for Inspection and Test plans for flanges, spectacle blinds & drip rings.

1.3 Ends of weld neck flanges shall be beveled to suit the schedule / thickness of matching pipe, as specified in the requisition.

1.4 Bevel end details for welding neck flanges shall be as per ASME B16.25. Contour of bevel end shall be as follows:

Material	Wall Thickness	Weld Contour
Carbon Steel (Except Low Temp. Carbon Steel)	Upto 22 mm	Figure 2 Type A
	> 22 mm	Figure 3 Type A
Alloy Steel, Stainless Steel & Low Temp. Carbon Steel	Upto 10 mm	Figure 4
	> 10 mm & Upto 25 mm	Figure 5 Type A
	> 25 mm	Figure 6 Type A

1.5 Bore of socket weld flanges & reducing blind flanges shall suit the outside diameter and schedule / thickness of matching pipe.

1.6 Bore of slip on flanges shall suit the outside diameter of matching pipe.

1.7 Flange face finish shall be normally specified in the requisition as serrated finish, 125 AARH etc. The interpretation for range of face finish shall be as follows:

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Stock Finish	:	1000 µ in AARH max.
Serrated Finish/125 AARH	:	Serrations with 125 to 250µin AARH
63 AARH	:	32 TO 63 µ in AARH

1.8 Galvanized flanges shall be coated with zinc by hot dip process conforming to IS 4736 / ASTM A153.

1.9 Ends of screwed flanges unless otherwise specified shall have taper threads as per ASME/ANSI B1.20.1.

1.10 For ring joint flanges, blinds and spacers the hardness shall be as follows:

Flange Material	Min. Hardness of Groove (BHN)
Carbon Steel	140
1% Cr to 5%, 9% Cr	150
9Cr-1Mo-V	190
Type 304, 316, 321, 347	160
Type 304L, 316L	150
Inconel UNS N06625	220
Incoloy UNS N08825	210
Duplex SS UNS S32205, S31803	250

1.11 For ring joint flanges, blinds and spacers, the hardness shall be recorded in the test report.

1.12 NACE/HIC Requirements

1.12.1 Flanges, blinds, drip rings under "NACE" category and those designated as "HIC1" shall meet the requirements given in NACE MR-0103 unless otherwise specified.

1.12.2 Flanges, blinds, drip rings made from plates and designated as "HIC1" shall meet the HIC requirements of EIL Specification 6-79-0013 unless otherwise specified.

1.13 All austenitic stainless steel flanges shall be supplied in solution annealed condition.

1.14 I.G.C. Test for Stainless Steels:

1.14.1 For all austenitic stainless steel flanges, blinds, drip rings & Fig.8 flanges intergranular corrosion test shall have to be conducted as per following:

ASTM A262 Practice 'B' with acceptance criteria of "60 mils/year (max.)".

OR

ASTM A262 Practice E : The bent specimen shall be examined under 20X magnification. The acceptance criteria is that there will be no crack or fissure in the bent specimen. The bent specimen shall also be subjected to metallographic examination at 250X magnification to ensure no crack or fissure. The photograph of the bent specimen along with comments shall be submitted for review.

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1.14.2 When specifically asked for in requisition for high temperature application of some grades of austenitic stainless steel (like SS309, 310, 316, 316H etc.) ASTM A262 Practice 'C' with acceptance criteria of "15 mils/year" shall have to be conducted.

1.14.3 For the IGC test as described in 1.14.1 & 1.14.2 two sets of samples shall be drawn from each solution treatment lot; one set corresponding to highest carbon content and the other corresponding to the highest rating / thickness.

1.15 All types of 321 or 347 stainless steel flanges shall be in a stabilized heat treated condition. Stabilizing heat treatment shall be carried out subsequent to the normal solution annealing. Soaking temperature and holding time for stabilizing heat treatment shall be 900 C and 4 hours respectively.

1.16 For dual grades of SS where specified, chemical composition and mechanical properties of both grades specified shall be ensured.

1.17 AWWA C207 flanges shall be ring type.

1.18 Dimensions for handle projection for Spacers & Blinds shall be as specified in EIL Std. 7-44-0166.

1.19 Where ever two sizes have been specified in the MR for flanges, it shall be considered a reducing flange.

1.20 All 1Cr-½Mo and 1¼Cr-½Mo flanges shall be normalised and tempered.

1.21 Ring Joint Fig-8 Flanges, Spacers & Blinds shall be female type only.

1.22 The handle for spacers & blinds for classes 900# & above shall be designed by the vendor. The handle may be integral or attached to the line blank / spacer by welding. In case of attachment by welding heat treatment & welding shall be in accordance with B31.3.

1.23 For Hydrogen service following special requirements shall also be met:

a. All carbon steel flanges having wall thickness 9.53 mm and above shall be normalised. The normalising heat treatment shall be a separate heat treatment operation and not a part of the hot forming operation.

b. All alloy steel (Cr-Mo) flanges shall be normalised and tempered. The normalising and tempering shall be a separate heat treatment operation and not a part of the hot forming operation.

c. For all carbon steels and alloy steels with wall thickness over 20mm, Charpy-V Notch impact testing shall be carried out in accordance with paragraph UG-84 of ASME Section VIII, Div-1 per heat of material and per heat treating batch. Impact test specimen shall be in accordance with ASTM A370. Impact energies at 0 C shall average greater than 27J (20 ft-lb) per set of 3 specimens, with a minimum of 20J (15ft-lb).

2.0 IBR REQUIREMENTS

2.1 IBR Documentation

2.1.1 Flanges coming under the purview of IBR (Indian Boiler Regulations) shall be accompanied with IBR Certificate original in Form III G duly approved and countersigned by IBR authority/ local authority empowered by Central Boiler Board of India. Photocopy of original

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certificate duly attested by the local boiler inspector where the supplier is located is the minimum requirement for acceptance.

2.2 For carbon steel flanges under IBR the chemical composition shall conform to the following:

Carbon (max) : 0.25%
Others (S, P, Mn) : As prescribed in IBR.

The chemical composition as indicated in this clause is not applicable for flanges other than IBR services.

3.0 ACCEPTABLE DEVIATIONS

3.1 Blind Flanges and Spacers & Blinds if specified as plate materials are acceptable in forging materials also in the corresponding material grades.

3.2 Flanges/Spectacle Blinds/Drip rings of Grades SS317 of corresponding material are acceptable in place of Grades SS316 or SS316 (2.5Mo min.).

3.3 Flanges/Spectacle Blinds/Drip rings of Grades SS317L of corresponding material are acceptable in place of Grades SS316L or SS316L (2.5Mo min.).

3.4 Dual Grade SS304/304L conforming to all chemical composition requirements of SS304L and mechanical properties of SS304 is acceptable in place of SS304L or SS304 grades. Any specific additional requirements given in the MR shall also be complied.

3.5 Dual Grade SS316/316L conforming to all chemical composition requirements of SS316L and mechanical properties of SS316 is acceptable in place of SS316L or SS316 grades. Any specific additional requirements given in the MR shall also be complied.

4.0 MARKING AND DESPATCH

4.1 All items shall be legibly and conspicuously stamped in accordance with the requirements of applicable ASME, API and MSS Standards. In addition, EIL item code, purchase order number & special conditions like "IBR", "CRYO", "NACE" "H2" etc. shall also be stamped.

4.2 All items coming under the purview of "IBR", "CRYO" , "NACE" & "H2" (hydrogen) shall be painted with one stripe of colour red, light purple brown, canary yellow & white respectively for easy identification. Width of stripe shall be 25mm and it shall be painted longitudinally across the complete thickness of flange other than hub.

4.3 Paint or ink for marking shall not contain any harmful metal or metal salts such as zinc, lead or copper which cause corrosive attack on heating.

4.4 All items shall be dry, clean and free from moisture, dirt and loose foreign materials of any kind.

4.5 All items shall be protected from rust, corrosion and mechanical damage during transportation, shipment and storage.

4.6 Rust preventive on machined surfaces to be welded shall be easily removable with a petroleum solvent and the same shall not be harmful to welding.

4.7 Each end of flange shall be protected with the following materials:

Flange face : Wood, metal or plastic cover

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Bevelled end	:	Wood, metal or plastic cover
Threaded end	:	Plastic plug
Socket welding end	:	Plastic cover or plug

4.8 Each size of flanges, blinds, etc. shall be supplied in separate packagings marked with the purchase order number, item code number, material specification, size and rating.

5.0 REFERENCES

6-81-0001	:	Specification for Positive Material Identification (PMI) at Supplier's Works.
6-81-0006	:	Inspection & test plan for flanges, spectacle blinds & drip rings
6-79-0013	:	Material requirements for carbon steel components used in sour service for petroleum refinery environments
7-44-0162	:	Standard for Spacers & Blinds ≥ 26" (150CL, 300CL & 600CL FF)
7-44-0164	:	Standard for Spacers & Blinds ≥ 26" (For AWWA Flanges)
7-44-0166	:	Dimensions for Handle projection for Spacers & Blinds ≥ ½"-24"

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बट वैल्डेड, साकेट वैल्डेड एवं पेंच फिटिंगों के लिए तकनीकी टिप्पणियाँ

TECHNICAL NOTES FOR BUTT WELDED, SOCKET WELDED AND SCREWED FITTINGS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
8	18.06.24	REVISED AND ISSUED AS STD SPECN	PK	SH	GB	MN
7	20.01.20	REVISED AND ISSUED AS STD SPECN	PK	SH	MI	RKT
6	25.09.14	REVISED AND ISSUED AS STD SPECN	SH	AK	RN ATD	SC
5	31.12.13	REVISED AND ISSUED AS STD SPECN	UK	SH	AK RN	SC
4	04.07.08	REVISED AND ISSUED AS STD SPECN	RN	SC	DM	VC

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Abbreviations:

AARH	:	ArithmeticAverage Roughness Height
ANSI	:	American National Standards Institute
API	:	American Petroleum Institute
ASME	:	American Society of Mechanical Engineers
ASTM	:	American Society for Testing & Materials
BHN	:	Brinell Hardness Number
CS	:	Carbon Steel
DP	:	Dye Penetrant
HAZ	:	Heat Affected Zone
HIC	:	Hydrogen Induced Cracking
IBR	:	Indian Boiler Regulations
IGC	:	Inter Granular Corrosion
IS	:	Indian Standard
LT	:	Low Temperature
MP	:	Magnetic Particle
MR	:	Material Requisition
MSS	:	Manufacturer's Standardisation Society
NACE MR	:	National Association of Corrosion Engineers : Material Requirement
NB	:	Nominal Bore
PMI	:	Positive Material Identification
PO	:	Purchase Order
PR	:	Purchase Requisition
SMYS	:	Specified Minimum Yield Strength
SS	:	Stainless Steel

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1.0 GENERAL

1.1 Chemical composition, physical properties, tests, dimensions and tolerances, heat treatment and marking shall conform to the applicable latest codes / standards / specifications as specified in the material requisition (MR). In case of any conflict amongst documents attached with the MR, the most stringent shall govern and Owner's/ EIL decision shall be final in this regard.

Supplier shall strictly comply with MR/PR stipulations and no deviations shall be permitted. Post Order Concession/Deviation as mentioned in Cl. 5.17 of Specification for Quality Management System Requirements from Bidders (6-78-0001) is not applicable.

1.2 Testing

1.2.1 Test reports shall be supplied for all mandatory tests as per the relevant material specifications/ MR. Test reports shall also be furnished for any supplementary tests as specified in the MR & Clauses 1.7, 1.8, 1.9, 1.10 & 1.11. Material test certificates (physical properties, chemical composition & heat treatment report including chart) shall also be furnished for fittings supplied.

1.2.2 Positive Material Identification (PMI) shall be performed as per scope and procedures defined in the Specification for Positive Material Identification (PMI) at Supplier's Works (6-81-0001).

1.2.3 Refer to specification no. 6-81-0005 for Inspection and Test plan for forged, seamless and welded fittings.

1.3 All fittings shall be seamless in construction unless otherwise specified. If fittings are specified as welded, the same shall conform to clause 1.7.

1.4 Outside diameters and wall thickness (unless otherwise mentioned) of butt welded fittings shall be in accordance with ASME B36.10 and ASME B36.19 as applicable.

1.5 For reducing butt weld fittings having different wall thicknesses at each end, the greater wall thickness of the fitting shall be employed and inside bore at each end shall be matched with the specified inside diameter.

1.6 Beveled ends for all fittings shall conform to ASME B16.25. Contour of bevel shall be as follows:

Material	Wall Thickness	Weld Contour
Carbon Steel (Except Low Temp. Carbon Steel)	Upto 22 mm	Figure 2 Type A
	> 22 mm	Figure 3 Type A
Alloy Steel, Stainless Steel & Low Temp. Carbon Steel	Upto 10 mm	Figure 4
	> 10 mm &Upto 25 mm	Figure 5 Type A
	> 25 mm	Figure 6 Type A

1.7 Welded Fittings

1.7.1 All welded fittings shall be double welded. Inside weld projection shall not exceed 1.6 mm. Welds shall be ground smooth at least 25 mm from the ends.

1.7.2 For fittings made out of welded pipe, the welded pipe shall be double welded type & shall be manufactured with the addition of filler metal.

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1.7.3 Welded tees/Lateral Tees shall not be of fabricated (stub-in/stub-on) type unless otherwise specified in the MR.

1.7.4 All welded fittings shall be normalized & 100% radiographed by X-ray on all welds made by fitting manufacturers & also welds on the parent materials. Radiography by Gamma rays is also acceptable for thickness 8mm & above.

1.7.5 Welded pipes employed for manufacture of fittings shall be made by automatic welding only.

1.7.6 Specified heat treatment for carbon steel & alloy steel fittings shall be carried out again after weld repairs.

1.7.7 Irrespective of the material code requirement, all welded fittings indicated in the MR as "Cryo"& "LT" shall meet impact test requirements of ASME B31.3. The impact test temperature shall be -196°C & -45°C for stainless steel & carbon steel respectively unless specifically mentioned otherwise in the MR.

1.7.8 For welded Carbon steel fittings wherever heat treatment is specified, hardness of weld and HAZ shall be 200 BHN (max.). For welded Alloy steel fittings, hardness after heat treatment shall be as per relevant ASTM material specification unless otherwise specified.

1.8 Stainless Steel Fittings

1.8.1 All stainless steel fittings shall be supplied in solution heat treated condition.

1.8.2 Solution annealing for stainless steel fittings shall be carried out again after weld repairs.

1.8.3 For all stainless steel fittings Inter Granular Corrosion (IGC) test shall have to be conducted as per the following:

ASTM A 262 Practice "B" with acceptance criteria of "60 mils/year (max.)".

Or

ASTM A262 Practice E : The bent specimen shall be examined under 20X magnification. The acceptance criteria is that there will be no crack or fissure in the bent specimen. The bent specimen shall also be subjected to metallographic examination at 250X magnification to ensure no crack or fissure.

1.8.4 When specifically asked for in MR for high temperature application of some grades of austenitic stainless steel (eg. SS309, 310,316,316H etc.) ASTM A 262 Practice "C" with acceptance criteria of "15 mils/year" shall have to be conducted.

1.8.5 For the IGC test as described in Clauses 1.8.3 & 1.8.4, two sets of samples shall be drawn from each solution treatment lot, one set corresponding to the highest carbon content and other set to the highest fitting thickness. When testing is conducted as per ASTM A 262 Practice "E", the photograph of the bent specimen along with comments shall be submitted for review.

1.8.6 For dual grades of SS where specified, chemical composition and mechanical properties of both grades specified shall be ensured.

1.9 NACE/HIC Requirements

1.9.1 Fittings under "NACE" category or those designated as "HIC1" shall meet the requirements of NACE MR-0103 unless otherwise specified.

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1.9.2 Fittings made from plates and designated as "HIC1" shall meet the HIC requirements of EIL specification 6-79-0013 unless otherwise specified.

1.10 Thickness/schedule lower or higher than specified for the finished product shall not be accepted.

1.11 The gasket contact surfaces of stub ends shall be flat with face finish specified in the requisition. Interpretation on the specified face finish is as follows:
125 AARH : Serrations with 125 to 250 μ in AARH

1.12 Seamless stub ends shall not have any welds on the body. Stub ends shall be long pattern type.

1.13 Galvanized fittings shall be coated with zinc by hot dip process conforming to IS 4736 / ASTM A153.

1.14 Threaded ends shall have NPT taper threads in accordance with ASME/ANSI B1.20.1 up to 1.5" NB & IS 554 from 2" to 6" NB.

1.15 Unless and otherwise specified in the MR, all socket welded and screwed fittings shall be in accordance with ASME B16.11 to the extent covered in the specification except for unions which shall be in accordance with MSS-SP-83.

1.16 Special fittings like weldolet, sockolet, sweepolet, latrolet, elbolet etc., the dimensions of which are not covered in ASME, MSS-SP & EIL Standards, shall be as per manufacturer's std. Contours of these fittings shall meet the requirements of ASME B31.3.Manufacturer shall submit drawings / catalogues of these items for records after acceptance of offer.

1.17 Length of all long half couplings shall be 100 mm unless otherwise specified in the MR.

1.18 For reducers to manufacturers' standard, length of reducer shall not be less than 0.7D where D is the outside diameter of the larger end.

1.19 All seamless pipes employed for manufacturing of fittings shall be required to have undergone hydrostatic test to ASTM A 530. Welded pipes employed for manufacture of fittings shall be tested as given below :

Welded Pipe Employed For Manufacture Of Welded Fittings.	Test Criteria
ASTM A671 Gr. C65,70 (Cl.32) ASTM A672 Gr. C60,65,70 (Cl.12, 22) ASTM A671 Gr. CF60,65,70,66 (Cl.32) ASTM A691 Gr. ½Cr, 1Cr, 1¼Cr, 2¼Cr, 5Cr, 9Cr (Cl.42), 91 (Cl.42)	P = 2ST / D S = 90% of SMYS. T = Nom. Wall Thickness D = 0.D. of Pipe.
API 5L ASTM A358 TP 304, 304L, 304H, 318, 318L, 318H, 321, 347 (Cl.1, 3, 4)	P = 2ST / D S = 85% of SMYS. T = Nom. Wall Thickness D = 0.D. of Pipe.
ASTM B725	ASTM B725
ASTM B517	ASTM B517
ASTM B514	ASTM B514

1.20 The bevel ends of all butt weld fittings shall undergo 100% MP / DP test.

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1.21 Abbreviations for ends of swages and nipples shall be as follows:

PBE	:	Plain Both Ends
TBE	:	Threaded Both Ends
TOE	:	Threaded One End
TSE	:	Threaded Small End
TLE	:	Threaded Large End

1.22 All types of SS321 or SS347 fittings shall be in stabilized heat treated condition. Stabilizing heat treatment shall be carried out subsequent to normal solution annealing. Soaking temperature and holding time for stabilizing heat treatment shall be 900°C and 4 hours respectively.

1.23 For Hydrogen service fittings following special requirements shall also be met:

a. All carbon steel fittings having wall thickness 9.53 mm (0.375") and above shall be normalised. Cold drawn fittings shall be normalised after the final cold draw pass for all thicknesses. In addition, fittings made from forgings shall have Carbon- 0.35 % max. and Silicon- 0.35 % max. The normalising heat treatment shall be a separate heating operation and not a part of the hot forming operation

b. All alloy steel (Cr-Mo) fittings shall be normalised and tempered. The normalising and tempering shall be a separate heating operation and not a part of the hot forming operation. The maximum room temperature tensile strength shall be 100,000 psi.

c. For carbon steel fittings, hardness of weld and HAZ shall be 200 BHN (max.). For alloy steel fittings, hardness of weld and HAZ shall be 225 BHN (max.).

d. For all Carbon steel and Alloy steel fittings with wall thickness over 20 mm, Charpy-V Notch impact testing shall be carried out in accordance with paragraph UG-84 of ASME Section VIII, Div-1 for weld metal and base metal from the thickest item per heat of material and per heat treating batch. Impact test specimen shall be in complete heat treated condition and accordance with ASTM A370. Impact energies at 0°Celsius shall average greater than 27J (20 ft-lb) per set of three specimens, with a minimum of 20J(15 ft-lb).

1.24 For all welded alloy steel fittings with mandatory requirements of heat treatment and radiography, radiography shall be performed after heat treatment.

1.25 All 1Cr-0.5Mo & 1.25Cr-0.5Mo fittings shall be normalized and tempered. All 2.25Cr-1Mo, 5Cr-0.5Mo, 9Cr- 1 Mo & 9Cr-lMo-V welded fittings shall be normalized and tempered.

1.26 Fitting material as per ASTM A234 Gr. WP11/WP22/ WP5/WP9/WP91, wherever specified, shall be as per 'Cl.1', unless otherwise specified.

1.27 Materials designated as structural steel grades like IS 2062, SA 36 etc. or similar specification are not permitted for manufacture of fittings.

1.28 Pipe Bends (Other than Elbows)

Bending shall be as per ASME B31.3 except that corrugated or creased bends shall not be used. Final Wall thickness after bending process shall not be less than 87.5% of the thickness specified. All other tolerances shall be as per PFI ES-24.

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2.0 IBR REQUIREMENTS

2.1 IBR Documentation Required

2.1.1 Fittings under the purview of "IBR" (Indian Boiler Regulations) shall be accompanied with original IBR certificate in Form III-C duly approved and countersigned by IBR authority / local authority empowered by Central Boiler Board of India. Photocopy of the original certificate duly attested by the local boiler inspector where the supplier is located is the minimum requirement for acceptance.

2.1.2 For materials 1¼Cr - ½Mo (ASTM A 234Gr.WP11 Cl.1 & ASTM A234 Gr.WP11W Cl.1) & 2¼Cr - 1Mo (ASTM A 234 Gr.WP22 Cl.1 & ASTM A234 Gr. WP22W Cl.1) & 9Cr-1Mo-V (A234 Gr.WP91/A234Gr.WP91W),where fittings are manufactured from pipe, Form III-C approved by IBR shall include the tabulation of E_t, S_c, &S_r values for the entire temperature range given below. E_t, S_c, &S_r values shall be such that throughout the temperature range

$$\left.\begin{array}{ll} E_t / 1.5 & \geq \\ S_r / 1.5 & \geq \\ S_c & \geq \end{array}\right| S_A$$

S_A : Allowable stress at the working metal temperature.
E_t : Yield point (0.2% proof stress at the working metal temperature)
S_c : The average stress to produce elongation of 1%(creep) in 100000 hrs at the working metal temperature.
S_r : The average stress to produce rupture in 100000 hrs at the working metal temperature and in no case more than 1.33 times the lowest stress to produce rupture at this temperature.

	S_A (psi)											
Temp(F) Material	500	600	650	700	750	800	850	900	950	1000	1050	1100
A234Gr.WP11 Cl.1/ A234Gr.WP11W Cl.1	16200	15700	15400	15100	14800	14400	14000	13600	9300	6300	4200	2800
A234Gr.WP22 Cl.1 /A234Gr.WP22W Cl.1	17900	17900	17900	17900	17900	17700	17100	13600	10800	8000	5700	3800
A234Gr.WP91/ A234Gr.WP91W	28100	27700	27300	26700	25900	24900	23700	22300	20700	18000	14000	10300

Note : S_A values shall be as per the latest edition of ASME B31.3 prevailing.

2.2 For carbon steel Fittings under IBR the chemical composition shall conform to the following:

Carbon (max) : 0.25%
Others (S, P, Mn) : As prescribed in IBR.

The chemical composition as indicated in this clause is not applicable for fittings other than IBR services.

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3.0 ACCEPTABLE DEVIATIONS

3.1 Seamless fittings are acceptable in place of welded fittings, however, welded fittings are not acceptable in place of seamless fittings. Forged fittings are acceptable in place of wrought fittings. However, wrought seamless fittings are acceptable in place of forgings only in case of swages.

3.2 Fittings of Grades SS317 of corresponding material are acceptable in place of Grades SS316 or SS316(2.5Mo min.).

3.3 Fittings of Grades SS317L of corresponding material are acceptable in place of Grades SS316L or SS316L(2.5Mo min.).

3.4 Dual Grade SS304/304L conforming to all chemical composition requirements of SS304L and mechanical properties of SS304 is acceptable in place of SS304L or SS304 grades. Any specific additional requirements given in the MR shall also be complied.

3.5 Dual Grade SS316/316L conforming to all chemical composition requirements of SS316L and mechanical properties of SS316 is acceptable in place of SS316L or SS316 grades. Any specific additional requirements given in the MR shall also be complied.

4.0 MARKING AND DESPATCH

4.1 Each fitting shall be legibly and conspicuously stamped in accordance with the requirements of applicable standards along with special condition like "IBR", "Cryo", "NACE" and "H2" etc.

4.2 Steel die marking with round bottom punch may be permitted on body of butt weld CS & lower alloy steel fittings, but for SS & higher alloy steel fittings, the same should be marked by electro-etching only.

4.3 Paint or ink for marking shall not contain any harmful metals or metal salts such as Zinc, Lead or Copper which causes corrosive attack on heating.

4.4 Fittings shall be dry, clean and free of moisture, dirt and loose foreign materials of any kind.

4.5 Fittings shall be protected from rust, corrosion and mechanical damage during transportation, shipment and storage.

4.6 Rust preventive used on machined surfaces to be welded shall be easily removable with a petroleum solvent and the same shall not be harmful to welding.

4.7 Fittings coming under the purview of "IBR", "CRYO" , "NACE" & "H2"(hydrogen) shall be painted with one circumferential stripe of colour red, light purple brown, canary yellow & white respectively for easy identification. Width of stripe shall be 12mm for sizes less than 3" and 25mm for sizes 3" and above. Stripe shall be located centrally for elbows, diagonally for caps, at the larger end for reducing fittings, longitudinally for couplings and at one end near to the bevel/socket/screwed end for other fittings.

4.8 Each end of fitting shall be protected with a wood, metal or plastic cover.

4.9 Each size of fitting shall be supplied in separate packaging marked with the purchase order number, item code number, material specification, size and schedule / thickness / rating. For small quantities, fittings of different sizes may be packed in separate packing size-wise and these packing may be packed in a bigger package/ container clearly identifying the contents.

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5.0 REFERENCES

6-81-0001	:	Specification for Positive Material Identification (PMI) at Supplier's Works
6-81-0005	:	Inspection & test plan for forged, seamless and welded fittings
6-79-0013	:	Material requirements for carbon steel components used in sour service for petroleum refinery environments

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गास्केट्स के लिए तकनीकी टिप्पणियाँ

TECHNICAL NOTES FOR GASKETS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
7	15.03.24	REVISED & ISSUED AS STANDARD SPECIFICATION	PK	SH	GB	MN
6	11.08.21	REVISED & ISSUED AS STANDARD SPECIFICATION	PK	SH	GB	SM
5	30.03.18	REVISED & ISSUED AS STANDARD SPECIFICATION	PK	SH	MI	RN
4	21.03.13	REVISED & ISSUED AS STANDARD SPECIFICATION	UK	SH	RN ATD	DM
3	23.07.07	REVISED & ISSUED AS STANDARD SPECIFICATION	RN	ATD	DM	VC

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Abbreviations:

AARH	:	Average Arithmetic Root Height
BHN	:	Brinnel Hardness Number
CS	:	Carbon Steel
MR	:	Material Requisition
PMI	:	Positive Material Identification
RTJ	:	Ring Type Joint

Piping Standards Committee

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1.0 GENERAL

1.1 All gaskets shall conform to the codes/standards and specifications given in the requisition. In case of any conflict amongst documents attached with the MR, the most stringent shall govern and Owner's/ EIL decision shall be final in this regard.

Supplier shall strictly comply with MR/PR stipulations and no deviations shall be permitted.

1.2 Process of manufacture, dimensions and tolerances not specified in requisition shall be in accordance with the requirements of the manufacturer's standards.

1.3 Testing

1.3.1 Test reports shall be supplied for all mandatory tests for gaskets as per the standards specified in the requisition.

1.3.2 Chemical composition and hardness of RTJ gaskets shall also be furnished in the form of test reports on samples.

1.3.3 For Spiral wound material following shall be furnished:

a. Manufacturer's test certificate for filler material and spiral material as per the relevant material specifications/ MR.

b. Manufacturer's test certificate for raw materials and tests for compressibility/ seal-ability & recovery as per the relevant material specifications/ MR.

1.3.4 PMI shall be performed as per the scope and procedures defined in the Specification for PMI at Supplier's Works (6-81-0001) for ring type joint gaskets.

1.3.5 Refer Specification no 6-81-0008 for 'Inspection & Test Plan for Gaskets'.

1.4 Full face gaskets shall have bolt holes punched out.

1.5 Filler material for spiral wound gaskets shall not have any colour or dye.

1.6 All spiral wound gaskets shall be supplied with Outer ring. Material of the outer ring shall be CS unless otherwise specified in the MR.

1.7 Inner rings shall be provided for all Spiral Wound Gaskets. For spiral wound gaskets, material of Inner Compression ring shall be same as Spiral Strip material.

1.8 Hardness of metallic RTJ gaskets shall not exceed the values specified below unless otherwise specified in MR:

Ring Gasket Material	Maximum Hardness (BHN)
Soft Iron	90
Carbon steel	120
5 Cr. ½ Mo	130
Type 304, 316, 321, 347	140

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Type 304L, 316L	135
Inconel UNS N06625	200
Incoloy UNS N08825	190
Duplex SS UNS S32205, S31803	230

1.9 Face finish of metallic RTJ gaskets shall be 32 to 63 AARH.

1.10 Gaskets of different types and sizes shall be placed in separate shipping containers and each container clearly marked with the size, rating, material specification and item code.

1.11 All items shall be inspected and approved by EIL Inspector or any other agency authorized by EIL.

1.12 Any additional requirements specified in the requisition, shall be fully complied with.

1.13 Non-metallic ring gaskets as per ASME B16.21 shall match flanges to ASME B16.5 upto 24" and to ASME B16.47B above 24" unless specified otherwise.

1.14 Spiral wound gasket as per ASME B16.20 shall match flanges to ASME B16.5 upto 24" and to ASME B16.47B above 24" unless specifically mentioned otherwise.

1.15 The following abbreviations have been used in the Material Requisition for Spiral Wound Gaskets :

(I)	:	Inner Ring
(O)	:	Outer Ring
GRAFIL	:	Grafoil Filler

1.16 Specialties mentioned in item description like "IBR", "LT", "HIC1", "H2", "CRYO" etc. shall be ignored.

2.0 REFERENCES

6-81-0001	Specification for Positive Material Identification (PMI) at Supplier's Works
6-81-0008	Inspection & Test Plan for Gaskets
6-78-0001	Specification for Quality Management System Requirements from Bidders

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बोल्ट्स एवम नट्स के लिए तकनीकी टिप्पणियाँ

TECHNICAL NOTES FOR BOLTS AND NUTS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
7	15.03.24	REVISED & ISSUED AS STANDARD SPECIFICATION	PK	SH	GB	MN
6	28.03.23	REVISED & ISSUED AS STANDARD SPECIFICATION	PK	SH	GB	SM
5	30.03.18	REVISED & ISSUED AS STANDARD SPECIFICATION	PK	SH	MI	RN
4	21.03.13	REVISED & ISSUED AS STANDARD SPECIFICATION	UK	SH	RN ATD	DM
3	23.07.07	REVISED & ISSUED AS STANDARD SPECIFICATION	RN	ATD	DM	VC

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Abbreviations:

ASME	:	The American Society of Mechanical Engineers
ASTM	:	The American Society for Testing and Materials
GALV	:	Galvanized
HDG	:	Hot Dip Galvanized
MR	:	Material Requisition
PMI	:	Positive Material Identification
SS	:	Stainless Steel

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1.0 GENERAL

1.1 The process of manufacture, heat treatment, chemical & mechanical requirements and marking for all stud bolts, m/c bolts, jack screws & nuts shall be in accordance with the codes/standards and specifications given in the requisition. Supplier shall strictly comply with MR stipulations and no deviations shall be permitted. In case of any conflict amongst documents attached with the MR, the most stringent shall govern and Owner's/ EIL decision shall be final in this regard.

All codes and standards for manufacture, testing, inspection etc. shall be of latest editions as on issue date of RFQ.

1.2 Testing

1.2.1 Test reports shall be supplied for all mandatory tests as per the relevant material specifications/ MR.

1.2.2 Material test certificate shall also be furnished. (Heat Analysis, Product Analysis, Mechanical Requirement and any other testing as per MR).

1.2.3 PMI shall be performed as per the scope and procedures defined in the Specification for PMI at Supplier's Works (6-81-0001).

1.2.4 Stress Rupture Test as detailed in ASTM A453 shall be carried out for all ASTM A453 bolting material irrespective of the temperature.

1.2.5 Refer Specification no 6-81-0007 for 'Inspection & Test Plan for Bolting Material'.

1.3 All bolting shall be as per ASME B 18.2.1 for studs, M/c bolts and jackscrews and ASME B18.2.2 for nuts.

1.4 Threads shall be unified (UNC for up to 1" dia and 8UN for > 1" dia) as per ASME B1.1 with class 2A fit for studs, M/c bolts and jackscrews and class 2B fit for nuts.

1.5 Stud bolts shall be threaded full length with two heavy hexagonal nuts unless otherwise specified. Length tolerance shall be in accordance with the requirement of ASME B 16.5.

1.6 The nuts shall be double chamfered, semi-finished, heavy hexagonal type and shall be made by the hot forged process and stamped as per respective material specification.

1.7 Heads of jackscrews and m/c bolts shall be heavy hexagonal type. Jackscrew end shall be rounded.

1.8 All items shall be inspected and approved (stage-wise) by EIL inspector or any other agency authorized by EIL.

1.9 The heat treatment for stud bolts & nuts shall be as per code unless mentioned otherwise.

1.10 All austenitic stainless steel bolts, nuts, screws shall be supplied in solution annealed condition unless specified otherwise in the material specification.

1.11 Any additional requirements specified in the requisition shall be fully complied with.

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1.12 Stud bolts, nuts & jackscrews shall be impact tested wherever specified in the material specification and also where the material specification is indicated as "CRYO". For S.S. nuts and bolts minimum impact energy absorption shall be 27 Joules and test temperature shall be -196°C unless mentioned otherwise. For other materials impact energy and test shall be as per respective code.

1.13 Bolts/nuts of material of construction B7M/2HM shall be 100% Hardness tested as per supplementary requirement S3 of ASTM A193.

1.14 When specified as "GALV.", the studs, M/C bolts and nuts shall be 'hot dip zinc coated' in accordance with requirements of 'class C' of 'ASTM A 153'. As an alternative, electro-galvanizing as per IS 1573, 'Service Grade Number 2' is also acceptable. However, for bolting where "HDG" has been specified, only 'hot dip zinc coating' in accordance with requirements of 'class C' of 'ASTM A 153' is acceptable.

1.15 All Stud Bolts of Bolt diameter size 1" and above shall be provided with three nuts irrespective of whatever has been specified elsewhere in the MR.

1.16 For stud bolt diameters not covered in ASTM A320, mechanical properties shall match the values specified for the matching grades and stud bolt diameters in ASTM A193.

1.17 In cases where the lengths of Stud/Machine bolts specified in the MR are not multiples of 0.25", the length supplied shall be equal to the specified length rounded up to the next higher 0.25".

1.18 All Specialties mentioned in item description like "IBR", "LT", "H2", etc. other than **"CRYO"& "NACE"** shall be ignored.

1.19 'Nuts' to ASTM A194Gr.7 to be supplied wherever ASTM A194Gr.4 is specified in the MR/PR.

2.0 ACCEPTABLE DEVIATIONS

2.1 Stud Bolts to ASTM A453 Gr.660 Cl.B are acceptable in lieu of ASTM A453 Gr. 660 Cl.A and vice versa.

2.2 In case of ASTM A453 Gr.660, Nuts machined from raw material duly heat treated & tested (including stress rupture test) as per relevant material specifications are acceptable. However, all tests required as per MR shall be repeated on finished product.

3.0 MARKING AND DESPATCH

3.1 Bolting shall be protected by non-corrosive oil or grease before dispatch to prevent rusting.

3.2 The applicable identification symbol in accordance with the material specification shall be stamped on each bolt and nut.

3.3 Each size of studs & m/c bolts with nuts and jackscrews shall be supplied in assembled condition in separate containers. Each container shall be clearly marked with the size, material specification, and item code. 'CRYO' shall be marked additionally in case 'CRYO' is specified in the requisition. Packing of studs/bolts and nuts separately are not acceptable.

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4.0 REFERENCES

6-81-0001	Specification for Positive Material Identification (PMI) at Supplier's Works
6-81-0007	Inspection & Test Plan for Bolting Material
6-78-0001	Specification for Quality Management System Requirements from Bidders
6-78-0003:	Specification for documentation requirements from suppliers

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हौज एवं हौज कपलिंग के लिए तकनीकी टिप्पणियाँ

TECHNICAL NOTES FOR HOSES & HOSE COUPLINGS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
3	28.03.23	REVISED & ISSUED AS STANDARD SPECIFICATION	PK	SH	SB	SM
2	30.03.18	REVISED & ISSUED AS STANDARD SPECIFICATION	PK	SH	MI	RN
1	28.03.13	REVISED & ISSUED AS STANDARD SPECIFICATION	UK	SH	RN ATD	DM
0	29.06.09	ISSUED AS STANDARD SPECIFICATION	PK	RN	SC	ND

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Abbreviations:

AARH	:	Arithmetic Average Roughness Height
ASME	:	American Society of Mechanical Engineers
CS	:	Carbon Steel
eDMS	:	Electronic Document Management System
MR	:	Material Requisition
PMI	:	Positive Material Identification

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1.0 PURPOSE & SCOPE

These Technical Notes shall form part of Material Requisition as well as the Purchase Requisition for Hoses & Hose couplings. These shall also serve as reference for Materials Engineer and Inspection. These notes cover the technical requirements, documentation, inspection, testing, marking and dispatch requirements for hoses and hose couplings. Supplier shall strictly comply with MR/PR stipulations and no deviations shall be permitted.

All codes and standards for manufacture, testing, inspection etc. shall be of latest editions as on issue date of RFQ.

2.0 TECHNICAL REQUIREMENTS

2.1 Hose material and Ends thereof shall be as per Material Requisition (MR).

2.1.1 The material composition, physical properties, heat treatment, mandatory tests, dimensions and tolerances and marking shall conform to the applicable codes/standards/specifications.

2.2 Hoses shall be suitable for outdoor installation in an atmosphere containing hydrocarbon vapour, steam etc. The outer cover shall be resistant to ageing, abrasion & weather effects etc.

2.3 Flanges for flanged hoses shall be in accordance with ASME B16.5 unless specified otherwise in the requisition. Flange finish shall be as specified in the requisition. The interpretation for range of face finish shall be as follows:

Serrated/Smooth/125AARH: 125 to 250 micro inch AARH.

2.4 Hose end connections shall be supplied as per MR.

2.5 CS Fittings (hose couplings, clamps, claws, nozzles etc.) shall be cadmium chromium Plated.

2.6 Manufacturer shall guarantee suitability of hoses for the service and working conditions (design pressure, design temperature) as specified in Data sheet of hoses and hose couplings.

3.0 DOCUMENTATION

3.1 No documents shall be submitted along with the offer. However, vendor shall submit the following documents for records through EIL eDMS:

- Duly signed and stamped data sheet for hoses & hose couplings.
- Vendor's catalogue/ drawings showing detailed dimensions along with material for different parts.
- Material test certificates as applicable; test reports of mandatory tests, hydrotest and special tests as per applicable specifications and standards.

3.2 In addition to submissions through eDMS, the following documents shall be submitted in hard copies (6 sets) and soft copies (2 CDs/DVDs) along with the delivery of respective items:

- Vendor's catalogue/ drawings showing detailed dimensions along with material for different parts.

4.0 TESTING & INSPECTION

4.1 All hoses shall be tested at 2 times the design Pressure along with end connections.

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4.2 Steam resistance test, vacuum test and electrical continuity test shall be carried out as applicable in Clauses 4.2.1 & 4.2.2 and shall fulfill the requirements of the applicable design codes mentioned in MR. In cases where these are not specified, tests shall be as per specifications followed by the manufacturer.

4.2.1 Electrical continuity test shall be conducted on all individual non-metallic hoses.

4.2.2 Vacuum test shall be conducted on all individual metallic and rubber hoses intended for steam service. For rubber hoses intended for steam service, steam resistance test shall also be conducted.

4.3 Flanges shall be so aligned so that the deviations measured in any direction do not exceed 0.5°.

4.4 The length of the finished hose assembly shall not differ from the specified length by more than ±1%. Hose assembly shall be measured after being subjected to the various tests. Tolerances shall be as per specified design code.

4.5 Positive Material Identification (PMI) shall be performed as per the scope and procedures as defined in the 'Specification for Positive Material Identification (PMI) at Supplier's Works (No. 6-81-0001).

4.6 Refer Specification no 6-81-0135 for 'Inspection & Test Plan for Hose Pipes and Couplings'.

5.0 MARKING & DESPATCH

5.1 All hoses along with their couplings shall be dry, clean and free from moisture, dirt and loose foreign material of any kind. All hoses shall be suitably packed and protected to avoid damage during transportation, shipment and storage.

5.2 Each hose shall have a weatherproof tag attached with a corrosion resistant metal wire. The weatherproof tag shall be embossed with item code, size of hose and length of hose. In addition, all hoses shall be clearly marked with service and maximum working pressure at both ends.

6.0 ATTACHMENTS

6-44-0064-A1 : Sketches for hoses and hose couplings (End details)

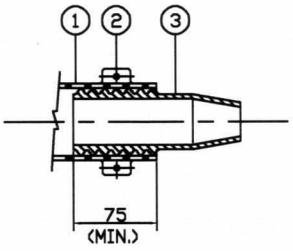
7.0 ATTACHMENTS FOR MR

Format No.3-1643-0095: Data sheet for hoses and hose couplings

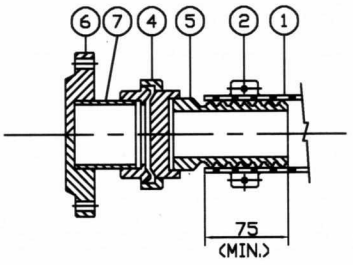
8.0 REFERENCES

6-81-0001	Specification for Positive Material Identification (PMI) at Supplier's Works
6-81-0135	Inspection & Test Plan for Hose Pipes and Couplings
6-78-0001	Specification for Quality Management System Requirements from Bidders
6-78-0003:	Specification for documentation requirements from suppliers

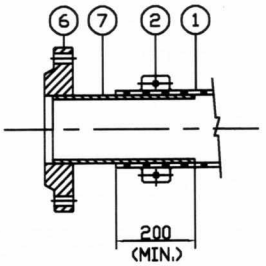
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TYPE-1

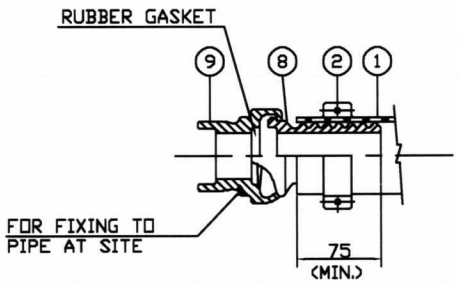


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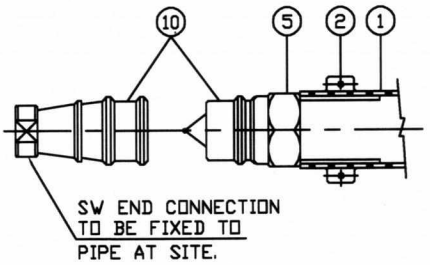


TYPE-3A & 3B

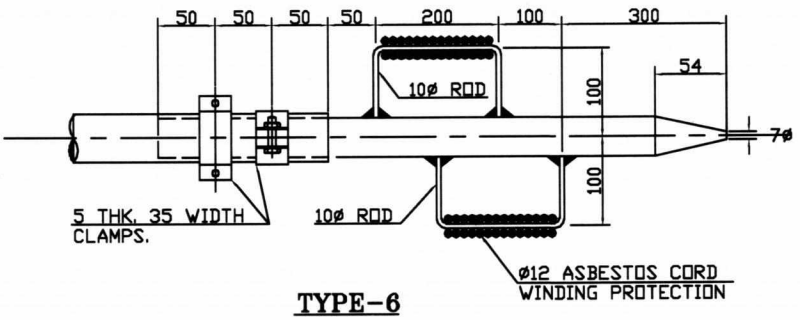
NOTE: FOR TYPE 3B HOSE TO BE FULLY VULCANIZED OVER NIPPLE & NO CLAMP



TYPE-4



TYPE-5



TYPE-6

(FOR STEAM HOSE CONNECTION)
PIPE OD 33.4 & 4.5 THK.

ITEM No.	DESCRIPTION
1	HOSE PIPE AS SPECIFIED
2	HOSE PIPE CLAMP WITH BOLTS MINIMUM 6mm THK. STEEL PLATE (IS2062) IN TWO PARTS BOLT/ NUTS A307 GR'B'
3	PIPE NIPPLE MATERIAL AS SPECIFIED (SEAMLESS)
4	3000 LB SW UNION, ENDS TO SUIT ITEM ⑤ AND ⑦. MATERIAL AS SPECIFIED
5	SEAMLESS PIPE NIPPLE WITH SERRATIONS TO SUIT ITEMS ① AND ④. MATERIAL AS SPECIFIED
6	END FLANGE MATERIAL AND DETAIL AS SPECIFIED
7	PIPE MATERIAL AS SPECIFIED WITH SERRATIONS
8	QUICK CLAW COUPLING (HOSE END) MATERIAL AS SPECIFIED BOTH COUPLINGS TO BE SUPPLIED IN TYPE 4
9	QUICK CLAW COUPLING WITH SOCKET WELD PIPE END. MATERIAL AS SPECIFIED
10	QUICK ACTING, QUICK RELEASE COUPLER/ ADAPTOR ASSEMBLY WITH BUILT IN CHECK VALVE BOTH COUPLER AND ADAPTOR SHALL BE SUPPLIED IN TYPE 5.

NOTE:-

ALL DIMENSIONS ARE IN MM.

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वाष्प एवम् वायुट्रैप्स,मेनिफोल्ड्स एवम् असेम्बलीज हेतु तकनीकी टिप्पणियाँ

TECHNICAL NOTES FOR STEAM AND AIR TRAPS, MANIFOLDS AND ASSEMBLIES

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	28/03/24	REVISED AND ISSUED AS STANDARD SPECIFICATION	PK	SH	~~GB~~	MN
3	20/01/20	REVISED AND ISSUED AS STANDARD SPECIFICATION	PK	SH	MI	RKT
2	23/09/14	REVISED AND ISSUED AS STANDARD SPECIFICATION	SH	AK	RN ATD	SC
1	30/06/09	REVISED & ISSUED AS STANDARD SPECIFICATION	PK	RN	SC	ND
0	22/04/04	ISSUED AS STANDARD SPECIFICATION	AK	BRB	MRC	SKG

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Abbreviations:

AARH	:	Arithmetic Average Roughness Height
AISI	:	American Iron and Steel Institute
ASME	:	American Society of Mechanical Engineers
ASTM	:	American Society for Testing and Materials
BHN	:	Brinell Hardness Number
BW	:	Butt Weld
DP	:	Dye Penetrant
IBR	:	Indian Boiler Regulations
MOC	:	Material of Construction
MP	:	Magnetic Particle
PMI	:	Positive Material Identification
Rc	:	Rockwell C Hardness
SCRD	:	Screwed
SS	:	Stainless Steel
SW	:	Socket Weld
WN	:	Weld Neck
eDMS	:	Electronic Document Management System

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1.0 PURPOSE & SCOPE

This specification covers the design and construction, IBR requirements, documentation, testing, inspection, marking and dispatch requirements for Traps, Compact Steam Trap Assemblies (CSTAs) and Steam Supply (SS)/Condensate return(CR) manifolds. Vendor shall supply Traps, CSTAs and SS/CR manifolds in accordance with the technical notes and details specified in the data sheet for steam/air traps, CSTAs & SS/CR Manifolds. Supplier shall strictly comply with MR stipulations and no deviations shall be permitted.). In case of any conflict amongst documents attached with the MR, the most stringent shall govern and Owner's/ EIL decision shall be final in this regard.

Post order Concession/ Deviation as mentioned in Cl. 5.17 of Specification for Quality Management System Requirements from Bidders (6-78-0001) is not applicable.

2.0 DESIGN AND CONSTRUCTION

2.1 All Codes and Standards for manufacture, testing and inspection etc. shall be of latest editions.

2.2 The material of construction shall be as per the data sheet; for parts not mentioned in the datasheet, vendor shall guarantee the material used for the service conditions specified. For flanged traps, MOC of end flanges shall correspond to the material specified in the data sheet.

For welding of dissimilar materials required for trap assembly, welder qualification procedure shall be done prior to welding.

2.3 The material composition, physical properties, heat treatment & mandatory test reports, dimensions and tolerances shall conform to the applicable codes/standards/specifications as specified in the requisition.

2.4 All traps shall be designed with back pressure upto 80% of upstream pressure unless otherwise specified in the datasheet.

2.5 All traps shall have an integral strainer which can be serviced and its material shall be SS304/SS316. However, Ball Float and Inverted Bucket traps may be supplied with separate strainer of trap or line size, but vendor should quote composite price for the same. Trap and strainer shall be supplied in assembled condition having strainer in the upstream. This strainer shall be of Y-type having 40mesh size and material of construction for body and internals shall be same as that of trap.

2.6 Thermodynamic traps shall have seat integral or seal-welded to the body & central entry with respect to the disc. The seat and disc shall be differentially hardened to Rc 45-50 and Rc 40-45 respectively maintaining a minimum difference of Rc 5 to ensure wear on the disc.

2.7 Thermostatic traps shall be designed with subcool temperature setting as per data sheet. If nothing is specified in data sheet, subcooling of 10 Deg C should be considered by default.

2.8 Upto 300 Class rating, Composite Impulse cum Thermodynamic type steam trap with two integral strainers in place of Thermodynamic and Thermostatic trap is also acceptable.

2.9 Inverted bucket steam trap shall be of horizontal entry & exit type.

2.10 For flanged end traps, weld-on flanges are also acceptable. However, the type of flange shall be WN.

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2.11 Ends shall be as specified in the data sheet. The applicable dimension standards are:

Flanged ends	:	ASME B16.5
SW ends	:	ASME B16.11
SCRD ends	:	ASME B16.11
BW ends	:	ASME B16.25

2.12 Bevel end details for BW steam traps shall be as per ASME B16.25. Contour of bevel end shall be as follows :

Material	Wall Thickness	Weld Contour
Carbon Steel (Except Low Temp. Carbon Steel)	Upto 22 mm	Figure 2 Type A
	> 22 mm	Figure 3 Type A
Alloy Steel, Stainless Steel & Low Temp. Carbon Steel	Upto 10 mm	Figure 4
	> 10 mm &Upto 25 mm	Figure 5 Type A
	> 25 mm	Figure 6 Type A

2.13 Flanged end face finish shall be normally specified in the data sheet. The interpretation for range of face finish shall be as follows:

Stock Finish	:	1000 µ in AARH max.
Serrated/Smooth Finish/125 AARH	:	Serrations with 125 to 250µin AARH
Extra Smooth/63 AARH	:	32 TO 63 µ in AARH

2.14 For traps with ring joint type flanged ends the hardness shall be as follows :

Flange Material	Min. Hardness of Flange Groove (BHN)	Max. Gasket Hardness (BHN)
Carbon Steel	140	90
1% Cr to 5% Cr, 9Cr	150	130
Type 304, 316, 321, 347	160	140
Type 304L, 316L	150	135
9Cr-1Mo-V	190	130

2.15 For traps with flanged ring type joint ends, the hardness shall be recorded in the test report.

2.16 All 1Cr-0.5Mo & 1.25Cr-0.5Mo traps shall be normalized and tempered.

2.17 All piping components like pipes, reducers, elbows, etc. used for fabrication of steam trap assembly shall be of metallurgy equivalent to trap body and of seamless construction.

2.18 CSTAs & SS/CR Manifolds shall be supplied in single piece construction. If SS/CR manifolds are multi piece construction, the individual sections of min. 4 nos. connection shall be butt-welded/socket-welded to form the manifold. All these butt-weld joints shall be 100% radiographed and socket weld joints shall be 100% DP/MP tested.

2.19 CSTAs and CR Manifolds shall be supplied with a provision for depressurisation of steam trap.

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2.20 CSTAs & SS/CR Manifolds shall also meet applicable requirements of "Technical notes for Butt welded, socket welded and screwed fittings", Document No. 6-44-0054 and "Technical notes for valves", Document No. 6-44-0052.

2.21 SS/CR Manifolds shall be supplied with threaded supporting bosses at least at two locations for Manifolds with 4 no. of connections and at least four locations for manifolds with 8/12 no. of connections. The bosses having provisions for screwing in M12 studs shall be bolted with support member with a suitable spacer between manifold and support member. Sufficient play shall be provided in Bolt holes to account for expansion of manifolds in design condition. Suitable support member as per 6-44-0066-A1 shall be provided in assembled condition with manifold.

2.22 All open outlet connections of CSTAs & CR manifolds (from depressurization/test valves) shall be supplied with suitable 0.5" SS tubing (minimum 100mm length) pointing away from operating personnel for safe operation. In case of manifolds, all bypass outlet connections on each side of manifold shall be joined in a separate common pipe header equivalent to manifold material.

2.23 Wherever back pressure is specified in MR, Functionality test is to be performed on each model, metallurgy and size for intended back pressure specified in MR. For the same model, with equal or higher back pressure, earlier successfully performed functionality test reports shall also be acceptable.

3.0 IBR REQUIREMENTS

3.1 IBR Documentation

3.1.1 Traps coming under the purview of IBR (Indian Boiler Regulations) shall be accompanied with IBR Certificate original in Form III C duly approved and countersigned by IBR authority / local authority empowered by Central Boiler Board of India. Photocopy of original certificate duly attested by the local boiler inspector where the supplier is located is the minimum requirement for acceptance.

3.1.2 For carbon steel traps described as "IBR", chemical composition for all carbon steel components shall conform to the following :

Carbon (max.)	:	0.25% (C=0.30% for A182 Gr. F1)
Others (S, P, Mn)	:	As prescribed in IBR Regulation

4.0 ACCEPTABLE DEVIATIONS

4.1 Following alternative body materials are acceptable :

- AISI 420/AISI 410/A743 Gr.CA40/A743 Gr.CA15 in lieu of ASTM A105.
- A182 F22 in lieu of A182 F11.
- AISI 420/A182 F11 in lieu of A182 F1.

4.2 Cast traps including strainer with integrally cast flanges are also acceptable in lieu of equivalent forged material. All castings offered in place of forgings shall be radiographed.

4.3 Forgings of equivalent material shall be acceptable in place of castings.

4.4 For traps where capacity has been specified in the datasheet, and if the trap meets the capacity requirement, in these cases trap of same type but of lower size is also acceptable. End connection size and type shall be same as that specified in datasheet.

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4.5 Bimetallic traps of same capacity are acceptable in place of Balanced Pressure Thermostatic traps but not vice versa. Suitability of trap for design conditions shall be ensured.

5.0 DOCUMENTATION

5.1 No documents shall be submitted with the offer.

5.2 Detailed dimensioned cross section drawing with parts, materials, weight, etc. shall be submitted through EIL eDMS for records/information.

6.0 TESTS AND INSPECTION

6.1 IBR steam traps shall be hydrostatically tested as per IBR regulations (latest edition). Other steam traps shall be hydrostatically tested to twice the design pressure for which the traps are suitable. For air traps test pressure shall be 1.5 times the design pressure.

Hydrostatic testing of assembled SS/CR Manifolds and Compact Steam Trap Assemblies shall be as per MR or at two times the design pressure, if not specified in MR.

Test pressure shall be maintained for a sufficient length of time not less than 10 minutes. Test pressure shall be released only after physical checking of all the joints and attachments are completed, to permit thorough inspection of all joints and connections for leakage or signs of failure. Any joint found leaking during a pressure test shall be retested to the specified pressure after repair.

Seat leakage for all valves shall be performed as per BS EN-12266-1. Leakage rate shall be category-A.

6.2 In case cast material is specified for trap in the datasheet, radiography of trap shall be as follows:

a. For carbon steel and stainless steel upto Class rating 300, 10% of traps shall be radiographed, with a minimum of one number against each type, size, rating and material.

b. For all ratings in alloy steel and Class rating 600 and above in carbon steel/stainless steel, traps shall be 100% radiographed.

6.3 Radiography of BW joints shall be as follows :

a. For carbon steel and stainless steel upto Class rating 600, 10% of joints shall be radiographed, with a minimum of one number against each type, size, rating and material. Joints for weld-on flanges shall be 100% radiographed.

b. For all ratings in alloy steel and Class rating 900 and above in carbon steel/stainless steel, BW joints shall be 100% radiographed.

6.4 Positive Material Identification (PMI) shall be performed as per the scope and procedures as defined in the 'Standard Specification for Positive Material Identification (PMI) at Supplier's Works' (No. 6-81-0001).

6.5 Test reports shall be supplied for all mandatory tests as per the relevant material specifications/requisition. Test reports shall also be furnished for hydrotest and any other supplementary tests as specified in the requisition.

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6.6 Material test certificates (physical properties, chemical composition & heat treatment report and any other testing as per MR) of the pressure containing parts shall be furnished for the steam traps supplied. Material test certificates for the other parts shall also be furnished for verification during inspection.

6.7 EIL/Client's authorised representatives reserve full right to witness stagewise inspection of all mandatory/applicable supplementary tests. However, for IBR items, the tests/inspection shall be by IBR authority or IBR authorized representative.

6.8 Refer Specification 6-81-0134, 6-81-0004, 6-81-0005 for Inspection & Test Plan for Steam Traps, Valves and Fittings respectively.

7.0 MARKING AND DESPATCH

7.1 Vendor shall securely attach on the body a metal tag stamped with item code, Tag no. (If mentioned in requisition), size, rating and special conditions like 'IBR'. Wherever nameplate is provided, marking can be done on the same. Direction of flow shall be marked integrally on the body.

7.2 Paint or ink for marking shall not contain any harmful metal or metallic salts such as zinc, lead or copper which cause corrosive attack on heating. IBR traps shall be painted with red stripes (25mm width).

7.3 All items shall be dry, clean and free from moisture, dirt and loose foreign material of any kind.

7.4 All items shall be protected from rust, corrosion and mechanical damage during transportation, shipment and storage.

7.5 Rust preventive on machined surfaces to be welded shall be easily removable with a petroleum solvent and shall not be harmful to welding.

7.6 Each end of trap shall be protected with the following materials :

Flange Face	:	Wood or Plastic Cover
Bevelled End	:	Wood or Plastic Cover
SW & SCRD End	:	Plastic Cap

7.7 End protectors of wood / plastic to be used on flange faces shall be attached by at least three bolts and shall not be smaller than the outside diameter of the flange. However plastic caps for SW & SCRD end steam traps shall be press fit type. End protectors to be used on bevelled end shall be securely and tightly attached.

8.0 ATTACHMENTS FOR MR

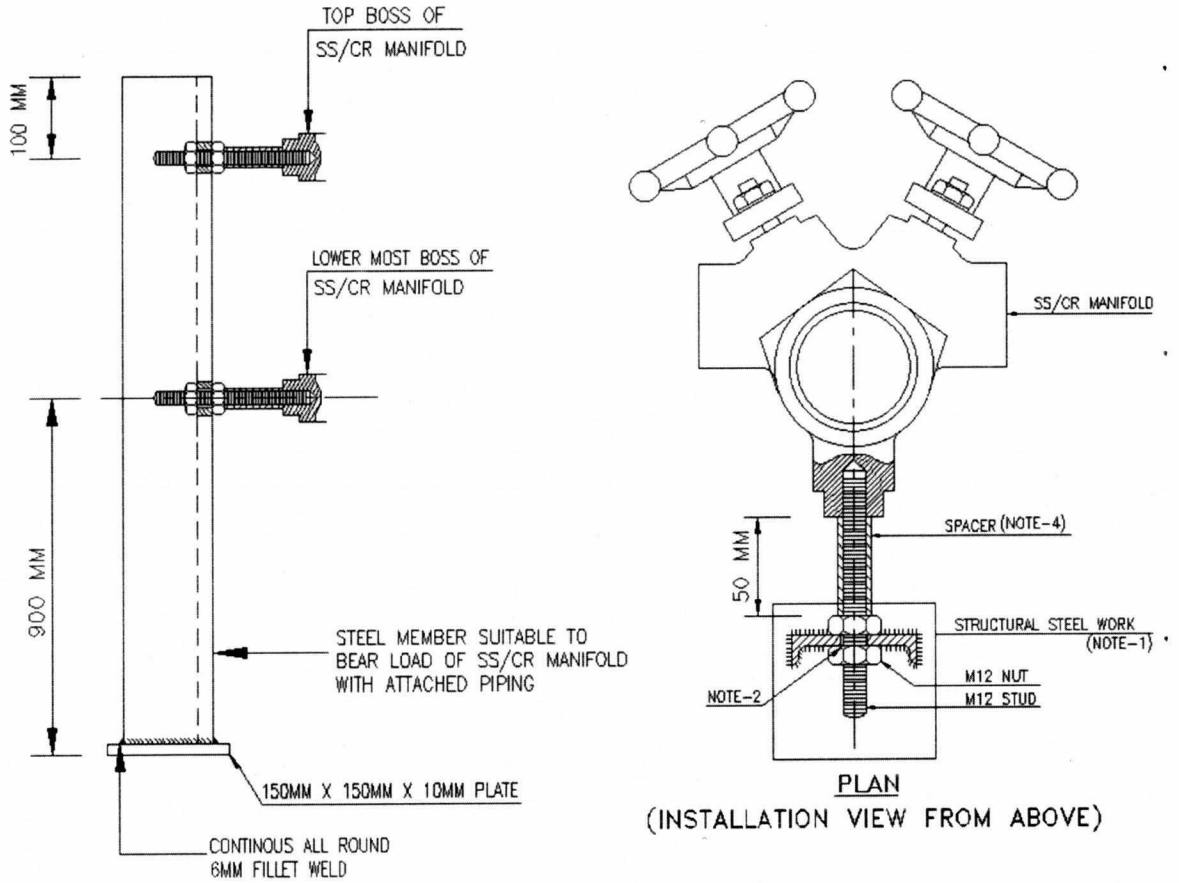
Format No3-16-43-0094	:	Data Sheet for Steam Traps
-	:	Job Specific Process data sheet for Process steam trap/Air trap (as applicable)

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9.0 REFERENCES

6-81-0001	:	Specification for PMI at Supplier's Works
6-81-0004	:	Inspection and Test Plan for Valves
6-81-0005	:	Inspection and Test Plan for fittings
6-81-0134	:	Inspection and Test Plan for Steam Traps
6-78-0001	:	Specification for Quality Management System Requirements from Bidders
6-44-0066-A1	:	Supporting arrangement for SS/CR manifolds

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NO. OF CONNECTIONS	NUMBER OF SUPPORTING STUDS	THREADED CONNECTIONS TO BE USED	DIA OF OPENING IN SUPPORTING STEEL (EXCEPT FOR TOP MOST STUD) (NOTE-2)
04	2	TOP MOST	--
		LAST	M12+3 MM
08	2	TOP MOST	--
		LAST	M12+4 MM
12	4	TOP MOST	--
		THIRD	M12+3 MM
		FOURTH	M12+4 MM
		LAST	M12+6 MM

NOTES:

1. Support steel, base plate, studs, nuts, spacer shown in above detail is in vendor's scope of supply along with SS/CR manifold.
2. Except for topmost support, openings in structural steel shall be larger than the supporting stud (Refer table above).
3. Material of studs & nuts shall be ASTM A193 GR. B7 and A194 GR. 2H respectively.
4. Spacer may be cut from 0.5 Inch pipe.
5. Base plate & structural steel material shall be IS-2062.

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TECHNICAL NOTES FOR STRAINERS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
3	05.04.2022	REVISED AND ISSUED AS STANDARD SPECIFICATION	PK	SH	GB	SM
2	20.01.2020	REVISED AND ISSUED AS STANDARD SPECIFICATION	PK	SH	MI	RKT
1	23.09.2014	REVISED AND ISSUED AS STANDARD SPECIFICATION	SH	AK	RN ATD	SC
0	29.06.2009	ISSUED AS STANDARD SPECIFICATION	PK	RN	SC	ND

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Abbreviations:

AARH	:	Arithmetic Average Roughness Height
AISI	:	American Iron and Steel Institute
ASTM	:	American Society for Testing & Materials
BHN	:	Brinell Hardness Number
BW	:	Butt Weld
DP	:	Dye Penetrant
FLGD	:	Flanged
FN	:	Ferrite Number
H2	:	Hydrogen
HAZ	:	Heat Affected Zone
IBR	:	Indian Boiler Regulations
MOC	:	Material of Construction
MP	:	Magnetic Particle
NACE	:	National Association of Corrosion Engineers
PMI	:	Positive Material Identification
SCRD	:	Screwed
SW	:	Socket Weld
UNC	:	Unified Coarse
WN	:	Weld Neck

Piping Standards Committee

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1.0 PURPOSE & SCOPE

This specification covers the design and construction, IBR requirements, documentation, testing, inspection, marking and despatch requirements for Strainers. Vendor shall supply Strainers in accordance with the technical notes and details specified in the Data Sheet for strainers. Supplier shall strictly comply with MR/PR stipulations and no deviations shall be permitted. Post order Concession/ Deviation as mentioned in Cl. 5.17 of Specification for Quality Management System Requirements from Bidders (6-78-0001) is not applicable.

2.0 DESIGN & CONSTRUCTION

2.1. All codes and Standards for manufacture, testing and inspection etc. shall be of latest editions.

2.2 The material of construction shall be as per the data sheet. The internals specified in the strainer schedule shall include mesh and mesh frame. Supporting attachments that are welded to the body shall have metallurgy equivalent to body. For parts not mentioned in the data sheet, vendor shall guarantee the material used for the service conditions specified.

For flanged strainers, MOC of end flanges shall correspond to the material specified in the Data sheet.

For welding of dissimilar materials required for strainer assembly, welder qualification procedure shall be done prior to welding.

2.3 The material composition, physical properties, heat treatment, mandatory test reports, dimensions and tolerances shall confirm to the applicable codes/standards/specifications as specified in the requisition.

2.4 Design shall be based on EIL Std 7-44-0300 for temporary strainers, EIL Stds7-44-0303/0304 for T-type permanent strainers and Manufacturer's std. for Y-type strainers.

2.5 Dimension Standards for various components are as follows:

Body	-	ASME B16.9/B16.11
Flanges	-	ASME B16.5/B16.47 Series B
Gaskets	-	ASME B16.20/B16.21
Bolts & Nuts	-	ASME B18.2.1 & B 18.2.2 respectively

2.6 Ends of body shall either be Flanged, BW, SW or Screwed as specified in the data sheet.

2.6.1 The ends for strainers shall correspond to the following standards:

FLGD	-	ASME B16.5/B16.47 Series B
BW	-	ASME B16.25
SW	-	ASME B16.11
SCRD	-	ASME B16.11

2.6.2 Bevel end details for BW strainers shall be as per ASME B16.25. Contour of bevel end shall be as follows:

Material	Wall Thickness	Weld Contour
Carbon Steel (Except Low Temp. Carbon Steel)	Upto 22 mm	Figure 2 Type A
	> 22 mm	Figure 3 Type A

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Material	Wall Thickness	Weld Contour
Alloy Steel, Stainless Steel & Low Temp. Carbon Steel	Upto 10 mm	Figure 4
	> 10 mm &Upto 25 mm	Figure 5 Type A
	> 25 mm	Figure 6 Type A

2.7 Flange face finish shall be normally specified in the strainer data sheet. The interpretation for range of face finish shall be as follows:

Stock Finish	:	1000 µ in AARH max.
Serrated/Smooth Finish/125AARH	:	Serrations with 125 to 250 µ in AARH
Extra Smooth Finish/63 AARH	:	32 TO 63 µ in AARH

2.8 For strainers with ring type joint flanged ends the hardness shall be as follows:

Flange Material	Min. Hardness of Groove (BHN)	Max. Gasket Hardness (BHN)
Carbon Steel	140	90
1% Cr to 5% Cr, 9% Cr	150	130
Type 304, 316, 321, 347	160	140
Type 304L, 316L	150	135
Inconel UNS N06625	220	200
Incoloy UNS N08825	210	190
Duplex SS UNS S32205, UNS S31803	250	230

2.9 For strainers with flanged ring type joint ends, the hardness shall be recorded in the test report.

2.10 Ends of screwed strainers unless otherwise specified shall have taper threads as per ASME/ANSI B1.20.1 (upto 1.5" NB) & IS 554 (for 2" to 6" NB).

2.11 All 2" and higher size Y type strainers shall be provided with 3/4" screwed plug for drain connection. For less than 2" this shall be 1/2" size.

For Y type, SW end Strainers (size 1.5" & below) to MNF'STD, blind end is also acceptable with threaded plug cover instead of flanged end. In this case, plug shall be of forged material equivalent to body material.

2.12 For Y type strainers, cast strainers with integrally cast flanges and with end cover / blind flange in cast/forged construction is acceptable.

2.13 For flanged end strainers, weld-on flanges(WN) are acceptable.

2.14 Pressure drop calculations shall be furnished by vendor along with the offer, wherever specified in the data sheet.

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2.15 Stainless Steel Strainers

2.15.1 All Austenitic Stainless Steel items shall be supplied in solution annealed condition.

2.15.2 For all Austenitic Stainless Steel items Inter-granular Corrosion Test shall be conducted as per following:

- ASTM A 262 Practice 'B' with acceptance criteria of '60mils/year (max.)'

OR

- ASTM A262 Practice E: The bent specimen shall be examined under 20X magnification. The acceptance criteria is that there will be no crack or fissure in the bent specimen. The bent specimen shall also be subjected to metallographic examination at 250X magnification to ensure no crack or fissure. The photograph of the bent specimen along with comments shall be submitted for review.

2.15.3 When specifically asked for in MR for High Temp. application of some grades of Austenitic Stainless Steel (like SS 309, 310, 316H etc.) ASTM A 262 practice 'C' with acceptance criteria of "15mils/year" shall be conducted.

2.15.4 All types of SS321 or SS347 material shall be in stabilized heat treated condition. Stabilizing heat treatment shall be carried out subsequent to normal solution annealing. Soaking temperature and holding time for stabilizing heat treatment shall be 900 °C and 4 hours respectively.

2.16 IBR Requirements

2.16.1 For SW / BW end carbon steel strainers under IBR, the chemical composition shall conform to the following :

Carbon (Max)	:	0.25%
Others (S, P, Mn)	:	As per IBR regulations

2.16.2 Strainers coming under the purview of "IBR" (Indian Boiler Regulations) shall each be individually accompanied by original IBR certificate in Form III-C, duly approved by IBR authority / local authority empowered by the Central Boiler Board of India. Photocopy of original certificate duly attested by the local boiler inspector where the supplier is located is the minimum requirement for acceptance.

2.17 In case of T-type strainer, body construction shall be 'Seamless' unless otherwise specified in the data sheet.

2.18 Welded Tees shall not be of fabricated (Stub-in/stub-on) type.

2.19 Strainers with welded body shall be in normalized condition& 100 percent radiographed by X-ray.

2.20 All 1Cr-0.5Mo & 1.25Cr-0.5Mo strainers shall be normalized and tempered. All 2.25Cr-1Mo, 5Cr-0.5Mo, 9Cr-1Mo & 9Cr-1Mo-V welded strainers shall be normalized and tempered & 100 percent radiographed by X-ray.

2.21 Weld joints shall be stress relieved as per the requirement specified in the Strainer MR Attachment.

2.22 NACE/HIC Requirements

2.22.1 Strainers under "NACE" category or those designated as "HIC1" shall meet the requirements of NACE MR-0103 unless otherwise specified.

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2.22.2 Strainers made from plates and designated as "HIC1" shall meet the HIC requirements of EIL specification 6-79-0013 unless otherwise specified.

2.23 Strainers of Hydrogen service category shall meet the requirements as specified in clause 4.0 below.

2.24 Galvanized strainers shall be coated with zinc by hot dip process conforming to IS 4736 / ASTM A153.

2.25 Gaskets

2.25.1 Non-metallic gaskets shall conform to B16.21 (corresponding to B16.5) up to 24" and B16.21 (corresponding to B16.47 Series 'B') beyond 24", unless otherwise specified.

2.25.2 Spiral wound gaskets shall conform to B16.20.

2.25.3 Ring type and spiral wound gasket shall be self-aligning type.

2.25.4 Ring Joint gasket shall be Octagonal type and shall conform to B16.20.

2.26 Bolting

2.26.1 All bolts shall conform to B18.2.1, nuts to B18.2.2. Reference shall also be made to B16.5 for studs.

2.26.2 Threads shall be unified (UNC for upto 1"dia and 8UN for > 1"dia) as per ANSI B.1.1 with class 2A fit for studs and M/C bolts and class 2B fit for nuts.

2.26.3 Nuts for Bolts & Studs shall be the American Standard Hexagon Heavy Series.

3.0 DOCUMENTATION

3.1 No documents shall be submitted with the offer.

3.2 Detailed dimensioned cross section drawing with parts, materials, weight, etc. shall be submitted through EIL eDMS for records/information.

4.0 SPECIAL REQUIREMENTS FOR HYDROGEN SERVICE

4.1 Method of Manufacture

4.1.1 All carbon steel strainers having wall thickness 9.53 mm and above shall be normalized. Carbon content shall be limited to .35% max. and silicon .35% max. The normalizing heat treatment shall be a separate heat treatment operation and not a part of the hot forming operation. Normalizing shall be done after final cold draw pass for all thicknesses if cold drawn.

4.1.2 All alloy steel (Cr-Mo) strainers shall be normalized and tempered. The normalizing and tempering shall be a separate heat treatment operation and not a part of the hot forming operation. The maximum room temperature tensile strength shall be 100,000 psig.

4.2 Impact Test

For all carbon steels and alloy steels with wall thickness over 20 mm, Charpy-V Notch impact testing shall be carried out in accordance with paragraph UG-84 of ASME Section VIII, Div-1 per heat of material and per heat treating batch. Impact test specimen shall be in accordance

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with ASTM A370. Impact energies at 0° C shall average greater than 27J (20 ft-lb) per set of 3 specimens, with a minimum of 20 J (15ft-lb).

4.3 Hardness of weld and HAZ shall be 200 BHN (max) for carbon steel and 225 BHN (max) for alloy steel.

5.0 TESTING & INSPECTION

5.1 All strainers shall be hydrostatically tested at the lower of twice the design pressure and 1.5 times the class rating as per ASME B16.5 at ambient temperature.

5.2 All BW joints shall be 100% Radiographed and Fillet welds shall be 100% DP/MP checked.

5.3 Positive Material Identification (PMI) shall be performed as per the scope and procedures as defined in the 'Specification for Positive Material Identification (PMI) at Supplier's Works' (No. 6-81-0001).

5.4 All welded Tees indicated in the MR as "Cryo" & "LT" shall meet Impact test requirements of ASME B31.3. The Impact test temperature shall be (-)196°C &(-)45°C for Stainless Steel & Low Temperature Carbon Steel respectively unless otherwise mentioned in the MR.

5.5 The stage wise inspection of non-IBR Strainers shall be done by EIL inspector before despatch. EIL/Client's authorized representatives reserve full right to witness stagewise inspection of all mandatory/applicable supplementary tests. However, for IBR items, the tests/inspection shall be by IBR authority.

5.6 Material Test Certificates (Physical Properties, Chemical Composition and heat Treatment Report) shall also be furnished.

5.7 Test reports shall be supplied for all mandatory tests as per the relevant material specifications/requisition. Test reports shall also be furnished for hydrotest and other supplementary tests as specified in the requisition.

5.8 Refer Specification 6-81-0133 for Inspection & Test Plan for Strainers.

6.0 ACCEPTABLE DEVIATIONS

6.1 Following alternative body materials are acceptable :

- AISI 420/AISI 410/A743 Gr.CA40/A743 Gr.CA15 in lieu of ASTM A105.
- A182 F22 in lieu of A182 F11.
- AISI 420/A182 F11 in lieu of A182 F1.

6.2 Cast strainers with integrally cast flanges are also acceptable in lieu of equivalent forged material. All castings offered in place of forgings shall be radiographed.

6.3 Forgings of equivalent material shall be acceptable in place of castings.

6.4 In the case of T type strainers, 'Seamless' body is acceptable in place of "Welded" body. 'Welded' body shall not be acceptable in place of 'Seamless'.

7.0 MARKING & DESPATCH

7.1 Each Strainer shall be legibly & conspicuously stamped on the body, in accordance with the requirements of applicable standards along with special condition like IBR, CRYO, NACE,

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H2 etc. Vendor shall also mark on the body the direction of flow, Location/Tag No. and Line Number mentioned in MR attachment.

7.2 All items shall be dry, clean and free from moisture, dirt and loose foreign material of any kind.

7.3 All items shall be protected from rust, corrosion, and mechanical damage during transportation, shipment and storage.

7.4 Rust preventive, on machined surfaces to be welded, shall be easily removable with a petroleum solvent or shall not be harmful to welding.

7.5 Paint or ink for marking shall not contain any harmful metal or metallic salts such as Zinc, Lead or Copper which causes corrosive attack on heating.

7.6 Strainers under "IBR", "CRYO", "NACE" & "H2" shall be painted in Red, Light Purple, Canary Yellow and sea green strips respectively for easy identification. Width of strip shall be 25 mm. Strainers coming under the purview of "IBR", "CRYO" , "NACE" & "H2"(hydrogen) shall be painted with one circumferential stripe of colour red, light purple brown, canary yellow & white respectively for easy identification. Width of stripe shall be 12mm for sizes less than 3" and 25mm for sizes 3" and above. Stripe shall be located one end near to the bevel/socket/screwed/flanged end.

7.7 After testing, one coat of inorganic zinc silicate (minimum DFT 65 to 75 microns) shall be applied as primer over the external surface for carbon steel / alloy steel strainers.

7.8 Each end of strainer shall be protected with the following materials :

Flange Face	:	Wood or Plastic Cover
Bevelled End	:	Wood or Plastic Cover
SW & SCRD End	:	Plastic Cap

End protectors of wood / plastic to be used on flange faces shall be attached by at least three bolts and shall not be smaller than the outside diameter of the flange. However plastic caps for SW & SCRD end strainers shall be press fit type. End protectors to be used on beveled end shall be securely and tightly attached.

8.0 ATTACHMENTS FOR MR

Format No.3-1643-0093: Data sheet for Strainers

9.0 REFERENCES

6-81-0001	:	Specification for PMI at Supplier's Works
6-81-0133	:	Inspection and Test Plan for Strainers
6-78-0001	:	Specification for Quality Management System Requirements from Bidders

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TECHNICAL NOTES FOR SPRING SUPPORT ASSEMBLIES

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	08.01.25	REVISED & ISSUED AS STANDARD SPECIFICATION	PK	SH	GB	MN
3	28.03.23	REVISED & ISSUED AS STANDARD SPECIFICATION	PK	SH	GB	SM
2	30.03.18	REVISED & ISSUED AS STANDARD SPECIFICATION	PK	SH	MI	RN
1	21.03.13	REVISED & ISSUED AS STANDARD SPECIFICATION	UK	SH	RN ATD	DM

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Abbreviations:

AS	:	Alloy Steel
ASME	:	The American Society of Mechanical Engineers
ASTM	:	The American Society for Testing and Materials
BS	:	British Standard
CS	:	Carbon Steel
eDMS	:	Electronic Document Management System
IS	:	Indian Standard
MR	:	Material Requisition
SS	:	Stainless Steel

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1.0 PURPOSE & SCOPE

This document covers supply, material, fabrication, testing and inspection requirements for 'Spring Support Assemblies' with helical, hot coiled & heat treated compression type springs. Detailed design of spring assemblies is Supplier's responsibility. Supplier shall guarantee proper functioning of the Spring Assemblies under specified load & travel conditions. Items not indicated clearly in Supplier's offer but required as per this requisition shall be considered in Supplier's scope of supply. Supplier shall strictly comply with MR/PR stipulations and no deviations shall be permitted.

All codes and standards for manufacture, testing, inspection etc. shall be of latest editions as on issue date of RFQ.

2.0 TECHNICAL REQUIREMENTS:

2.1 Material Requirements:

Unless otherwise specified, the material of construction shall be as follows.

Clamp (CS)	IS 2062 Gr.A/B
Clamp (AS) – Note 1	ASTM A 387 Gr.11/22 or SS 316 / 321.
Clamp (SS)	SS 316 / 321
Lugs (CS) – Note 2	IS 2062 Gr.A/B
Lugs (AS) – Note 3	ASTM A 387 Gr.11/22
Lugs (SS) – Note 3	SS 316 / 321
Protection shield at pipe or elbow	Same as Pipe material specified in Spring Schedule or Equivalent Plate material
Eye rod (CS Forged / Rolled Bar)	IS 1875 Cl-II/IIA / ASTM A 105 / IS 2062 Gr.A/B
Hanger Rod (CS)	IS 1875 Cl-II/IIA / ASTM A 105 / IS 2062 Gr.A/B
Turn Buckle	IS 1875 Cl-II/IIA, ASTM A 105 for sizes ≤ M30. For sizes > M30 these may be fabricated type of equivalent material (refer clause 2.8.)
Plates 5, 10, 12, 20, 25 mm etc.	IS 2062 Gr.A/B.
Stud / Bolt for CS Clamps	ASTM A 193 Gr.B7
Stud / Bolt for AS Clamps	ASTM A 193 Gr.B16
Stud / Bolt for SS Clamps	ASTM A 193 Gr.B8
Nuts for CS Clamps	ASTM A 194 Gr.2H

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Nuts for AS Clamps	ASTM A 194 Gr.7
Nuts for SS Clamps	ASTM A 194 Gr.8
Spring Coil	BS 970 EN 42, 45-45A, 47, 50 Cr.V4, 51 Cr.Mo.V4, 52CrMoV4, 51CrV4, SUP7 (JIS G 4801) IS-4454 Pt2-Gr.FD-SiCr, BS EN 10089 GR.51CRV4, BS EN 10270-2 FD SiCr, A229/A689 Gr. G6150, IS-4454-Part 1 Gr. SH to be used up to 40 mm coil dia. only.
Casing	IS 1239-1 (Medium) / IS 2062 Gr. A, 5.00 mm thk. (Min.) / API 5L Gr. A/B ERW, 5.00 mm (Min.) / IS 3589 Gr. 330 ERW, 5.00 mm (Min.)
Name Plate	SS / Aluminum
Load Indicator	SS / Aluminum
Welding Electrode	IS 814
Other Bolts / Nuts	IS 1367 Cl. 4.6 / IS 1367 Cl. 4.0
Roller / Ball arrangement (Note – 4)	SS 304 / 316 / SAE 52100

Notes:

1. In case of Alloy Steel Clamps Supplier can alternately supply SS Clamps.
2. Lug material for both pipe side & structure side attachments
3. Lug material for pipe side attachment.
4. Balls shall be provided in a semi encapsulated type enclosure with separators for each ball. The balls shall be protruding above the enclosure so that the pipe support plate rests on the balls & the balls remain at the same location and move on their axis in case of movement of pipe. Sliding of balls in case of pipe movement is not acceptable.

2.2 Design & Manufacturing Requirements.

2.2.1 Design & manufacture of Hot coiled helical compression spring shall be to BS 1726, Part 1 / MSS-SP-58 & ASTM A 125. All requirements of the specification must be met.

2.2.2 Unless otherwise stated all joints shall be of welded construction and shall be in accordance with IS 816 / ASME Sec IX.

2.2.3 All weld sizes shall be 6 mm or 0.8 times the thickness of metal (whichever is more) to be connected.

2.2.4 All bolt holes shall be minimum 2 mm larger than the bolt dia.

2.2.5 All threads shall be metric type to IS 4218 – Standard Coarse Pitch, alternatively ISO Metric threads may be employed.

2.3 The springs shall be coiled, ensuring that the coils are uniformly spaced and are parallel to the axis of the spring.

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2.4 The springs shall have their ends ground flat and smooth at right angles to the axes of the springs over the full circumference so that they stand perpendicular when placed on a horizontal plane.

2.5 All springs shall be enclosed in a robust casing of specified material with two 6 mm dia holes or equivalent at lowest point 180 deg apart for drainage.

2.6 The entire spring assembly including attachments & preset locking device shall be designed for 2 times the service load or the hydro test load whichever is higher and shall be of the nut–bolt type for variable spring assemblies and pin type for constant spring assemblies. The springs shall also have suitable features so that they can be locked in any position within the range of load capacity of the hangers.

2.7 Each spring shall be factory preset to the load as per the approved vendor drawing.

2.8 All springs shall be supplied with lengths as specified in the MR. Deviation in lengths is not acceptable. Each Can type spring shall also be provided with a means of adjusting the installed length by a minimum of 25 mm. Rod and turnbuckle assembly shall be designed for +/- 50 mm adjustment over the specified length of spring support assembly. Turnbuckles shall be made from forged material for sizes up to M30 and for sizes above M30 they can be forged type or machined from rolled bar or fabricated type. In case of Can type springs, if required, the specified height may be achieved with the suitable attachments like stools, structural arrangements by the Spring vendor.

2.9 All springs shall have an affixed load and travel plate on which hot and cold positions are clearly marked. The load on the spring at any instant shall be indicated by an integral pointer on a load position plate. Pointers or scales shall be provided on at least two sides of spring to ensure readability from the platform.

2.10 All hanger type spring assemblies shall allow minimum 4 Deg. Horizontal movement of pipe in any direction. For both hanger & can type springs, vendor to ensure that the spring will be suitable for the horizontal movement specified in the spring schedule. Variable springs shall have max 15% load variation on operating load unless otherwise specified. However for constant springs deviation from specified load shall not exceed 5%. Supplier may offer springs with lesser % load variation than specified above. The value of spring constant if specified is the maximum value spring can have. Supplier may offer springs with up to 6% lesser spring constant but not vice versa. Where both preset load & spring constant are specified in MR, the same shall be complied irrespective of maximum % load variation.

2.11 If both upward and downward travel are mentioned in spring schedule, springs shall be designed accordingly considering travel in both upward and downward directions.

2.12 All springs shall be provided with a means of positively and firmly locking the piston plate for hydrostatic testing of the pipe.

2.13 Teflon / Graphite pads for reducing lateral frictional force shall be provided when specified in the requisition. Wherever temperature is greater than 204°C, only graphite pad shall be used. Thickness of Teflon / Graphite pads shall be minimum 10 mm / 12.7 mm respectively. Retainer plate of 8 mm / 10 mm thickness respectively shall be welded around the pads so that the pads are projected minimum 2 mm above the retainer plates. It must be ensured that the low friction material is bonded with the steel base plate and remains in place at the specified load conditions by using suitable adhesives. Adhesives used for pads should be capable of withstanding the line temperatures. Additionally two or more countersunk screws may also be installed to avoid dislocation in case of Graphite pads.

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2.14 The hanger support, except for the spring shall be designed with a safety factor of 5.

2.15 All Constant & Variable spring supports weighing more than 45 Kg. shall be provided with lifting lugs.

2.16 All spring coils shall be neoprene or polyeurethane coated to prevent corrosion. Alternatively, equivalent or superior coating of spring coil is also acceptable. However, corrosion protection of spring through electroplating is not acceptable.

2.17 All Alloy Steel Springs shall be shot-peened.

2.18 Springs with free height to mean diameter ratio of more than 4 shall not be used without external guiding arrangements.

2.19 Drawing showing arrangement of spring hangers shall be considered for overall guidance. The individual components shall be designed by the Supplier to meet the requirements of the requisition.

2.20 Protection shield, if indicated in support arrangement drawings, shall be under the supplier's scope of supply.

3.0 PAINTING & GALVANIZING:

The spring support shall be thoroughly scrapped and Wire brushed on all surfaces to remove dust, mill scales etc. All external & internal surfaces other than spring shall be given two coats of Zinc Chromate Red Oxide Primer to IS-2074 followed by intermediate paint of 2 coats of Epoxy-High Build coating cured by polyamide hardener @ 100 microns DFT/coat and finish paint of 1 coat of Acrylic Polyurethane @ 40 microns DFT/coat.Total DFT of the coating system shall be 300 microns minimum. All threaded parts / components shall be galvanized to ASTM A153 / A123 / IS-1573 / IS-1367, Part XIII.

4.0 DOCUMENTATION

4.1 All document submissions to EIL shall be through EIL eDMS (electronic Document Management System)

4.2 After placement of order and before commencement of manufacturing, Supplier shall obtain approval on design calculations and detailed dimension drawings complete with material for different parts only if specified in the material requisition. The detailed dimensional drawing submitted by supplier shall also include individual spring assembly weight. Vendor shall submit drawings unit wise for approval.

4.3 Material test certificates (physical properties) report, Heat treatment report (wherever specified or required as per code) and chemical composition shall be furnished for all materials other than coil. For coil material, chemical composition load travel, cramp test certificate shall also be furnished.

4.4 Test reports for each spring for all mandatory tests and other supplementary tests as specified in the requisition shall be submitted.

4.5 Final Documents to be provided, in addition to submission through eDMS, along with delivery of the springs.

- 2 Hard Copies and 2 Pen drives of As Built drawings of spring assemblies.
- 2 Copies and 2 Pen drive of Catalogues, Operation Manual & Installation Procedure.

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5.0 TESTING & INSPECTION

5.1 Testing of springs shall be as per BS-1726 Part 1.

5.2 A compression test shall be made by pressing the spring solid at least three times in succession. The spring should thereafter conform to dimensional requirements.

5.3 A cramp test shall be made by holding the spring compressed to the minimum working compressed length for a period of not less than 12 hours with full load. The spring shall show a reduction of not more than 5% in its free length.

5.4 The manufacturer shall conduct tests to establish the spring rate, and the measurement shall be carried out within 30% to 70% of the maximum travel of the spring (free height minus solid height). The actual load test shall be conducted on the spring supports in the final assembled condition and shall be witnessed by the purchaser's representative.

5.5 All alloy steel springs shall be examined by magnetic particle method.

5.6 Refer Specification no 6-81-0137 for 'Inspection & Test Plan for Spring Support Assemblies'.

6.0 MARKING AND DESPATCH

6.1 In addition to standard marking /stenciling, each spring support shall be marked with MR number and Spring Number / Tag Number by etching or punching on the casing or on a SS/Aluminum tag attached firmly to the support.

Hangers shall be assembled to the degree practical, taking into account shipping and handling limitations,Items separated from the original assembly shall be properly tagged and marked in the packing list clearly as "loose".

6.2 All items shall be dry, clean and free from moisture, dirt & loose foreign material of any kind.

6.3 All items shall be properly packed in Wooden boxes / Crates and shall be protected from rust, corrosion and mechanical damage during transportation, shipment & storage.

7.0 REFERENCES

3-1643-0717:	Spring Schedule
3-1643-0717A:	Spring Schedule (Spring Support Types)
6-81-0137 :	Inspection and Test Plan for Spring Support Assemblies
6-78-0001 :	Specification for Quality Management System Requirements from Bidders
6-78-0003:	Specification for documentation requirements from suppliers

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एच.ओ.टी.क्रेन के लिए मानक विनिर्देशन

STANDARD SPECIFICATION FOR H.O.T. CRANE

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5	25.02.22	REVISED AND REISSUED	DS	PD	NK	SM
4	01.04.16	REVISED AND REISSUED	MS	SPC	PB/RKT	RN
3	13/08/10	REVISED AND REISSUED	SPC	PB	MK/DM	ND
2	31/07/06	REVISED AND REISSUED	PPP	AK	SMA	VJN
1	05/08/99	REVISED AND REISSUED	AK	SMA	NN	AS
0	28/12/94	ISSUED AS STANDARD SPECIFICATION	AK	SSC	DKD	AS

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Abbreviations:

CI	:	Cast Iron
CS	:	Cast Steel
CT	:	Cross Travel
HTB	:	High Tensile Brass
IS	:	Indian Standard
LT	:	Long Travel
QA	:	Quality Assurance
SS	:	Stainless Steel
SWL	:	Safe Working Load

Packaged Equipment Standards Committee

Convenor : Mr. Nalin Kumar

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

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1.0 GENERAL

This specification outlines the minimum requirements for design, engineering, manufacturing and assembly at shop, painting, inspection, testing, supply and performance testing at site of Hand Operated Overhead Travelling (H.O.T) crane, complete with all accessories.

2.0 CODES AND STANDARDS

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

IS 28	:	Phosphor Bronze Ingots and Castings
IS-210	:	Grey Iron Castings-Specification
IS 304	:	High Tensile Ingots and Castings
IS 305	:	Aluminium Bronze Ingots and Castings
IS:807	:	Code of Practice for Design, manufacture, erection and testing (structural portion) of cranes and hoists.
IS:1570	:	Schedule for Wrought Steels
IS:2429	:	Specification for Round Steel Short Link Chains (Electric Butt Welded), Grade L(3)
IS:3177	:	Code of Practice for Electric Overhead Travelling Cranes and Gantry Cranes other than Steel Work Cranes. (As applicable)
IS:3443	:	Crane Rail Sections.
IS:3832	:	Hand-operated Chain Pulley Block-Specification.
IS: 15560	:	Specification for Point hooks with shank up to 160 Tonne.
EIL Std.-7-76-0103	:	Instructions to vendor for site performance guarantee requirements for packaged units.
EIL Spec.-6-81-0136		Inspection and Test Plan for H.O.T crane

Latest revision of the above-mentioned standards as on the date of enquiry shall be applicable. For hazardous area application, following additional standards shall also govern.

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 good engineering practices and norms of the industry shall be applicable.

2.4 National Laws and statutory provisions together with any local bylaws for the state wherein package is required to be installed shall be complied with.

3.0 TECHNICAL REQUIREMENT

Technical requirements of H.O.T Crane shall be as per Indian Standards referred in clause2.1 above, subject to the following additions, deletions and modifications:

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3.1 Addition / Deletion / Modifications to IS-3177: 1999 (Reaffirmed 2015)

i) Clause no..4.2.b (Deletion): Clause deleted.

ii) Clause no..4.2.f (Deletion): The part "such as motors" from sentence deleted.

iii) Clause no. 7.4.8 (Deletion): Clause deleted.

iv) Clause no. 8.1.2 (Modification): Hook latch shall be provided on all hooks.

v) Clause no. 8.3 (Deletion): Clause deleted.

vi) Clause no. 8.4 (Deletion): Clause deleted.

vii) Clause no. 8.5 (Deletion): Clause deleted.

viii) Clause no. 8.6.1 (Addition): Wheels for Crane shall be double flanged when the crane /hoist are top running type and shall be single flanged when the crane/ hoist is underslung type. The tread and flange of wheels shall be machined accurately to size and flanges shall be tapered and radiused. The wheels shall be of single piece type. However for cranes working in hazardous area, wheels with tyre of non-ferrous metallurgy as specified in cl. no. 3.6 below shall be provided.

ix) Clause no. 8.6.3 (Modification): Wheel hardness shall not be applicable for hazardous area Cranes having HTB/Aluminium bronze tyred wheels.

x) Clause no. 8.6.4 (Modification): For Cranes working in hazardous areas, wheels shall be provided with HTB/Aluminium bronze tyres. The minimum thickness of tyres shall be 30mm at the tread.

xi) Clause no. 8.6.6 (Addition): For wheels with HTB/Aluminium bronze tyres, the minimum tread diameter of the wheel on which the HTB/Aluminium bronze tyre is shrunk, shall be calculated as per the formula given in IS-3177.

xii) Clause no. 8.6.11(Addition): The width of wheel tread shall be at least 35mm and 15 mm greater than the rail head, for Long travel and Cross travel wheels respectively, unless specified otherwise.

xiii) Clause no. 8.7.1 (Modification): Only anti-friction bearings shall be used. Bearing enclosure shall be dust tight. Bearing caps/nipples shall be provided with fittings for lubrication.

xiv) Clause 8.7.3 (Deletion): Clause deleted.

xv) Clause 8.8.3 (Deletion): Clause deleted.

xvi) Clause 8.11.2 (Modification): Buffers shall be made from resilient plastic, rubber or polyurethane.

xvii) Clause 8.12 (Deletion): Clause deleted.

xviii) Clause 9.1 (Deletion): From second paragraph the sentence "suitable guards shall be provided on the down shop lead side to prevent accidental contact between wire ropes or hook block or lifting attachments and live conductors" shall be deleted.

xix) Clause 9.2 (Deletion): The term "electrical" deleted.

xx) Clause 9.3 (Deletion): The term "electrical" deleted.

xxi) Clause 11.2.b (Deletion): Clause deleted.

xxii) Clause 11.4.f (Deletion): Clause deleted.

xxiii) Clause12 to 25 (Section 3)(Deletion):Clause deleted.

xxiv) Clause 26.2 (Deletion): The term "electrical" deleted.

xxv) Clause 26.3.10 to 26.3.17 (Deletion): Clause deleted.

xxvi) Clause 28.1 &2(Deletion): Clause deleted.

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xxvii) Clause 28.3(Modification): Load test shall be carried out to the extent applicable for H.O.T crane.

3.2 Addition / Deletion / Modification to IS 807: 2006 (Reaffirmed 2020)

i) Clause no. 24.1 (Addition): End carriage shall be made from rolled steel sections welded together to form a box. The design shall be such that the load is uniformly distributed. For the attachment of end carriages to the main girders, gusset plates or diagonal bracings shall be employed to provide lateral strength.

End carriages shall be designed so as to enable the track wheels to be withdrawn readily. Jacking pads shall be provided for jacking up the crane for changing crane wheels.

ii) Clause no. 24.2 (Addition): Square bar type rail may be provided for LT motion, if specified in data sheet.

3.3 Addition / Deletion / Modification to IS 3832: 2005 (Reaffirmed 2020)

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.5.1(Addition): The frame shall be built from steel plates with bolted/welded construction.

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

iv) Clause no. 5.5 (Addition): Only anti friction bearing shall be used.

v) 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.

vi) Clause no. 5.7.1 (Addition): Hooks (both top and bottom) shall be provided with safety latches to prevent accidental unhooking unless otherwise stated.

vii) 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."

viii) 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.

ix) 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 joist size and the hoisting capacity.

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

a) "Non Sparking Type" on chain Pulley Block suitable for hazardous area.

xi) Clause no. 11.2 (Modification): The chain pulley block shall carry ISI (BIS) stamp for safe area application.

3.4 Additional requirements

i) The Crane may be under slung type if specifically asked in data sheet. For under slung cranes, geared type four wheeled trolley shall be provided. The wheels/runner shall be suitable for the flange of the I sections used for the girders.

ii) The bridge drive assembly shall consist of reduction gear assemblies with shaft extensions and couplings to connect the bridge cross shaft extensions to truck wheels. The travelling motion shall be communicated by endless hand chain wheel to a steel cross shaft, positively driving one travelling wheel in each end carriage. The cross shaft shall be suitably supported. The wheels and cross shaft shall have roller/ball bearings.

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iii) Cross traversing motion shall be transmitted through suitable gearing by an endless hand chain and chain wheel.

3.5 The following material shall be used for construction of various parts of the crane. However, equivalent or superior metallurgy is also acceptable subject to review and approval by Client /Consultant.

SL No.	Name of Part	Material
1.	Girder	CS weldable quality as per IS 2062 (100% Radiography to be taken on all Butt welded joints)
2.	End carriage	CS weldable quality as per IS 2062
3.	Hand chain wheel for trolley	CI grade 25 of IS 210, or fabricated steel or pressed steel metal.
4.	Hand chain for LT and Trolley	Grade L3 as per IS 2429
5.	CT trolley	CS weldable quality as per IS:2062
6.	Rails for LT	Crane rails as per IS:3443 or Square Bar as per IS: 2062, as applicable.
7.	Wheels for LT	55C8 (Old designation:C55Mn75) as per IS:1570 (part 2/sec 1)
8.	Gears	45C8 (Old designation:C45)as per IS:1570 (part 2/sec 1)
9.	Pinions	50C4 (Old designation:C50) as per IS:1570 (part 2/sec 1)
10.	Shafts	30C8 (Old designation:C30) as per IS:1570 (part 2/sec 1)
11.	Axles	45C8 (Old designation:C45) as per IS:1570 (part 2/sec 1)
12.	Couplings	Forged steel as per IS:1570
13.	Suspension pin in the trolley	50C4 (Old designation:C50) as per IS:1570 (part 2/sec 1)

All materials shall be of tested quality and shall conform to the standards as mentioned above.

3.6 Special Requirements for Hazardous Area Cranes

3.6.1 For H.O.T. Crane to be located in hazardous area, non-sparking type design features shall be incorporated. Basic approach for such application calls for use of non-ferrous material for one out of two mating parts for a non-lubricated mating/striking pair.

3.6.2 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/ High Tensile Brass /Stainless Steel
	Hand chain wheel	Solid construction of Aluminium Bronze/ Phosphor Bronze/ High Tensile Brass /Stainless Steel
	Load chain wheel	Solid construction in Aluminium Bronze/ High Tensile Brass/Stainless Steel

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	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/ Phosphor Bronze/ High Tensile Brass /Stainless Steel
	Hand chain wheel	Solid construction of Aluminium Bronze/ Phosphor Bronze/ High Tensile Brass /Stainless Steel
	Ungeared and geared wheels	Solid construction in Aluminium Bronze/ High Tensile Brass/Stainless Steel or Tyre of Aluminium Bronze/ High Tensile Brass /Stainless Steel shrunk fitted on core wheel of C55Mn 75 or equivalent/superior MOC.
C	**LT Mechanism**	
	LT wheels	Solid construction in Aluminium Bronze/ High Tensile Brass /Stainless Steel or Tyre of Aluminium Bronze/ High Tensile Brass /Stainless Steel shrunk fitted on core wheel of C55Mn 75 or equivalent/superior MOC.

3.6.3 Phosphor Bronze, High Tensile Brass and Aluminium Bronze shall conform to IS 28, IS 304 and IS 305 respectively.

3.6.4 The minimum thickness of tyres shall be 30mm at the tread.

4.0 INSPECTION AND TESTING

4.1 Equipment shall be subjected to stage wise inspection and testing at vendor's/sub-vendor's works by purchaser/its authorised inspection agency. Vendor shall list out all items in the H.O.T Crane for inspection categorization. Subsequently, detailed Quality Assurance Plan (QAP) shall be submitted for review / approval. Approved Quality Assurance (QA) plan shall form the basis for equipment inspection.

4.2 Testing at Works

4.2.1 Vendor shall perform tests and inspection necessary to ensure that the material and workmanship confirm to the requirement of this specification.

4.2.2 Vendor shall submit to the purchaser, for his review and comments, detailed procedures for all running tests and all specified optional tests, including acceptance criteria for all monitored parameters. Inspection and Test Plan (ITP) for H.O.T crane is attached with the requisition. The same shall form basis of Inspection and Testing of the package. For the items for which no ITP has been attached with requisition, vendor shall furnish their job specific ITP during detail engineering which shall be subject to review/ approval by purchaser/its authorised inspection agency.

4.2.3 Testing at vendors works shall be carried out in accordance with IS:3177 and 3832 and shall include following tests as minimum:

- Full load and 125% overload test for hoist & cross travel motions at works (chain pulley block shall be separately tested for operational proof as per cl. No. 9.2 of IS 3832).
- Deflection Test at Works.

4.2.4 Any or all the tests, at purchaser's option, shall be witnessed by purchaser/its authorised inspection agency.

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The shop tests besides being witnessed by Purchaser's/Consultant's Inspector may also be witnessed by Owner's/Consultant's equipment specialists. Vendor shall inform the purchaser about the scheduled test dates six (6) weeks in advance and reconfirm the firm date of testing one (1) week in advance

4.2.5 Acceptance of shop tests shall not constitute a waiver of requirements to meet field tests or performance guarantee under the specified operating conditions, nor such inspection & testing shall absolve the Vendor of his responsibilities in any way whatsoever.

However, such inspection shall be regarded as check-up and in no way absolve the vendor of his responsibility.

4.3 Performance Testing and Guarantees at Site

4.3.1 A field performance test shall be conducted by the vendor to demonstrate the performance of the equipment after commissioning in accordance with test procedure prepared as per EIL Standard 7-76-0103.

4.3.2 Testing at site shall be carried out in accordance with IS: 3177.Following parameters shall be guaranteed and demonstrated during the performance testing.

i) SWL of Hoist

ii) Deflection of bridge girder (deflection shall be within limits specified in IS-807)

4.3.3 All parts of the crane shall operate satisfactorily with no undue friction, noise or display of any other unfavourable characteristics during the performance test.

4.3.4 All equipment and component parts shall be guaranteed by the vendor against defective material and design for a period as specified in Purchaser's general purchase conditions.

4.3.5 If any defect occurs during the guaranteed period the Vendor shall make all necessary alterations, repairs and replacement at their own cost.

4.3.6 Necessary instruments for the performance testing shall be arranged by the vendor, and shall be tested and calibrated before undertaking the performance test. Only test load shall be provided by purchaser near test site.

5.0 PROTECTION AND PAINTING

5.1 Unless otherwise specified in job specification, surface preparation and painting system for fabricated items shall be as below:

Surface preparation	Primer	Finish Paint
SSPC-SP-10 (SA-2 ½)	• One (1) coat of F-9 (Inorganic zinc silicate coating) @ 65-75 µm DFT/coat. • One (1) coat of P-6 (Epoxy zinc phosphate primer) @ 40 µm DFT/coat.	• Two (2) coats of F-6B (polyamide cured epoxy resin medium suitably pigmented) @ 100 µm DFT/coat • One (1) coat of F-2 (Acrylic-Polyurethane finish paint) @ 40µm DFT/coat. Total DFT of Primer + finish shall be 345 (minimum).

Refer Table Nos. 5.1, 5.2 and 5.3 attached at the end of this specification for the properties of different paints (primer/finish paint) as mentioned above.

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

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

5.4 Surface preparation and paintings for all bought out components shall be as per respective sub-vendor's standards suitable for industrial corrosive environment.

5.5 The colour of Crane shall be golden yellow (RAL 1004), unless otherwise specified.

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 dismantled into major components, suitable for shipment and shall be properly packed to provide adequate protection during shipment. All assemblies shall be properly match marked for site erection.

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.

6.5 Vendor shall furnish procedure for prolonged storage of supplied equipment/ material at site.

7.0 SPARE PARTS

7.1 Vendor shall submit 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 is facilitated.

7.2 Recommended spares and their quantities should 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.

7.3 Vendor shall supply adequate quantity of commissioning spares. The commissioning spares shall be sufficient for trouble free commissioning of the system at site. Any commissioning spares required during commissioning, over and above, the commissioning spares supplied, shall be made available by the vendor without any cost and time implication to purchaser. If for any reason, during commissioning, vendor needs to utilise spares from 2 years' operation spares (if already available at site), the same shall be replenished by vendor within a reasonable time without any cost implication to purchaser. Any unused commissioning spares shall be handed over to owner.

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TABLE No. 5.1 PRIMERS

Sl. No.	DESCRIPTION	P-2	P-4	P-6	P-7
1	Technical name	Chlorinated rubber Zinc Phosphate primer.	Etch primer/wash primer	Epoxy zinc phosphate primer	ZINGA, LOCKTITE or ZRC cold galvanizing
2	Type and composition	Single pack, air drying chlorinated rubber based medium plasticised with unsaponifiable plasticizer, pigmented with zinc phosphate.	Two pack polyvinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate.	Two component polyamine cured epoxy resin medium, pigmented with zinc phosphate.	One pack Synthetic Resin based zinc galvanizing containing min 92% of electrolytic zinc dust of 99.95% purity.
3	Volume Solids %	40 ±3	10±1	50±1	37%
4	DFT (Dry Film thickness) per coat in microns	40-45	8-10	40-50	40-50µ
5	Theoritical covering capacity in M^2/coat/ litre	8-10	8-10	8-10	4m²/kg
6	Weight per litre in kgs/litre	1.3±0.05	1.2±0.05	1.4±0.05	2.67 kg at 15°C
7	Touch dry at 30°C (minimum)	30 minutes	2 hrs.	After 30 min.	10 minutes
8	Hard dry at 30°C (maximum.)	8 hrs.	24 hrs.	8 hrs	24 hrs.
9	Overcoating interval	Min.: 8 hrs	Min: 4-6 hrs.	Min.:8hrs.	Min.:4 hrs
10	Pot life at 30°C for two component paints	Not Applicable	Not applicable	6 - 8 hrs.	Unlimited
11	Temperature (Resistance (minimum)	60 °C Dry service	NA Dry service	80°C Dry service	50°C Dry service

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TABLE No. 5.2FINISH PAINTS

Sl. No	DESCRIPTION	F-2	F-3	F-6A/B	F-6C	F-7
1	Technical name	Acrylic Polyurethane finish paint	Chlorinated rubber based finish paint	Epoxy-High Build coating	Solvent less epoxy coating	High build coal tar epoxy coating.
2	Type and composition	Two-pack aliphatic isocynate cured acrylic finish paint.	Single pack plasticised chlorinated rubber based medium with chemical and weather resistant pigments.	F-6A Two-pack Aromatic amine cured epoxy resin medium suitably pigmented. F-6B: polyamide cured epoxy resin medium suitably pigmented	Two pack, cured with Amine Adduct; catalyzed epoxy resin suitably pigmented	Two pack polyamide cured epoxy resin blended with coaltar medium, suitably pigmented
3	Volume Solids %	40 ± 3	38±2	60±3	99±1	65±3
4	DFT (Dry Film thickness) per coat in microns	30-40µ	30-40	100-125µ	200-500	100-125µ
5	Theoritical covering capacity in M^2/coat/litre	11-15	11-15	5-6	2-3	5.2-6.5
6	Weight per liter in kgs/litre	1.15±0.03	1.15±0.03	1.42±0.03	1.40±0.03	1.40±0.03
7	Touch dry at 30°C	30 minutes	30 minutes.	3 hrs.	3 hrs.	4 hrs.
8	Hard dry at 30°C (max) Full cure at 30°C (for immersion/ high temperature service)	8 hrs	8 hrs	16 hrs 5 days	16 hrs	48 hrs 5 days
9	Over-coating interval at 30 °C	Min. 12 hrs.	Min.: Overnight	Min.: Overnight Max.: 5 days	Min.: 8 hrs. Max.: 48 hrs.	Min.: 24 hrs Max.: 5 days.
10	Pot life (approx.) at 30°C for two component paints	6-8 hrs.	Not applicable	4-6 hrs	30 minutes	4-6 hrs.
11	Temperature Resistance (minimum)	80 °C Dry service min	60 °C Immersion service	80°C Dry service	120°C(Dry service), 50°C (Immersion service)	125°C Immersion service

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TABLE No. 5.3FINISH PAINTS

Sl. No	DESCRIPTION	F-8	F-9	F-11	F-12
1	Technical name	Self priming type surface tolerant high build epoxy coating (complete rust control coating).	Inorganic zinc silicate coating	Heat resistant synthetic medium based two pack Aluminium paint suitable upto 250°C dry temp.	Heat resistant silicone Aluminium paint suitable upto 500°C dry temp.
2	Type & composition	Two pack epoxy resin based suitable pigmented and capable of adhering to manually prepared surface and old coating.	A two pack air drying self curing solvent based inorganic zinc silicate coating with minimum 80% zinc content on dry film. The final cure of the dry film shall pass the MEK rub test.	Heat resistant synthetic medium based two pack Aluminium paint suitable upto 250°C.	Single pack silicone resin based medium with Aluminium flakes.
3	Volume Solids %	78±3	60±3	38±0.03	20±2
4	DFT (Dry Film thickness) per coat in microns	100-125	65-75µ	15-20µ	15-20µ
5	Theoritical covering capacity in M^2/coat/ litre	6.0-7.2	8-9	10-12	8-10
6	Weight per liter in kgs/litre	1.41±0.03	2.3±0.03	0.95±0.03	1.00±0.03
7	Touch dry at 30°C (maximum)	3 hrs.	30 minutes.	3 hrs.	30 minutes.
8	Hard dry at 30°C (maximum) Full cure 30°C (for immersion /high temperature service)	24 hrs 5days	12 NA	12 hrs NA	24 hrs NA
9	Over-coating interval	Min.: 10 hrs	Min.: 12 hrs.at 20°C & 50 % RH	Min. 24 hrs	Min.: 24 hrs
10	Pot life at 30°C for two component paints	90 minutes.	4-6 hrs.	Not applicable	Not applicable
11	Temperature Resistance (minimum)	80 °C Dry service	400 °C Dry service	250°C Dry service	500°C Dry service

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NOTES (for tables 5.1 to 5.3):

1. Covering capacity and DFT depends on method of application. Covering capacity specified above are theoretical. Allowing the losses during application, min specified DFT should be maintained.

2. All primers and finish coats should be cold cured and air drying unless otherwise specified.

3. All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship should be ensured. In case of conflict between this specification and manufacturer's recommendation, the same shall be clarified through EIL SMMS department.

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अग्निरोधक नियंत्रण स्टेशन के लिए विनिर्देश

SPECIFICATION FOR FLAMEPROOF CONTROL STATIONS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	29.9.20	REVISED AND ISSUED AS STANDARD SPECIFICATION	NNB/ RKS	ANPS	SA	SM
5	24.02.16	REVISED AND ISSUED AS STANDARD SPECIFICATION	NNB/AK	ANPS	BRB	SC
4	11.04.11	REVISED AND ISSUED AS STANDARD SPECIFICATION	PS	ANPS	UAP	DM
3	24.08.07	REVISED AND ISSUED AS STANDARD SPECIFICATION	ANPS	UAP	JMS	VC
2	30.01.02	REVISED AND ISSUED AS STANDARD SPECIFICATION	UAP	AAN	VPS	GRR

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Abbreviations:

AC	Alternating Current
BIS	Bureau of Indian Standards
CEA	Central Electricity Authority
CT	Current Transformer
DC	Direct Current
FRLS	Flame Retardant Low Smoke
FRP	Fibre Reinforced Plastic
GI	Galvanised Iron
IEC	International Electro-technical Commission
IP	Ingress Protection
IS	Indian Standards
LED	Light Emitting Diodes
LV	Low Voltage
MR	Material Requisition
NABL	National Accreditation Board for Testing and Calibration Laboratories
PB	Push Button
PESO	Petroleum and Explosives Safety Organisation
PVC	Poly Vinyl Chloride
SMD	Surface Mounted Device
SWG	Standard Wire Gauge
XLPE	Cross Linked Poly Ethylene

Electrical Standards Committee

Convenor: Ms. Sumita Anand

Members:
Mr. Parag Gupta
Mr. M. K. Sahu
Ms. Arvind N. P. Singh
Mr. Harish Kumar
Ms. Shalini Verma
Mr. Raman Sood
Mr. V. K. Jain
Ms. Shirali Aggarwal
Mr. Ayush Mathur (Projects)
Mr. Rajesh Sinha (Inspection)

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1.0 SCOPE

This specification covers the requirements of design, manufacture, testing, packing and supply of flameproof control stations and accessories suitable for installation in locations handling flammable liquids and gases/ vapors.

2.0 CODES AND STANDARDS

2.1 The equipment shall comply with the requirements of latest revision of the following standards issued by BIS:

IS-5	: Colours for ready mixed paints and enamels.
IS-1248	: Direct acting indicating analogue measuring instruments and their accessories.
IS / IEC 60079-0	: Electrical apparatus for explosive gas atmospheres (General Requirements).
IS / IEC 60079-1	: Electrical apparatus for explosive gas atmospheres (Equipment Protection by Flameproof Enclosures "d").
IS / IEC 60529	: Degree of protection provided by enclosures (IP Code).
IS / IEC 60947	: LV switchgear and control gear.

2.2 In case of imported equipment, only IECEx (or equivalent, if more stringent than the applicable IEC) certified equipment shall be used.

2.3 The equipment shall also confirm to the provisions of CEA Regulations with latest amendments and other statutory regulations currently in force in the country.

2.4 In case Indian standards are not available for any equipment, standards issued by IEC or equivalent agency (if more stringent than IEC) shall be applicable.

2.5 In case of any conflict between requirements specified in various applicable documents for the project, the most stringent requirement shall govern. However, Owner/ EIL's decision in this regard will be final and binding.

3.0 GENERAL REQUIREMENTS

3.1 The offered equipment shall be brand new with state of art technology and having proven field track record. No prototype equipment shall be offered.

3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 10 years from the date of supply.

4.0 SITE CONDITIONS

The equipment shall be suitable for installation and satisfactory operation in classified hazardous locations in tropical, humid and corrosive atmosphere as prevalent in refineries, petrochemical and fertilizer plants. Unless otherwise specified, a design ambient temperature of 40° C and an altitude not exceeding 1000 m above mean sea level shall be considered.

5.0 CERTIFICATION

The equipment shall have test certificates issued by NABL-approved/ Central Government labs in India/ IECEx-approved/ equivalent labs). All equipment (indigenous & imported) shall also have valid statutory approvals as applicable for the specified location and marking as per IS/ IEC 60079 or IEC 60079 and as required by statutory authorities. All indigenous flameproof equipment shall have valid BIS license.

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6.0 TECHNICAL REQUIREMENTS

6.1 Construction

6.1.1 The enclosures of the control stations shall be made of cast light metal alloy, unless otherwise specified. The enclosures of the control stations intended for use in units handling sulphuric acid/ other corrosive materials shall be made of stainless steel grade SS-316L, if specified in MR/ tender.

6.1.2 The control stations shall be suitable for use in outdoor open locations and shall have minimum IP-55 degree of protection. They shall preferably be provided with integral canopy. However, where the enclosure has been certified without integral canopy, a separate canopy can be accepted. The separate canopy shall be made of at least 1.6 mm (16 gauge) galvanised sheet steel/ FRP/ stainless steel minimum SS-304 (as specified in purchase specifications). The canopy shall be suitable for providing protection against rain from top, back and two sides.

6.1.3 The control station enclosure shall be provided with gaskets for IP, if required by equipment certification. Gaskets, wherever provided, shall be made of non-inflammable and self-extinguishing material.

6.1.4 All metal surfaces shall undergo manufacturer's standard cleaning/ painting/ powder coating cycle. After surface preparation, the equipment shall be painted with two coats of epoxy based final paint or epoxy powder coated with minimum coating thickness of 80 microns, with colour shade as below:

- Flame proof (Gas group IIA/ IIB) : Dark admiralty grey shade 632 of IS-5/ RAL 7031
- Flame proof (Gas group IIC) : Light yellow shade 355 of IS-5/ RAL 1012

All unpainted parts shall be suitably treated to prevent rust formation/ corrosion. If these parts are moving then these shall be greased. Grease, which does not solidify, shall be applied to flamepath. However, in case of Stainless Steel control stations, finish shall be Electropolish/ Buffed/ equivalent finish.

6.1.5 Equipment shall be marked as per IS/IEC 60079.

6.1.6 All accessories like nuts, bolts, washers etc. and operating shaft of push buttons, switches etc. shall be made of stainless steel SS-304. Alternatively, Nickel-plated brass material may be used for the operating shafts of push buttons, switches etc.

6.1.7 The control stations shall be provided with two earthing studs (minimum M10 bolt, nut with spring and plain washer) with lugs on the external surface of the enclosures suitable for termination of 8 SWG GI wire. No screw type fixing arrangement shall be allowed.

6.1.8 The control station shall be provided with two cable entries at bottom, and one entry to be blocked with flameproof nickel plated brass sealing plug, unless otherwise specified. Required number of flameproof double compression nickel plated brass cable glands shall be provided. The cable termination chamber of the control station shall be large enough to provide a minimum space of 100mm between top of the cable gland and bottom of the terminal block.

6.1.9 The control stations shall have external fixing lugs for mounting on wall or column. The holes provided on these lugs shall be of oblong type.

6.1.10 A tag plate indicating Tag Number shall be provided on each control station. A nameplate shall be provided to indicate the Name of Manufacturer, test certificate number, serial number, BIS license number, applicable gas group etc. as per IS/IEC 60079 and any additional marking required by statutory authority like approval no. etc. The nameplates shall be engraved type or laser-marked and permanently fixed on the equipment. In case the standard details given above are embossed on the enclosures, the same need not be repeated on the name plate. All

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tag plates shall be engraved, 3 ply laminate fixed with screws and name plate shall be Al anodized or SS-304 engraved or laser-marked and fixed with rivets.

6.1.11 All flameproof control stations shall be suitable for 240V AC as well as 110V/ 220V DC control supply.

6.2 Component Specification

6.2.1 Push buttons for START/ OPEN and STOP/ CLOSE shall be of GREEN and RED colour respectively. The STOP push button shall be mushroom type with stay put feature and lockable in pressed position. Refer Sketch 1 for wiring and other details for various types of local control stations.

6.2.2 All selector switches shall have minimum two poles for each position. Each position of switch shall be indelibly marked on the control station. Exact configuration of selector switch (e.g. LOCAL-OFF-REMOTE) shall be as per datasheet/ MR requirement.

6.2.3 All ammeters shall be of moving iron type having an accuracy class of 1.5 and suitable for 1 Ampere CT secondary. Minimum size of ammeter shall be either 72mm x 72 mm or 65 mm diameter. 80% of the scale length shall cover 100% of the CT primary current uniformly and the balance 20% of the scale shall cover 100-800% of the CT primary. A red mark corresponding to the full load current of the motor shall be provided on the ammeter dial. The ammeter front glass shall be toughened.

6.2.4 Indicating lamp(s) wherever provided shall be clustered LED type or SMD chip type LED with colour lens of minimum 25mm diameter.

6.3 Terminals & Wiring

6.3.1 The control stations shall be provided with sufficient number of terminals. More than 2 wires per terminal shall not be permitted. If required, additional terminal with shorting link may be used. Each terminal for external cable connection shall be suitable for termination of 2.5 mm^2 (unless otherwise specified) stranded copper conductor. Tinned copper lugs shall be provided for cable termination wherever applicable.

6.3.2 All internal wiring shall employ 1.5 mm^2, 660V/ 1100V grade, FRLS type, XLPE/ PVC insulated copper conductor wires. All termination shall be with suitable lugs.

7.0 INSPECTION, TESTING AND ACCEPTANCE

7.1 During fabrication, the equipment shall be subjected to inspection by EIL/ Owner or by an agency authorized by the Owner, as per agreed Inspection Test Plan. Manufacturer shall furnish all necessary information concerning the supply to EIL/ Owner's inspector. All routine/acceptance tests shall be carried out at manufacturer's works under his care & expense.

7.2 Type test certificates from NABL-approved/ Central Government Labs in India/ IECEx-certified/ equivalent Labs, Manufacturer's works test reports, applicable PESO approval and BIS license shall be shown to the inspection agency on demand during inspection. The certificates, BIS license and PESO approval must be valid at the time of despatch.

7.3 Test certificates of bought out components shall be submitted to the inspection agency, as per Inspection and Test Plan no. 6-81-1006.

7.4 All equipments shall be subjected to various routine / acceptance tests as per Inspection and Test Plan no. 6-81-1006.

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8.0 PACKING AND DESPATCH

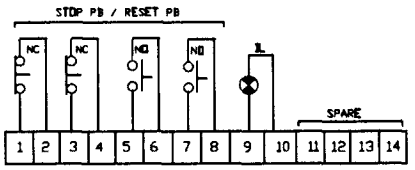
All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for the selected mode of transportation, i.e. by ship/ rail or trailer, and shall be wrapped in polythene sheets before being placed in crates/ cases to prevent damage to finish. The crates/ cases shall have skid bottom for handling. Special notations such as 'Fragile', 'This side up', 'Center of gravity', 'Weight', 'Owner's particulars', 'PO no.' etc., shall be clearly marked on the packages together with other details as per purchase order.

The equipment may be stored outdoors for long periods before installation. The packing should be suitable for outdoor storage in areas with heavy rains and high ambient temperature unless otherwise agreed. A set of instruction manuals for installation, testing and commissioning, a set of operation & maintenance manuals and a set of final drawing shall be enclosed in a waterproof cover along with the shipment.

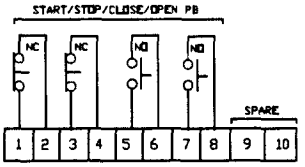
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SKETCH–1

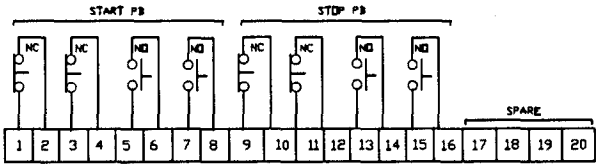
WIRING DETAILS OF LOCAL CONTROL STATIONS



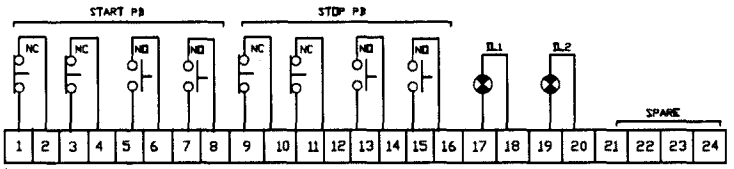
TYPE–A1 (STOP P.B. WITH LAMP)
OR
(RESET P.B. WITH LAMP)
(CABLE SIZE : 4Px2.5 Sq.mm)



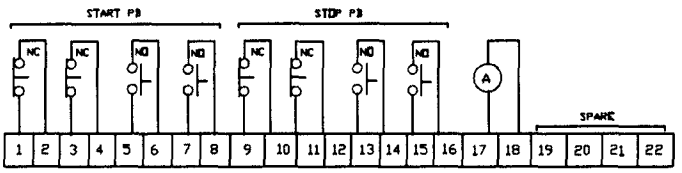
TYPE–A2
(START PB) OR (STOP PB) OR (CLOSE PB) OR (OPEN PB)
(CABLE SIZE : 2Px2.5 Sq.mm)



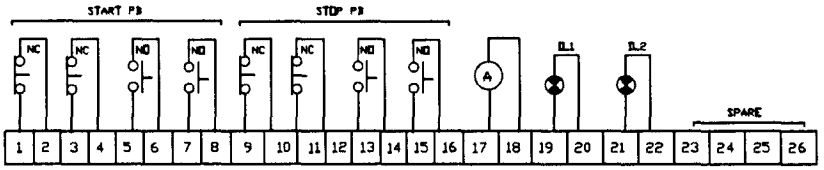
TYPE–B1 (WITH START & STOP PBs) OR (WITH CLOSE & OPEN PBs)
(CABLE SIZE : 4Px2.5 Sq.mm)



TYPE–B2 (WITH START & STOP PBs & INDICATION LAMPS)
OR
(WITH CLOSE & OPEN PBs & INDICATION LAMPS)
(CABLE SIZE : 6Px2.5 Sq.mm)

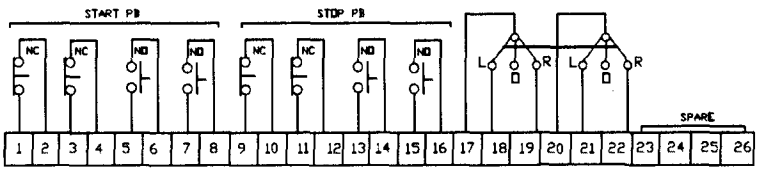


TYPE–C1 (WITH START & STOP PBs & AMMETER)
(CABLE SIZE : 4Px2.5 Sq.mm)

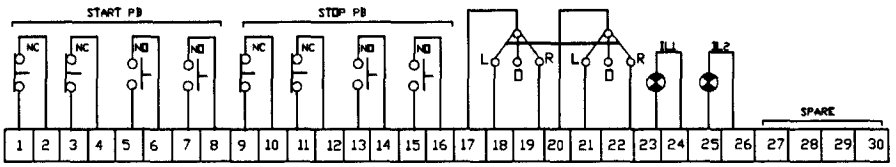


TYPE–C2 (WITH START & STOP PBs, AMMETER & INDICATION LAMPS)
(CABLE SIZE : 6Px2.5 Sq.mm)

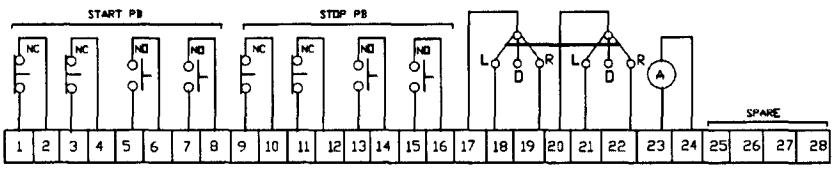
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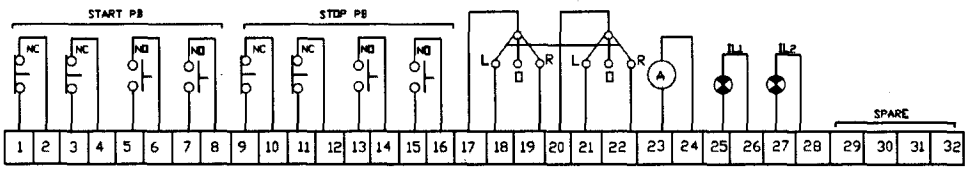
TYPE–D1 (WITH START & STOP PBs & L–O–R SELECTOR SWITCH)
(CABLE SIZE : 6Px2.5 Sq.mm) (REFER NOTE–11)



TYPE–D2 (WITH START & STOP PBs, L–O–R SELECTOR SWITCH & INDICATION LAMPS)
(CABLE SIZE : 12Px2.5 Sq.mm) (REFER NOTE–11)

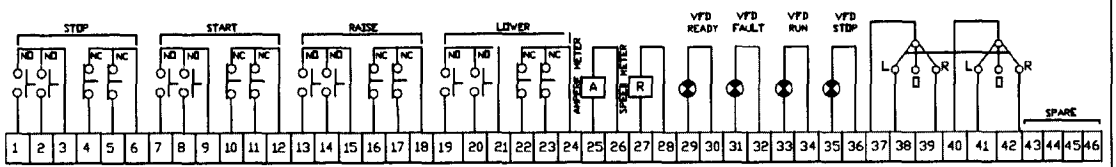


TYPE–E1 (WITH START & STOP PBs, AMMETER & L–O–R SELECTOR SWITCH)
(CABLE SIZE : 6Px2.5 Sq.mm) (REFER NOTE–11)

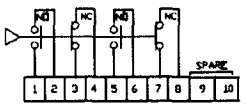


TYPE–E2 (WITH START & STOP PBs, AMMETER, L–O–R SELECTOR SWITCH & INDICATION LAMPS)
(CABLE SIZE : 12Px2.5 Sq.mm) (REFER NOTE–11)

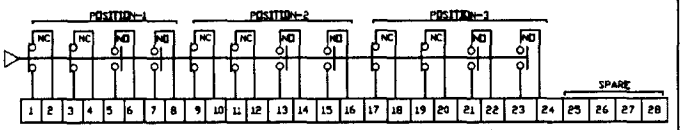
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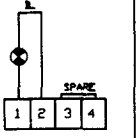
TYPE–F (WITH START & STOP PBs, RAISE & LOWER PBs, L–O–R SWITCH, AMPERE METER, SPEED METER & INDICATING LAMPS) (REFER NOTE–5,6,7)
(CABLE SIZE : 12Px2.5 Sq.mm)



TYPE–11
SEL SWITCH (2POSITION)



TYPE–12 SEL SWITCH (3POSITION)



TYPE–13
(LAMP STATION)

GENERAL NOTES:

1. SHORTING LINKS SHALL BE PROVIDED BY VENDOR. REQUIREMENT SHALL BE INFORMED DURING VENDOR DRAWING REVIEW.
2. WIRING DETAILS SHALL BE READ IN CONJUNCTION WITH MR/TENDER.
3. CABLE SIZES AS INDICATED ABOVE ARE TENTATIVE AND MINIMUM. EXACT CABLE SIZES SHALL BE INFORMED DURING VENDOR DRAWING REVIEW. VENDOR TO PROVIDE REQUIRED SIZE OF CABLE TERMINATION CHAMBER WITH SUITABLE TERMINALS, CABLE ENTRIES, CABLE GLANDS AND LUGS. CROSS SECTIONAL AREA SHALL BE 2.5 SQ.MM, UNLESS OTHERWISE SPECIFIED.
4. AMMETER WHEREVER PROVIDED, SHALL BE ANALOGUE OR 4–20mA TYPE AS DEFINED IN MR/TENDER.
5. FOR VFD LCS, LAMP SUPPLY VOLTAGE SHALL BE SAME AS VFD CONTROL SUPPLY VOLTAGE.
6. FOR VFD LCS, IF EXTERNAL SUPPLY IS REQUIRED FOR METERS, THEN SAME SHALL BE AS VFD CONTROL SUPPLY VOLTAGE.
7. METERS IN VFD LCS SHALL BE SUITABLE FOR 4–20mA TRANSDUCER OUTPUTS AND SHALL BE CALIBRATED FOR THE ACTUAL MOTOR CURRENT. FOR DRIVERS WITH BYPASS FACILITY, METERS SHALL BE CAPABLE OF READING BYPASS MODE FULL LOAD AND STARTING CURRENTS AS WELL AS VFD MODE DRIVE CURRENT.
8. NUMBER AND COLOUR OF INDICATING LAMPS SHALL BE AS PER THE JOB SPECIFATION/TENDER.
9. LCS TYPE "I" ARE TYPICALLY FOR INSTRUMENTATION USE.
10. ALL PUSH BUTTON AND CONTROL SWITCH CONTACTS SHALL BE RATED FOR MINIMUM 5A AT 240V(AC–15) AND 1A AT 110V(DC–13) DUTY. CONTACT RATINGS FOR LCS FOR INSTRUMENTATION USE SHALL BE AS PER INSTRUMENTATION REQUIREMENT.
11. SECOND CONTACT OF L–O–R SWITCH REQUIRED ONLY WHERE DCS INTERFACE IS REQUIRED BY INSTRUMENTATION.
12. THE EXACT DESCRIPTION OF PB'S WHETHER START/STOP OR OPEN/CLOSE SHALL BE INFORMED DURING VENDOR DRAWING REVIEW.
13. ALL L–O–R SELECTOR SWITCHES SHALL BE LOCKABLE IN OFF POSITION.

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अग्निरोधक लाइटिंग और पावर पैनलों के लिए विनिर्देश

SPECIFICATION FOR FLAMEPROOF LIGHTING AND POWER PANELS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	22.03.21	REVISED AND ISSUED AS STANDARD SPECIFICATION	RKS	ANPS	PG	SM
5	24.02.16	REVISED AND ISSUED AS STANDARD SPECIFICATION	NNB/AK	ANPS	BRB	SC
4	11.04.11	REVISED AND ISSUED AS STANDARD SPECIFICATION	PS	ANPS	UAP	DM
3	24.08.07	REVISED AND ISSUED AS STANDARD SPECIFICATION	ANPS	UAP	JMS	VC
2	30.01.02	REVISED AND ISSUED AS STANDARD SPECIFICATION	UAP	AAN	VPS	GRR

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Abbreviations:

AC	Alternating Current
BIS	Bureau of Indian Standards
CEA	Central Electricity Authority
DGMS	Directorate General of Mines Safety
EIL	Engineers India Limited
ELCB	Earth Leakage Circuit Breaker
FRLS	Flame Retardant Low Smoke
GI	Galvanized Iron
IEC	International Electro-technical Commission
IP	Ingress Protection
IS	Indian Standards
LV	Low Voltage
MCB	Miniature Circuit Breaker
MR	Material Requisition
NABL	National Accreditation Board for Testing and Calibration Laboratories
PESO	Petroleum and Explosives Safety Organisation
PO	Purchase Order
PVC	Poly Vinyl Chloride
SPN	Single Phase and Neutral
SS	Stainless Steel
TPN	Three Phases and Neutral
XLPE	Cross Linked Poly Ethylene

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1.0 SCOPE

This specification covers the requirements of design, manufacture, testing, packing and supply of flameproof Lighting and Power panels/ accessories suitable for installation in locations handling flammable liquids and gases / vapours.

2.0 CODES AND STANDARDS

2.1 The equipment shall comply with the requirements of latest revision of the following standards issued by BIS:

IS-5	:	Colours for ready mixed paints and enamels
IS-12640	:	Residual current operated circuit breakers
IS / IEC 60079-0	:	Electrical apparatus for explosive gas atmospheres (General requirements)
IS / IEC 60079-1	:	Electrical apparatus for explosive gas atmospheres (Equipment Protection by Flameproof Enclosures "d")
IS / IEC 60529	:	Degree of protection provided by enclosures (IP Code)
IS / IEC 60898	:	Electrical Accessories - circuit breakers for over protection for household and similar installations
IS / IEC 60947	:	LV switchgear and control gear.

2.2 In case of imported equipment, only IECEx (or equivalent, if more stringent than the applicable IEC) certified equipment shall be used.

2.3 The equipment shall also confirm to the provisions of CEA Regulations with latest amendments and other statutory regulations currently in force in the country.

2.4 In case Indian standards are not available for any equipment, standards issued by IEC or equivalent agency (if more stringent than IEC) shall be applicable.

2.5 In case of any conflict between requirements specified in various applicable documents for the project, the most stringent requirement shall govern. However, Owner's/ EIL's decision in this regard will be final and binding.

3.0 GENERAL REQUIREMENTS

3.1 The offered equipment shall be brand new with state of art technology and having proven field track record. No prototype equipment shall be offered.

3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 10 years from the date of supply.

4.0 SITE CONDITIONS

The equipment shall be suitable for installation and satisfactory operation in classified hazardous locations in tropical, humid and corrosive atmosphere as prevalent in refineries, petrochemical and fertilizer plants. The lighting and power panels shall be designed to operate under site conditions as specified in the data sheet. If not specifically mentioned therein, a design ambient temperature of 40° C and an altitude not exceeding 1000m above mean sea level shall be considered.

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5.0 POWER SUPPLY

5.1 Lighting and power panels shall be suitable for 415V, 50Hz, TPN incoming power supply and outgoing circuits for 240V, SPN power supply.

5.2 For projects falling under the jurisdiction of DGMS, the following additional requirements shall apply:

5.2.1 The phase-to-phase voltage shall not exceed 125V (where electric lighting is used in underground mine)/ 250V (where electric lighting is used in open cast mine or surface of a mine), with the neutral or the mid-point of the lighting system connected with earth.

5.2.2 The panels shall have three phase, 3-wire system, without neutral.

5.2.3 Outgoing circuits shall be controlled by 2-pole MCBs. Earth leakage protection shall be provided for all outgoing circuits, which shall isolate both poles.

6.0 CERTIFICATION

The equipment shall have test certificates issued by NABL-approved/ Central Government labs in India/ IECEx-approved/ equivalent labs. All equipment (indigenous & imported) shall also have valid statutory approvals, as applicable, for the specified location, and marking as per IS/IEC 60079 and as required by statutory authorities. All indigenous flameproof equipment shall have valid BIS license.

7.0 TECHNICAL REQUIREMENTS

7.1 Construction

7.1.1 The enclosures of the lighting and power panels shall be made of cast light metal alloy, unless otherwise specified. The enclosures of the lighting and power panels intended for use in units handling sulphuric acid/ other corrosive materials shall be made of stainless steel grade SS-316L, if specified in MR/ Tender.

7.1.2 The panels shall be suitable for use in outdoor open locations and shall have minimum IP-55 degree of protection. They shall preferably be provided with integral canopy. However, where the enclosure has been certified without integral canopy, a separate canopy can be accepted. The separate canopy shall be made of at least 1.6 mm (16 gauge) galvanized sheet steel/ stainless steel minimum SS-304 (as specified in MR/ Tender). The canopy shall be suitable for providing protection against rain from top, back and two sides.

7.1.3 The lighting and power panels shall be provided with gaskets made of non-inflammable and self-extinguishing material.

7.1.4 All metal surfaces shall undergo manufacturer's standard cleaning/ painting/ powder coating cycle. After surface preparation, the panels shall be painted with two coats of epoxy based final paint or epoxy powder coated with minimum coating thickness of 80 microns, with colour shade as below:

- Flame proof Exd (Gas group IIA/IIB): Dark admiralty grey shade 632 of IS-5/ RAL 7031
- Flame proof Exd (Gas group IIC): Light yellow shade 355 of IS-5/ RAL 1012.

All unpainted steel parts shall be suitably treated to prevent rust formation/ corrosion. If these parts are moving elements, then these shall be greased with non-solidifying grease. However, in case of stainless steel lighting and power panels, finish shall be Electropolish/ Buffed/ equivalent finish.

7.1.5 A warning inscription "DO NOT OPEN WHEN ENERGIZED" shall be provided on each enclosure. The warning inscription shall be embossed on the enclosure or a separate warning plate with above inscription shall be fixed to the enclosure with screws. The warning plate shall be of nickel plated brass or stainless steel.

7.1.6 All accessories like nuts, bolts, washers etc. shall be made of stainless steel SS-304.

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7.1.7 All the non-current carrying metallic parts of the panel shall be inherently bonded together. Each lighting and power panel shall be provided with two earthing studs (bolt, nut with spring and plain washer) with lugs on the exterior of the panel enclosure suitable for termination of 10 mm dia GI wire rope. No screw type fixing arrangement shall be allowed.

7.1.8 Each outgoing feeder shall be provided with distinct terminals for phase, neutral and earth. The terminal block enclosures shall be adequately sized to properly terminate the cables by taking into account the required bending radii of cable cores and shall have the following minimum gland to terminal distances:

Conductor Size	Up to 2.5 mm^2	Above 2.5 mm^2 & Up to 10 mm^2	Above 10 mm^2 & Up to 35 mm^2	Above 35 mm^2 & Up to 95 mm^2
Gland to terminal distance	40 mm	60 mm	100 mm	150 mm

7.1.9 The panels shall be provided with suitably sized cable entries at the bottom/ sides, for incoming and outgoing cables. Panels shall be complete with double compression type nickel plated brass flameproof cable glands. Flameproof nickel plated brass sealing plugs shall be supplied, for plugging the unused cable entries. The quantity of sealing plugs shall be equal to 20% of the total number of outgoing cable entries.

7.1.10 The panels shall have external fixing lugs for mounting on wall or column. The holes provided on these lugs shall be of oblong type.

7.1.11 A tag plate indicating Tag Number, engraved, 3 ply laminate fixed with screws, shall be provided on each lighting and power panel. Nameplates shall also be provided for each incoming and outgoing feeder. A separate nameplate shall be provided to indicate the name of manufacturer, testing agency, test certificate number, serial number, BIS license number, applicable gas group as per IS/IEC 60079, statutory agency (PESO) approval number and any additional marking required by statutory authority. The nameplates shall be Al anodized or SS-304 engraved type or laser-marked and permanently fixed on the equipment. In case the standard details given above are embossed on the enclosures, the same need not be repeated on the name plate.

7.2 Component Specification

7.2.1 Bus bars in the lighting and power panels shall be made of high conductivity copper, and shall be supported by non-hygroscopic insulators. Bus bars shall be colour coded for identification of phases and neutral.

7.2.2 The incomer shall have one no. 4 pole MCB isolator (without overload and short-circuit release) and one no. 4 pole ELCB (if specified in the MR/ Tender). ELCBs shall have a maximum sensitivity of 30mA.

7.2.3 The outgoing feeders shall be provided with double pole MCBs having overload and short-circuit releases. Further, separate 2 pole ELCBs with maximum sensitivity of 30mA shall be provided for outgoing feeders if specified in MR/ Tender.

7.2.4 All MCBs (except isolators) and ELCBs shall be with 10kA interrupting capacity.

7.2.5 The ELCB shall be hand reset type. Door mounted reset push button shall be provided for ELCB.

7.2.6 The operating knobs (ON/ OFF/ RESET) shall be provided with a suitable rack and pinion arrangement or cam type operating mechanism for operating them smoothly from outside.

7.3 Terminals & Wiring

7.3.1 The panels shall be provided with sufficient number of terminals. More than 2 wires per terminal shall not be permitted. If required, additional terminal with shorting link may be

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used. Tinned Copper lugs shall be provided for cable termination. Incoming and outgoing terminals shall be suitably segregated.

7.3.2 All internal wiring in lighting and power panels shall employ adequately sized, 660V/ 1100V grade, FRLS type, XLPE/ PVC insulated, Copper conductor wires, colour coded for phase, neutral and earth, with minimum conductor sizes as below:

Incomer : 16 mm²

Outgoing : 2.5 mm²

All terminations shall be with suitable lugs.

8.0 INSPECTION, TESTING AND ACCEPTANCE

8.1 During fabrication, the equipment shall be subjected to inspection by EIL/ Owner or by an agency authorised by the Owner, as per agreed Inspection Test Plan. Manufacturer shall furnish all necessary information concerning the supply to EIL/ Owner's inspector. All routine/ acceptance tests shall be carried out at manufacturer's works under his care and expense.

8.2 Type test certificates from NABL-approved/ Central Government Labs in India/ IECEx-certified/ equivalent Labs, Manufacturer's works test reports, applicable PESO approval and BIS license shall be shown to the inspection agency on demand during inspection. The certificates, BIS license and PESO approval must be valid at the time of despatch.

8.3 Test certificates of bought out components shall be submitted to the inspection agency, as per inspection and Test Plan no. 6-81-1008.

8.4 All equipments shall be subjected to various routine/ acceptance tests as per Inspection and Test plan no. 6-81-1008.

9.0 PACKING AND DESPATCH

All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for the selected mode of transportation, i.e. by ship/ rail or trailer and shall be wrapped in polythene sheets before being placed in crates/ cases to prevent damage to finish. The crates/ cases shall have skid bottom for handling. Special notations such as 'Fragile', 'This side up', 'Center of gravity', 'Weight', 'Owner's particulars', 'PO no.' etc., shall be clearly marked on the packages together with other details as per purchase order.

The equipment may be stored outdoors for long periods before installation. The packing should be suitable for outdoor storage in areas with heavy rains and high ambient temperature unless otherwise agreed. A set of instruction manuals for installation, testing and commissioning, a set of operation & maintenance manuals and a set of final drawing shall be enclosed in a waterproof cover along with the shipment.

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पैकेज उपस्कर के निम्न वोल्टेज वाले फ़िक्स किस्म के स्विच बोर्ड के लिए विनिर्देश

SPECIFICATION
FOR
LV SWITCHBOARD FIXED TYPE
FOR PACKAGE EQUIPMENT

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	20.03.2025	REVISED AND REISSUED AS STANDARD SPECIFICATION	CA	SA	HK	MN
5	10.02.2021	REVISED AND REISSUED AS STANDARD SPECIFICATION	CA/RKS	SA	PG	SM
4	01.04.2016	REVISED AND REISSUED AS STANDARD SPECIFICATION	CA/RKS	SA	BRB	RN
3	03.02.2011	REVISED AND REISSUED AS STANDARD SPECIFICATION	DA	SG	UAP	DM
2	07.03.2005	REVISED AND REISSUED AS STANDARD SPECIFICATION	SSM	RR	AAN	SKG
1	19.11.2001	REVISED AND ISSUED AS STANDARD SPECIFICATION	SSM	AAN	VPS	GRR

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Abbreviations:

A	Ampere
AC	Alternating Current
BIS	Bureau of Indian Standards
CEA	Central Electricity Authority
CPRI	Central Power Research Institute
CRCA	Cold Rolled Cold Annealed
CT	Current Transformer
CBCT	Core Balance Current Transformer
DC	Direct Current
DMPR	Digital Motor Protection Relay
DOL	Direct On Line
EIL	Engineers India Limited
ELR	Earth Leakage Relay
EPDM	Ethylene Propylene Diene Monomer
FRLS	Flame Retardant Low Smoke
HDPE	High-Density Polyethylene
HRC	High Rupture Capacity
Ics	Rated service short circuit current
Icu	Rated ultimate short circuit current
IEC	International Electrotechnical Commission
IP	Ingress Protection
IS	Indian Standard
kA	kilo Ampere
kW	kilo Watt
kWH	kilo Watt Hour
LED	Light Emitting Diode
MCB	Miniature Circuit Breaker
MCCB	Moulded Case Circuit Breaker
MFM	Multi-Function Meter
LV	Low Voltage
NO	Normally Open
NC	Normally Closed
PVC	Poly Vinyl Chloride
V	Volt
XLPE	Cross-linked polyethylene

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1.0 SCOPE

This specification covers the requirement of design, fabrication, testing, packing and supply of Low voltage fixed type switchboard in single front execution required for receipt, control and distribution of power to various low voltage consumers of the package equipment such as Air conditioning plant, Pressurisation plant, etc.

2.0 CODES AND STANDARDS

2.1 The equipment shall comply with the requirements of latest revision of the following standards issued by BIS unless otherwise specified.

IS : 1248	:	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories
IS : 2824	:	Method for determining the proof and the comparative tracking indices of solid insulating materials.
IS : 5082	:	Wrought aluminum and aluminum alloy bars, rods, tubes and sections for electrical purposes.
IS : 5578	:	Guide for marking of insulated conductor.
IS : 11353	:	Guide for uniform system marking and identification of conductors and apparatus terminals.
IS : 13703	:	Low voltage fuses for voltages not exceeding 1000V AC or 1500V DC.
IS : 16227/ IEC: 61869	:	Instrument transformers
IS/IEC: 60255	:	Measuring Relays and Protection Equipment.
IS/IEC: 60269	:	Low-Voltage Fuses
IS/IEC: 60529	:	Degree of protection provided by enclosures (IP Code).
IS/IEC: 60947	:	Low Voltage Switchgear and control gear.
IS/IEC: 61439	:	Low voltage switchgear and control gear assemblies.

2.2 In case of imported equipment, standards of the country of origin shall be applicable if these standards are equivalent or stringent than the applicable Indian standards.

2.3 The equipment shall also conform to the provisions of CEA Regulations with latest amendments and other statutory regulations currently in force in the country.

2.4 In case Indian standards are not available for any equipment, standards issued by IEC or equivalent agency shall be applicable.

2.5 In case of any contradiction between various referred standards/specifications/data sheet and statutory regulations, the most stringent requirement shall govern and decision of owner/EIL in this regard shall be final & binding.

3.0 GENERAL REQUIREMENTS

3.1 The offered equipment shall be brand new with state of art technology and having proven field track record. No prototype equipment shall be offered.

3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment at least for 10 years from the date of supply.

3.3 Vendor shall give a notice of at least one-year to the end user of equipment and EIL before phasing out the product/spares to enable the end user for placement of order for spares and services.

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4.0 SITE CONDITIONS

4.1 The switchboards shall be suitable for installation and satisfactory operation in a pressurised room or in room with restricted natural air ventilation in a tropical, humid and corrosive atmosphere.

4.2 The switchboards shall be designed to operate under specified site conditions. If not specifically mentioned, a design ambient temperature of 40° C and altitude not exceeding 1000 metres above mean sea level shall be considered.

4.3 All the equipments described in this specification are intended for continuous duty with the specified ratings under the specified ambient conditions unless indicated otherwise.

5.0 DESIGN AND FABRICATION REQUIREMENTS

5.1 The switchboard shall be free standing, suitable for directly flush mounting with the wall, with complete front access for operation and maintenance. The switchboard shall be fixed type, in single front execution, assembled in single line up, metal enclosed, fully compartmentalised, totally segregated compartments for feeders, cables and bus bar, dust and vermin proof suitable for indoor installation with form of internal separation minimum "Form-3b" as per IS/IEC-61439, unless otherwise specified elsewhere. The switchboard shall be completely type tested for the following tests (Short circuit, Temperature rise, Degree of Protection, Impulse withstand etc), as per IS/IEC standards. The switchboard shall also be completely Design Verified as per IS/IEC 61439-1 and Design Verification Report shall be submitted for the same.

5.2 The switchboard enclosure shall be dust and vermin proof and shall provide a degree of protection not less than IP-41.

5.3 The switchgear shall be assembled out of vertical panels of uniform height not exceeding 2450 mm in a single line up. The maximum height of the operating handle/switches shall not exceed 1900 mm and the minimum height not below 300 mm.

5.4 The switchboard shall be designed to ensure maximum safety during operation, inspection, and connection of cables, relocation of outgoing circuits and maintenance with the bus bar system energised and without taking any special precautions. The switchgear shall permit maximum interchangeability. All identical equipments and corresponding parts shall be fully interchangeable.

5.5 It shall be possible to extend the switchboard, in either direction at a later date. End of bus bars shall be suitably drilled for this purpose. Panels at extreme end shall have openings, which shall be covered with plates screwed to the panel.

5.6 Adequate means shall be provided to prevent shorting of power and / or control terminals due to accidental dropping of maintenance tools etc. inside the switchboard. Checking and removal of components shall be possible without disturbing adjacent equipment/modules/feeders.

5.7 The frame, of individual vertical panels shall be fabricated using pressed and cold rolled sheet steel. The sheet steel used for panel shall be of minimum 2mm (14SWG) CRCA except the doors and covers that may be made of 1.6mm (16SWG) CRCA. Wherever required, stiffeners shall be provided to increase mechanical strength of large size doors and covers.

As an alternative to CRCA, Aluzinc/pre-galvanised sheet steel can also be provided for internal inter-panel partitions only as per vendor's standard manufacturing practices. However, all external surfaces shall be of CRCA with specified paint shade.

5.8 The switchboard shall be provided with integral base frame for each vertical panel. The switchboard integral base frame shall be suitable for tack welding.

5.9 All hardware shall be corrosion resistant. All joints and connections of the panel members shall be made of galvanised or zinc passivated cadmium plated high quality steel bolts, nuts and washers, secured against loosening.

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5.10 All openings, covers and doors shall be provided with gaskets of Neoprene/HDPE/EPDM or equivalent around the perimeter to make the switchboard dust and vermin proof.

5.11 Suitable removable type eyebolts/ lifting hooks shall be provided for lifting of the panel/shipping section. These eyebolts/ lifting hooks, when removed shall not leave any opening in the panels.

5.12 After preparation of the under surface, the panel shall be spray painted with two coats of epoxy based final paint or shall be powder coated. The colour shade of final paint shall be as RAL-7032, unless specified otherwise. Panel finish shall be free from imperfections like pinholes, orange peels, runoff paint, etc.

5.13 All unpainted steel parts shall be zinc passivated, cadmium plated or suitably treated to prevent rust and corrosion. If these parts are moving elements, then these shall be greased.

5.14 The switchboard shall be suitable for top or bottom cable entry as mentioned in datasheet, and shall be provided with removable gland plates. The gland plate thickness shall be minimum 3mm. Non-magnetic cable gland plates shall be provided for termination of single core cables. The switchboard shall have a separate cable alley for each vertical panel with cable tying arrangement. The cable alley width shall be sufficient to accommodate the required number of cables. However, in any case it shall not be less than 200mm width. The cable alley shall be provided with a suitable hinged door. Required number of single compression nickel plated brass cable glands and tinned copper compression type lugs (for bolted terminals) for all power and control cables shall be included in the vendor's scope of supply.

5.15 The switch board shall comprise of incoming load break switch panel or air circuit breaker panel, outgoing switch fuse, switch fuse contactor feeders, MCCB feeders, motor starter feeders, control supply transformers, both power and auxiliary/control bus bars, cable termination compartment etc. All these shall be housed in independent compartments separated from each other by metallic barrier.

5.16 Main horizontal bus bars shall be provided at the bottom in separate compartment for switchboards with top cable entry and at the top for switchboards with bottom cable entry. Vertical bus bars required for connection between main bus bars and outgoing feeders shall be in separate vertical chamber. One set of vertical bus bars can be provided for feeding outgoing feeders in two panels on either side of the vertical bus bar.

5.17 All components including bus bars and cable termination shall be accessible only from the front side for repair and maintenance.

5.18 Each outgoing feeder shall be in multitier arrangement having minimum height of individual module as defined in switchboard data sheet. All feeders shall be of modular design with height in multiples of standard unit size.

5.19 All auxiliary devices for control, reset, indication, measurement and protection except the bimetallic relays shall be mounted on the front side of the respective compartment. Components requiring frequent inspection during operation shall be easily accessible. The design shall be such that all power ON/OFF or START / STOP and relay reset operations shall be performed without opening the panel door.

5.20 Each vertical panel shall be provided with space heater to prevent moisture condensation rated for 240V AC supply, provided with a switch, fuse or double pole MCB and thermostat having variable setting range of 30-70 °C. The panels shall be provided with suitable illuminating LED lamp with switch and fuse or MCB. Further, one number 240V AC, 6/ 16A, 5 Pin socket for owner's use shall be provided inside panels.

5.21 Main bus bars shall be of high conductivity electrolytic aluminium/ copper having uniform current rating throughout their length. Horizontal and vertical bus bars shall be sized depending upon the maximum expected current and to limit the specified maximum operating temperature at specified design ambient temperature.

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5.22 The hot spot temperature of busbars, conductors including joints at design ambient temperature shall not exceed 130°C for Copper busbar and 120°C for Aluminium busbar. Temperature rise at all other locations shall be maintained in line with IS/IEC 61439.

5.23 Minimum clearance & creepage distances between live parts, between live parts/neutral to earth shall be as per IS/IEC 61439 for the selected material group and specified pollution degree.

5.24 Adequately sized auxiliary copper bus bars running horizontally in a separate enclosure / compartment shall be provided for space heaters, control supply and metering requirements. Necessary tee-off connections shall be used for distributing auxiliary supply to each vertical panel.

5.25 All horizontal and vertical bus bars shall be insulated with heat shrink PVC sleeves of 1100 V grade and removable shrouds shall be provided for joints. All bus bars shall be prominently marked with red, yellow and blue colour rings for easy phase identification at regular interval and at every power tap off point and designed to withstand specified short circuit currents for one second. The sleeves shall be rated to withstand the system line-to-line voltage for 1 minute.

5.26 Copper earth bus of minimum 30x6 mm^2 size for fault level upto 31.5 kA and minimum 50x6 mm^2 size for fault level upto and including 65 kA shall be provided throughout the length of the switchboard with provision for interconnection to earthing grid at two ends. All non-current carrying metallic parts of the mounted equipment shall be earthed. Doors and movable parts shall be earthed using flexible copper connections.

5.27 Inside the switchboards, the wiring for power, control, signalling, protection and instrument circuits shall be done with FRLS, PVC/XLPE insulated copper conductors & BIS approved having 660/1100 V grade insulation.

5.28 For modules rated above 100 A, preferably copper strip connections shall be used. The controls connections shall be done with 660V grade PVC/XLPE insulated FRLS wires having stranded copper conductors. Minimum size of control wire shall be 1.5 mm^2 copper for circuits having fuse rating 10 A or less. For higher fuse rating control circuits, minimum 2.5 mm^2 copper conductor shall be used. Each wire shall be identified at both ends by self-sticking wire marker tapes or PVC ferrules. Transparent shrouds shall be used on outgoing power terminals.

5.29 Clamp type terminals shall be acceptable for wires upto 10 mm^2 size, for conductors larger than 10 mm^2, bolt type terminals with crimping lugs shall be provided. Each wire shall be terminated at a separate terminal. A minimum of 10% spare terminal shall be provided on each terminal block. Shorting links shall be provided for all CT terminals.

5.30 Components of similar modules of same sizes shall be identically located and wired. Control supply change over switch shall be provided in case the switchboard is with two bus-sections.

5.31 In open doors condition of compartment, all live parts or terminals of all door-mounted, internal components and bus contact openings shall be IP-2X protected.

5.32 Unless otherwise specified elsewhere, the switchboard assembly and components shall be suitable for use in pollution degree 3 environment as per IS/IEC.

6.0 EQUIPMENT / COMPONENTS SPECIFICATION

6.1 All circuit breaker shall be air break type. All switches shall be load break, heavy duty/motor duty, air break type with the operating handle mounted on the compartment door, complete with necessary interlock and defeat mechanism. All switches drives other than rotary switches shall be lockable in OFF position. Rating of switches for starter module shall meet the requirements of AC-23 duty as per IS/ IEC 60947 and minimum rating shall be as specified in job specification/data sheets.

6.2 The incomers & buscoupler shall be provided with 4 pole load break switch/breaker.

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6.3 All contactor-controlled starter feeders shall meet the requirements of type-2 co-ordination as per IS/IEC: 60947. However, contactor-controlled motor feeders shall meet the requirements of type-2 co-ordination as per IS/IEC: 60947 considering energy efficient motors of IE-3/IE-4 type (as per job specification), unless otherwise specified elsewhere.

6.4 All fuses shall be non-deteriorating HRC cartridge link type, BIS approved. Power fuses shall be pressure fitted type and shall preferably have ribs on the contact blades to ensure good line contact. It shall be possible to handle fuses during off load conditions with full voltage available on the terminals. Wherever required fuse pullers shall be provided. The fuse base shall be so located in the modules to permit insertion of fuse pullers and removal of fuse links without any problem.

6.5 The contactors shall be air break type, equipped with three main contacts and provided with 1NO+1NC potential free spare auxiliary contacts wired to the terminal block for owner's use. The main contacts of contactor for motor starter module shall have AC-3 or AC-4 rating as per package requirements. Unless specified otherwise, the coil of the contactor shall be suitable for operation on 240 V, 1 Phase, AC supply.

6.6 Bimetal relays shall be provided for protecting the motor from thermal overload. Bimetal thermal overload relays shall be manually reset type with the reset push button provided on the cubical door. Bimetal relays shall be three elements, positive acting ambient temperature compensated type with adjustable setting range and built-in single phasing prevention feature, which operates even with 50% rated current at the time of single phasing.

6.7 MCCBs shall be provided with spring assisted quick make/ break manually operated trip free mechanism. `ON' and `OFF' position of the operating handle of MCCB shall be displayed and the operating handle shall be mounted on the door of the compartment. MCCB's as part of motor starter module shall be current limiting type and type tested for type-2 co-ordination as per IS/ IEC-60947 considering energy efficient motors of IE-3/ IE-4 type (as per job specification) unless otherwise specified elsewhere. MCCB shall be suitable for Ics=Icu=100%.

6.8 For MCCB feeders other than those provided with DMPR or any other numerical relay, MCCBs shall be provided with a tripping device with inverse time characteristic for over load protection and instantaneous characteristics for short circuit protection and earth fault protection.

6.9 Current transformers for metering shall have an accuracy class 1.0 and instrument security factor not greater than 5. Protective current transformers shall have an accuracy class 5P and an accuracy limit factor greater than 20.

6.10 All measuring AC instruments shall be moving iron, flush mounting type and of 72 x 72 mm square pattern instruments for incomer and outgoing feeders. The accuracy class for all instruments shall be 1.0 as per IS-1248. Ammeters for motor feeders shall have a non-linear compressed scale at the end to indicate motor starting current and red mark for the full load current. The KW/KWH meters shall be suitable to measure unbalanced loads on 3 phases 4-wire system. Test terminal block shall be provided for KWH meters.

6.11 Multifunction meters/ Digital meters shall be provided, if specified in job specifications/datasheets. All MFM/ digital meters shall be highly reliable, accurate and compact. MFM/ Digital meter data shall be saved in case of power failure. Communicable type MFM/ Digital meter shall be provided if specified in datasheet/ job specification.

6.12 Digital motor protection relay shall be provided, if specified in job specifications/datasheets. All DMPR relay shall have Multi-Protection features like Motor protection (Overload, Overcurrent, Earth leakage Protection, Ground fault, Stalled Rotor, Loss of load, Phase unbalance, Negative phase sequence, Reverse connection), overcurrent, undercurrent & under voltage protection.

6.13 DMPR shall also have display and following features shall be provided in display like type of fault, three phase current, power, voltage, power factor and motor load (%) etc.

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6.14 CT ratio shall be settable in Digital MPR and communicable type DMPR shall be provided if specified in datasheet/ job specification.

6.15 CBCT with Earth Leakage Relay shall be provided if specified in job specifications/datasheets. ELR shall be manually hand reset type. In case hand reset feature is not available in the offered relay model, vendor to provide external hardware logic for manual hand resetting of the earth leakage relay.

6.16 All Control/selector switches shall be rotary back-connected types having a cam operated contact mechanism with knob type handle. Ammeter selector switch shall have make before break feature on its contacts. The selector switch shall generally have 4 positions, three for reading 3 phase currents and the fourth position for off. The voltmeter selector switch shall also have 4 positions. Three positions shall be used to measure phase-to-phase voltage and fourth shall be OFF position.

6.17 Auxiliary relays/contactors shall generally be used for interlocking and multiplying contacts.

6.18 MCB shall have minimum breaking capacity of 9kA unless otherwise specified. Positive ON/OFF indication shall be provided.

6.19 Indicating lamps shall be cluster LED type of minimum 8mm-diameter size. The following indicating colours shall be used.

Closed/on	:	Red
Open/off	:	Green
Fault trip	:	Amber
Control supply on	:	White

6.20 Push button colours shall be as follows:

Stop/open/emergency stop	:	Red
Start/close	:	Green
Reset/test	:	Yellow/Black/White

The 'Stop' push button shall be stayput type.

All motor starter feeders shall have Stop and Reset push buttons and On and Trip indication lamps.

6.21 A centrally located engraved nameplate shall be provided for the switchboard. Each module shall have engraved nameplate bearing data as per approved drawings. Nameplate or polyester adhesive stickers shall be provided for each equipment mounted on & inside the switchboard. Identification tags shall be provided inside the panels matching with those shown on the circuit diagram. Special warning labels shall be provided on removable covers or doors giving access to cable terminals and bus bars.

Engraved nameplates shall preferably be of 3- ply (Black-White- Black) lamicoid sheets or anodised aluminium. However back engraved perspex sheet nameplates may also be acceptable. Nameplates shall be fastened by screws and not by adhesives.

7.0 INSPECTION, TESTING AND ACCEPTANCE

7.1 During fabrication, the switchboard shall be subject to inspection by EIL / Owner, or by an agency authorised by the Owner, to assess the progress of work, as well as to ascertain that only quality raw material is used. The manufacturer shall furnish all necessary information concerning the supply to EIL / Owner's inspectors.

7.2 For testing requirements refer Inspection & Test Plan No. 6-81-1012. Prior notice of minimum 4 weeks shall be given to EIL/owner for witnessing the final testing of the complete assembly to ensure satisfactory operation of all components. Tests shall be carried out at manufacturer's works under his care and expense.

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7.3 Test certificates of bought out components shall be submitted to the inspection agency, as per Inspection and Test Plan no. 6-81-1012.

8.0 PACKING AND DESPATCH

All the equipment shall be divided in to several shipping sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. The panels shall be wrapped in polyethylene sheets before being placed in wooden crates /cases to prevent damage to the finish. Crates /cases shall have skid bottoms for handling. Special precaution notations such as Fragile, This side up, centre of gravity, weight, Owner's particulars, Purchase order number etc. shall be clearly marked on the package together with other details as per purchase order.

The equipment may be stored outdoors for long periods before installation. The packing should be suitable for outdoor storage in areas with heavy rains and high ambient temperature unless otherwise agreed. A set of instruction manuals for installation, testing and commissioning, a set of operation & maintenance manuals and a set of final drawing shall be enclosed in a waterproof cover along with the shipment.

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औद्योगिक किस्म के नियंत्रण स्टेशन के लिए विनिर्देश

SPECIFICATION FOR INDUSTRIAL TYPE CONTROL STATIONS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	18.01.21	REVISED AND ISSUED AS STANDARD SPECIFICATION	PS	RSR	PG	SM
5	11.03.16	REVISED AND ISSUED AS STANDARD SPECIFICATION	SV	ANPS	BRB	SC
4	11.04.11	REVISED AND ISSUED AS STANDARD SPECIFICATION	JM	ANPS	UAP	DM
3	24.08.07	REVISED AND ISSUED AS STANDARD SPECIFICATION	ANPS	UAP	JMS	VC
2	30.01.02	REVISED AND ISSUED AS STANDARD SPECIFICATION	UAP	AAN	VPS	GRR

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Abbreviations:

AC	Alternating Current
BIS	Bureau of Indian standards
CEA	Central Electricity Authority
CT	Current Transformer
DC	Direct Current
EIL	Engineers India Limited
FRLS	Flame Retardant Low Smoke
GI	Galvanised Iron
IEC	International Electrotechnical Commission
IP	Ingress Protection
IS	Indian Standards
LED	Light Emitting Diode
LV	Low Voltage
NC	Normally Closed
NO	Normally Open
PB	Push Button
PO	Purchase Order
PVC	Poly Vinyl Chloride
SMD	Surface Mount Device
SS	Stainless Steel
SWG	Standard Wire Gauge
VFD	Variable Frequency Drive
XLPE	Cross Linked Poly Ethylene

Electrical Standards Committee

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1.0 SCOPE

This specification covers the requirements of design, manufacture, testing, packing and supply of industrial type control stations and accessories suitable for installation in non-hazardous/ safe outdoor areas.

2.0 CODES AND STANDARDS

2.1 The equipment shall comply with the requirements of latest revision of following standards issued by BIS:

IS: 5	:	Colours for ready mixed paints and enamels.
IS: 1248	:	Direct acting indicating analogue measuring instruments and their accessories.
IS / IEC: 60529	:	Degrees of protection provided by enclosures (IP code).
IS / IEC: 60947	:	LV switchgear and control gear.

2.2 In case of imported equipment, IEC standards or equivalent standards shall be applicable, if these standards are equivalent or more stringent than the applicable Indian Standards.

2.3 The equipment shall also conform to the provisions of CEA Regulations with latest amendments and other statutory regulations currently in force in the country.

2.4 In case Indian standards are not available for any equipment, standards issued by IEC or equivalent agency (if more stringent than IEC) shall be applicable.

2.5 In case of any conflict between requirements specified in various applicable documents for the project, the most stringent requirement shall govern. However, Owner's/EIL's decision in this regard will be final and binding.

3.0 GENERAL REQUIREMENTS

3.1 The offered equipment shall be brand new with state of art technology and having proven field track record. No prototype equipment shall be offered.

3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 10 years from the date of supply.

4.0 SITE CONDITIONS

The equipment shall be suitable for installation and satisfactory operation in tropical, humid and corrosive atmosphere as prevalent in refineries, petrochemical and fertilizer plants. Unless otherwise specified, a design ambient temperature of 40° C and an altitude not exceeding 1000 m above mean sea level shall be considered.

5.0 TECHNICAL REQUIREMENTS

5.1 Construction

5.1.1 The enclosures of the control stations shall be made of either sheet steel or cast light metal alloy, unless otherwise specified.

5.1.2 The control stations shall be suitable for use in outdoor open locations and shall have minimum IP-55 degree of protection. Suitable canopy shall be provided for protection against rain from top, back and two sides. The separate canopy shall be made of at least 1.6 mm (16 gauge) galvanized sheet steel/ stainless steel minimum SS-304 (as specified in purchase specifications).

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5.1.3 All control stations shall be suitable for 240V AC as well as for 110V/220V DC control supply.

5.1.4 The control stations shall be provided with gaskets made of non-inflammable and self-extinguishing material.

5.1.5 All metal surfaces shall undergo manufacturer's standard cleaning/ painting/ powder coating cycle. After surface preparation, the equipment shall be painted with two coats of epoxy based final paint or epoxy powder coated with minimum coating thickness of 80 microns, with colour shade as dark admiralty grey, shade 632 of IS-5/ RAL 7031. All unpainted parts shall be suitably treated to prevent rust formation/ corrosion. If these parts are moving, then these shall be greased with grease which does not solidify.

5.1.6 All accessories like nuts, bolts, washers etc. and operating shaft of push buttons, switches etc. shall be made of stainless steel SS-304. Alternatively, nickel-plated brass material may be used for the operating shafts of push buttons, switches etc.

5.1.7 The control stations shall be provided with two earthing studs (minimum M10 bolt, nut with spring and plain washer) with lugs on the external surface of the enclosures suitable for termination of 8 SWG GI wire. No screw type fixing arrangement shall be allowed.

5.1.8 The control stations shall be provided with undrilled gland plate. However, double compression nickel-plated brass cable glands shall be supplied loose to suit the specified cable sizes. The cable termination chamber of the control station shall be large enough to provide a minimum space of 100 mm between top of the cable gland and bottom of the terminal block.

5.1.9 The control stations shall have external fixing lugs for mounting on wall or column. The holes provided on these lugs shall be of oblong type.

5.1.10 A tag plate indicating Tag Number shall be provided on each control station. The tag plate shall be engraved, 3 ply laminate fixed with screws.

5.2 Component Specification

5.2.1 Push buttons for START/ OPEN and STOP/ CLOSE shall be of GREEN and RED colour respectively. Each push button shall have two NO and two NC contacts. The STOP push button shall be mushroom type with stay put feature and lockable in pressed position. Refer Sketch 1 for wiring and other details for various types of control stations

5.2.2 All selector switches shall have minimum two poles for each position. Each position of switch shall be indelibly marked on the control station. The configuration of selector switch shall be LOCAL-OFF-REMOTE.

5.2.3 All ammeters shall be of moving iron type having an accuracy class of 1.5 and suitable for 1 Ampere CT secondary. Minimum size of ammeter shall be either 72 mm x 72 mm or 65 mm diameter. 80% of the scale length shall cover 100% of the CT primary current uniformly and the balance 20% of the scale shall cover 100-800% of the CT primary. A red mark corresponding to the full load current of the motor shall be provided on the ammeter dial. The ammeter front glass shall be toughened.

5.2.4 Indicating lamp(s), wherever provided, shall be clustered LED type or SMD chip type LED with colour lens of minimum 25 mm diameter.

5.3 Terminals & Wiring

5.3.1 The control stations shall be provided with sufficient number of terminals. More than 2 wires per terminal shall not be permitted. If required, additional terminal with shorting link may be used. Each terminal for external cable connection shall be suitable for termination of 2.5 mm^2 (unless otherwise specified) stranded copper conductor. Tinned copper lugs shall be provided for cable termination wherever applicable.

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5.3.2 All internal wiring shall employ 1.5 mm^2, 660V/ 1100V grade, FRLS type, XLPE/ PVC insulated copper conductor wires. All termination shall be with suitable lugs.

6.0 INSPECTION, TESTING AND ACCEPTANCE

6.1 During fabrication, the equipment shall be subjected to inspection by EIL/ Owner or by an agency authorised by the Owner, as per agreed Inspection Test Plan. Manufacturer shall furnish all necessary information concerning the supply to EIL/ Owner's inspector. All routine/ acceptance tests shall be carried out at manufacturer's works under his care and expense.

6.2 Test certificates of bought out components shall be submitted to the inspection agency, as per Inspection and Test Plan no. 6-81-1014.

6.3 All equipment shall be subjected to various routine / acceptance tests as per Inspection and Test Plan no. 6-81-1014.

7.0 PACKING AND DESPATCH

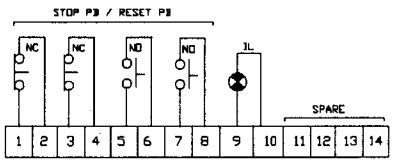
All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for the selected mode of transportation, i.e. by ship/ rail or trailer, and shall be wrapped in polythene sheets before being placed in crates/ cases to prevent damage to finish. The crates/ cases shall have skid bottom for handling. Special notations such as 'Fragile', 'This side up', 'Center of gravity', 'Weight', 'Owner's particulars', 'PO no.' etc., shall be clearly marked on the packages together with other details as per purchase order.

The equipment may be stored outdoors for long periods before installation. The packing shall be suitable for outdoor storage in areas with heavy rains and high ambient temperature unless otherwise agreed. A set of instruction manuals for installation, testing and commissioning, a set of operation & maintenance manuals and a set of final drawing shall be enclosed in a waterproof cover along with the shipment.

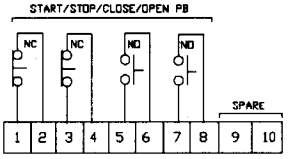
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SKETCH–1

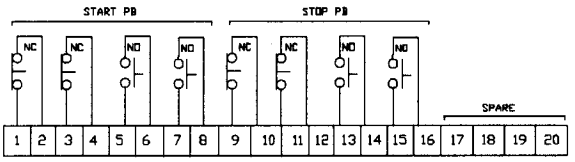
WIRING DETAILS OF CONTROL STATIONS



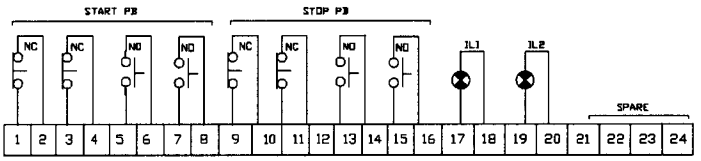
TYPE–A1 (STOP P.B. WITH LAMP)
OR
(RESET P.B. WITH LAMP)
(CABLE SIZE : 4Px2.5 Sq.mm)



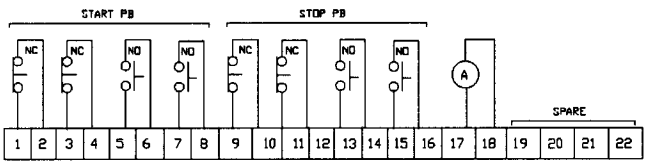
TYPE–A2
(START PB) OR (STOP PB) OR (CLOSE PB) OR (OPEN PB)
(CABLE SIZE : 2Px2.5 Sq.mm)



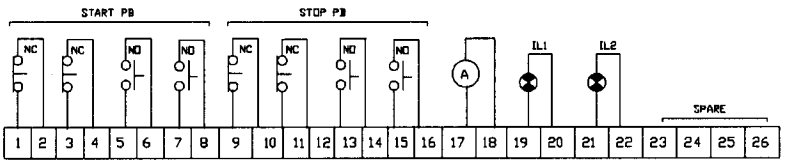
TYPE–B1 (WITH START & STOP PBs) OR (WITH CLOSE & OPEN PBs)
(CABLE SIZE : 4Px2.5 Sq.mm)



TYPE–B2 (WITH START & STOP PBs & INDICATION LAMPS)
OR
(WITH CLOSE & OPEN PBs & INDICATION LAMPS)
(CABLE SIZE : 6Px2.5 Sq.mm)

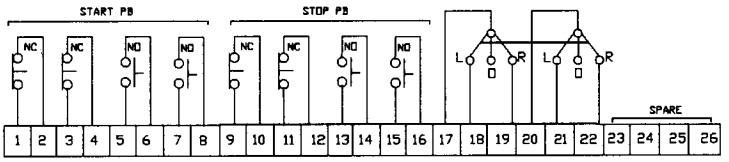


TYPE–C1 (WITH START & STOP PBs & AMMETER)
(CABLE SIZE : 4Px2.5 Sq.mm)

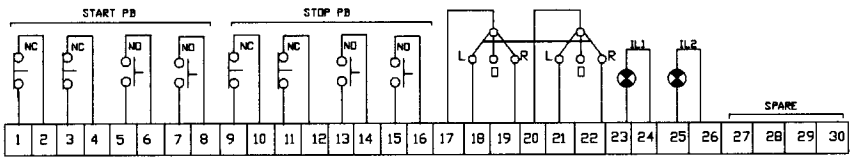


TYPE–C2 (WITH START & STOP PBs, AMMETER & INDICATION LAMPS)
(CABLE SIZE : 6Px2.5 Sq.mm)

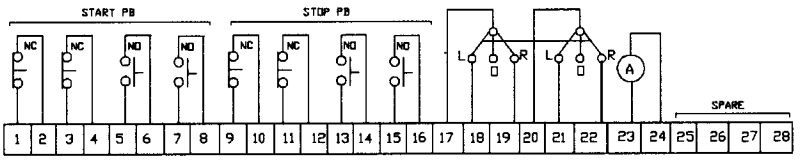
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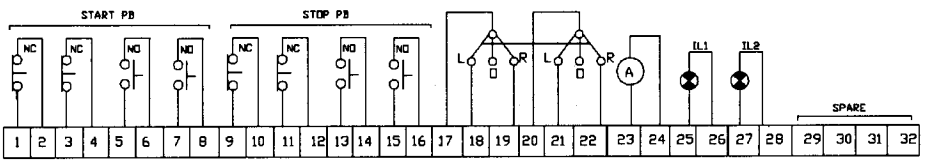
TYPE–D1 (WITH START & STOP PBs & L–O–R SELECTOR SWITCH)
(CABLE SIZE : 6Px2.5 Sq.mm)



TYPE–D2 (WITH START & STOP PBs, L–O–R SELECTOR SWITCH & INDICATION LAMPS)
(CABLE SIZE : 12Px2.5 Sq.mm)

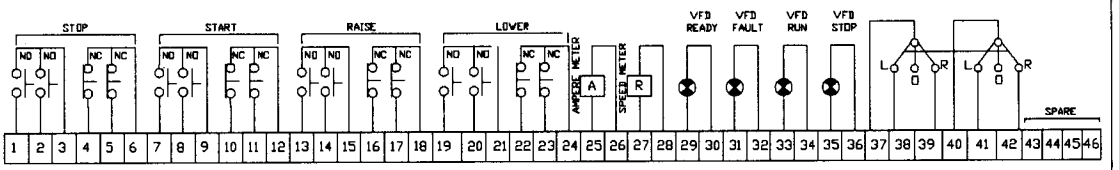


TYPE–E1 (WITH START & STOP PBs, AMMETER & L–O–R SELECTOR SWITCH)
(CABLE SIZE : 6Px2.5 Sq.mm)

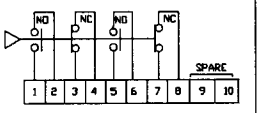


TYPE–E2 (WITH START & STOP PBs, AMMETER, L–O–R SELECTOR SWITCH & INDICATION LAMPS)
(CABLE SIZE : 12Px2.5 Sq.mm)

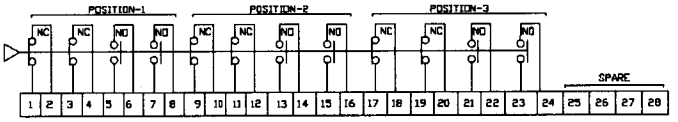
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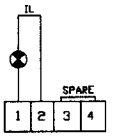
TYPE–F (WITH START & STOP PBs, RAISE & LOWER PBs, L–O–R SWITCH, AMPERE METER, SPEED METER & INDICATING LAMPS) (REFER NOTE–5,6,7)
(CABLE SIZE : 12Px2.5 Sq.mm)



TYPE–I1
SEL SWITCH (2POSITION)



TYPE–I2 SEL SWITCH (3POSITION)



TYPE–I3
(LAMP STATION)

GENERAL NOTES:

1. SHORTING LINKS SHALL BE PROVIDED BY VENDOR. REQUIREMENT SHALL BE INFORMED DURING VENDOR DRAWING REVIEW.
2. WIRING DETAILS SHALL BE READ IN CONJUNCTION WITH MR/TENDER.
3. CABLE SIZES AS INDICATED ABOVE ARE TENTATIVE AND MINIMUM. EXACT CABLE SIZES SHALL BE INFORMED DURING VENDOR DRAWING REVIEW. VENDOR TO PROVIDE REQUIRED SIZE OF CABLE TERMINATION CHAMBER WITH SUITABLE TERMINALS, CABLE ENTRIES, CABLE GLANDS AND LUGS. CONDUCTOR SIZE SHALL BE 2.5 SQ.MM, UNLESS OTHERWISE SPECIFIED.
4. AMMETER WHEREVER PROVIDED, SHALL BE ANALOGUE TYPE UNLESS OTHERWISE SPECIFIED. 4–20 MA TYPE SHALL BE PROVIDED IF DEFINED IN MR/TENDER.
5. FOR VFD CONTROL STATIONS, LAMP SUPPLY VOLTAGE SHALL BE SAME AS VFD CONTROL SUPPLY VOLTAGE.
6. FOR VFD CONTROL STATIONS, IF EXTERNAL SUPPLY IS REQUIRED FOR METERS, THEN SAME SHALL BE AS VFD CONTROL SUPPLY VOLTAGE.
7. METERS IN VFD CONTROL STATIONS SHALL BE SUITABLE FOR 4–20mA TRANSDUCER OUTPUTS AND SHALL BE CALIBRATED FOR THE ACTUAL MOTOR CURRENT. FOR VFD HAVING BYPASS FACILITY, METERS SHALL BE CAPABLE OF READING BYPASS MODE FULL LOAD AND STARTING CURRENTS AS WELL AS VFD MODE DRIVE CURRENT.
8. NUMBER AND COLOUR OF INDICATING LAMPS SHALL BE AS PER THE JOB SPECIFATION/TENDER.
9. CONTROL STATIONS TYPE "I" ARE TYPICALLY FOR INSTRUMENTATION USE.
10. ALL PUSH BUTTON AND CONTROL SWITCH CONTACTS SHALL BE RATED FOR MINIMUM 5A AT 240V(AC–15) AND 1A AT 220V/110V(DC–13) DUTY. CONTACT RATINGS FOR CONTROL STATIONS FOR INSTRUMENTATION USE SHALL BE AS PER INSTRUMENTATION REQUIREMENT.
11. THE EXACT DESCRIPTION OF PB'S WHETHER START/STOP OR OPEN/CLOSE SHALL BE INFORMED DURING VENDOR DRAWING REVIEW.
12. ALL L–O–R SELECTOR SWITCHES SHALL BE LOCKABLE IN OFF POSITION.

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अग्निरोधक प्लगों, साकेटों तथा हैंडलैम्पों के लिए विनिर्देश

SPECIFICATION FOR FLAMEPROOF PLUGS, SOCKETS AND HAND LAMPS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	31.08.20	REVISED AND ISSUED AS STANDARD SPECIFICATION	NNB/AR	ANPS	SA	SM
5	24.02.16	REVISED AND ISSUED AS STANDARD SPECIFICATION	NNB/AK	ANPS	BRB	SC
4	11.04.11	REVISED AND ISSUED AS STANDARD SPECIFICATION	PS	ANPS	UAP	DM
3	29.08.07	REVISED AND ISSUED AS STANDARD SPECIFICATION	ANPS	UAP	JMS	VC
2	30.01.02	REVISED AND ISSUED AS STANDARD SPECIFICATION	UAP	AAN	VPS	GRR

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Abbreviations:

BIS	Bureau of Indian Standards
BS	British Standard
CEA	Central Electricity Authority
COB	Chip On Board
DGMS	Directorate General of Mines Safety
DOB	Driver On Board
ES	Edison Screw
FRLS	Flame Retardant Low Smoke
FRP	Fibre Reinforced Plastic
GI	Galvanised Iron
HRC	High Rupturing Capacity
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical & Electronics Engineers
IP	Ingress Protection
IS	Indian Standard
LED	Light Emitting Diode
LV	Low Voltage
NABL	National Accreditation Board for Testing and Calibration Laboratories
NEMA	National Electrical Manufacturers Association
PCB	Printed Circuit Board
PESO	Petroleum and Explosives Safety Organisation
PVC	Poly Vinyl Chloride
RCCB	Residual Current Circuit Breaker
SPN	Single Phase Neutral
SS	Stainless Steel
TPN	Three Phase Neutral
VDE	Verband der Elektrotechnik, Elektronik und Information stechnik

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1.0 SCOPE

This specification covers the requirements of design, manufacture, testing, packing and supply of flameproof plugs, sockets, transformers, hand lamps and accessories suitable for installation in locations handling flammable liquids and gases/ vapours.

2.0 CODES AND STANDARDS

2.1 The equipment shall comply with the requirements of latest revision of the following standards issued by BIS:

IS-5	:	Colours for ready mixed paints and enamels.
IS-10322	:	Luminaires
IS-13383	:	Photometry of luminaires - Method of measurement
IS-16101	:	General lighting – LEDs and LED modules – Terms and definitions.
IS-16102	:	Self-ballasted LED lamps for general lighting services.
IS / IEC 60079-0	:	Electrical apparatus for explosive gas atmospheres (General Requirements).
IS / IEC 60079-1	:	Electrical apparatus for explosive gas atmospheres (Equipment Protection by Flameproof Enclosures “d”).
IS / IEC 60529	:	Degrees of protection provided by enclosures (IP Code).
IS / IEC 60947	:	LV switchgear and control gear.

National Lighting Code (NLC)-2010

2.2 In case of imported equipment, only IECEx (or equivalent, if more stringent than the applicable IEC) certified equipment shall be used.

2.3 The equipment shall also conform to the provisions of CEA Regulations with latest amendments and other statutory regulations currently in force in the country.

2.4 In case Indian standards are not available for any equipment, standards issued by IEC or equivalent agency (if more stringent than IEC) shall be applicable.

2.5 In case of any conflict between requirements specified in various applicable documents for the project, the most stringent requirement shall govern. However, Owner’s/ EIL’s decision in this regard will be final and binding.

3.0 GENERAL REQUIREMENTS

3.1 The offered equipment shall be brand new with state of art technology and having proven field track record. No prototype equipment shall be offered.

3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 10 years from the date of supply.

4.0 SITE CONDITIONS

The equipment shall be suitable for installation and satisfactory operation in classified hazardous locations in tropical, humid and corrosive atmosphere as prevalent in refineries, petrochemical and fertilizer plants. Unless otherwise specified, a design ambient temperature of 40° C and an altitude not exceeding 1000 m above mean sea level shall be considered.

5.0 CERTIFICATION

The equipment shall have test certificates issued by NABL-approved/ Central Government labs in India/ IECEx-approved/ equivalent labs. All equipment (indigenous & imported) shall also have valid statutory approvals as applicable for the specified location and marking as per

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IS/IEC 60079 or IEC 60079 and as required by statutory authorities. All indigenous flameproof equipment shall have valid BIS license.

6.0 TECHNICAL REQUIREMENTS

6.1 Construction

6.1.1 The enclosures of the plugs, sockets, transformers and hand lamps shall be made of cast light metal alloy.

6.1.2 The equipment shall be suitable for use in outdoor open locations and shall have minimum IP-55 degree of protection. The sockets for fixed installation, i.e. 415 V three phase sockets and 240 V single phase sockets, shall preferably be provided with integral canopy. However, where the enclosure has been certified without integral canopy, a separate canopy can be accepted. The separate canopy shall be made of at least 1.6 mm (16 gauge) galvanised sheet steel/ FRP/ stainless steel minimum SS-304 (as specified in purchase specifications). The canopy shall be suitable for providing protection against rain from top, back and two sides.

6.1.3 The enclosures shall be provided with gaskets for IP, if required by equipment certification. Gaskets, wherever provided, shall be made of non-inflammable and self-extinguishing material.

6.1.4 All metal surfaces shall undergo manufacturer's standard cleaning/ painting/ powder coating cycle. After surface preparation, the equipment shall be painted with two coats of epoxy based final paint or epoxy powder coated with minimum coating thickness of 80 microns, with colour shade as below:

- Flame proof (Gas group IIA/ IIB) : Dark admiralty grey shade 632 of IS-5/ RAL 7031
- Flame proof (Gas group IIC) : Light yellow shade 355 of IS-5/ RAL 1012

All unpainted steel parts shall be suitably treated to prevent rust formation/ corrosion. If these parts are moving then these shall be greased. Grease, which does not solidify, shall be applied to flamepath.

6.1.5 Equipment shall be marked as per IS/IEC 60079.

6.1.6 All accessories like nuts, bolts, washers etc. shall be made of stainless steel SS-304.

6.1.7 All the non current carrying metallic parts of the equipment shall be inherently bonded together. The TPN sockets shall be provided with two earthing studs, with lugs on the exterior of the enclosure, suitable for termination of 10 mm dia. GI wire rope. Internal earth terminals shall be provided in each enclosure for all single phase plugs and sockets for connecting the earth core of the cables.

6.1.8 The terminal block enclosures shall be adequately sized to properly terminate the cables by taking into account the required bending radii of cable cores and shall have the following minimum gland to terminal distances:

Conductor Size	Up to 2.5 mm^2	Above 2.5 mm^2 & Up to 10 mm^2	Above 10 mm^2 & Up to 35 mm^2	Above 35 mm^2 & Up to 70 mm^2
Gland to terminal distance	35 mm	60 mm	100 mm	150 mm

6.1.9 The sockets shall be provided with 2 nos. suitably sized cable entries at the bottom for specified cable sizes and complete with 2 nos. flameproof double compression type nickel plated brass flameproof cable glands. The plugs shall be supplied with 1 no. suitably sized cable entry for specified cable size and complete with 1 no. double compression type nickel plated brass flameproof cable gland. Each socket shall be supplied with 1 no. flameproof nickel plated brass sealing plug, for plugging the unused cable entry.

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6.1.10 The sockets shall have external fixing lugs for mounting on wall or column. The holes provided on these lugs shall be of oblong type.

6.1.11 A tag plate indicating Tag Number shall be provided on each socket. A nameplate shall be provided to indicate the Name of Manufacturer, test certificate number, serial number, BIS license number, applicable gas group etc. as per IS/IEC 60079 and any additional marking required by statutory authority like approval no. etc. The nameplates shall be engraved type or laser-marked and permanently fixed on the equipment. In case the standard details given above are embossed on the enclosures, the same need not be repeated on the name plate. All tag plates shall be engraved, 3 ply laminate fixed with screws and name plate shall be Al anodized or SS-304 engraved or laser-marked and fixed with rivets.

6.2 Socket Outlets & Plugs

6.2.1 The sockets shall be provided with a switch and a mechanical interlock so as to break the electrical circuit before the plug is completely withdrawn and make the circuit after the plug is fully inserted.

6.2.2 In order to prevent accidental removal of plug from socket, the engagement and disengagement shall be by two separate and distinct movement and positions.

6.2.3 415V, 63A three phase flameproof plugs and socket meant for welding receptacle/ any other three phase auxiliary load, shall be provided with 4 pins (3P+E).

6.2.4 4 pin socket shall be provided with 63A, three pole heavy duty switch; whereas, 5 pin socket shall be provided with four pole (TPN) heavy duty switch. Heavy duty switch shall be suitable for AC duty rating as applicable.

6.2.5 Both 24V and 240V, 15A single phase flameproof plug and socket shall be provided with 3 pins (2P+E).

6.2.6 Provision shall be made so that it shall not be possible to insert 24V plug on to a 240V socket.

6.2.7 The sockets shall be provided with either a spring loaded hinged cover, or with a cap connected through metallic chain, to close the same when not in service.

6.2.8 Scraping earth connection shall be provided between the plug and socket. Earth pin of plug shall first engage with earth pin of switch socket.

6.2.9 The plug assembly shall be mechanically rugged, light and shall not unduly stress the socket or its own pins when fitted on to the socket. The diameter of the earth pin of the plug and socket shall be at least 1.1 times the diameter of the phase pins.

6.3 240V/ 24V Portable Transformer units

6.3.1 The 240V/ 24V portable transformer unit shall be supplied complete with 240V/ 24V transformer having a 24V socket on the secondary side and 5 meter length of 3x1.5 mm^2 copper conductor, PVC insulated, metal braided flexible cable, duly terminated in the transformer primary at one end and having 240V plug on the other end. The socket outlets and plugs shall meet the requirements of clause 6.2 above.

6.3.2 The 240V/ 24V transformer shall be designed for 30VA rating on continuous basis. Insulation Class shall be "B", as a minimum. Automatic protection employing earth leakage detection scheme with 30mA current sensitivity shall be provided to disconnect supply on occurrence of an earth fault. 30mA RCCB (preferable)/ HRC fuses shall be provided on primary and secondary side of the transformer. The transformer shall have an earthed screen between primary and secondary winding.

6.3.3 Suitable handle for carrying the transformer unit shall be provided.

6.3.4 Alternatively, 24V socket outlet (as per Cl. 2.5 above) shall be provided with a built-in 240V/24V 30VA transformer duly protected by HRC fuse in phase on primary side. In this case, a separate portable 240/24V transformer unit is not required.

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6.4 24V Hand Lamp units

6.4.1 Each hand lamp unit shall be supplied complete with 15 meter length of 3x1.5 mm² copper conductor, PVC insulated, metal braided flexible cable, duly terminated in the hand lamp at one end and having 24V plug on the other end. The plug shall meet the requirements of clause 6.2 above.

6.4.2 The well glass provided shall be clear and toughened type. Hand lamp shall be provided with 10W, 24V AC LED lamp with ES27 cap having minimum output of 900 lumens. Alternatively, if specified in MR, it shall be with lens/ glass and 20W, 24V AC COB/ discrete LED with driver/ LED PCB with DOB having minimum output of 1800 lumens. The minimum output for 10W or 20W shall be guaranteed at 18V to 26V.

6.4.3 Hand lamp shall be provided with either galvanised steel or epoxy powder coated mild steel protective wire cage using minimum 3mm welded steel construction and having mesh dimension not exceeding 50mm x 50mm.

6.4.4 Suitable handle for carrying the hand lamp unit and a stand type guard suspension hook shall be provided.

6.5 Terminals & Wiring

6.5.1 All equipments shall be provided with sufficient number of terminals. More than 2 wires per terminal shall not be permitted. If required, additional terminal with shorting link may be used. The terminals shall be suitable for termination of stranded conductors. Tinned copper lugs shall be provided for cable termination.

6.5.2 All internal wiring shall employ adequately sized, 660V grade, FRLS type, PVC insulated Copper conductor wires, colour coded for phase, neutral and earth, with minimum conductor sizes as below:

TPN Plugs and sockets:	16 mm²
SPN Plugs and sockets:	2.5 mm²

7.0 INSPECTION, TESTING AND ACCEPTANCE

7.1 During fabrication, the equipment shall be subjected to inspection by EIL/ Owner or by an agency authorised by the Owner, as per agreed Inspection Test Plan. Manufacturer shall furnish all necessary information concerning the supply to EIL/ Owner's inspector. All routine/ acceptance tests shall be carried out at manufacturer's works, under his care and expense.

7.2 Type test certificates from NABL-approved/ Central Government Labs in India/ IECEx-certified/ equivalent Labs, Manufacturer's works test reports applicable PESO/ DGMS approval and BIS license shall be shown to the inspection agency on demand during inspection. The certificates, BIS license and PESO approval must be valid at the time of despatch.

7.3 Test certificates of bought out components shall be submitted to the inspection agency, as per Inspection and Test Plan no. 6-81-1021.

7.4 All equipments shall be subjected to various routine/ acceptance tests as per Inspection and Test Plan no. 6-81-1021.

8.0 PACKING AND DESPATCH

All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for the selected mode of transportation, i.e. by ship/ rail or trailer, and shall be wrapped in polythene sheets before being placed in crates/ cases to prevent damage to finish. The crates/ cases shall have skid bottom for handling. Special notations such as 'Fragile', 'This side up', 'Center of gravity',

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'Weight', 'Owner's particulars','PO no.' etc., shall be clearly marked on the packages together with other details as per purchase order.

The equipment may be stored outdoors for long periods before installation. The packing should be suitable for outdoor storage in areas with heavy rains and high ambient temperature unless otherwise agreed. A set of instruction manuals for installation, testing and commissioning, a set of operation & maintenance manuals and a set of final drawing shall be enclosed in a waterproof cover along with the shipment.

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मध्यम वोल्टेज इंडक्शन मोटरों के लिए विनिर्देश

SPECIFICATION FOR MEDIUM VOLTAGE INDUCTION MOTORS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
7	24.07.25	REVISED AND ISSUED AS STANDARD SPECIFICATION	RKR	ST	HK	MN
6	26.12.18	REVISED AND ISSUED AS STANDARD SPECIFICATION	RKR	VKJ	BRB	RKT
5	20.11.13	REVISED AND ISSUED AS STANDARD SPECIFICATION	SA	BRB	UAP/JMS	SC
4	26.09.07	REVISED AND ISSUED AS STANDARD SPECIFICATION	SD	BRB	JMS	VC
3	09.04.02	REVISED AND RE-ISSUED	UG	AAN	VPS	SKG
2	01.02.97	REVISED AND ISSUED AS STANDARD SPECIFICATION	AAN	VPS	SG	AS

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Abbreviations:

BIS	Bureau of Indian Standard
BS	British Standards
CEA	Central Electricity authority
CIMFR	Central Institute of Mines and Fuel Research
CT	Current Transformer
DOL	Direct On Line
EIL	Engineers India Limited
FM	Factory Mutual
FRP	Fiberglass Reinforced Plastic
IEC	International Electro-technical Commission
IEEE	Institute of Electrical & Electronics Engineers
IS	Indian Standard
JEC	Japanese Electro-technical Committee
LCIE	Laboratoire Central des Industries Electriques
LRWT	Locked Rotor Withstand Time
NEMA	National Electrical Manufacturers Association
OEM	Original Equipment manufacturer
PESO	Petroleum & Explosives safety organisation
PO	Purchase Order
PVC	Poly Vinyl Chloride
p.u.	per unit
RPM	Revolutions per Minute
r.m.s	Root Mean Square
TPIA	Third party Inspection Agency
TETV	Totally enclosed Tube Ventilated
UL	Underwriter's Laboratories
VDE	Verband Deutscher Elektrotechniker
VFD	Variable Frequency drive

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1.0 SCOPE

This specification covers the design, manufacture, testing, packing and supply of medium voltage squirrel cage induction motors rated above 1000 V.

2.0 CODES AND STANDARDS

2.1 The squirrel cage induction motors and their components shall comply with the latest editions of following standards issued by BIS (Bureau of Indian Standards) unless otherwise specified:

IS - 5	Colours for ready mixed paints and enamels
IS - 1271	Electrical insulation - Thermal evaluation & Designation
IS - 2071	Methods of high voltage testing
IS - 2253	Designation for type & construction and mounting arrangement of rotating electrical machines
IS - 2968	Dimensions of slide rails for electrical motors
IS - 4029	Guide for testing of three phase induction motors
IS - 4889	Method of determination of efficiency of rotating electrical machines
IS - 6362	Designation of methods of cooling of rotating electrical machines
IS - 7816	Guide for testing insulation resistance of rotating machines
IS - 8223	Dimensions and output series for rotating electrical machines
IS – 8789	Values of performance characteristics for three phase induction motors
IS - 12065	Permissible limits of noise level for rotating Electrical Machines
IS - 12075	Mechanical vibration of Rotating Electrical Machines with shaft heights 56 mm and higher measurement, evaluation and limits of vibration severity
IS - 13529	Guide on effects of unbalanced voltages on the performance of three phase induction motors
IS - 13555	Guide for selection and application of three phase induction motors for different types of driven equipments
IS - 14222	Impulse voltage withstands levels of rotating electrical machines with form-wound stator coils
IS - 14568	Dimension and output series for rotating electrical machines, frame numbers 355 to 1000 and flange numbers 1180 to 2360
IS / IEC60079-0	Electrical apparatus for explosive gas atmospheres (General Requirements)
IS/IEC60079-1	Equipment protection by Flame proof enclosures “d’.
IS/IEC60079-2	Explosive protection by pressurized enclosure "p"
IS/IEC60079-7	Explosive atmospheres-Equipment protection by increased safety –“e”
IS/ IEC: 60529	Degree of protection provided by enclosures (IP Code)
IS/IEC-60034	Rotating Electrical machines
IEEE-386	Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V

2.2 In case of imported motors, standards of the country of origin shall be applicable if these standards are equivalent or stringent than the applicable Indian Standards.

2.3 The motors shall also conform to the provisions of CEA regulations and other statutory regulations currently in force in the country.

2.4 In case Indian Standards are not available, standards issued by IEC/BS/VDE/IEEE/JEC/NEMA or equivalent agency shall be applicable.

2.5 In case of any conflict between requirements specified in various applicable documents, the most stringent one shall prevail. However, owner’s decision in this regard shall be final and binding.

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3.0 GENERAL REQUIREMENTS

3.1 The offered equipment shall be brand new with state of the art technology and proven field track record. No prototype equipment shall be offered.

3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment at least for 10 years from the date of supply.

3.3 Vendor shall give a notice of at least one year to the end user of equipment and EIL before phasing out the product/spares to enable the end user for placement of order for spares and services.

4.0 OPERATING CONDITIONS

4.1 Ambient Conditions

Motors shall be suitable for operating satisfactorily in humid and corrosive atmospheres found in refineries, fertilizer, petrochemical and metallurgical plants. Service conditions shall be as specified in the motor data sheet. If not specifically mentioned therein, a design ambient temperature of 40°C and an altitude not exceeding 1000 meters above mean sea level shall be taken into consideration.

4.2 Frequency and Voltage variations.

Unless otherwise agreed, motors shall be designed for continuous operation at rated output under the following conditions:

a) The terminal voltage differing from its rated value by not more than ± 6 %
b) The frequency differing from its rated value by not more than ± 3 %
c) Any combination of (a) and (b)

4.3 Starting

a) Motors shall be designed for direct on line starting or other method of starting as specified in datasheet.

b) Motors shall be designed for re-acceleration with full load after a momentary loss of voltage, not exceeding 0.2 seconds, with the possibility of application of 100% of the rated voltage when the residual voltage has dropped down to 50% and is in phase opposition to the applied voltage.

c) Motors shall be designed to allow the minimum number of starts on full load indicated in Table below:-

Min. Number of starts	Up to 1000 KW	Above 1000 KW
No. of consecutive start-ups with initial temperature of the motor at ambient level (cold.)	3	2
No. of consecutive start-ups with initial temperature of the motor at full load operating level (hot)	2	1

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d) Unless otherwise specified, the locked rotor withstand time under hot condition at 100% voltage (time t_E for increased safety i.e. Ex e motor) shall be minimum 5 seconds more than the starting time at 100 % voltage, under specified load conditions.

4.4 Unless otherwise stated in the motor data sheet, motors shall be suitable for starting at 80% of the rated voltage against the torque speed characteristics of the driven equipment.

a) Starting torque and minimum torque of the motor shall be compatible with the speed torque characteristics of the driven equipment under specified starting and operating conditions.

b) For heavy duty drives such as blowers, crushers, compressors etc., high starting torque motors shall be provided.

This shall be checked against the speed torque characteristics of the load and the thermal withstand characteristics of the motors.

4.5 The pull-out torque at rated voltage shall be not less than 175 percent of the rated load torque with no negative tolerance. In case of motors driving equipments with pulsating loads (e.g. reciprocating compressors), the minimum value of the pull out torque at 80% of rated voltage shall be more than the peak value of the pulsating torque and the current pulsation shall be limited to 40%.

Unless otherwise agreed, the pull out torque shall not exceed 300% of the rated load torque.

4.6 Direction of rotation

Motors shall preferably be suitable for either direction of rotation. In case unidirectional fan is provided for motors, direction of rotation for which the motor is designed shall be permanently indicated by means of an arrow. Any alteration required for obtaining a change in the direction of rotation such as reversal of the fan, must be clearly specified. Motors which are suitable for only one direction of rotation shall have this direction of rotation clearly indicated on the motor together with the phase sequence of the terminals associated with this rotation in indelible marking. Motors suitable for bi-directional rotation shall be provided with a double headed arrow. Directional arrow should be manufactured from corrosion resistant material.

Normally, clockwise rotation is desired as observed from the driving (coupling) end, when the terminals ABC are connected to a supply giving a terminal phase sequence in the order ABC. Counter clockwise rotation of the motor shall be obtained by connecting the supply to terminals so that the phase sequence corresponds to the reversed alphabetical sequence of the terminal letters. Ample space shall be provided at the terminal box for interchanging external leads C and A for this purpose.

5.0 PERFORMANCE

5.1 Motors shall be rated for continuous duty (S_1), unless otherwise specified.

5.2 Motors shall have adequate torque to accelerate the load from zero to full speed under the specified starting and operating conditions.

5.3 Starting current shall be 500% subject to IS/IEC tolerance for motors up to 1000 kW. For motors above 1000 kW, it shall be as agreed with purchaser for each case.

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5.4 In particular cases, when the starting current is to be limited, care shall be taken such that the design values of torque meets the load requirement while at the same time complying with clause 4.3 above of this specification.

5.5 In particular cases, when the starting with reduced voltage is specified, care shall be taken such that the design values of torque meets the load requirement while at the same time complying with clause 4.4 and 4.5 above of this specification.

5.6 Motors fed by variable frequency drive shall additionally meet the following requirements:

5.6.1 The motors shall be suitable for the current wave forms produced by the power supply including harmonics generated by the drive. The motor shall withstand the dv/dt and V_{peak} level of VFD.

5.6.2 The motors shall be designed to operate continuously at any speed over the range (10–100%) of rated speed or as specified in data sheet. The characteristics shall be based on the application – in terms of constant torque / variable torque as per the driven equipment. Additional cooling fan shall be provided if required to limit the temperature rise to specified limits.

5.6.3 The motors shall withstand torque pulsation resulting from harmonics generated by the solid-state power supply.

5.6.4 The motors required to be transferred to DOL bypass mode shall be rated for specified variations in line voltage and frequency.

5.6.5 In addition to above, clause no. 5.5.1 of EIL specification no. 6-51-0050 (Specification for variable frequency drive) shall be also followed for motors fed by variable frequency drive.

6.0 CONSTRUCTION DETAILS

6.1 Windings

6.1.1 Motors shall be provided with class-F insulation. The permissible temperature rise above the specified ambient temperature shall be limited to those specified in the applicable Indian Standards for class-B insulation.

6.1.2 The windings, along with the stator, shall be tropicalised and shall be vacuum impregnated (resin poor type).

Winding shall be adequately braced to prevent any relative movement during operation. In this respect, special care shall be taken for the stator windings of direct-on-line starting squirrel cage motors. Insulation shall be provided between coils of different phases which lie together.

6.1.3 Core laminations must be capable of withstanding burnout for rewind at 350°C without damage or loosening.

In case of motors driving equipment with pulsating loads, special attention shall be paid to the joints of rotor bars and end rings to avoid premature failures due to induced fatigue stresses.

For Ex e motors, the conductor insulation must be carried right up to the terminal clamp.

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6.1.4 Motors shall be designed to withstand impulse voltages specified in applicable Indian Standards/relevant IEC. The wave shape shall be as per IS/relevant IEC.

6.1.5 Windings of motors shall be star connected. For VFD fed motors, the main winding connected in 'Delta' can also be considered acceptable subject to motor manufacturer having adequate proven track record.

6.2 Terminals, terminal boxes and cable entries

6.2.1 The ends of the winding shall be brought out into a terminal box. The terminations shall be by means of clamp type or bushings with adequately sized bolted terminals. Line terminals shall be properly insulated from the frame with material resistant to tracking.

6.2.2 The terminal box shall be located on the right hand side viewed from the driving (coupling) end. Unless otherwise specified, the terminal box shall be suitable for side cable entry. The size of the cable end boxes shall be large enough to provide a minimum distance of 600 mm between cable gland plate and terminal lug.

6.2.3 The neutral point of the star windings shall also be brought out to a separate terminal box. This shall house the current transformers for differential protection of motors wherever required and shall be located on the opposite side of main terminal box.

6.2.4 The main and neutral terminal box shall be of fabricated sheet steel. The main terminal box shall be phase segregated type, unless otherwise agreed. However for Non sparking motors phase insulated type terminal box is also acceptable.

Motors can have elastimold phase insulated terminals in a common box. Ex d type (flame proof) motors can have phase insulated terminal box of Exd rating whereas Ex p type (pressurized) motors can have phase insulated terminal box of Ex d/Ex p rating.

Ex d (Flameproof) motors with non phase segregated & non phase insulated flameproof terminal box duly tested at independent test laboratory can be considered acceptable subject to motor manufacturer having adequate proven track record.

6.2.5 The terminal box must be of robust construction, with necessary clearance, creepage distances between live parts and between live parts to earth considering air insulation and without any compound filling.

6.2.6 The terminal box shall be provided with pressure relief flaps/devices for increased safety i.e. Ex e motors and safe area motors, as per manufacturer's standard.

6.2.7 The terminal box shall be capable of withstanding the fault current for a period of 0.2 seconds specified in the motor data sheet. For phase insulated elastimould terminations, the short time current rating and duration shall be as per IEEE:386-2006.

6.2.8 Appropriate phase markings as per IS/IEC shall be provided inside the terminal box. The markings shall be non-removable and indelible.

6.2.9 The terminal box shall be provided with suitably sized entries for suitable cable glands corresponding to the size of the specified cables. For termination of multi run of power cables, more than one terminal box is not acceptable.

Equipment and accessories provided shall conform to the hazardous area classification and the environmental conditions as specified in the motor data sheet.

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6.2.10 An adequately sized earth terminal shall be provided for cable armour termination. It is essential that all metal parts (mounting rail and cable glands) are bonded and connected to the earth system. Bonding straps are also required across joints on non-active parts.

6.2.11 Separate terminal boxes shall be provided for space heaters, resistance temperature detectors and vibration probes.

6.2.12 Main and neutral terminal box covers must be provided with handles to facilitate easy removal. Terminal boxes covers having weight up to 5kg can be accepted without handles.

6.3 Motor casing and type of enclosure

6.3.1 All Motors shall be suitable for installation directly outdoor and must have degree of protection corresponding to IP-55 as per IS.

6.3.2 All internal and external metallic parts, which can come into contact with cooling air (Piping, air supply and discharge conduits, protective grills air deflectors, filters and supports etc.) shall be of corrosion resistant material or appropriately treated to resist corrosive agents which may be present in the atmosphere. Screws and bolts shall be of rust proof material or protected against corrosion.

6.3.3 Effective equipotential bonding straps to guard against the occurrence of sparks due to presence of circulating currents shall be provided in type Ex e and Ex p motors.

6.4 Bearing and lubrication

6.4.1 Motors shall have grease lubricated ball or roller type bearings or of the manufacturer's standard type. However, 2 pole motors above 750 kW rating shall be provided with sleeve bearings as a minimum, except for motors intended to be installed in hazardous area having gas group IIC. Sleeve bearings when provided shall be of proven design.

6.4.2 The bearings shall be chosen to give a minimum L- 10 rating life of 5 yrs. (40,000 hrs) at rated operating conditions.

(The L -10 rating life is the number of hours at constant speed that 90 % of a group of identical bearings will complete or exceed before the first evidence of the failure).

6.4.3 Where bearing supports are attached to the motor casing, adequate bracing shall be provided on these supports to reduce vibrations and ensure long life of the bearings. Bearings shall be adequate to absorb axial thrust in either direction produced by the motor itself or due to shaft expansion.

6.4.4 Motor bearings exposed to high temperatures (e.g. motors for hot oil/boiler feed pumps) shall have adequate provisions for cooling of bearings.

6.4.5 Vertical motors where the external thrust is envisaged on motor side, shall be provided with angular contact/thrust bearings suitable for the load imposed by the driven equipment.

6.4.6 Motors shall be designed to permit removing/replacement of bearings.

6.4.7 **Grease lubricated bearings**

Bearings shall be capable of grease injection from outside without removal of covers. The bearing boxes shall be provided with labyrinth seals, to prevent loss of grease or entry of dust or moisture. When grease nipples are provided, these shall be associated, where

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necessary, with appropriately located relief devices, which ensure passage of grease through the bearings.

The motors shall have facility for on-line greasing.

6.4.8 **Sleeve bearings**

Sleeve type bearings shall be fitted with oil rings for continuous lubrication. The oil reservoirs shall have a form suitable for allowing settling of any solids or residual particles contained in the oil.

The covers shall be provided with suitable openings for adding and draining oil, together with an overflow plug and level indication. Oil sight glass provided for checking the oil level can also be considered acceptable in place of overflow plug/level indicator subject to motor manufacturer having proven track record. The shaft shall have perfect seals so as to prevent entry of dust or moisture.

6.4.9 **Forced lubrication bearings**

The oil lubrication system shall be independent of the driven machine. Common lubrication system for the driven equipment and the motor can be accepted provided it is separate from the seal oil system. The common lubrication system shall be provided with suitable degassing equipments to extract gas reducing the probability of gas entering the motor.

In the independent lubrication system, oil supply shall be guaranteed by one of the following methods:

- With a mechanical pump co-axial with the motor and supplemented by a separate electric motor driven pump for initial lubrication during start up and stopping operations.

- With a separate electric motor driven pump. In this case the lubricating system shall consist of two identical motor driven pumps, one running and one acting as standby.

In addition to the pumps, the lubrication system shall be supplied complete with the following as a minimum:

a) An oil cooler of shell and tube type with tubes of inhibited admiralty brass. Internal coolers shall not be accepted. To prevent the oil from being contaminated, if the cooler fails, the oil side operating pressure shall be higher than the water side operating pressure.

b) An austenitic stainless steel oil reservoir with the following characteristic :

   - The capacity to avoid frequent filling, to provide adequate allowance for system rundown and to provide a retention time of at least 3 minutes to settle.
   - Provision to eliminate air and minimize flotation of foreign matter to the pump suction.
   - Fill connections, reflex type level indicators and breathers suitable for outdoor use.
   - Sloped bottoms and connections for complete drainage.
   - Clean out openings as large as is practicable.

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- A bypass line that returns below the oil level to eliminate aeration and static electricity.
- A thermostat with two electrical contacts for alarm & tripping in case of high oil temperature.

c) A supply and return system.

d) A duplex full flow filter with replaceable elements and filtration of 25 µm nominal or finer as recommended by the bearing manufacturer. Filter cartridge material shall be corrosion resistant. Metal mesh or sintered metal filter elements shall not be acceptable. The filter shall not be equipped with a relief valve or an automatic bypass.

e) The motor driven auxiliary pumps shall be provided with suction stainer and an automatic/manual control system arranged to start automatically on low oil pressure and with manual shutdown only.

f) Sight flow indicators in each bearing drain line.

g) Temperature gauges (with thermowells) in the reservoir, after the oil cooler and each bearing drain line.

h) Low oil pressure alarm and shutdown switches.

i) A pressure gauge (valved for removal) for each pressure level and a pressure differential indicator to measure filter pressure drop.

j) Thermostatically controlled electric immersion heater with a sheath of austenitic stainless steel for heating the charge capacity of oil before start-up in cold weather. The heating device shall have sufficient capacity to heat the oil in the reservoir from the specified minimum site ambient temperature to the start-up temperature, as required by the manufacturer, within 12 hours. The watt density of heater shall not exceed 2.33 watts per sq. mm.

k) The oil pumps shall have steel casings unless they are enclosed in a reservoir. All other oil containing pressure components shall be of steel.

A control panel shall be provided for operation & control of the lubrication system. The control panel shall include fuses/MCBs, electrical contactors and thermal relays for the protection and operation of the motor driven pumps, push-buttons, auxiliary relays and timer relays for the automatic and manual starting up and shutting down of the oil pump.

Equipment and accessories provided shall conform to the hazardous area and the environmental conditions specified in the motor data sheet.

Armoured cables suitable for high temperature duty shall be used for external electrical connections between the control panel and the lubrication system.

6.4.10 **Bearing Insulation-Shaft Voltage**

Induced voltage at the drive end of the motor at no load shall not exceed 250 mV r.m.s. for roller and ball bearings and 400 mV r.m.s. for sleeve bearings. If the shaft voltage exceeds these values, the non-driving end bearing shall be insulated from the motor frame to avoid circulating currents. In case of VFD fed motors both end bearings shall be insulated irrespective of the shaft voltage.

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The insulated bearing end shield or pedestal shall bear a prominent warning and manufacturer shall provide detailed drawings showing insulation arrangement.

6.5 Cooling System

All motors shall preferably be self-ventilated. Motors with higher outputs having manufacturer's standard designs using forced ventilation cooling or closed circuit cooling employing external coolants may also be considered.

6.5.1 Self Ventilated Motors

All motors shall be fan cooled. The fans shall be of corrosion resistant material and appropriately protected. For fertilizer plants, brass or bronze are not permitted materials. The material of fan for motors to be used in hazardous areas shall be anti-static & non-incendive type.

Motors for installation in dusty atmospheres or in the presence of sand, fuels or other suspended solid particles in the air shall be fitted with filters for the cooling air. The filters shall be easily accessible for inspection and removable for cleaning and re-use. The material of the filters and supports trays shall be rust proof or protected against oxidation or corrosion.

6.5.2 Motors with forced ventilation

Motors with forced ventilation shall be equipped with two motor driven fans each capable of supplying the full quantity of cooling air required by the motor at full load.

Where air cooler design permits provision of one fan only; the second fan shall be supplied loose. Cooler design shall allow easy replacement of fan in such case.

The ventilating system shall include the flanges for the air intake and the mating flanges for the discharge ducts. An airflow indicator as described in paragraph 7.3 (a) shall also be provided.

Motors and fans used for forced ventilation shall conform to the hazardous area classification and environmental conditions specified in the motor data sheet.

6.5.3 Motors with closed circuit cooling with water to air heat exchangers

The material of the heat exchangers shall be corrosion resistant (e.g. cupro-nickel alloy, muntz metal, admiralty brass) and suitable for the type of water used. The heat exchangers shall be designed for minimum water pressure of 5 kg / cm ^{2} and with head losses not greater than 0.5 kg / cm ^{2}, unless otherwise agreed.

The heat exchangers shall be arranged by the side(s) of the motor, if possible. Screens shall be provided to protect the motor windings from water leaks or leakage in the tubes. Suitable drains shall be fitted for draining water in case of leakage. The cooling system shall include the trip and alarm devices mentioned in paragraph 7.3 (b). Heat exchangers for identical motors shall be interchangeable.

6.5.4 Motors with closed circuit cooling with air-to-air heat exchangers

The heat exchanger tubes shall be of stainless steel or extruded aluminum. All exposed surfaces of the heat exchanger shall be treated for anti-corrosion procedure with suitable anti corrosion paint. Motors shall be safeguarded against corrosion by suitable [illegible]

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