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1. SCOPE (Substitution)

(i) This specification together with the inquiry document covers the minimum requirements & give recommendations for shaft seals and related sealing auxiliary systems for centrifugal and rotary pumps used in the petroleum, natural gas and chemical industries. It is applicable for all services. It is required for the improvement of equipment availability and the reduction of emissions to the atmosphere and of life-cycle sealing costs.

The applications addressed in this specification covers sealing duties for pumps with a working temperature range of -40 °C to +400 °C (-40 °F to 750 °F) and a maximum allowable working pressure of 4 MPa (40 bar) (600 psig). It covers seals for pump shaft diameters from 20 mm (0.75 in) to 110 mm (4.3 in). Seal applications outside these boundaries are specified as Engineered seals and specific requirements for the same are included in this specification.

Seals and auxiliary systems for ISO 13709/API 610 Type OH6 high speed integrally gear driven pumps shall comply with this specification as far as practical, with allowance being made for the relatively inflexible constraints of the seal hardware arrangement.

Seals and auxiliary systems for hydraulic power recovery turbines shall conform to the requirements in this specification as much as practical, but these are engineered systems and require consultant's /owner's approval.
The pump vendor shall review all seal and auxiliary system applications and shall notify the consultant/owner if, according to their best practice and experience with seals or auxiliary systems in similar applications, a deviation from the requirements in the data sheets or this specification would result in equal or improved sealing. Pump vendor's recommendation shall be necessarily corroborated by seal vendor's recommendation/past supply reference list.

Seals and Seal systems shall necessarily be procured from seal manufacturer.

(ii) Vendor shall comply with the requirement of this specification and other specifications/attachments to inquiry/order. No deviation or exception shall be permitted without the written approval of the purchaser.

(iii) Compliance with this Specification shall not relieve the vendor of the responsibility of furnishing equipment and accessories /auxiliaries of proper design, materials and workmanship to meet the specified start up and operating conditions.

In case the vendor considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the equipment, they shall recommend the same along with reasons in a separate section along with his proposal and include the same in their scope of supply.

(iv) Except as modified herein, the main equipment and their auxiliaries shall be designed, manufactured, tested and supplied strictly in accordance with the **API Standard 682, Fourth Edition, May 2014, "PUMP SHAFT SEALING SYSTEMS FOR CENTRIFUGAL AND ROTARY PUMPS"**

(v) Except for new paragraphs, the number and title of the paragraphs in the following Modifications to API Standard – 682 correspond to the respective sections and paragraphs of the above standard. Paragraphs not addressed in this specification shall be strictly in accordance to API Standard 682, Fourth **Edition, May 2014** requirements.

The word in parenthesis following the number or title of a paragraph indicates the following:

(Addition)	:	An addition to a part, section or paragraph referred to.
(Modification)	:	An amplification or rewording has been made to a part of the corresponding section or paragraph but not a substitution replacing the entire section or paragraph.
(Substitution)	:	A substitution has been made for the corresponding section or paragraph of the standard in its totality.

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(New)	:	A new section or paragraph having no corresponding section or paragraph in the Standard.
(Delete)	:	This paragraph is deleted.

2. NORMATIVE REFERENCES (Addition)

ISO 5199 Technical Specification for Centrifugal Pumps – Class II

NFPA 20 Standard for the Installation of Stationary Pumps for Fire Protection Applicable for Jockey Pumps Only

3. TERMS, DEFINITIONS, AND SYMBOLS (Addition)

3.1.96 Auto-ignition product
Hydrocarbon liquid that may spontaneously ignite upon exposure to atmosphere

3.1.97 Plan 54 (plant wide)
Is a Plan 54 where the external seal flush is supplied from a plant-wide system engineered and supplied by the Buyer.

3.1.98 Plan 54 (stand-alone)
Is a Plan 54 where the external seal flush is supplied from a stand-alone seal support console engineered and supplied by the Seal Supplier. There will be one such console per pump.

4. SEALING SYSTEMS

4.1 Seal categories, types, and arrangements

4.1.4.1 (Addition)
Note 3 When a nitrogen supply is required, for example as a buffer gas or to pressurize a system, equipment shall be sized considering the plant nitrogen system minimum and maximum supply pressures

5. GENERAL

5.1 Unit Responsibility (Modification)

The pump vendor having the UNIT RESPONSIBILITY shall be responsible for complete design, engineering, packaging, testing, supply & supervision of erection & commissioning of the seal system as per specification requirements. Vendor's scope shall include but not limited to the responsibility for execution, coordination of all technical aspects of equipment and its auxiliary systems, their selection & integration into a complete package constituting total order. All drawings/documents, including sub vendor's drawings, pertaining to the order shall be duly reviewed & approved by the pump vendor before onward submission.

6. DESIGN REQUIREMENTS

6.1 Common Design Requirements (All Categories)

6.1.1 General information

6.1.1.1 (Addition)
The requirement for seal removal is not applicable to vertical close-coupled pumps (i.e. ISO 13709, designation OH5).

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6.1.1.2 (Modification)
If recommended by seal manufacturer, a stationary flexible element can be supplied for Type A and Type B seals based on technical justifications and field proven past references.

6.1.1.3 (Modification)
If recommended by seal manufacturer, a rotating flexible element can be supplied for Type C seals based on technical justifications and field proven past references.

6.1.1.4 (Addition)
The assembly bolting of seal cartridges shall have sufficient strength to withstand the force needed to remove the cartridge from the pump, taking into account the high friction which may be present due to deposits between the shaft and the shaft sleeve.

6.1.1.6 (Modification)
The static sealing pressure rating (SSPR) of mechanical seals shall be greater than or equal to the maximum static sealing pressure (MSSP), which shall be calculated as indicated below.

For Arrangement 1 seals, the MSSP of each seal shall be equal to the maximum static seal chamber pressure that can occur in the pump. Unless otherwise specified, this shall be the shut-off pressure of the pump at maximum suction pressure or pump MAWP whichever is higher.

For Arrangement 2 seals, the MSSP of both the inner and outer seal shall be equal to the maximum static seal chamber pressure that can occur in the pump. Unless otherwise specified, this shall be the shut-off pressure of the pump at maximum suction pressure or pump MAWP whichever is higher.

For Arrangement 3 seals, the MSSP of the outer seal shall be equal to the maximum static seal chamber pressure that can occur in the pump. Unless otherwise specified, this shall be the greater of 1) shut-off pressure of the pump at maximum suction pressure or 2) the maximum barrier fluid pressure or 3) pump MAWP. The MSSP of the inner seal shall be the greater of 1) differential between the maximum barrier fluid pressure and the minimum seal chamber pressure or 2) the maximum differential between maximum seal barrier fluid pressure and atmospheric pressure or 3) pump MAWP.

Non pressure containing parts of Mechanical seals (such as seal ring, mating ring, sleeves, miscellaneous internal seal parts etc.) shall be suitable for maximum shut-off pressure under static conditions.

However, for Bellows seals, bellows shall be suitable upto bellows design pressure, as a minimum.

Note: Shut-off head to be considered for calculating maximum shut off pressure shall be either the value specified in the approved pump mechanical datasheet or the approved value recorded during pump performance testing, which ever is higher.

6.1.1.11(Addition)
Unless otherwise specified by the Purchaser, if a single mechanical seal is considered suitable it shall be of the metal bellows type and shall be suitable for the highest and lowest specified static or dynamic seal chamber pressure except for water applications wherein pusher type seals may be accepted.

6.1.2 Seal Chamber and Gland Plate

6.1.2.3 (Addition)
Internally mounted seal chambers are not acceptable.

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6.1.2.6 (Addition)

The use of lower clearances only for retrofit applications with purchaser's approval is acceptable.

6.1.2.8b (Addition)

Default seal cartridge centering shall be with inside diameter fit.
For Category 1 seals, shaft centering is acceptable.

6.1.2.15(Addition)

Lip seal type throat bushings shall not be supplied unless otherwise approved by the purchaser.

6.1.2.16(Modification)

Replace "purchaser" with "consultant's/owner's". 'If specified, or' stands deleted.

6.1.2.17(Addition)

Add to Table 2: Process vent (V) connection for seal configurations 3NC FF, 3NC BB, and 3NC FB shall only be used on vertical pumps with Plan 02.

Note (d) shall also apply to Plan 23 FI/FO connections for Category 2 and 3 seals.
Gland plate connection locations listed in the Table refer to the port entry to the ID of the gland plate. The external port locations on the OD of the gland may be altered to allow for tangential port connections or to avoid pump bracket obstructions.

6.1.2.18.2(Addition)

When seals are supplied installed in a pump, metal plugs shall be installed in all unused gland plate connections, before delivery.

6.1.2.20(Addition)

For vertical in-line pump the seal chamber shall be vented. A self-venting design (Plan 13) with seal flush piped to the pump suction line above the seal chamber to be provided. Use of a manual vent shall be avoided.

6.1.2.24(Modification)

'If specified' shall be read as "if specified or recommended by the seal Manufacturer".

6.1.2.24.1(New)

If heating jackets are provided, they shall have connections arranged so that the entire passageway can be mechanically cleaned, flushed and drained.

6.1.2.24.2(New)

If heating jackets are provided, heating jacket systems shall be designed to positively prevent the process stream from leaking into the heat transfer medium. Heating passages shall not open into casing joints.

6.1.2.24.3(New)

In case of steam jacketing, same shall be supplied complete with dedicated temperature control valve (TCV), pressure indicator, temperature indicator and a steam trap for each pump.

6.1.6 Materials

6.1.6.1.4(Addition)

If specified on the datasheet or materials are exposed to wet H2S, materials shall conform to requirements of NACE MR0175 or MR0103 (as applicable), applied based on the assessed severity or material limits.

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Copper or bronze filled carbon or other copper bearing materials shall not be used for services involving contact with carbonates, high concentrations of H2S, ammonia, ammonium chloride, and acetylene.

6.1.6.2.2(Modification)

Except as required by 6.1.6.2.4, one of the rings shall be premium grade, blister-resistant carbon graphite, with manufacturing treatment to reduce wear, provide chemical resistance and minimize porosity consistent with the intended service.

Carbon Ring material for seal faces shall be suitable to operate continuously at the maximum operating temperature and able to withstand the Design Temperature for the pump in which the seal is incorporated.

6.1.6.5.1(Substitution)

Unless otherwise specified, O-rings shall be fluor elastomer (FKM). Temperature limitations for elastomers are listed in B.4

6.1.6.5.2(Substitution)

Unless otherwise specified, if operating temperatures or chemical compatibility preclude the use of fluor elastomers (FKM), O-rings shall be perfluoro elastomers (FFKM). See B.4 for additional details.

6.1.6.10.5a(Modification)

'If specified' stands replaced with 'Wherever applicable'.

7. SPECIFIC SEAL CONFIGURATIONS

7.1 Arrangement 1 Seals

7.1.2.2 (Modification)

"if specified" stands replaced by "if pump design permits".

7.1.2.5 (Modification)

b) Seals equipped with a water/nitrogen quench shall be designed as per Fig G.24

7.1.2.5 (Addition)

e) Seal quench piping shall include a fixed metering orifice/ valve for the required quenching capacity for each mechanical seal. An appropriate steam trap and condensate drain shall be installed as close as practical to the pump in order to ensure a dry steam supply to the gland plate in the steam piping to the seal.

f) The quench drain shall be piped to the baseplate drain.

8. ACCESSORIES

8.1 General

8.1.2 (Modification)

The seal flushing plans shall be as specified in the Process datasheets/ Pump datasheets / Purchase requisition/ tender document. The pump vendor shall review all seal and auxiliary system applications and shall notify the consultant/owner if, according to their best practice and experience with seals or auxiliary systems in similar applications, a deviation from the requirements in the data sheets or this specification would result in equal or improved sealing. Pump vendor's recommendation shall be necessarily corroborated by seal vendor's recommendation/past supply reference list.

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8.1.3 (Modification)
The arrangement of the equipment including piping and auxiliaries shall be as specified in Purchase requisition/ tender document. The arrangement shall provide adequate clearance areas and safe access for operation and maintenance.

8.1.14 (Addition)
Electric motors, for example forced draft air cooler fan motors, shall be suitable for the hazardous area classification indicated on the datasheet/Purchase requisition/tender document.

8.1.15 (Addition)
Separate independent seal auxiliary systems (with exception of external source systems) shall be provided for each seal chamber.

8.2 Piping for Seal Auxiliary Systems

8.2.2 (Modified)

a) The complete sealing system along with instruments and all accessories shall be mounted/ installed on the Pump base plate by the pump OEM. In case of between bearing Pumps, there shall be two such independent units, one each for each stuffing box and both the system shall be mounted on the same side to allow for maintenance of the Pumps. Auxiliary Seals/ Seal Flushing Systems & Plans/ Cooling Systems & Plans shall be as per this specification.

b) All auxiliary piping interface connections shall be flanged terminated with a gate valve at the equipment battery limit (i.e. at the edge of the base plate) by the pump OEM.

c) As a minimum Piping material shall be Stainless Steel (300 series) for Seal Flushing Plans/ Lube Oil system and shall be Carbon Steel (A106 Gr. B) for Cooling Water Plans (unless otherwise specified).

d) Purchaser shall provide/ receive cooling water at single point inlet/ outlet at the edge of base plate of each Pump package for seal cooler & bearing housing (if applicable). The terminating flanges shall be of ¾" (minimum) size. Vendor shall provide sight flow glass at each cooling water outlet.

e) Between Bearing Pumps with two Seal Pots configuration shall have the drains of both the Seal Pots combined downstream of the individual drain isolation valves and shall be terminated at the edge of the base plate.

f) All Purchaser's piping interfacing will be done towards the base plate edge of non- drive end (NDE) of pump. As such all terminations including seal system drain shall be terminated at the base plate edge of non-drive end (NDE) of pump.

g) Pump nozzles especially at Purchaser's interface shall be as per Piping Material Specifications, attached elsewhere with the MR. In case, non- standard sizes or different from line rating nozzles are unavoidable, companion flanges along with bolts, nuts, gaskets and fasteners shall be included in the scope of the pump vendor.

8.2.13 (Modified)
Slip on Flanges shall not be used.

8.2.16 (Addition)
If chloride concentration exceeds this value, the piping or tubing material shall be upgraded to a material resistant to chloride cracking on all auxiliary systems except Plans 51, 53, 54, 72 and 74. Temperature exceeds 60 °C (140 °F) and atmospheric chlorides are present in sufficient quantity to cause chloride cracking of Type 316 SS pipe or tubing (e.g., caused by overspray

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from cooling water tower) then piping or tubing material shall be upgraded to a material resistant to chloride cracking.

8.2.21 (Modified)
Stainless Steel (300 series) / Duplex stainless steel shall be used for cooling water lines as per the water quality specified in enquiry document.

8.2.22 (Modified)
'If Specified' stands deleted.

8.2.24 (Modified)
'If specified' stands deleted.

8.2.25 (Addition)
Insulation or guarding shall be provided as an integral part of the auxiliary piping system to provide personnel protection when the non-insulated metal temperature exceeds 70°C (160°F) and the auxiliary piping system is in an area where it can be touched during normal operation and maintenance activities.

8.2.26 (Addition)
The need for steam or electric heat tracing in conjunction with insulation to prevent freezing (solidification) or viscosity related flow problems shall be discussed and agreed with the Seal Vendor and Pump vendor. Consideration should be given to normal conditions as well as start-up conditions.

8.3 Components of Seal Auxiliary Systems (if specified in Annex II)

8.3.2 Coolers

8.3.2.1.1 (Modification)
All coolers shall be of horizontal configuration and external. Coolers integral to the barrier / buffer fluid reservoirs are preferred. However cooling coil provision in plan 52 may be permitted based on heat soak calculations.

The seal Vendor shall remain responsible for the combined performance of the seal and seal system in accordance with this specification.

The type(s) of seal flush system(s) shall be specified on the bidding document.

8.3.2.1.13 (Addition)
The seal manufacturer shall include a provision enabling back-flushing of the cooling water side of the exchanger.

8.3.2.3 Air Coolers

8.3.2.3.5 (Addition)
Air Cooled Type Seal Cooler shall be designed for limiting temperature rise of buffer/barrier fluid within 10 C above maximum ambient temperature (including the surrounding temperature due to Main/Auxiliary Motors). In case the desired temperature is not achievable with one cooler, coolers in series shall be provided. Cooler fans shall be directly driven by Electric Motor (V-belt drives are not acceptable). Refer seal plan sketch attached in Annexure II.

8.3.2.3.6 (Addition)
Forced draft seal-flush coolers shall be equipped with either a device to alarm on high fluid temperature or loss of fan draft, if this event would lead to rapid seal failure.

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8.3.2.3.7 (Addition)
Motors for forced-draft fans shall meet the electrical classification of the area.

8.3.2.3.8 (Addition)
Fins shall be aluminium with an anticorrosion coating (unless otherwise agreed by the purchaser) to prevent atmospheric corrosion

8.3.5 Flow Control Orifice

8.3.5.2 (Modification)
Orifice shall be mounted in the auxiliary piping between a pair of flanges. Tubing is not recommended.

8.3.6 Barrier/Buffer Fluid Reservoirs and Accumulators

8.3.6.1 General

8.3.6.2.1(Modification)
Unless otherwise specified, the barrier/buffer fluid reservoir shall be arranged as shown in Annexure II.

8.3.6.1.1(Modification)
Sizing, instrumentation requirement and general arrangement of the barrier/buffer fluid reservoir or accumulator shall be as per the sketch of the respective seal plans attached with this specification. Fluid selection shall be compatible with the process fluid. For any clarification of fluid selection, seal vendor shall approach the Purchaser.

8.3.6.2 Barrier / Buffer Fluid Reservoirs

8.3.6.2.4(Modification)
Instrumentation requirement in the reservoir shall be as per the sketches attached to this specification.

8.3.9 Collection reservoir for Liquid Leakage

8.3.9.3 Reservoir for Containment Seal Chamber Leakage (Piping Plan 75)

8.3.9.3.3(Modification)
'if specified' stands deleted.

8.3.9.3.4(Modification)
'if specified' stands deleted.

9 INSTRUMENTATION (Substitution)
Refer Instrumentation Specification for Pump Seal Flushing Plans attached as Annexure-I.

10 INSPECTION, TESTING AND PREPARATION FOR SHIPMENT

10.3 Testing

10.3.3 (Addition)
Seal Acceptance Test
Any seal offered under "Engineered Seal" category or when seal area/stuffing box is subjected to operating pressure >=20Kg/cm^{2}g (i.e. seals having MDSP>=20Kg/cm2G) shall undergo the Seal Acceptance Test (SAT):
SAT shall be carried out on all seals installed in one pump per item / tag comprising of Four-

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hour static test, four-hour dynamic test and one-hour cyclic test with test fluid selection (refer Note-1 below) as per API 682 and test conditions commensurate with either API 682 test conditions or the conditions expected during operation in normal as well as start-up / shut-down conditions, whichever is more stringent. However, for temperature, API limit of 260° C may be followed for testing, in case of high temperature applications.

Propane testing, as per API 682 4th Edn. test conditions, shall be carried out only for liquids with S.G $\leq$ 0.6 & pumping temperature of -5°C to 176°C or for all flashing hydrocarbons with pumping temperature $\leq$ -5°C. Additionally, for propane testing, in case operating pressures are higher than API 682 4th edn. test conditions, additional seal acceptance testing with Diesel/Mineral oil (as applicable) shall be carried out at actual operating pressures. (as per above).

11 DATA TRANSFER

11.2 Data Requirement Forms (Substitution)

11.2.1 Engineering Design Drawings and data as required after purchase order has been specified in Vendor Data Requirement. 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.

11.2.2 All vendor data/drawings/documents shall be in English Language and in Metric Systems. All post order documents shall be submitted / approved through EIL VDM portal.

11.2.3 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.

12 ANNEXURES

SNO.	Deptt.	Document No.	Revision No.
1.	Instrumentation	6-41-0009-A1	0
2.	SMED	6-41-0009-A2	0

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ANNEXURE-I
INSTRUMENTATION SPECIFICATIONS

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by: Standards Committee Convenor	Approved by: Standards Bureau Chairman
0	20.08.2025	Issued as Annexure-I to Standard Specification 6-41-0009	JT	AR	MN	MN

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GENERAL

1.1 The purpose of this specification is to define general requirements and philosophy of Pump Seal instrumentation as per API Seal Plans.

1.2 This specification along with attached data sheets / standards and relevant part of this requisition covers the design, engineering, supply and testing of Instrumentation with all accessories and materials.

1.3 If there is any conflict between this specification, data sheets, related standard, codes etc, vendor shall refer the matter to Purchaser for clarification and only after obtaining the same, shall proceed further.

2.0 SCOPE OF SUPPLY AND WORK

2.1 Vendor's scope of instrumentation supply and work shall include the following as a minimum:

a) Design, Engineering, testing, inspection and supply of all instruments as per Pump Seal Plan typical schematic specified in the requisition.

b) Impulse piping and all other erection materials including fittings, isolation and drain/vent valve etc. required for erection of instruments alongwith mounting accessories, instrument supports (2" yoke type), canopy.

c) Cable glands/plugs supplied duly installed with the instruments.

e) Submission of filled in data sheets for all instruments along with sizing calculations for safety valve, self-actuated pressure control valve and restriction orifice where applicable. Vendor shall also indicate make and model numbers of the offered instruments. Data sheets shall be submitted for review/approval with one set of technical catalogues of offered instruments with model decoding details.

2.2 Instrumentation cabling and junction box required for interconnection between vendor's supplied field instruments like Pressure, level etc. and Owner's Control System shall be done by Others and it is excluded from vendor's scope of supply and work.

3.0 DESIGN PHILOSOPHY AND TECHNICAL REQUIREMENTS

3.1 All electronic field transmitters shall be intrinsically safe certified by statutory body for electrical hazardous area as specified elsewhere in the requisition.

A copy of approval for intrinsically safe instrument shall be provided as per following:

i) For all electrical items manufactured in India, the testing shall be carried out & test report issued by Indian test laboratory recognized by the Chief Controller of Explosives and valid copy of BIS license (only for Ex Electric Apparatus having flameproof type protection) or IECEx Certificate of Conformity, valid copy of IECEx Quality Assessment Report (summary) and IECEx Test Report.

ii) For all electrical items manufactured outside India, Test report issued by Indian test laboratory recognized by the Chief Controller of Explosives and valid copy of BIS license or IECEx Certificate of Conformity, valid copy of IECEx Quality Assessment Report (summary) and IECEx Test Report. OR EU Type Examination Certificate (Applicable for manufacturers having manufacturing locations in countries covered under the European Union), valid copy of Production Quality Assessment / Assurance Notification

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iii) For installations in India, additionally a copy of approval for intrinsically safe/flameproof enclosure from local statutory authority i.e 'Petroleum and Explosives Safety Organization (PESO), Nagpur in India' shall also be provided based on above.

3.2 All instruments shall also be weatherproof to IP65 as per IS/IEC-60529.

3.3 Vendor shall provide the instrument range and alarm set values for all transmitters during detail engineering as part of "INSTRUMENT RANGE AND ALARM SET POINT DOCUMENT".

3.4 No process switches shall be acceptable; even if it is shown in seal plan drawing. In place of process switches (pressure, temperature, level etc.), 4-20 mA DC SMART transmitters with HART Protocol shall be provided for Seal Plan.

3.5 All field instruments/transmitters shall be with dual cable entries. Unused entry shall be plugged using suitable metallic plug. All cable entries shall be 1/2" NPT (F) size and shall be fitted with double compression type SS cable glands with Slipper type PVC sleeves (cable shrouds) and suitable for hazardous area classification as indicated elsewhere. However, for duplex temperature elements and its cable connectivity with temperature transmitter, cable entry size shall be 3/4" NPTF.

3.6 Housing case material for Pressure Transmitters, Differential Pressure Transmitter and Temperature Transmitter shall be as per manufacturer standard. However, body and element material shall be SS 316 as a minimum and suitable for the fluid being handled.

3.7 All instruments shall be supplied as per the vendor list provided in the requisition.

3.8 Pressure rating of thermowell flanges for temperature element/ temperature gauge shall be minimum 300# rating or as per respective piping specification whichever is higher.

3.9 Instrument Installations Connections

Instrument installation connections shall be as follows on vessels/pipes:

a) The minimum rating of all instrument nozzles on the vessels shall be 300#.
b) Temperature Instrument nozzle connection on vessel shall be 1.5" flanged as a minimum.
c) Pressure Instrument impulse line connection on line shall be ¾" welded (SW/BW) and on vessel shall be ¾" Flanged, however the instrument connection shall be ½" NPT(F).
d) Temperature instrument connection on line shall be 1.5" Flanged upto 600# and 2" flanged for 900# and above pressure rating.
e) For side mounted level instrument, connection on vessel shall be ¾" Flanged.
f) For top mounted level Transmitter connection shall be 2" Flanged.

For mounting of the pressure instruments, root isolation valves and integral 2-Valve manifold arrangement for the instrument shall be applicable. However, for ratings 900# and above site fabricated external manifold with gate isolation valve and drain/vent valve arrangement shall be provided.

Impulse line shall be Piping with Tubing at instrument end for instrument installation. For pressure ratings 900# and above, impulse line shall be only piping upto the instrument end. The material of construction & specification for instrument installation impulse piping and fittings shall be as per pump seal vessel/pipe where the same are being installed. However, tubing material for instrument installation where provided shall be SS316L and Tube fittings shall be SS316.

3.10 All electronic instruments as applicable shall have internal terminal block, anti-vibration type for cable termination. Flying leads are not acceptable.

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3.11 S.S. tag plates shall be provided for all the instruments.

3.12 Prefabricated FRP canopy shall be used for field electronic instruments. Canopy for transmitters shall cover TOP and all 3 SIDES (back and 2 sides). SS canopy instead of FRP shall also be acceptable. Tag number shall be printed on the canopy.

Typical characteristics of FRP canopy shall be following:
i) High mechanical strength
ii) Weather resistant (Resistant to most of the acids, alkalies, vapours & fumes)
iii) UV resistant
iv) Anti-Static
v) Special rubber grommets for Cable/ Tube entry.

3.13 Data sheet for each instrument shall be provided by the vendor during detail engineering in ISA format. Vendor shall furnish filled in data sheet for each tag after sizing, range selection, material selection etc. These data sheets shall be reviewed by EIL / Purchaser after placement of order. Proper selection of instruments, materials etc. shall be vendor's responsibility. Any necessary change required later for meeting the specification shall be done by the vendor without any price or delivery implications. While filling the instruments data sheets, the following shall be taken care:

a) All the relevant data shall be filled in. If any point is not applicable then N/A shall be indicated.
b) Make and model number of the offered instruments shall be indicated with model decoding details for offered instrument, without model no, data sheet shall not be reviewed.
c) Vendor seal with signature shall be provided and vendor shall ensure the correctness of the process data.
d) Instruments tag numbers /data sheet numbers shall be indicated.

3.14 **Pressure Gauge**

a) Pressure gauge dial shall be 150mm white of non-rusting material with black figures. Pressure gauge shall have solid front for gauges having range of 0 to 100 kg/cm2g.
b) Pressure gauge shall have ½" NPT (M) bottom connection.
c) Pressure gauge shall be provided with features like bayonet bezel, externally adjustable zero, over range protection and blow out disc.
d) Sensing element (bourdon tube) shall be of SS 316 and movement of SS 304, as a minimum. Case material for pressure gauges shall be SS 304.
e) Pressure gauge shall have accuracy within 1% of URV (Upper Range Value) and range shall be so selected that gauge normally operates in middle third of the range.
f) Pressure gauge shall be suitable for maximum pressure or 130% of the range whichever is higher, without any calibration drift.

3.15 **Pressure Transmitter**

a) All transmitters used in the pump seal plan shall be SMART type having 4-20mA DC output with superimposed HART protocol and shall be suitable for the specified area class.
b) Integral LED/LCD output meter shall be provided for all transmitters.
c) Smart transmitters shall be used in analog mode with an accuracy of ± 0.065% of span with a rangeability of 10:1 and with stability of ± 0.2% of URL for a minimum period of 10 years. All smart transmitters shall be suitable to be configured using Purchaser's Universal type Hand held communicator.
d) Transmitters shall have static pressure rating of 160 kg/cm2g except for low-range (0-25 kg/cm2g or less) for which the static pressure shall be 52 kg/cm2g.
e) Threaded end connections shall be to NPT as per ANSI B 1.20.1. Flanged end connections shall be as per ANSI B 16.5.

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3.16 **Level Gauge**

a) Only Magnetic Type Level Gauges with ¾" flanged connection shall be used. All level gauges shall be provided with vent/ drain valves with plug. Body/ chamber and cover material shall be SS as a minimum for all type of level gauges and Body rating of gauge shall be considered suitably to meet the process design condition.

3.17 **Level Transmitter**

a) Level Transmitter shall be Time Domain Reflectometry type Guided Wave Radar level instrument. Transmitters shall be SMART type having 4-20mA DC output with superimposed HART protocol and shall be suitable for the specified area class.
b) 2" flanged connection size as a minimum shall be applicable for top mounted GWR Level transmitter.
c) Sensor shall be Wave Guided type with process wetted parts material suitable for process fluid (SS316 / 316L as minimum).
d) Accuracy of Guided wave radar shall be within ±3.0 mm. Co-axial type GWR shall be provided.
e) Level transmitter Chamber and other accessories materials like mounting Flanges; Stud bolts material shall be suitable for the process fluid.

3.18 **Temperature Gauges**

a) The temperature gauges shall be bimetallic type and shall be provided with 1½" flanged (min. 300# rating) thermowell with ½" NPT (F) connection for temperature gauges.
b) Thermowell shall be fabricated out of bar stock as per 7-52-0035/7-52-0036. For thermowell with RTJ Flange, flange bore diameter shall be as per ASME B16.5 and thermowell bar stock OD shall be considered accordingly for fitting with these flanges.
c) Temperature gauges shall have accuracy as per EN 13190 Class I.
d) Thermowell and flanges of Thermowell shall be minimum of SS-316 or better to suit the service conditions.
e) Case material for temperature gauges shall be SS 304.
f) The gauge movement material shall be of stainless steel, as a minimum
g) The case of bimetallic type of gauges shall be all angles rotatable type

3.19 **Temperature Transmitter**

a) All transmitters used in the pump seal plan shall be SMART type having 4-20mA DC output with superimposed HART protocol and shall be suitable for the specified area class
b) Duplex RTD element shall be provided.
c) Thermowell shall be fabricated out of bar stock as per 7-52-0035/7-52-0036. For thermowell with RTJ Flange, flange bore diameter shall be as per ASME B16.5 and thermowell bar stock OD shall be considered accordingly for fitting with these flanges.
d) Temperature transmitter shall be universal type, able to accept input from resistance temperature detector (RTD) or thermocouple (T/C) of any type and range.
e) Temperature transmitters shall be provided with dual compartment having metallic separation.
f) Temperature transmitter shall be remote mounted type with at least 10m armoured triad cable between Temperature element and temperature transmitter.
g) The accuracy of the temperature transmitter with RTD element shall be as follows:

Temperature Range	Accuracy
Above 350°C	±0.075%
Between 350°C to 150° C	±0.15%

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Below 150° C	±0.25%

h) Dual input capability with automatic transfer to back-up sensor shall be considered for all temperature transmitters. Accordingly, both the elements shall be wired to transmitters. Burnout protection (selectable Up Scale /Down Scale) must be provided for temperature transmitters.
i) Integral LED/LCD output meter shall be provided for all transmitters.

3.20 Variable Area Flowmeter (with Flow Transmitter)

a) Variable Area Flowmeter shall be of metal tube type. Transmitter shall be SMART type having 4-20mA DC output with superimposed HART protocol and shall be suitable for the specified area class.
b) The material for tube & float shall be SS 316 as a minimum.
c) The packing material shall be PTFE if the liquid temperature is below 200° C. For temperatures above 200° C, packing shall be of GRAFOIL.
d) Variable Area Flowmeter shall have an accuracy Class 1.6 or better as per VDE/VDI directive 3513/2

3.21 Restriction Orifice Plate

a) Restriction Orifice Plate shall be concentric square edged type.
b) Each Restriction 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 pipe size in inches and rating in psi.
   - Material of plate.
c) Restriction Orifice Plate material shall be SS 316 as a minimum or better.

3.22 Pressure Relief Valve / Thermal Relief Valve

a) Pressure Relief Valve shall meet the limiting relief valve requirements as defined in API RP-520 (Part-I & II) and in API-526.
b) Pressure Relief Valve shall be full nozzle full lift type and Thermal Relief Valve shall be modified nozzle type.
c) Percentage Accumulation shall be 10% for Pressure Relief Valve and 25% for Thermal Relief Valve.
d) Body material shall be Carbon Steel as a minimum. Nozzle and disc material shall be SS 316 as a minimum with machined SS guide and spindle. Spring material shall be selected as per operating conditions as follows:
   Between (-29°C to 230°C) : Plated Carbon steel as a minimum

   More than 230°C : Tungsten alloy steel

   Less than (-29°C) : Stainless Steel
e) Pressure Relief Valve shall have flanged connections for sizes 1" and above and shall have screwed connection for sizes 3/4" and below.
f) Thermal Relief Valve shall have screwed connection with 0.38 cm^2 orifice size and inlet outlet shall be of 3/4" NPT (M) X 1" NPT (F) sizes. For high pressure rating 900# and above, Thermal Relief Valve with flanged end connections shall be considered.
g) Selection of proper type of pressure relief valve type shall be vendor's responsibility suitable for the system.
h) Pilot operated relief valves shall be selected for special services and where set pressure is closer to the operating pressure by less than 10% or back pressure is above 50% of set pressure.

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4.0 TAG NUMBERING

5.1 Instrumentation symbol shall follow latest edition of ISA standard S 5.1.

5.2 All vendor-supplied instruments shall have Tag No. as assigned and provided by purchaser with the requisition or during detailed engineering.

ATTACHMENTS:

S. No.	Description	Document no.
1.	Thermowell	7-52-0035
2.	Thermowell/RTD assembly with thermowell	7-52-0036
3.	Instrument Range and Alarm Setpoint Document	

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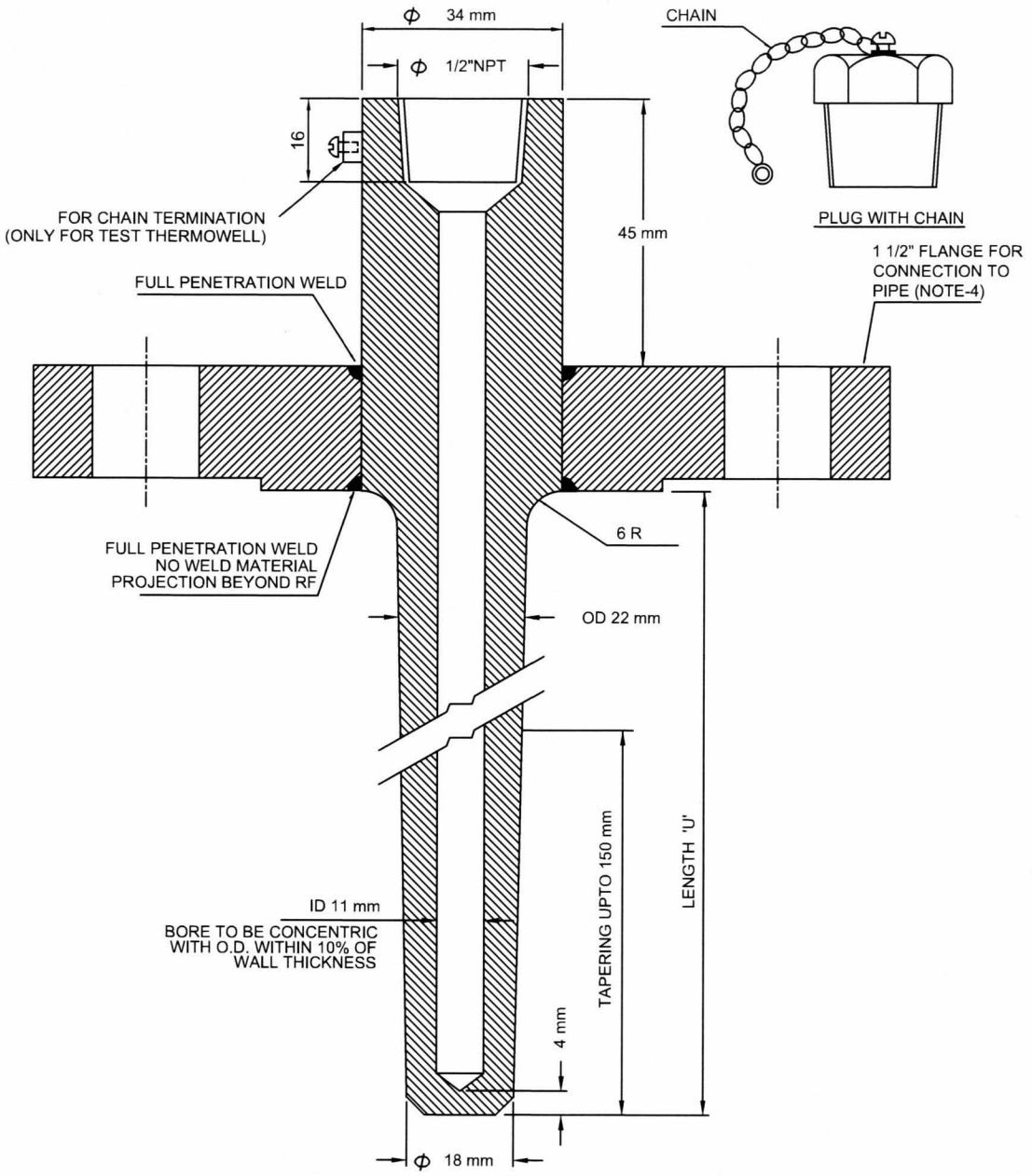

NOTES -

1. THIS STANDARD IS APPLICABLE FOR ;
   a) TEMPERATURE GAUGES, BEADED TEMPERATURE ELEMENTS AND DUPLEX TEMPERATURE ELEMENTS.
   b) THERMOWELL UPTO 1500 CLASS AS PER ASME OR EQUIVALENT WITH RF AS PER SPECIFICATIONS/PMS.
2. DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS. OTHER TESTING REQUIREMENT AS PER PMS.
3. CHAIN AND PLUG SHALL BE APPLICABLE ONLY FOR TEST THERMOWELLS.
4. FLANGE SIZE SHALL BE 2" FOR RATING (AS PER ASME CLASS) >600 OR THERMOWELL CONNECTION ON UNCLADDED EQUIPMENT. FOR CLADDED EQUIPMENT FLANGE SIZE SHALL BE 3"

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	14-11-23	REVISED & REISSUED	Kushal/RSC	AJS	MN	MN
4	25-04-18	REAFFIRMED & REISSUED	Manoj	MN	RG	RN

Approved by

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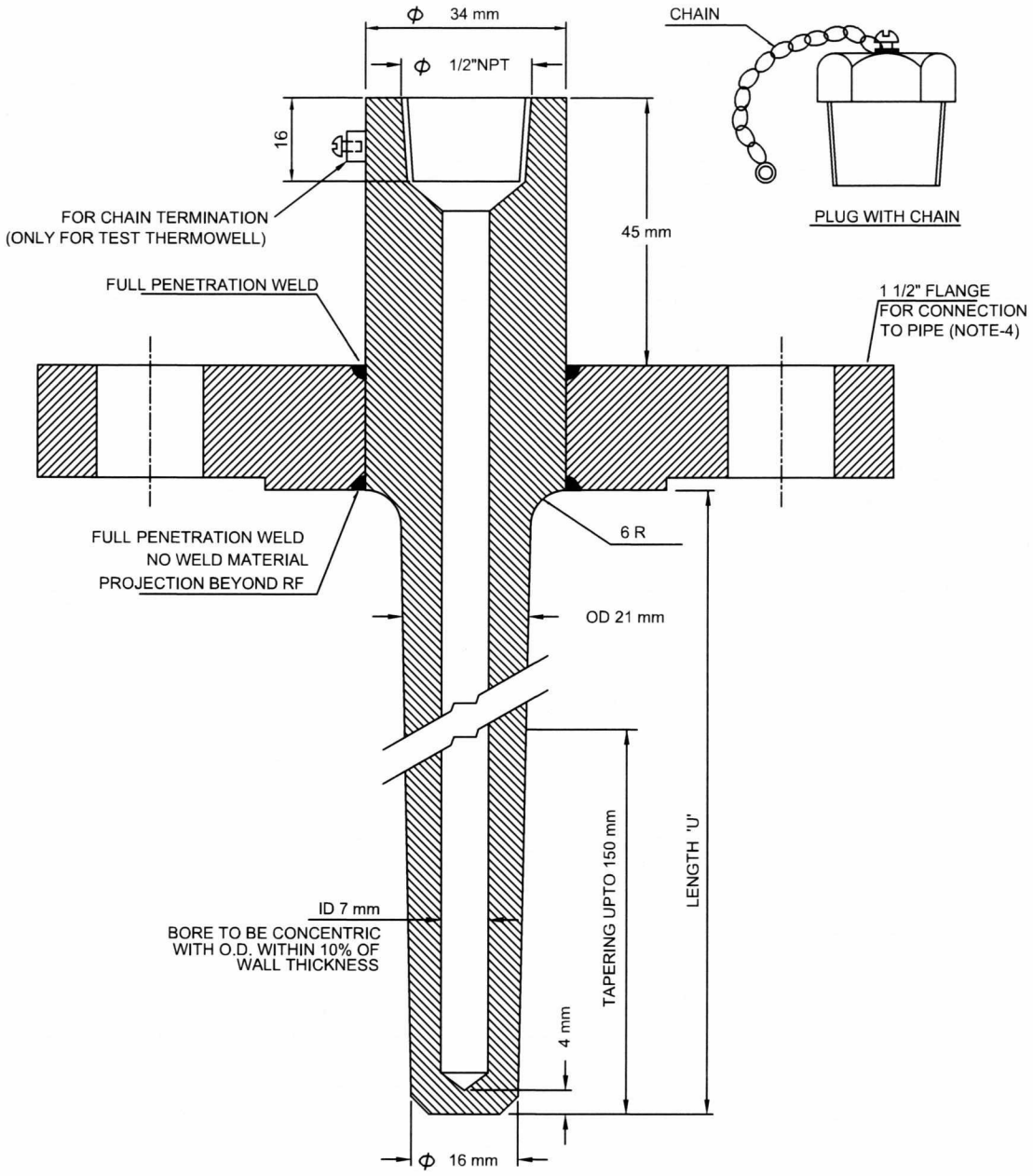

NOTES -

1. THIS STANDARD IS APPLICABLE FOR ;
   a) SINGLE TEMPERATURE ELEMENT.
   b) THERMOWELL UPTO 1500 CLASS AS PER ASME OR EQUIVALENT WTIH RF AS PER SPECIFICATIONS/PMS.
2. DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS. OTHER TESTING REQUIREMENT AS PER PMS.
3. CHAIN AND PLUG SHALL BE APPLICABLE ONLY FOR TEST THERMOWELLS.
4. FLANGE SIZE SHALL BE 2" FOR RATING (AS PER ASME CLASS) >600 OR THERMOWELL CONNECTION ON UNCLADDED EQUIPMENT. FOR CLADDED EQUIPMENT FLANGE SIZE SHALL BE 3"

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	14-11-23	REVISED & REISSUED	Kushal/RSC	AJS	MN	MN
4	25-04-18	REAFFIRMED & REISSUED	Manoj	MN	RG	RN

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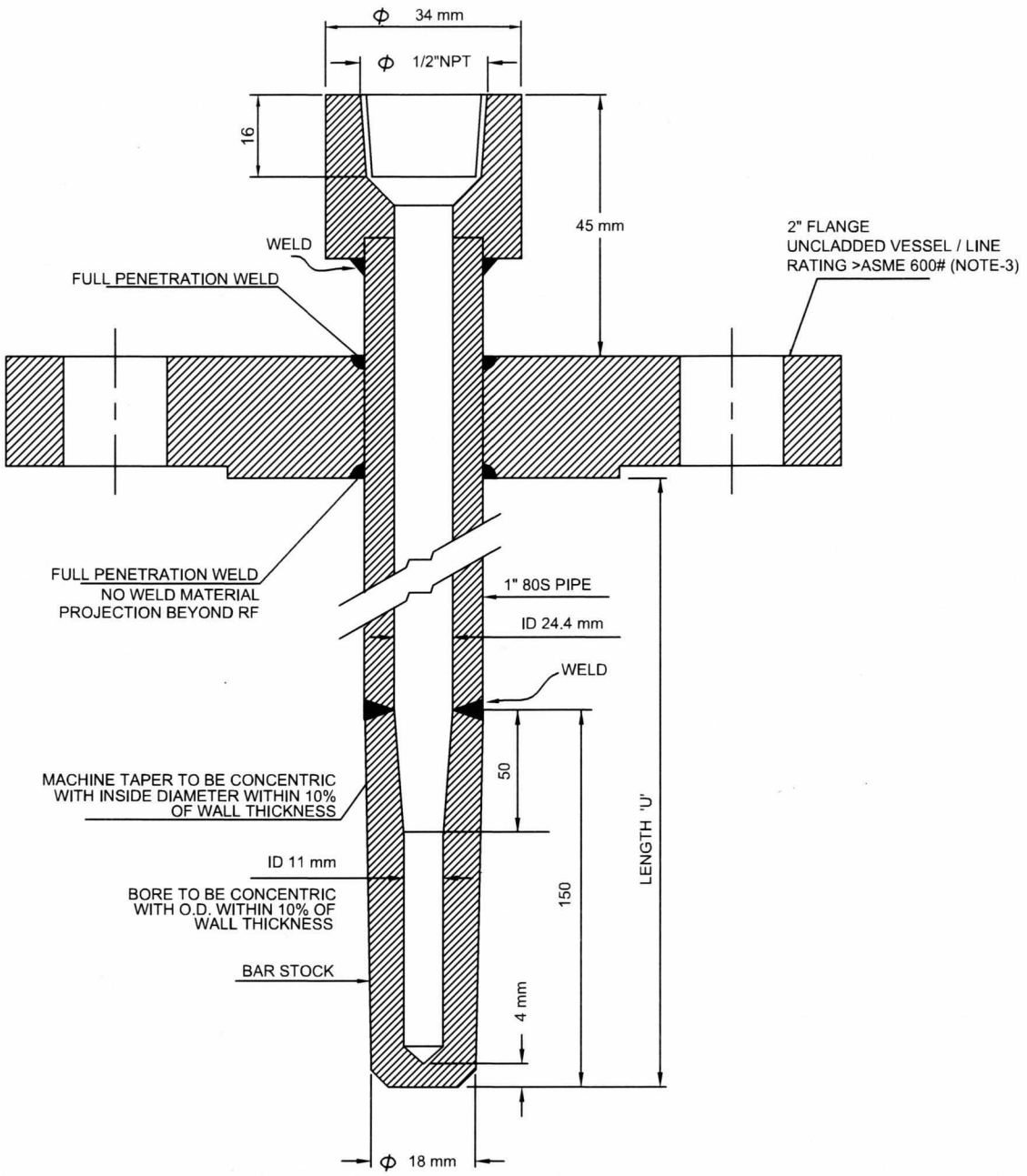
BUILT-UP THERMOWELL



NOTES:-

1. THIS STANDARD IS APPLICABLE FOR ;
   a) TEMPERATURE GAUGES, BEADED TEMPERATURE ELEMENTS AND DUPLEX TEMPERATURE ELEMENTS.
   b) THERMOWELL UPTO 1500 CLASS AS PER ASME OR EQUIVALENT WITH RF AS PER SPECIFICATIONS/PMS.
2. DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS. OTHER TESTING REQUIREMENT AS PER PMS.
3. FLANGE SIZE SHALL BE 3" FOR CLADDED EQUIPMENT, FLANGE SIZE SHALL BE 1.5" FOR LINE UP TO ASME CLASS 600#.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	14-11-23	REVISED & REISSUED	Kushal/RSC	AJS	MN	MN
4	25-04-18	REAFFIRMED & REISSUED	Manoj	MN	RG	RN

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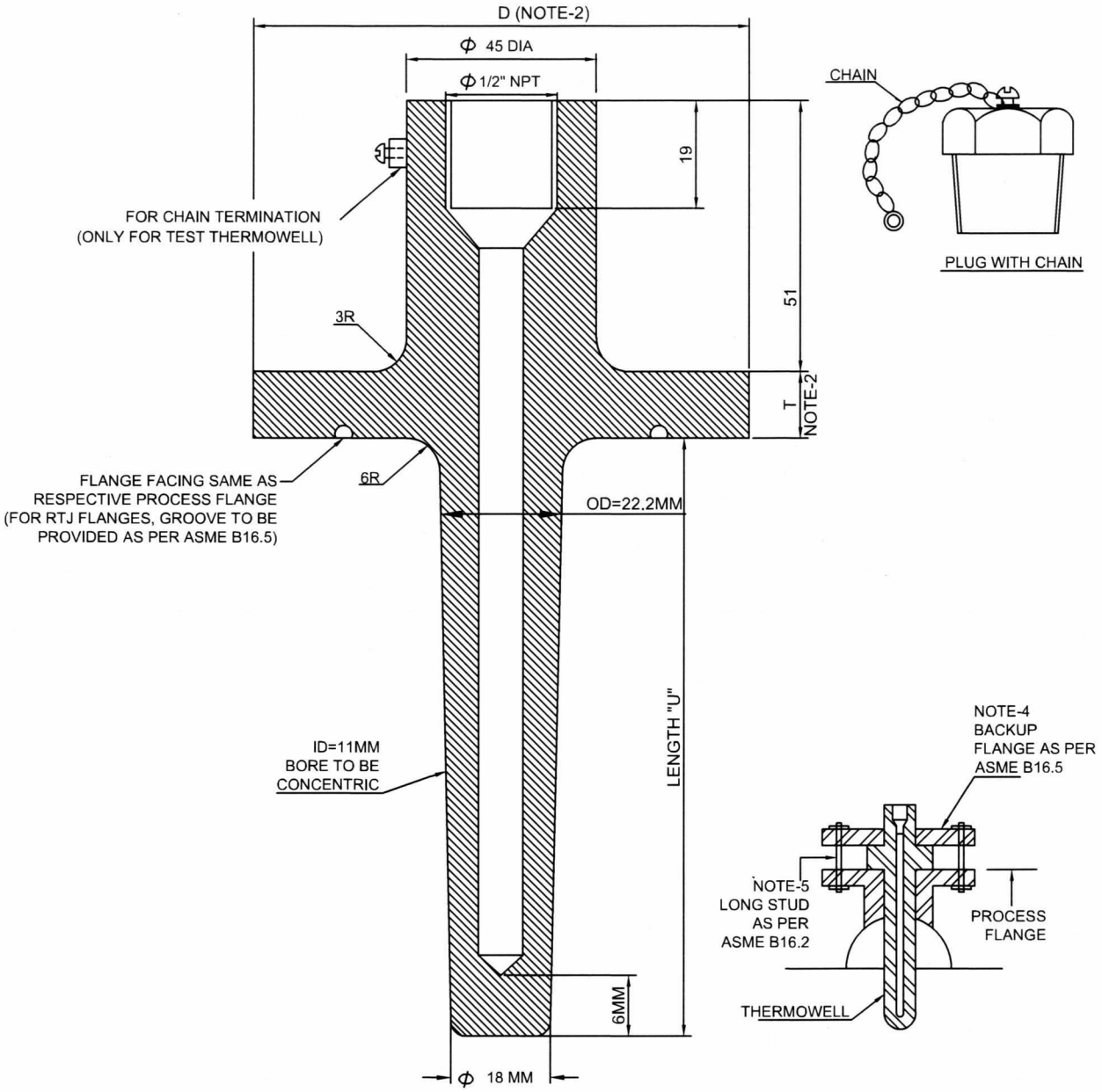
VANSTONE THERMOWELL BARSTOCK TAPERED



NOTES -

1. ALL DIMENSIONS ARE IN "MM". FIGURES IN BRACKETS ARE IN INCHES.
2. THE COLLAR SHOULD BE EQUAL TO RF DIA "R" FOR RF FACING WELD AND COLLAR DIA SHOULD BE DIA "K" AS PER ASME B16.5. THE COLLAR THICKNESS SHOULD BE 15MM FOR RF FACING UP TO 1500# AND 20MM FOR RF UPTO 2500# FLANGE END FOR ALL RATING OF RTJ FLANGE
3. THERMOWELLS SHALL BE HYDROSTATICALLY TESTED INTERNALLY FOR RESPECTIVE PRESSURE RATING.
4. VENDOR SHALL SUPPLY ASME BACK-UP FLANGE WITH A HOLE OF I.D. TO SUIT 45MM O.D. OF THERMOWELL WITH EACH THERMOWELL. THIS BACK UP FLANGE IS TO BE MOUNTED ON THE THERMOWELL ON THE OTHER SIDE OF PROCESS FLANGE. THE BACKUP FLANGE MATERIAL SHALL BE AS PER DATA SHEET.
5. SPECIAL LONG STUDS WITH NUTS TO FIX THE THERMOWELL WITH PROCESS FLANGE AND BACK-UP FLANGES SHALL BE SUPPLIED ALONG WITH EACH TAG.
6. FLANGE SIZE & RATING AS PER DATA SHEET.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	14-11-23	ISSUED AS STANDARD	Kushal/RSC	AJS	MN	MN

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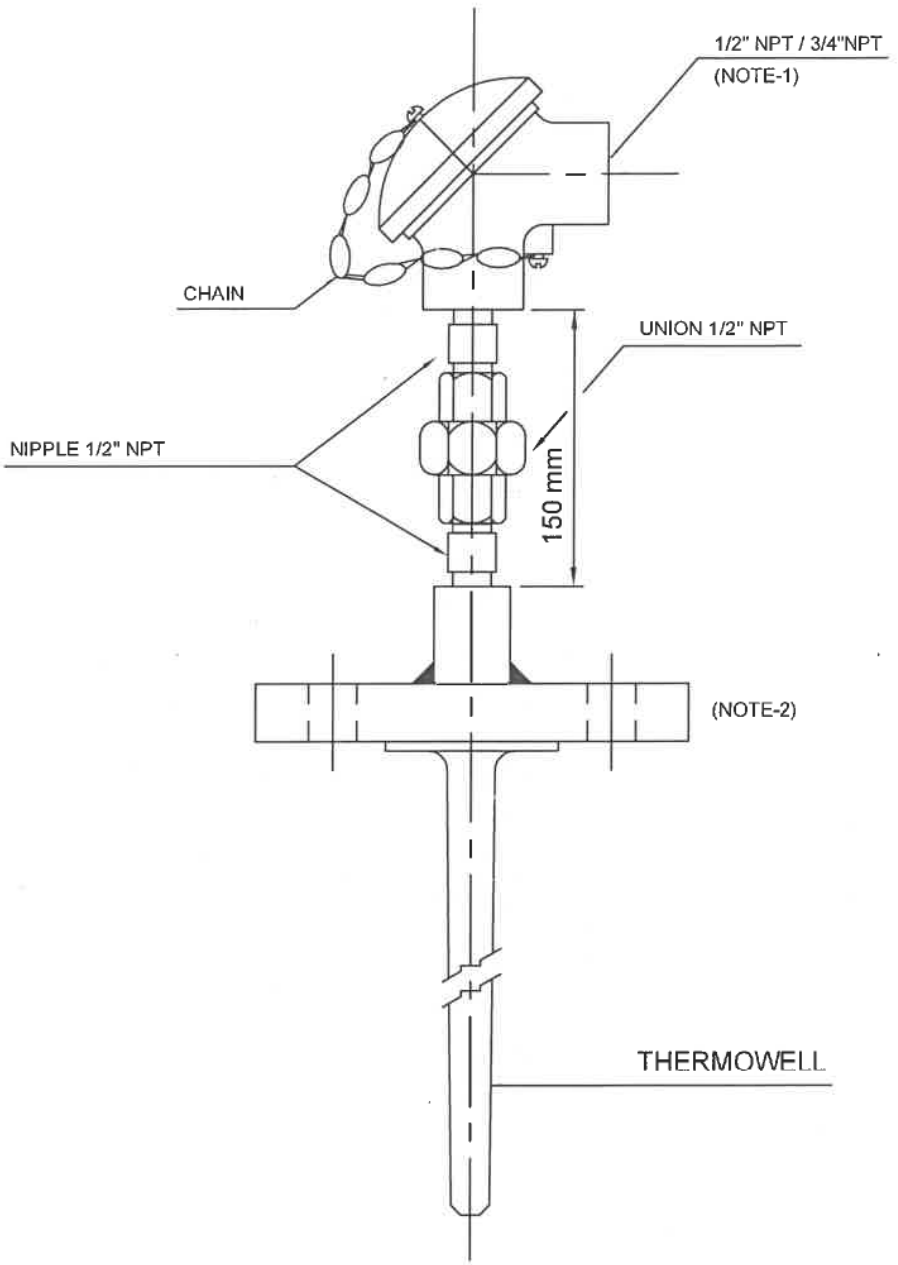

NOTE -
1. IN THE CASE OF DUPLEX THERMOCOUPLE/RTD, TWO INDEPENDENT 3/4"(NPT) CABLE ENTRIES SHALL BE PROVIDED.
2. FLANGE TYPE, SIZE AND RATING SHALL BE AS PER DATA SHEET.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	21.10.24	Reaffirmed & Reissued As Standard	Sonu	AJS	MN	MN
5	10.10.19	Reaffirmed & Reissued As Standard	Manoj	MN	RG	RN

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ANNEXURE-II

STANDARD FLUSH PLANS AND AUXILIARY HARDWARE

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
0	20.08.25	Issued as Annexure-II to Standard Specification 6-41-0009	MG	TK	NK	MN

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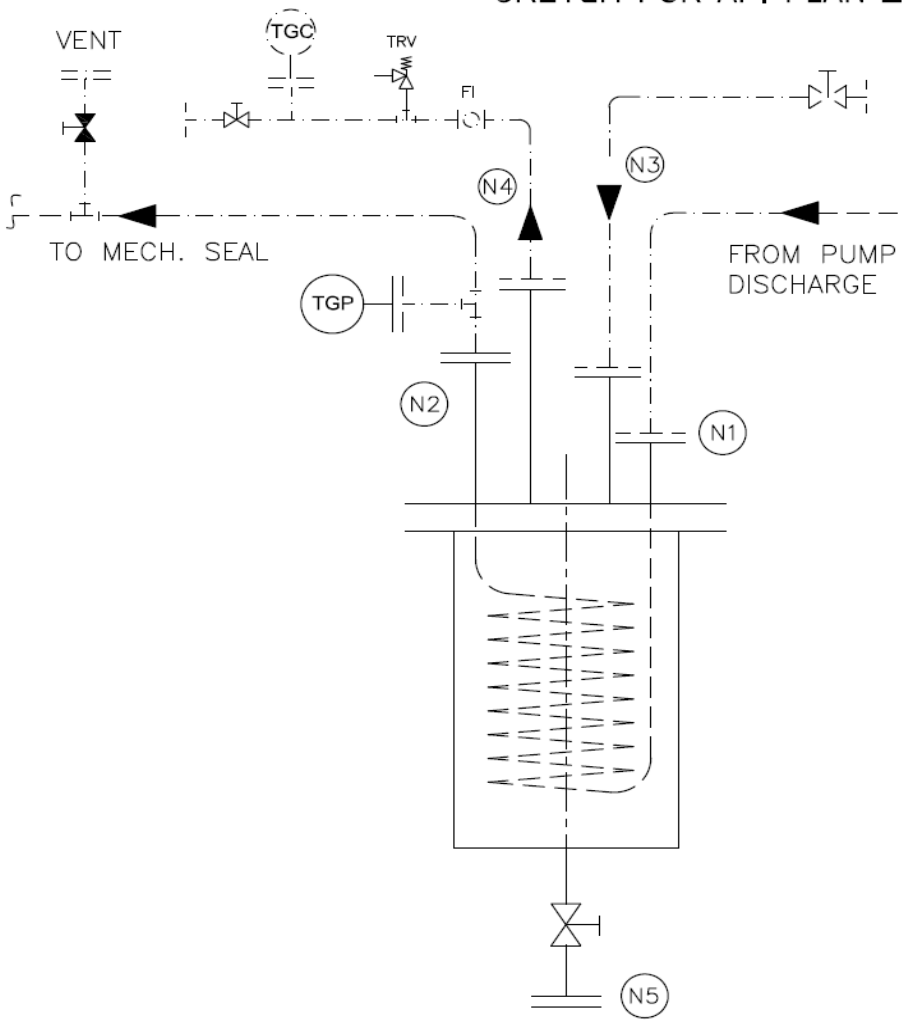
SKETCH FOR API PLAN 21



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	Process Inlet	DN15 (1/2") Sch 80	#300	SWRF
N2	Process Outlet	DN15 (1/2") Sch 80	#300	SWRF
N3	Cooling Water Inlet	DN20 (3/4") Sch 80	#300	SWRF
N4	Cooling Water Outlet	DN20 (3/4") Sch 80	#300	SWRF
N5	Drain	DN20 (3/4") Sch 80	#150	SWRF

LEGEND	
TGP	TEMPERATURE GAUGE PROCESS
TGC	TEMPERATURE GAUGE COOLING WATER
TRV	THERMAL RELIEF VALVE
FI	FLOW INDICATOR
	GATE VALVE

PUMP OEM's SCOPE

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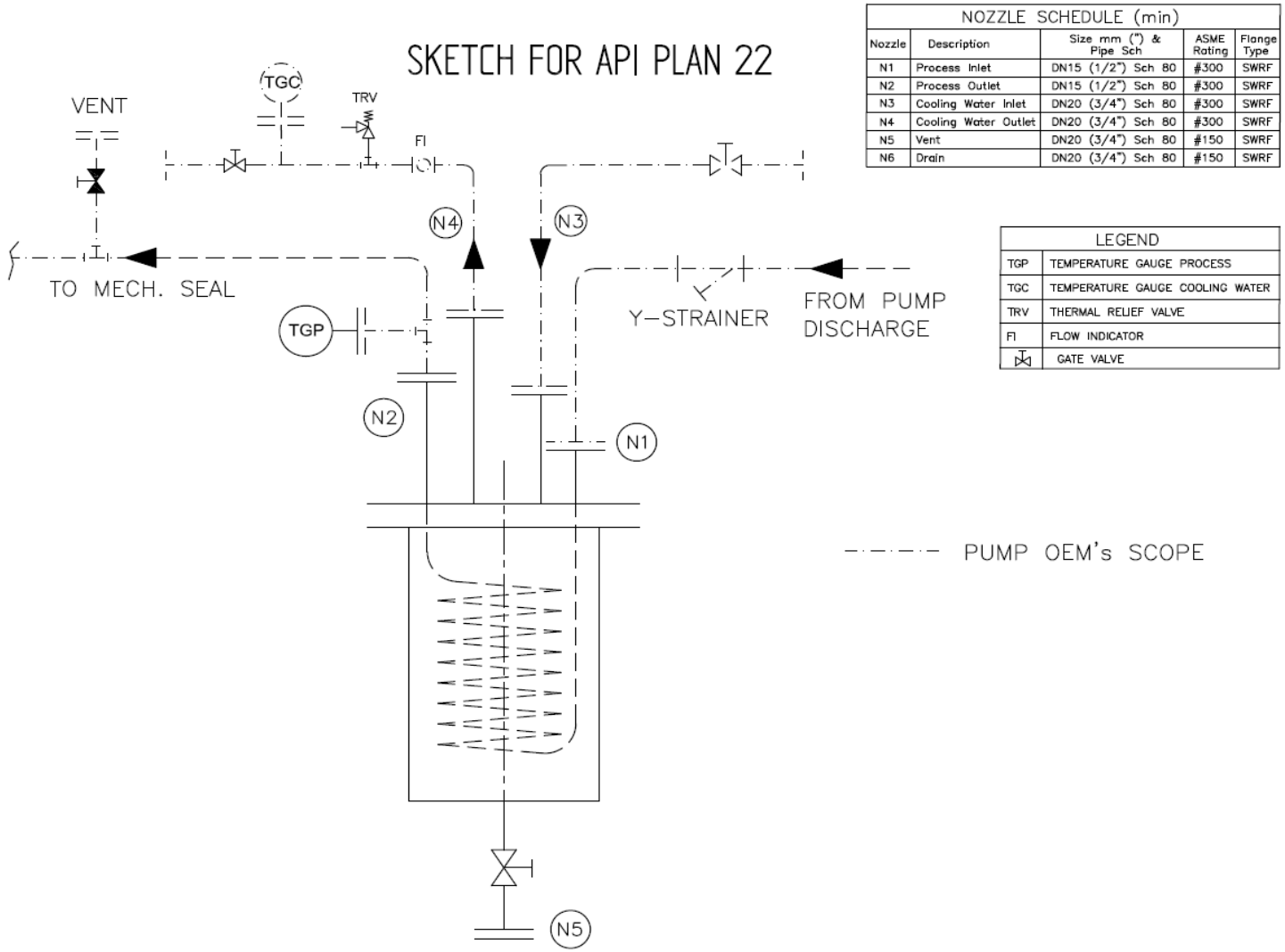

NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	Process Inlet	DN15 (1/2") Sch 80	#300	SWRF
N2	Process Outlet	DN15 (1/2") Sch 80	#300	SWRF
N3	Cooling Water Inlet	DN20 (3/4") Sch 80	#300	SWRF
N4	Cooling Water Outlet	DN20 (3/4") Sch 80	#300	SWRF
N5	Vent	DN20 (3/4") Sch 80	#150	SWRF
N6	Drain	DN20 (3/4") Sch 80	#150	SWRF

LEGEND	
TGP	TEMPERATURE GAUGE PROCESS
TGC	TEMPERATURE GAUGE COOLING WATER
TRV	THERMAL RELIEF VALVE
FI	FLOW INDICATOR
	GATE VALVE

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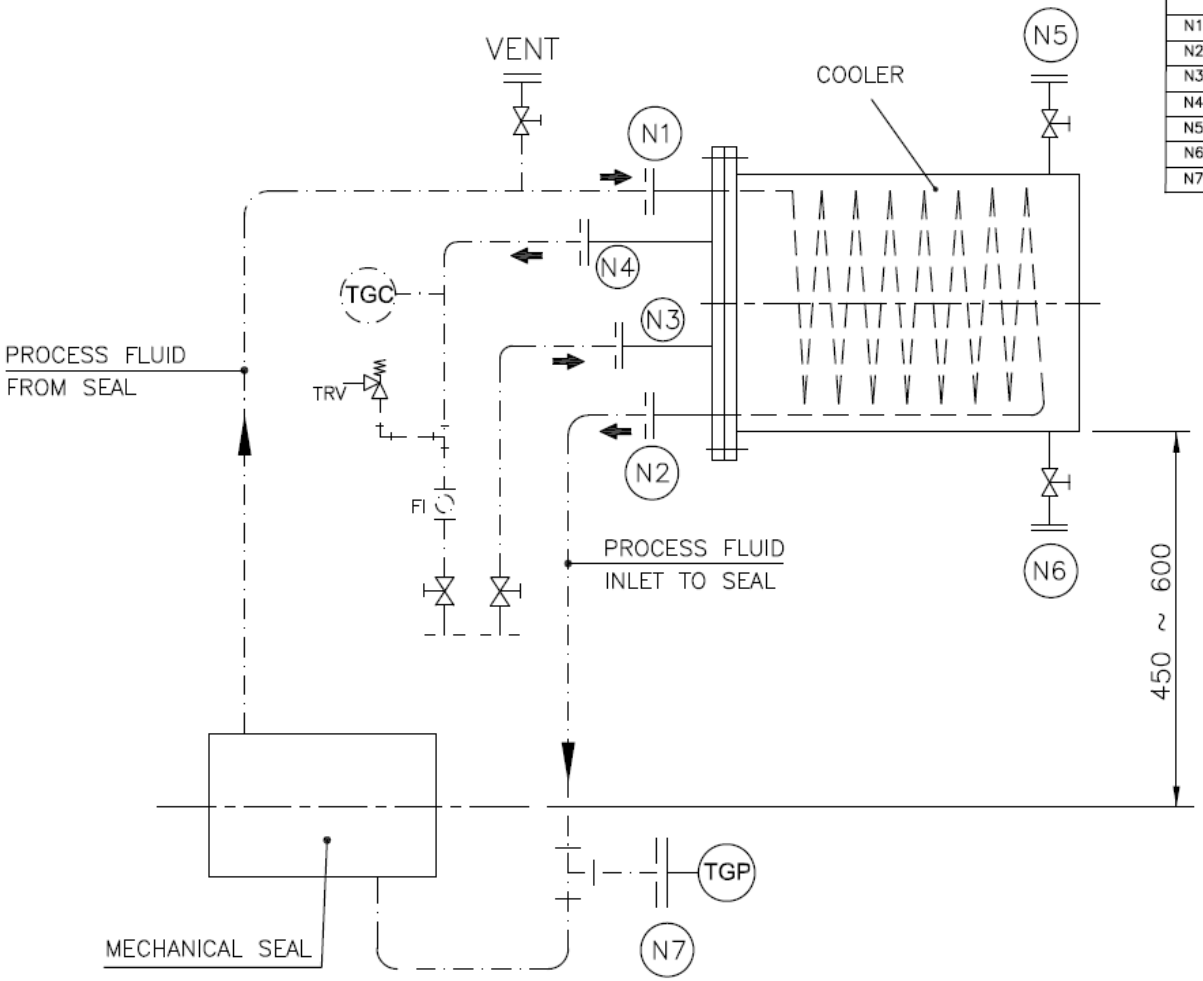
SKETCH FOR API PLAN 23



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	Process Inlet	DN15 (1/2") Sch 80	#300	SWRF
N2	Process Outlet	DN15 (1/2") Sch 80	#300	SWRF
N3	Cooling Water Inlet	DN20 (3/4") Sch 80	#300	SWRF
N4	Cooling Water Outlet	DN20 (3/4") Sch 80	#300	SWRF
N5	Vent	DN20 (3/4") Sch 80	#150	SWRF
N6	Drain	DN20 (3/4") Sch 80	#150	SWRF
N7	Temp. Gauge – Process	DN40 (3/4") Sch 80	#300	SWRF

LEGEND	
TGP	TEMPERATURE GAUGE PROCESS
TGC	TEMPERATURE GAUGE COOLING WATER
TRV	THERMAL RELIEF VALVE
FI	FLOW INDICATOR
	GATE VALVE

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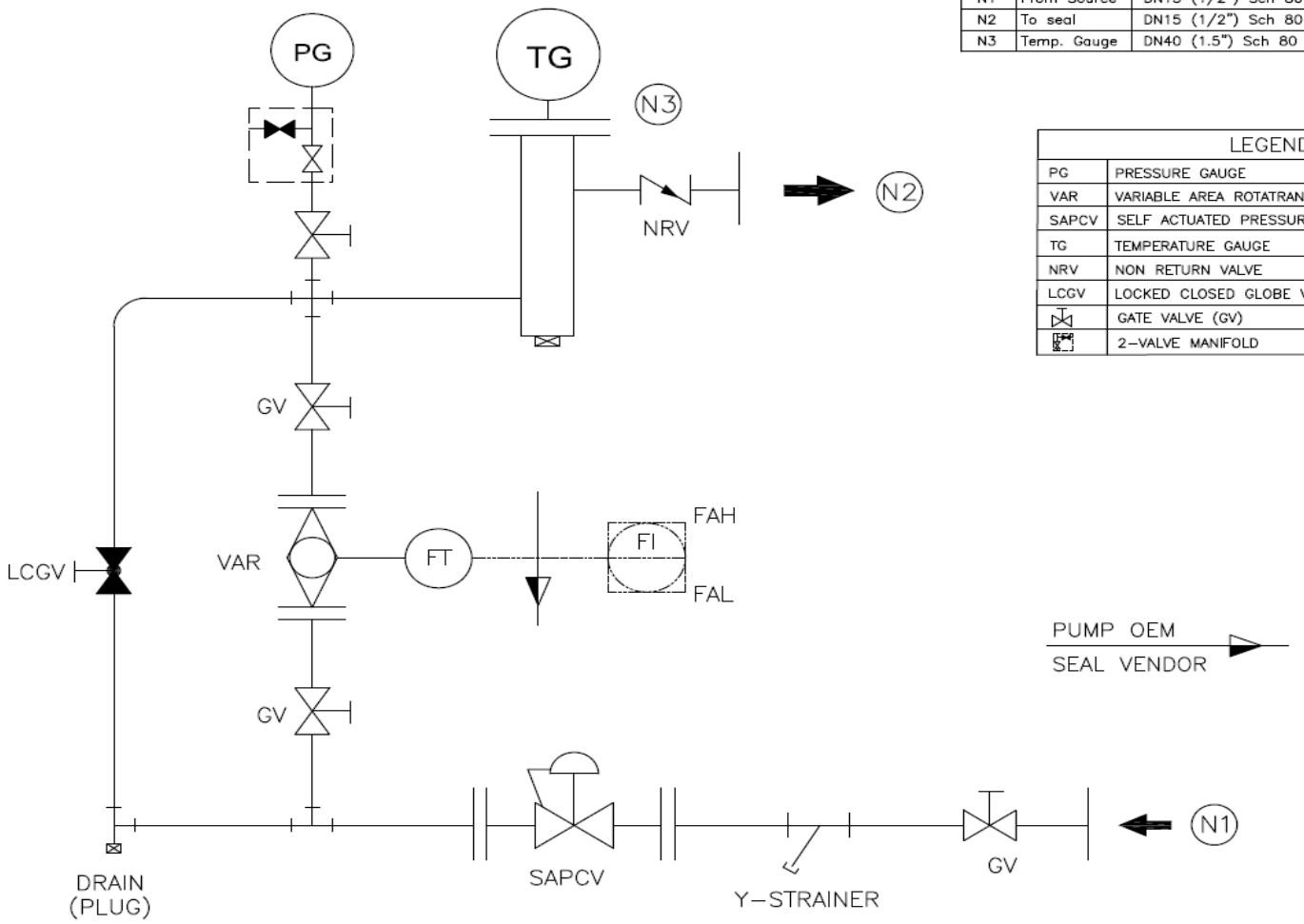
SKETCH FOR API PLAN 32



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	From Source	DN15 (1/2") Sch 80	#300	SWRF
N2	To seal	DN15 (1/2") Sch 80	#300	SWRF
N3	Temp. Gauge	DN40 (1.5") Sch 80	#300	SWRF

LEGEND	
PG	PRESSURE GAUGE
VAR	VARIABLE AREA ROTATRANSMITTER
SAPCV	SELF ACTUATED PRESSURE CONTROL VALVE
TG	TEMPERATURE GAUGE
NRV	NON RETURN VALVE
LCGV	LOCKED CLOSED GLOBE VALVE
	GATE VALVE (GV)
	2–VALVE MANIFOLD

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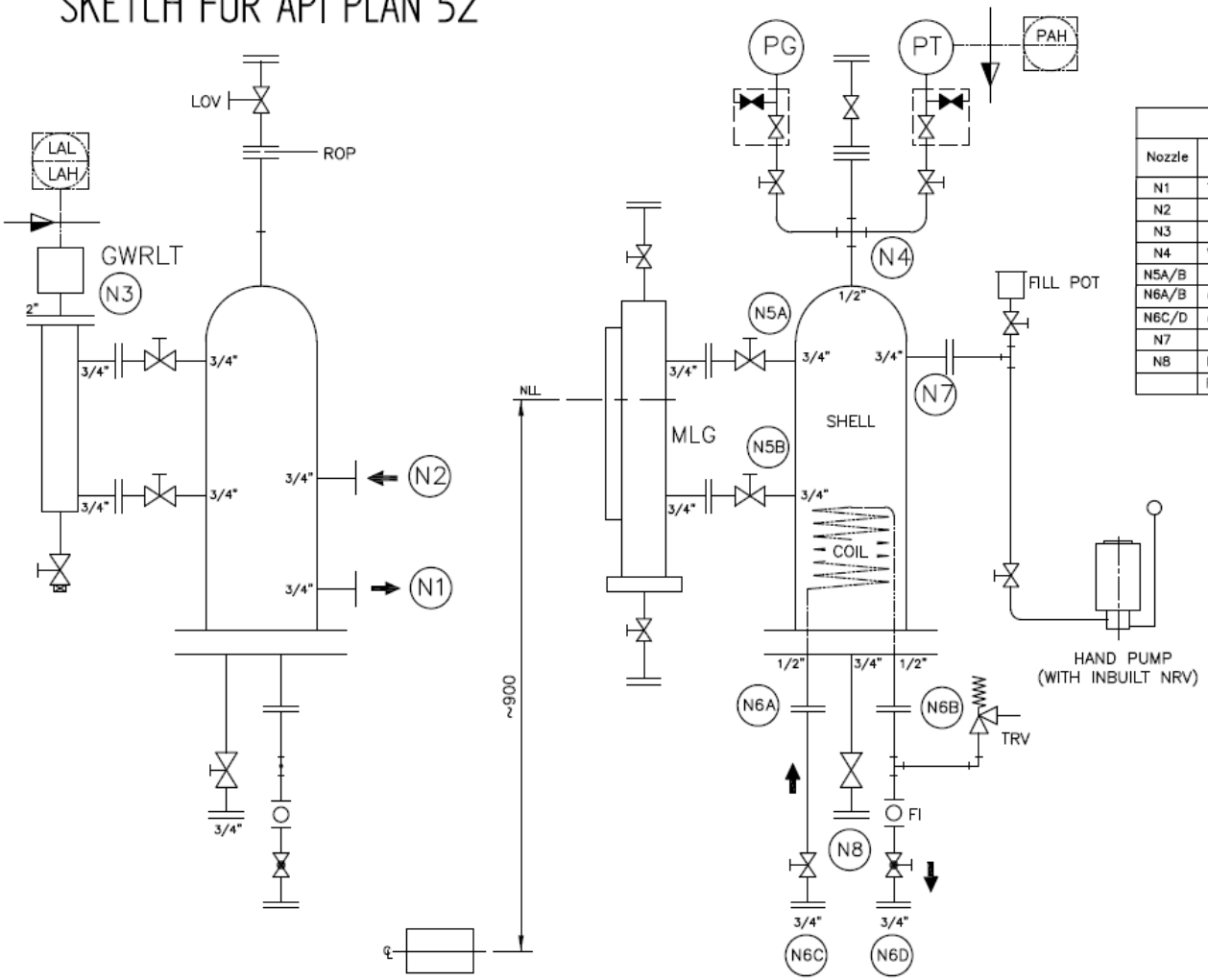
SKETCH FOR API PLAN 52



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") and Pipe Sch.	ASME Rating	Flange Type
N1	TO: Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N2	FROM: Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N3	Level Transmitter	DN50 (2") Sch 40	#300	SWRF
N4	Vent / Pr. Inst.	DN15 (1/2") Sch 80	#300	SWRF
N5A/B	Level Gauge	DN20 (3/4") Sch 80	#300	SWRF
N6A/B	Cooling Water (at reservoir)	DN15 (1/2") Sch 80	#300	SWRF
N6C/D	Cooling Water (at grade)	DN20 (3/4") Sch 80	#150	SWRF
N7	Fill Port	DN20 (3/4") Sch 80	#300	SWRF
N8	Drain	DN20 (3/4") Sch 80	#300	SWRF
	Reservoir Flange	DN200 (8") Sch 40	#300	WNRF

LEGEND	
MLG	MAGNETIC TYPE LEVEL GAUGE
PG	PRESSURE GAUGE
PT	PRESSURE TRANSMITTER
LT	LEVEL TRANSMITTER
ROP	RESTRICTION ORIFICE PLATE
LOV	LOCKED OPEN VALVE
TRV	THERMAL RELIEF VALVE
FI	FLOW INDICATOR
	GATE VALVE
	GLOBE VALVE
	2-VALVE MANIFOLD

PUMP OEM → SEAL VENDOR

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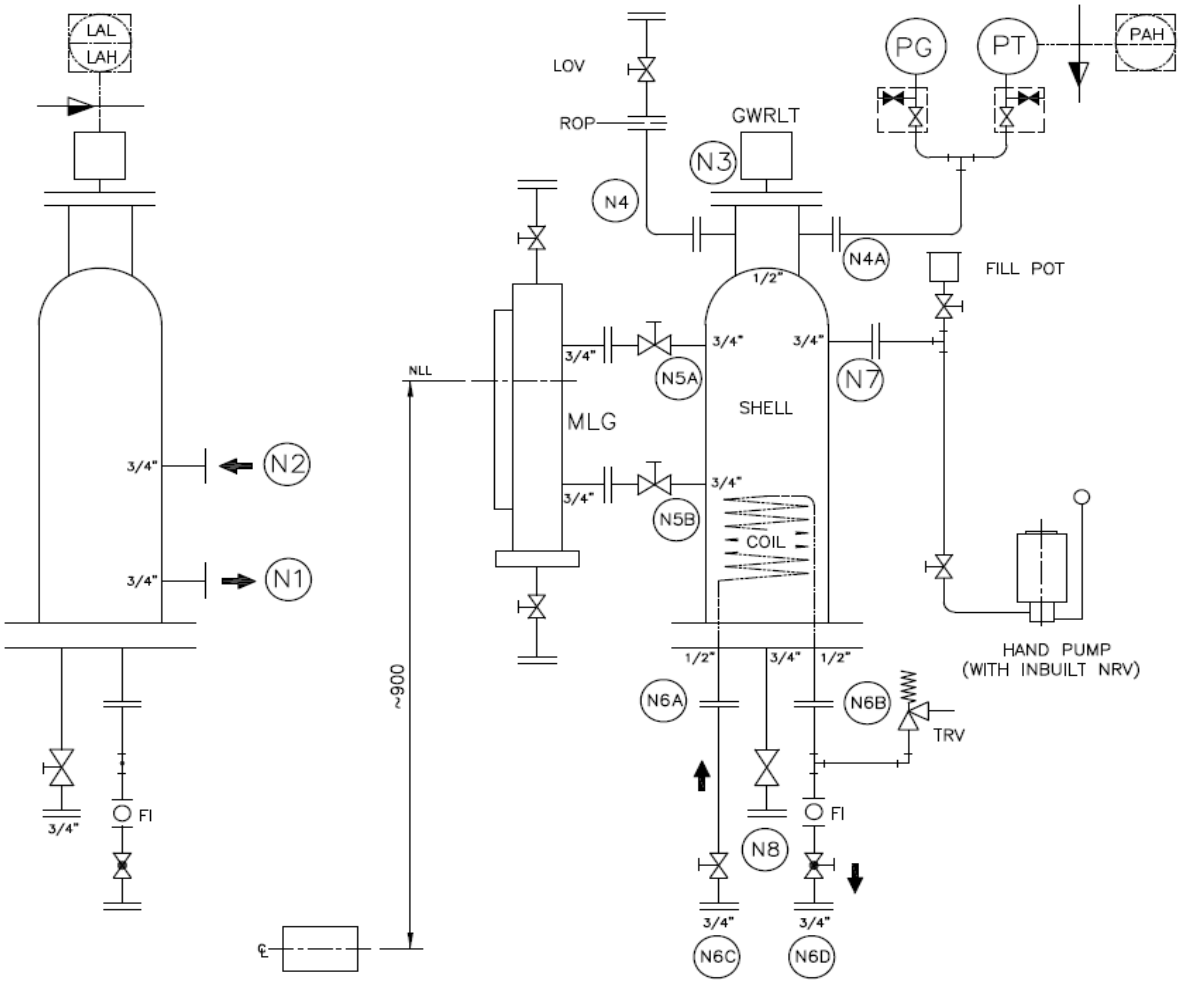
SKETCH FOR API PLAN 52



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") and Pipe Sch.	ASME Rating	Flange Type
N1	TO: Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N2	FROM: Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N3	Level Transmitter	DN100 (4") Sch 40	#300	WNRF
N4	Vent / Pr. Inst.	DN15 (1/2") Sch 80	#300	SWRF
N5A/B	Level Gauge	DN20 (3/4") Sch 80	#300	SWRF
N6A/B	Cooling Water (at reservoir)	DN15 (1/2") Sch 80	#300	SWRF
N6C/D	Cooling Water (at grade)	DN20 (3/4") Sch 80	#150	SWRF
N7	Fill Port	DN20 (3/4") Sch 80	#300	SWRF
N8	Drain	DN20 (3/4") Sch 80	#300	SWRF
	Reservoir Flange	DN200 (8") Sch 40	#300	WNRF

LEGEND	
MLG	MAGNETIC TYPE LEVEL GAUGE
PG	PRESSURE GAUGE
PT	PRESSURE TRANSMITTER
GWRLT	GUIDED WAVE RADAR LEVEL TRANSMITTER
ROP	RESTRICTION ORIFICE PLATE
LOV	LOCKED OPEN VALVE
TRV	THERMAL RELIEF VALVE
FI	FLOW INDICATOR
	GATE VALVE
	GLOBE VALVE
	2-VALVE MANIFOLD

PUMP OEM → SEAL VENDOR

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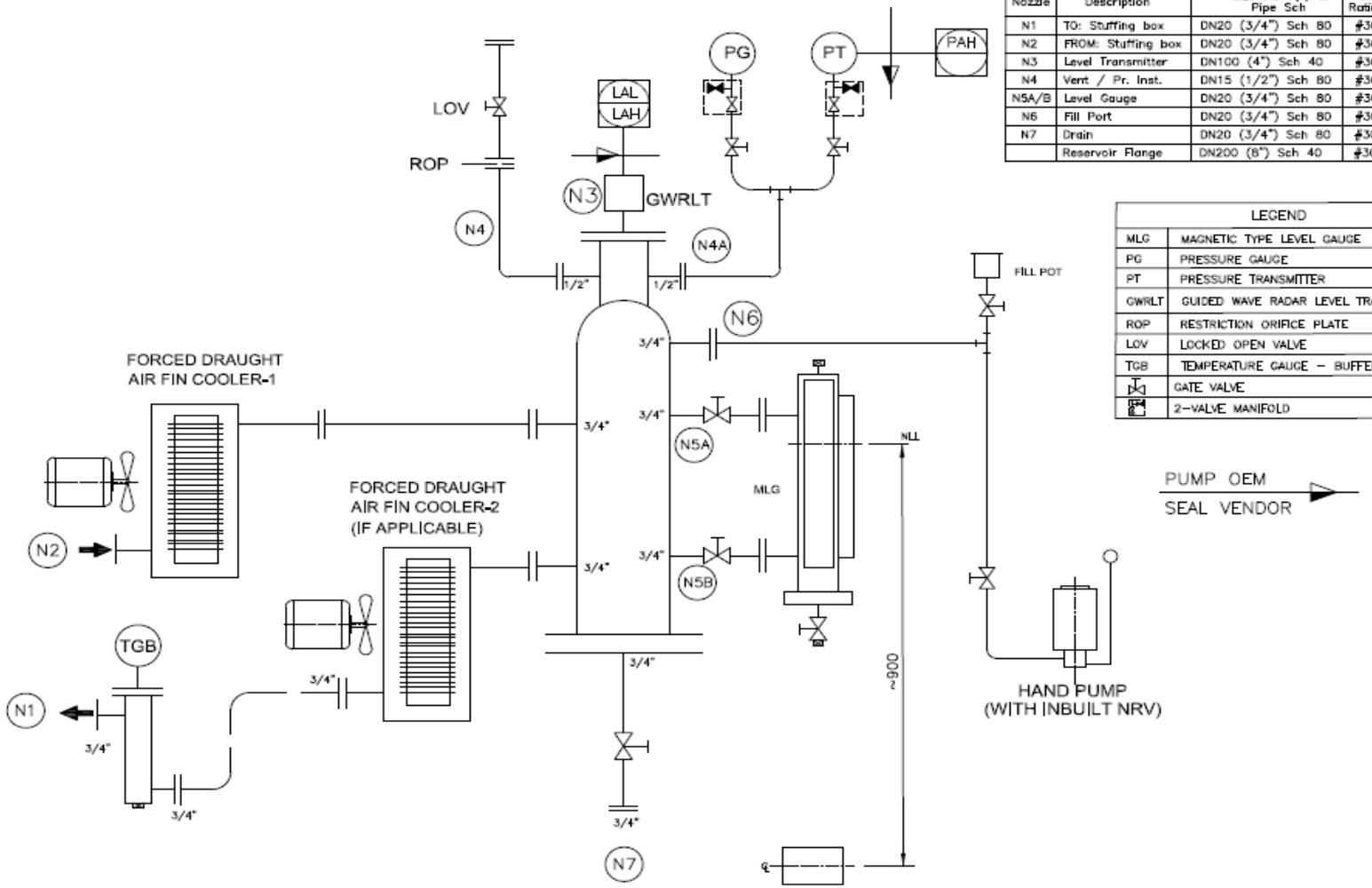
SKETCH FOR API PLAN 52



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	TO: Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N2	FROM: Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N3	Level Transmitter	DN100 (4") Sch 40	#300	WNRF
N4	Vent / Pr. Inst.	DN15 (1/2") Sch 80	#300	SWRF
N5A/B	Level Gauge	DN20 (3/4") Sch 80	#300	SWRF
N6	Fill Port	DN20 (3/4") Sch 80	#300	SWRF
N7	Drain	DN20 (3/4") Sch 80	#300	SWRF
	Reservoir Flange	DN200 (8") Sch 40	#300	WNRF

LEGEND	
MLG	MAGNETIC TYPE LEVEL GAUGE
PG	PRESSURE GAUGE
PT	PRESSURE TRANSMITTER
GWRLT	GUIDED WAVE RADAR LEVEL TRANSMITTER
ROP	RESTRICTION ORIFICE PLATE
LOV	LOCKED OPEN VALVE
TGB	TEMPERATURE GAUGE – BUFFER FLUID
	GATE VALVE
	2-VALVE MANIFOLD

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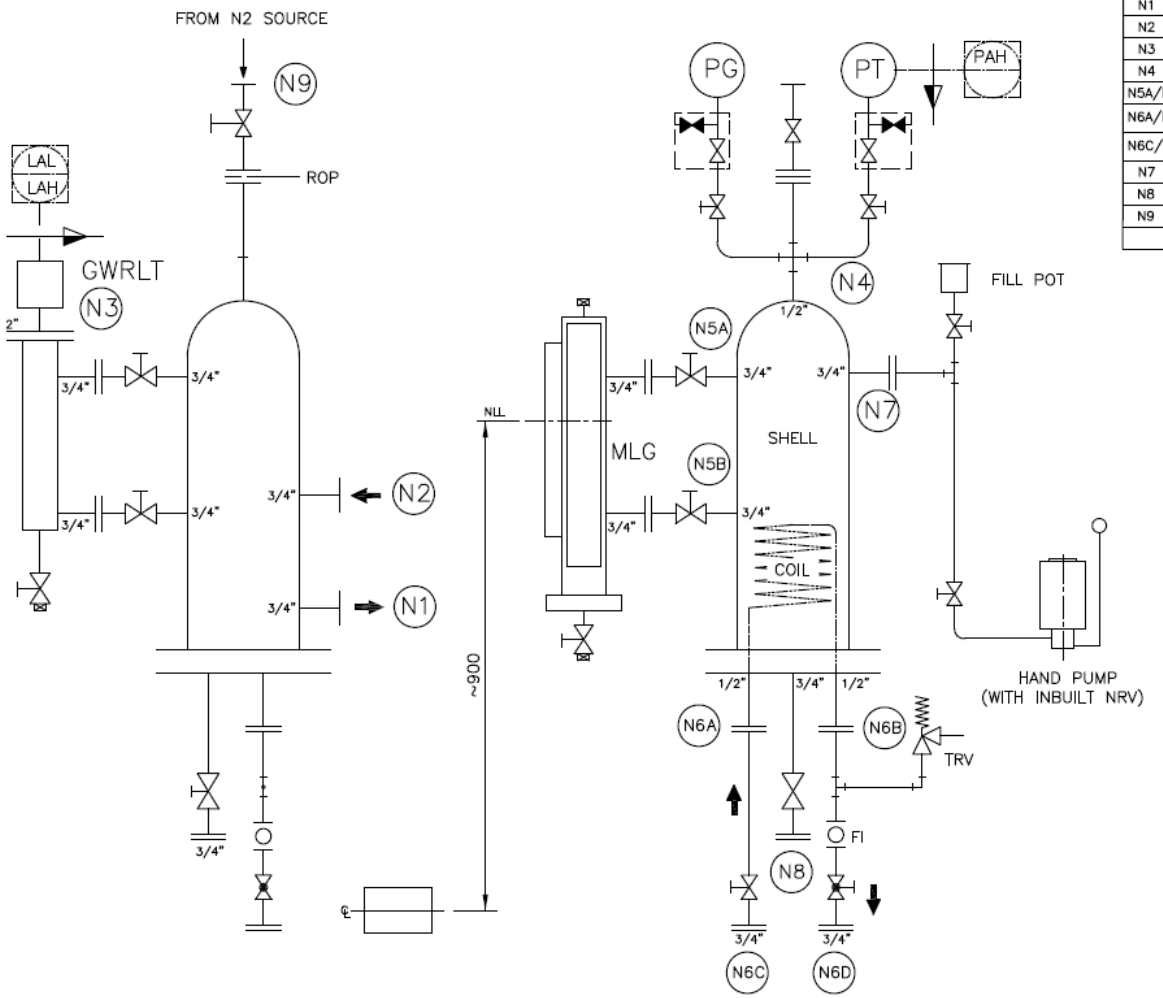
SKETCH FOR API PLAN 53A



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	TO:Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N2	FROM: Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N3	Level Transmitter	DN50 (2") Sch 40	#300	SWRF
N4	Pressure Instruments	DN15 (1/2") Sch 80	#300	SWRF
N5A/B	Level Gauge	DN20 (3/4") Sch 80	#300	SWRF
N6A/B	Cooling Water (at reservoir)	DN15 (1/2") Sch 80	#300	SWRF
N6C/D	Cooling Water (at grade)	DN20 (3/4") Sch 80	#150	SWRF
N7	Fill Port	DN20 (3/4") Sch 80	#300	SWRF
N8	Drain	DN20 (3/4") Sch 80	#300	SWRF
N9	Pressurization Conn.	DN20 (3/4") Sch 80	#300	SWRF
	Reservoir Flange	DN200 (8") Sch 40	#300	WNRF

LEGEND	
MLG	MAGNETIC TYPE LEVEL GAUGE
PG	PRESSURE GAUGE
PT	PRESSURE TRANSMITTER
GWRLT	GUIDED WAVE RADAR LEVEL TRANSMITTER
ROP	RESTRICTION ORIFICE PLATE
LOV	LOCKED OPEN VALVE
TRV	THERMAL RELIEF VALVE
FI	FLOW INDICATOR
	GATE VALVE
	GLOBE VALVE
	2-VALVE MANIFOLD

PUMP OEM
SEAL VENDOR

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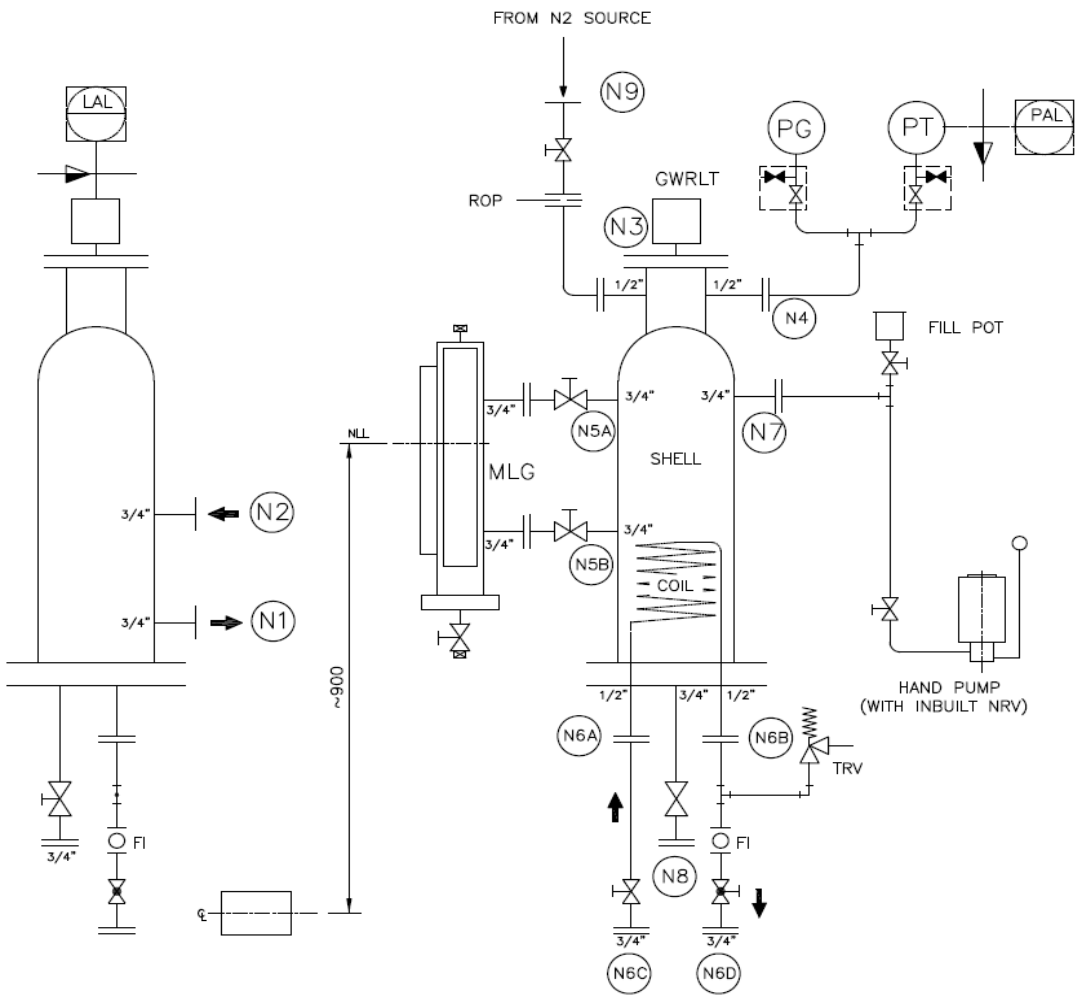
SKETCH FOR API PLAN 53A



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	TO:Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N2	FROM: Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N3	Level Transmitter	DN100 (4") Sch 40	#300	WNRF
N4	Pressure Instruments	DN15 (1/2") Sch 80	#300	SWRF
N5A/B	Level Gauge	DN20 (3/4") Sch 80	#300	SWRF
N6A/B	Cooling Water (at reservoir)	DN15 (1/2") Sch 80	#300	SWRF
N6C/D	Cooling Water (at grade)	DN20 (3/4") Sch 80	#150	SWRF
N7	Fill Port	DN20 (3/4") Sch 80	#300	SWRF
N8	Drain	DN20 (3/4") Sch 80	#300	SWRF
N9	Pressurization Conn.	DN20 (3/4") Sch 80	#300	SWRF
	Reservoir Flange	DN200 (8") Sch 40	#300	WNRF

LEGEND	
MLG	MAGNETIC TYPE LEVEL GAUGE
PG	PRESSURE GAUGE
PT	PRESSURE TRANSMITTER
LT	LEVEL TRANSMITTER
ROP	RESTRICTION ORIFICE PLATE
LOV	LOCKED OPEN VALVE
TRV	THERMAL RELIEF VALVE
FI	FLOW INDICATOR
	GATE VALVE
	GLOBE VALVE
	2–VALVE MANIFOLD

PUMP OEM
SEAL VENDOR

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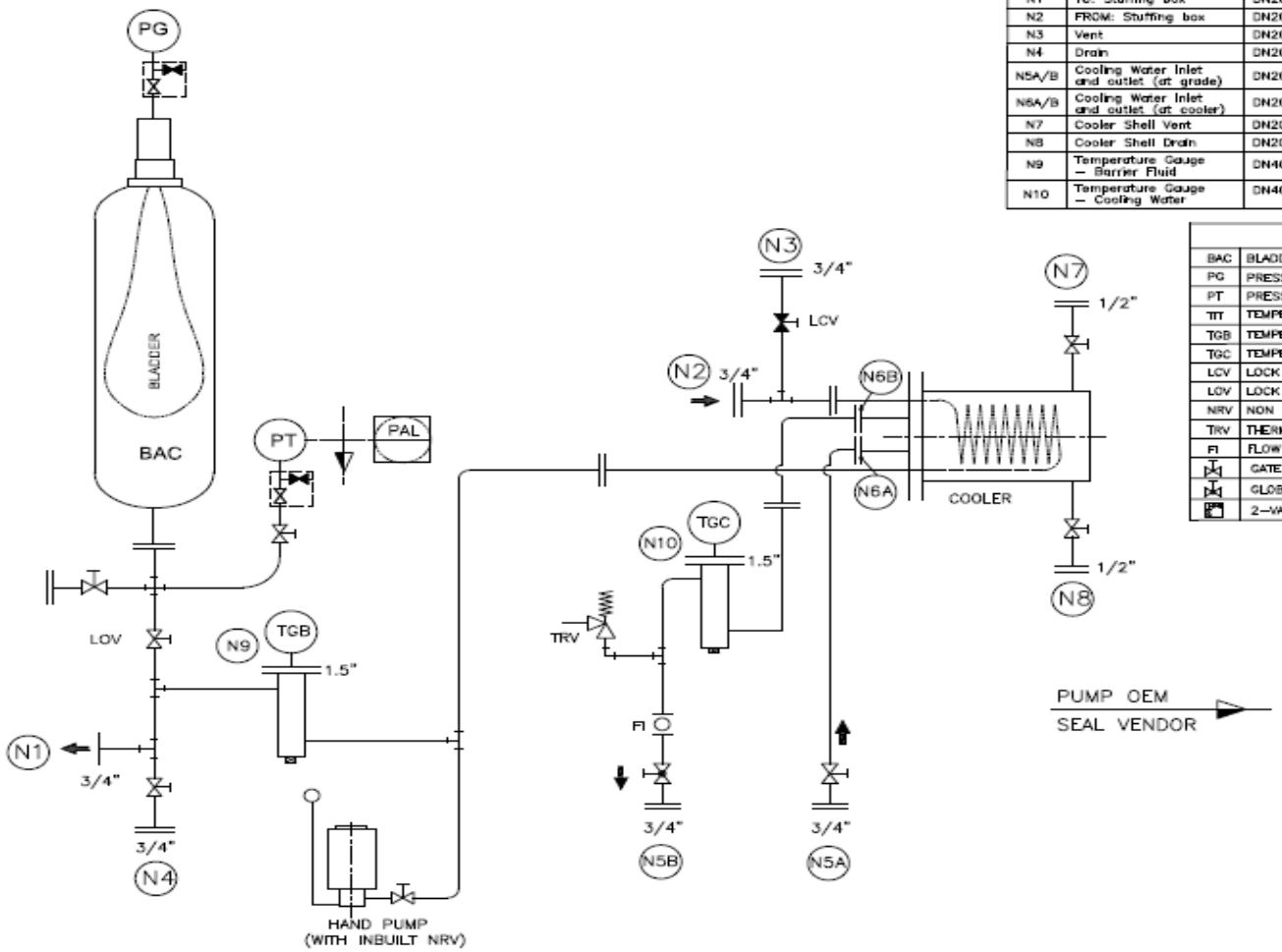
SKETCH FOR API PLAN 53B

(FIXED ALARM STRATEGY)



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	TO: Stuffing box	DN20 (3/4") Sch 80	≠300	SWRF
N2	FROM: Stuffing box	DN20 (3/4") Sch 80	≠300	SWRF
N3	Vent	DN20 (3/4") Sch 80	≠300	SWRF
N4	Drain	DN20 (3/4") Sch 80	≠300	SWRF
N5A/B	Cooling Water Inlet and outlet (at grade)	DN20 (3/4") Sch 80	≠150	SWRF
N6A/B	Cooling Water Inlet and outlet (at cooler)	DN20 (3/4") Sch 80	≠300	SWRF
N7	Cooler Shell Vent	DN20 (3/4") Sch 80	≠150	SWRF
N8	Cooler Shell Drain	DN20 (3/4") Sch 80	≠150	SWRF
N9	Temperature Gauge – Barrier Fluid	DN40 (1.5") Sch 80	≠300	SWRF
N10	Temperature Gauge – Cooling Water	DN40 (1.5") Sch 80	≠300	SWRF

LEGEND	
BAC	BLADDER ACCUMULATOR
PG	PRESSURE GAUGE
PT	PRESSURE TRANSMITTER
TIT	TEMPERATURE INDICATING TRANSMITTER
TGB	TEMPERATURE GAUGE BARRIER FLUID
TGC	TEMPERATURE GAUGE COOLING WATER
LCV	LOCK CLOSED VALVE
LOV	LOCK OPEN VALVE
NRV	NON RETURN VALVE
TRV	THERMAL RELIEF VALVE
FI	FLOW INDICATOR
	GATE VALVE
	GLOBE VALVE
	2–VALVE MANIFOLD

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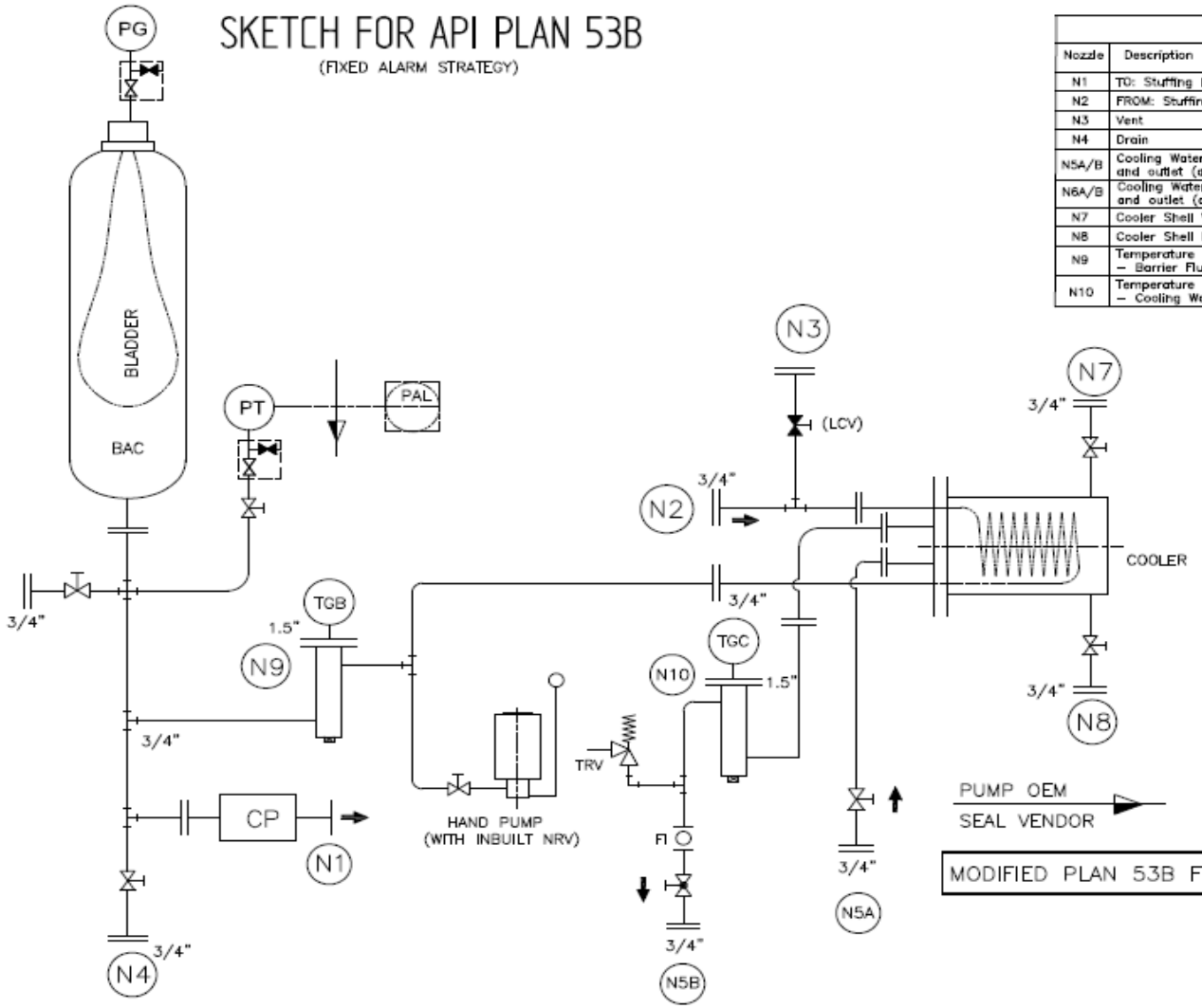
SKETCH FOR API PLAN 53B

(FIXED ALARM STRATEGY)



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	TO: Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N2	FROM: Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N3	Vent	DN20 (3/4") Sch 80	#300	SWRF
N4	Drain	DN20 (3/4") Sch 80	#300	SWRF
N5A/B	Cooling Water Inlet and outlet (at grade)	DN20 (3/4") Sch 80	#150	SWRF
N6A/B	Cooling Water Inlet and outlet (at cooler)	DN20 (3/4") Sch 80	#300	SWRF
N7	Cooler Shell Vent	DN20 (3/4") Sch 80	#150	SWRF
N8	Cooler Shell Drain	DN20 (3/4") Sch 80	#150	SWRF
N9	Temperature Gauge – Barrier Fluid	DN40 (1.5") Sch 80	#300	SWRF
N10	Temperature Gauge – Cooling Water	DN40 (1.5") Sch 80	#300	SWRF

LEGEND	
BAC	BLADDER ACCUMULATOR
PG	PRESSURE GAUGE
PT	PRESSURE TRANSMITTER
CP	CIRCULATING PUMP
TGB	TEMPERATURE GAUGE BARRIER FLUID
TGC	TEMPERATURE GAUGE COOLING WATER
LCV	LOCK CLOSED VALVE
LOV	LOCK OPEN VALVE
NRV	NON RETURN VALVE
TRV	THERMAL RELIEF VALVE
FI	FLOW INDICATOR
	GATE VALVE
	GLOBE VALVE
	2–VALVE MANIFOLD

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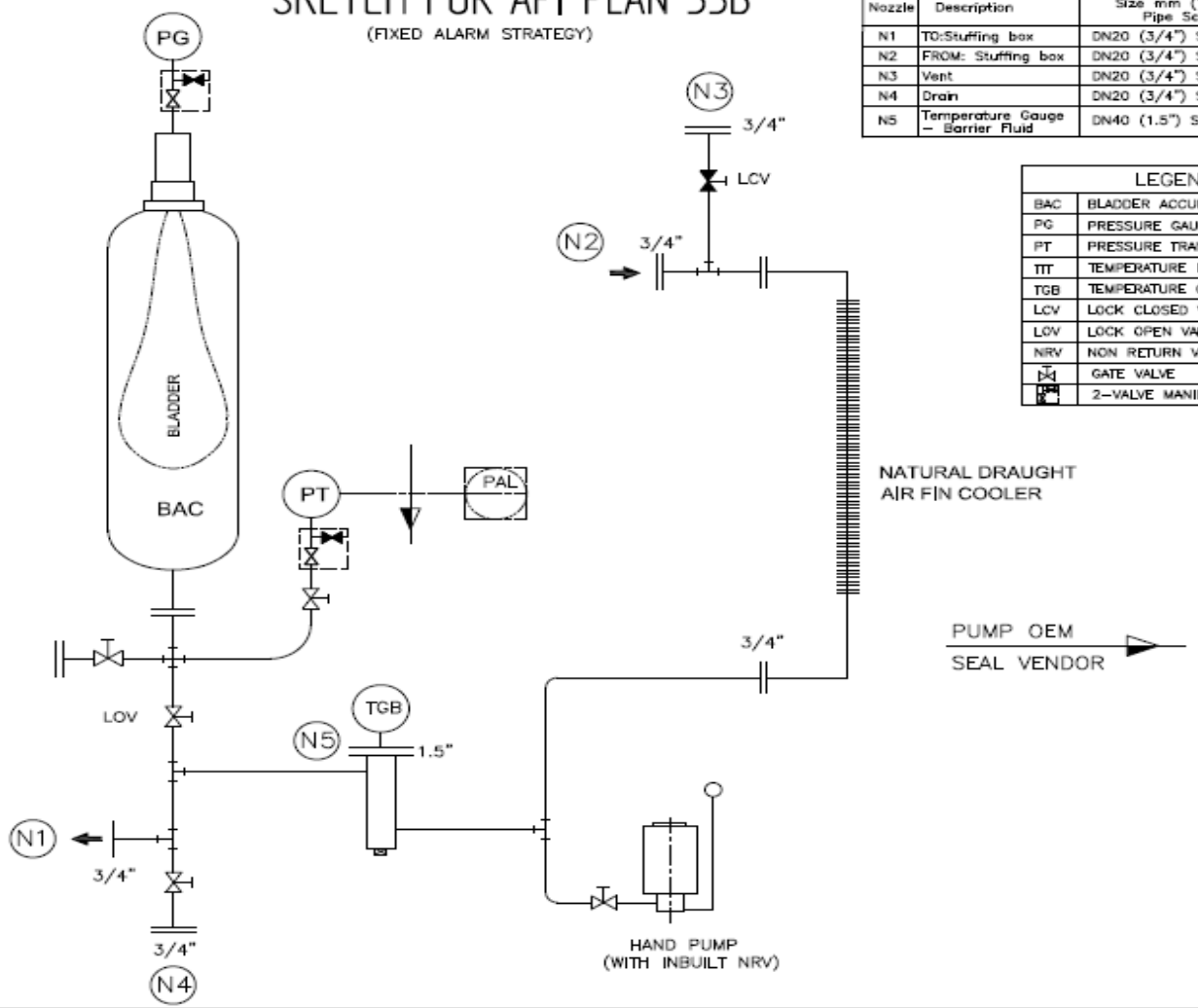
SKETCH FOR API PLAN 53B

(FIXED ALARM STRATEGY)



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	TO:Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N2	FROM: Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N3	Vent	DN20 (3/4") Sch 80	#300	SWRF
N4	Drain	DN20 (3/4") Sch 80	#300	SWRF
N5	Temperature Gauge – Barrier Fluid	DN40 (1.5") Sch 80	#300	SWRF

LEGEND	
BAC	BLADDER ACCUMULATOR
PG	PRESSURE GAUGE
PT	PRESSURE TRANSMITTER
TIT	TEMPERATURE INDICATING TRANSMITTER
TGB	TEMPERATURE GAUGE BARRIER FLUID
LCV	LOCK CLOSED VALVE
LOV	LOCK OPEN VALVE
NRV	NON RETURN VALVE
	GATE VALVE
	2–VALVE MANIFOLD

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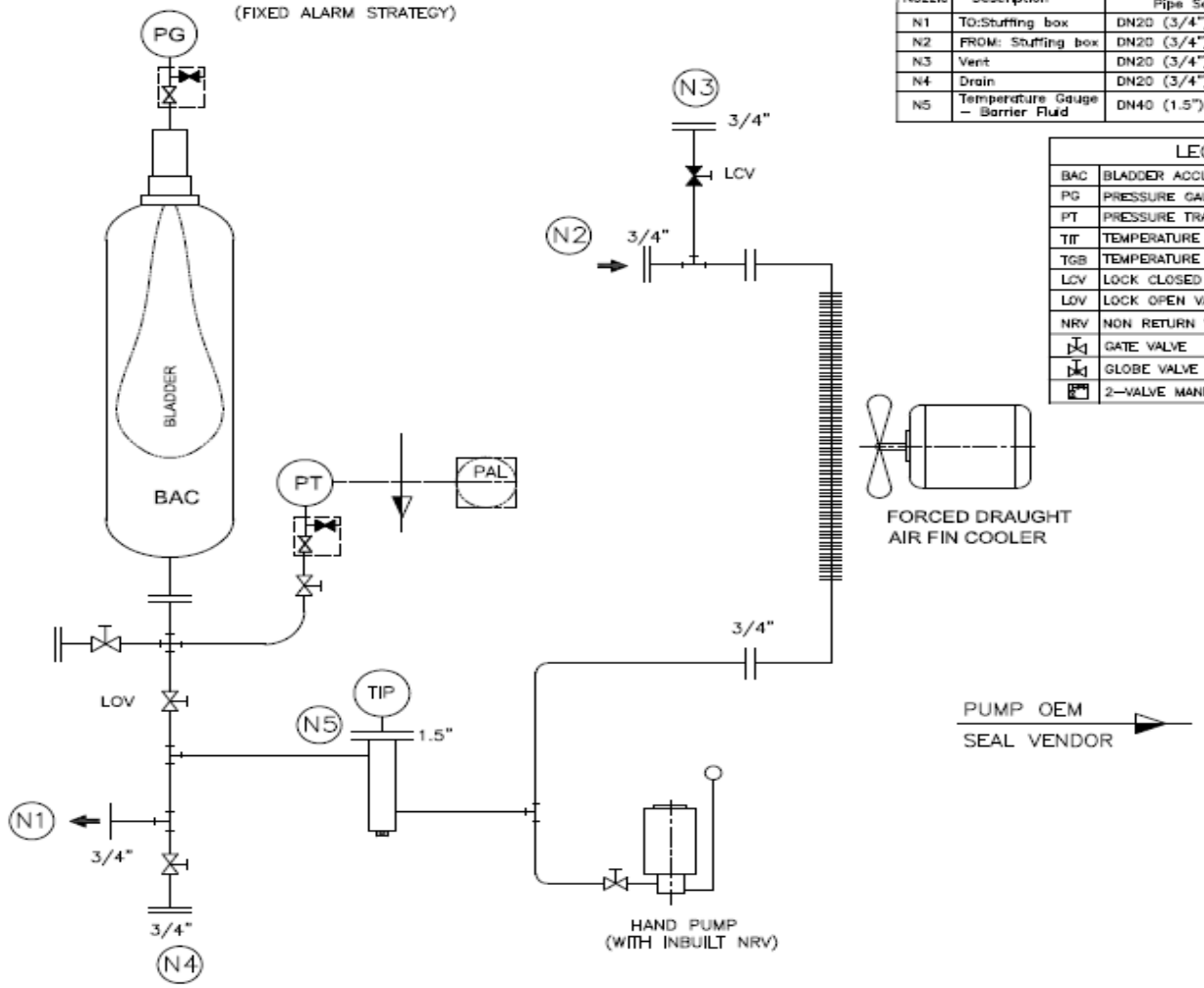
SKETCH FOR API PLAN 53B

(FIXED ALARM STRATEGY)



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	TO:Stuffing box	DN20 (3/4") Sch 80	≠300	SWRF
N2	FROM: Stuffing box	DN20 (3/4") Sch 80	≠300	SWRF
N3	Vent	DN20 (3/4") Sch 80	≠300	SWRF
N4	Drain	DN20 (3/4") Sch 80	≠300	SWRF
N5	Temperature Gauge – Barrier Fluid	DN40 (1.5") Sch 80	≠300	SWRF

LEGEND	
BAC	BLADDER ACCUMULATOR
PG	PRESSURE GAUGE
PT	PRESSURE TRANSMITTER
TIT	TEMPERATURE INDICATING TRANSMITTER
TGB	TEMPERATURE GAUGE BARRIER FLUID
LCV	LOCK CLOSED VALVE
LOV	LOCK OPEN VALVE
NRV	NON RETURN VALVE
	GATE VALVE
	GLOBE VALVE
	2–VALVE MANIFOLD

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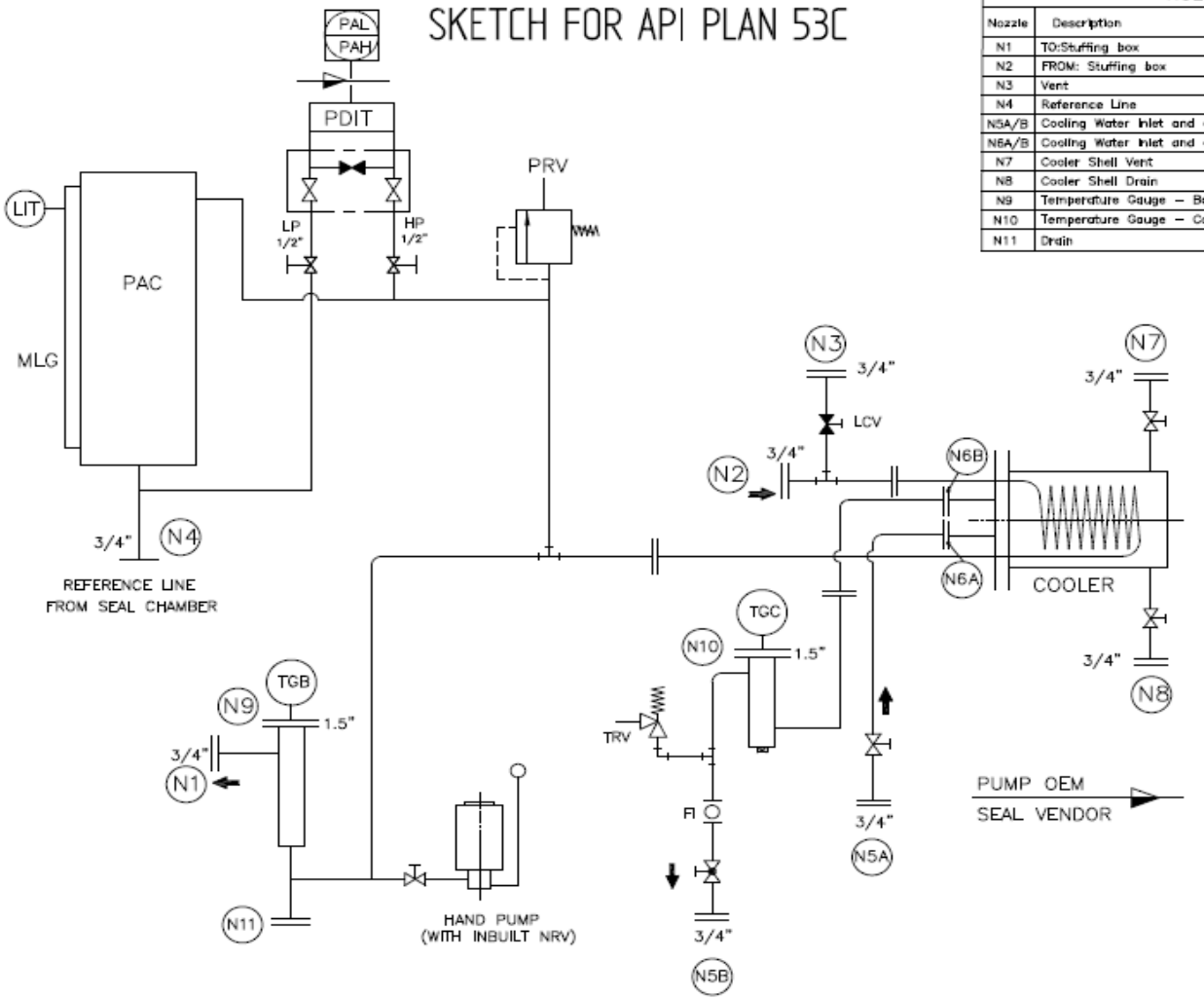
SKETCH FOR API PLAN 53C



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	TO:Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N2	FROM: Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N3	Vent	DN20 (3/4") Sch 80	#300	SWRF
N4	Reference Line	DN20 (3/4") Sch 80	#300	SWRF
N5A/B	Cooling Water Inlet and outlet (at grade)	DN20 (3/4") Sch 80	#300	SWRF
N6A/B	Cooling Water Inlet and outlet (at cooler)	DN20 (3/4") Sch 80	#300	SWRF
N7	Cooler Shell Vent	DN20 (3/4") Sch 80	#150	SWRF
N8	Cooler Shell Drain	DN20 (3/4") Sch 80	#150	SWRF
N9	Temperature Gauge – Barrier Fluid	DN40 (1.5") Sch 80	#300	SWRF
N10	Temperature Gauge – Cooling Water	DN40 (1.5") Sch 80	#300	SWRF
N11	Drain	DN20 (3/4") Sch 80	#300	SWRF

LEGEND	
PAC	PISTON ACCUMULATOR
TGB	TEMPERATURE GAUGE BARRIER FLUID
TGC	TEMPERATURE GAUGE COOLING WATER
LCV	LOCK CLOSED VALVE
NRV	NON RETURN VALVE
TRV	THERMAL RELIEF VALVE
PRV	PRESSURE RELIEF VALVE
FI	FLOW INDICATOR
PDIT	PRESSURE DIFF. INDICATING TRANSMITTER
LIT	LEVEL INDICATING TRANSMITTER
MLG	MAGNETIC LEVEL GAUGE
	GATE VALVE
	GLOBE VALVE
	2–VALVE MANIFOLD
	3–VALVE MANIFOLD (min)

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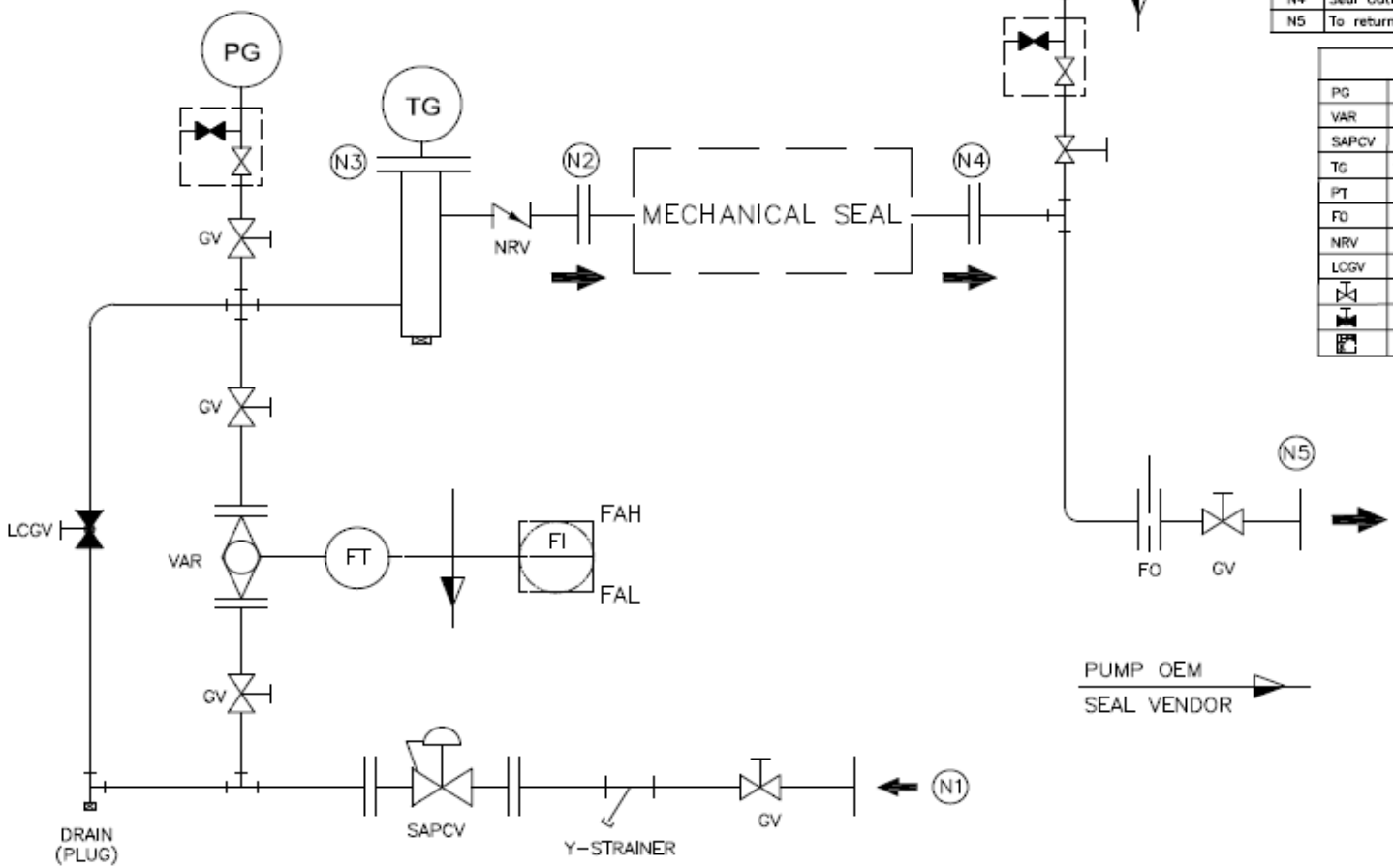
SKETCH FOR API PLAN 54

(FOR EACH SEAL CHAMBER)
(WHERE COMMON PLAN 54 IS USED IN THE PLANT)



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	From Source	DN15 (1/2") Sch 80	#300	SWRF
N2	To seal	DN15 (1/2") Sch 80	#300	SWRF
N3	Temp. Gauge	DN40 (1.5") Sch 80	#300	SWRF
N4	Seal Outlet	DN15 (1/2") Sch 80	#300	SWRF
N5	To return	DN15 (1/2") Sch 80	#300	SWRF

LEGEND	
PG	PRESSURE GAUGE
VAR	VARIABLE AREA ROTATRANSMITTER
SAPCV	SELF ACTUATED PRESSURE CONTROL VALVE
TG	TEMPERATURE GAUGE
PT	PRESSURE TRANSMITTER
FO	FLOW ORIFICE
NRV	NON RETURN VALVE
LCGV	LOCKED CLOSED GLOBE VALVE
	GATE VALVE
	LOCKED CLOSED GLOBE VALVE
	2-VALVE MANIFOLD

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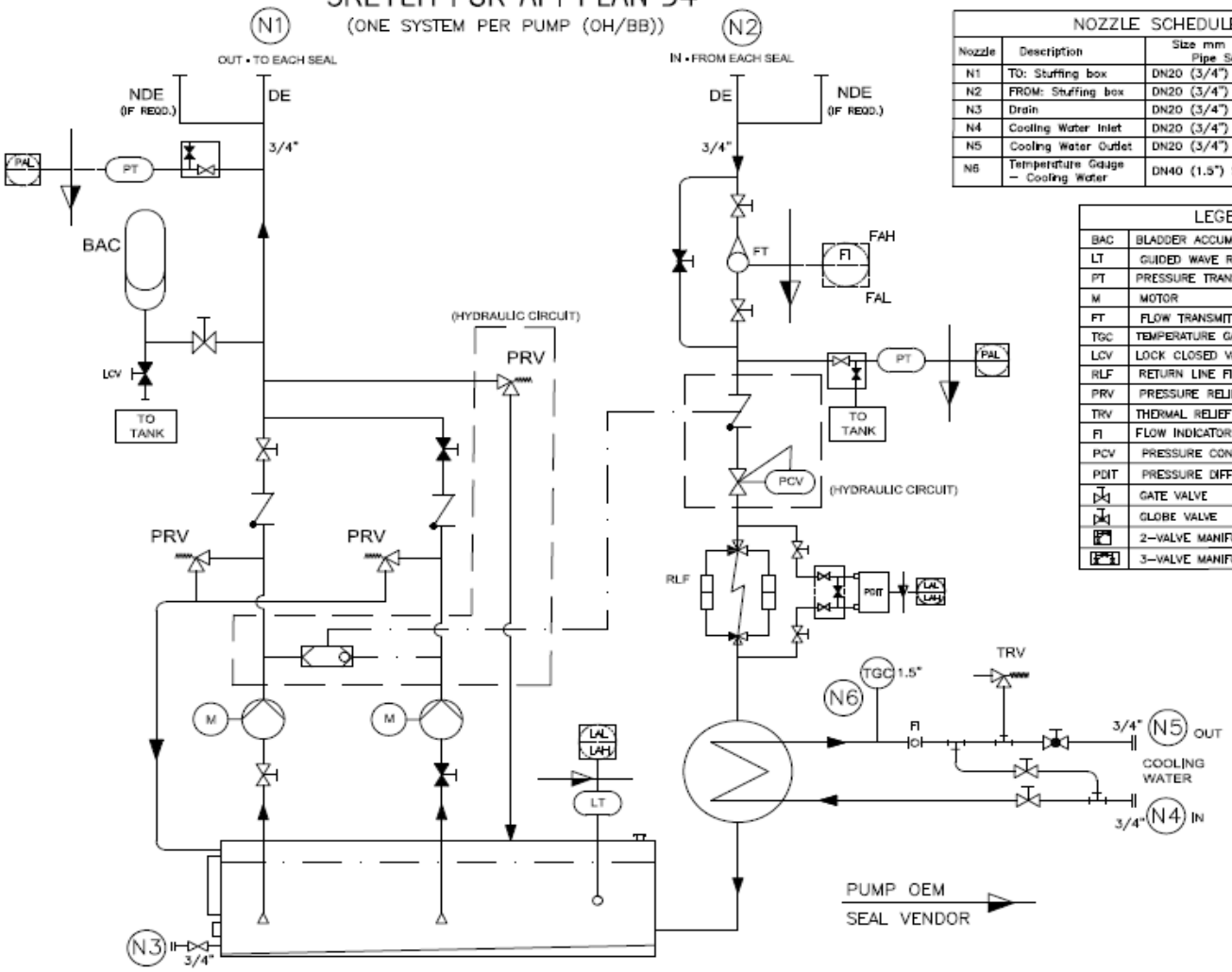
SKETCH FOR API PLAN 54

(ONE SYSTEM PER PUMP (OH/BB))



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	TO: Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N2	FROM: Stuffing box	DN20 (3/4") Sch 80	#300	SWRF
N3	Drain	DN20 (3/4") Sch 80	#300	SWRF
N4	Cooling Water Inlet	DN20 (3/4") Sch 80	#150	SWRF
N5	Cooling Water Outlet	DN20 (3/4") Sch 80	#300	SWRF
N6	Temperature Gauge – Cooling Water	DN40 (1.5") Sch 80	#300	SWRF

LEGEND	
BAC	BLADDER ACCUMULATOR
LT	GUIDED WAVE RADAR LEVEL TRANSMITTER
PT	PRESSURE TRANSMITTER
M	MOTOR
FT	FLOW TRANSMITTER
TGC	TEMPERATURE GAUGE COOLING WATER
LCV	LOCK CLOSED VALVE
RLF	RETURN LINE FILTER
PRV	PRESSURE RELIEF VALVE
TRV	THERMAL RELIEF VALVE
FI	FLOW INDICATOR
PCV	PRESSURE CONTROL VALVE
PDIT	PRESSURE DIFF. INDICATING TRANSMITTER
	GATE VALVE
	GLOBE VALVE
	2–VALVE MANIFOLD
	3–VALVE MANIFOLD (min)

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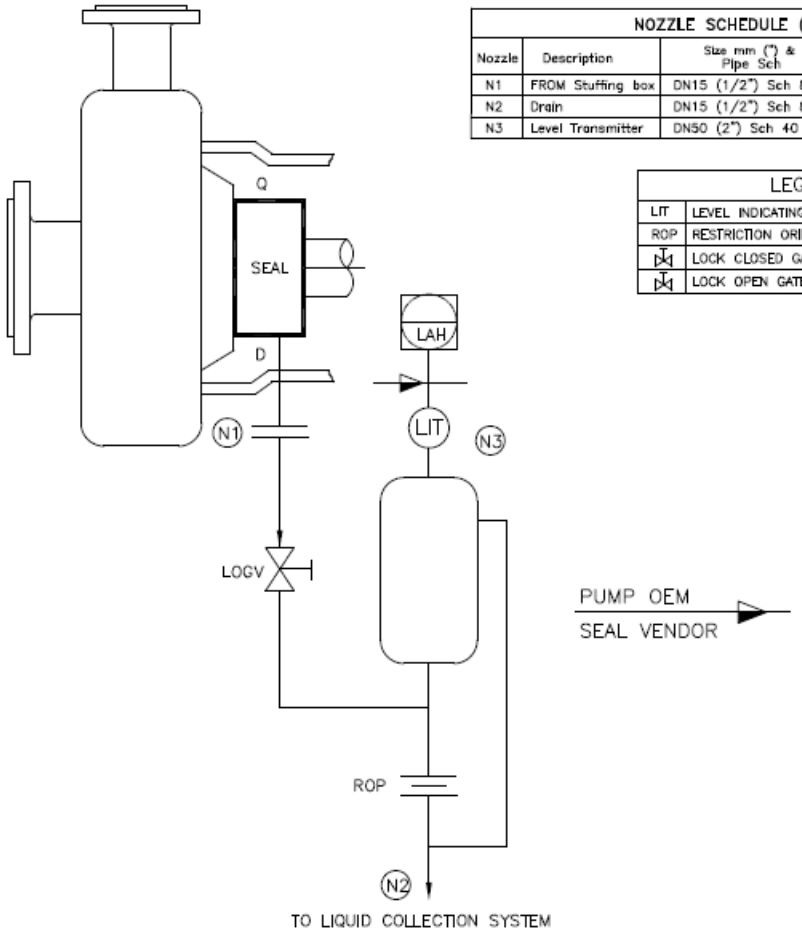
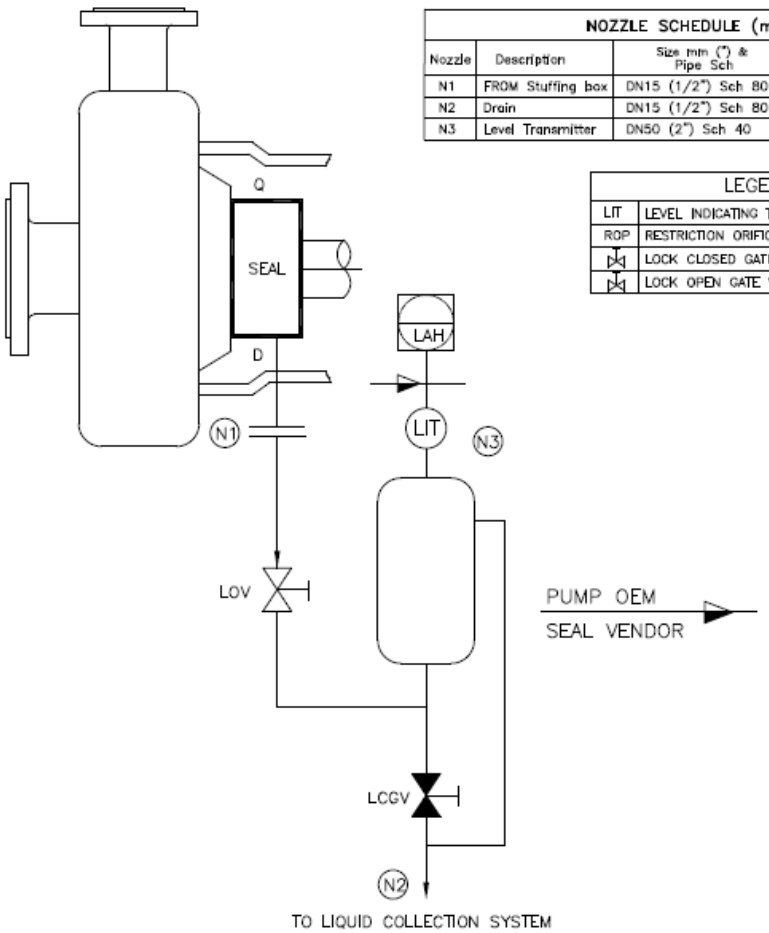
SKETCH FOR API PLAN 65A



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	FROM Stuffing box	DN15 (1/2") Sch 80	#300	SWRF
N2	Drain	DN15 (1/2") Sch 80	#300	SWRF
N3	Level Transmitter	DN50 (2") Sch 40	#300	SWRF

LEGEND	
LIT	LEVEL INDICATING TRANSMITTER
ROP	RESTRICTION ORIFICE PLATE
	LOCK CLOSED GATE VALVE (LCGV)
	LOCK OPEN GATE VALVE (LOGV)

SKETCH FOR API PLAN 65B



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	FROM Stuffing box	DN15 (1/2") Sch 80	#300	SWRF
N2	Drain	DN15 (1/2") Sch 80	#300	SWRF
N3	Level Transmitter	DN50 (2") Sch 40	#300	SWRF

LEGEND	
LIT	LEVEL INDICATING TRANSMITTER
ROP	RESTRICTION ORIFICE PLATE
	LOCK CLOSED GATE VALVE (LCGV)
	LOCK OPEN GATE VALVE (LOGV)

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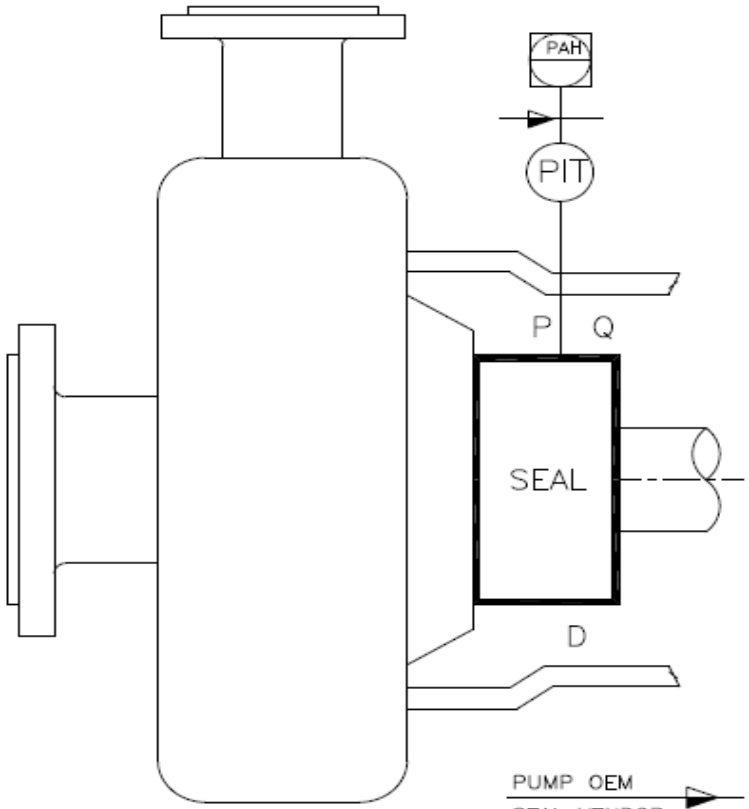
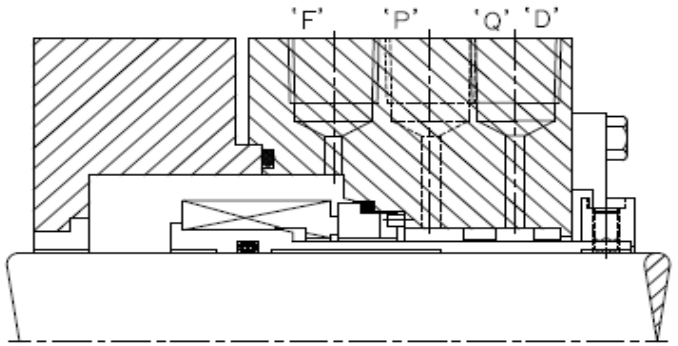
SKETCH FOR API PLAN 66A & 66B

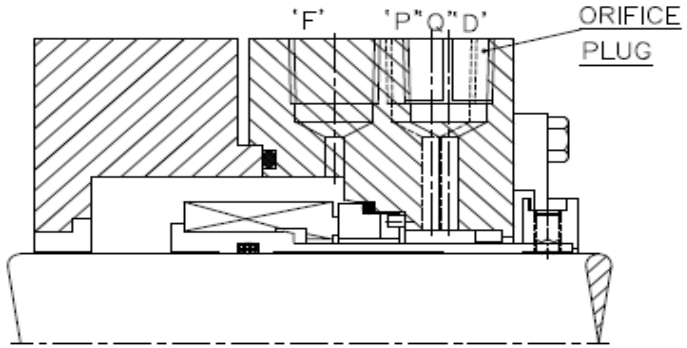


LEGEND	
PIT	PRESSURE INDICATING TRANSMITTER
F	FLUSHING
Q	QUENCH
D	DRAIN
P	CONNECTION FOR PIT

API PLAN 66A



API PLAN 66B



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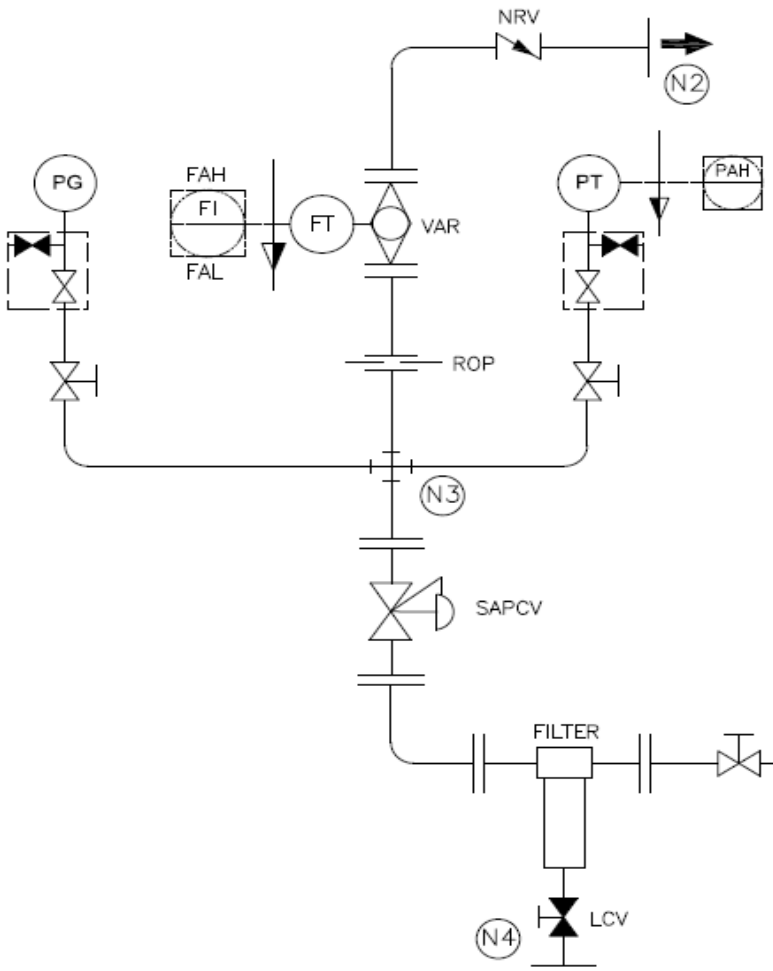
SKETCH FOR API PLAN 72



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	From Nitrogen Source	DN15 (1/2") Sch 80	#300	WNRF
N2	To Stuffing box	DN15 (1/2") Sch 80	#300	WNRF
N3	Vent / Pr. Inst.	DN15 (1/2") Sch 80	#300	WNRF
N4	Drain	DN15 (1/2") Sch 80	#300	WNRF

LEGEND	
SAPCV	SELF ACTUATED PRESSURE CONTROL VALVE
PG	PRESSURE INDICATOR
PT	PRESSURE TRANSMITTER
ROP	RESTRICTION ORIFICE PLATE
LCV	LOCKED CLOSED VALVE
NRV	NON RETURN VALVE
FILTER	COASLESCING TYPE FILTER
VAR	VARIABLE AREA ROTATRANSMITTER
	GATE VALVE
	2-VALVE MANIFOLD

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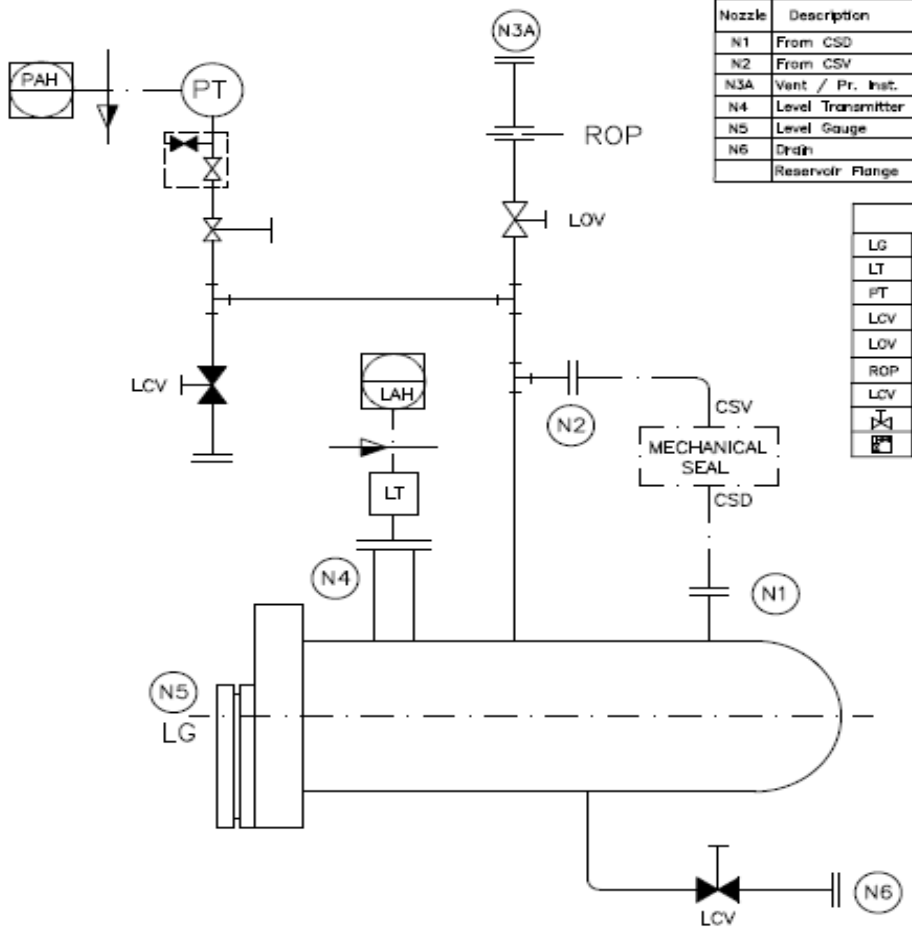
SKETCH FOR API PLAN 75M



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	From CSD	DN15 (1/2") Sch 80	#300	SWRF
N2	From CSV	DN15 (1/2") Sch 80	#300	SWRF
N3A	Vent / Pr. Inst.	DN15 (1/2") Sch 80	#300	SWRF
N4	Level Transmitter	DN40 (1.5") Sch 80	#300	SWRF
N5	Level Gauge	———	——	—
N6	Drain	DN20 (3/4") Sch 80	#300	SWRF
	Reservoir Flange	DN200 (8") Sch 40	#300	WNRF

LEGEND	
LG	WELD PAD TYPE REFLEX LEVEL GAUGE
LT	LEVEL TRANSMITTER
PT	PRESSURE TRANSMITTER
LCV	LOCK CLOSED VALVE
LOV	LOCK OPEN VALVE
ROP	RESTRICTION ORIFICE PLATE
LCV	LOCKED CLOSED GATE VALVE (LCV)
	GATE VALVE
	2–VALVE MANIFOLD

THE LIQUID COLLECTION POT MAY BE IN VERTICAL ORIENTATION

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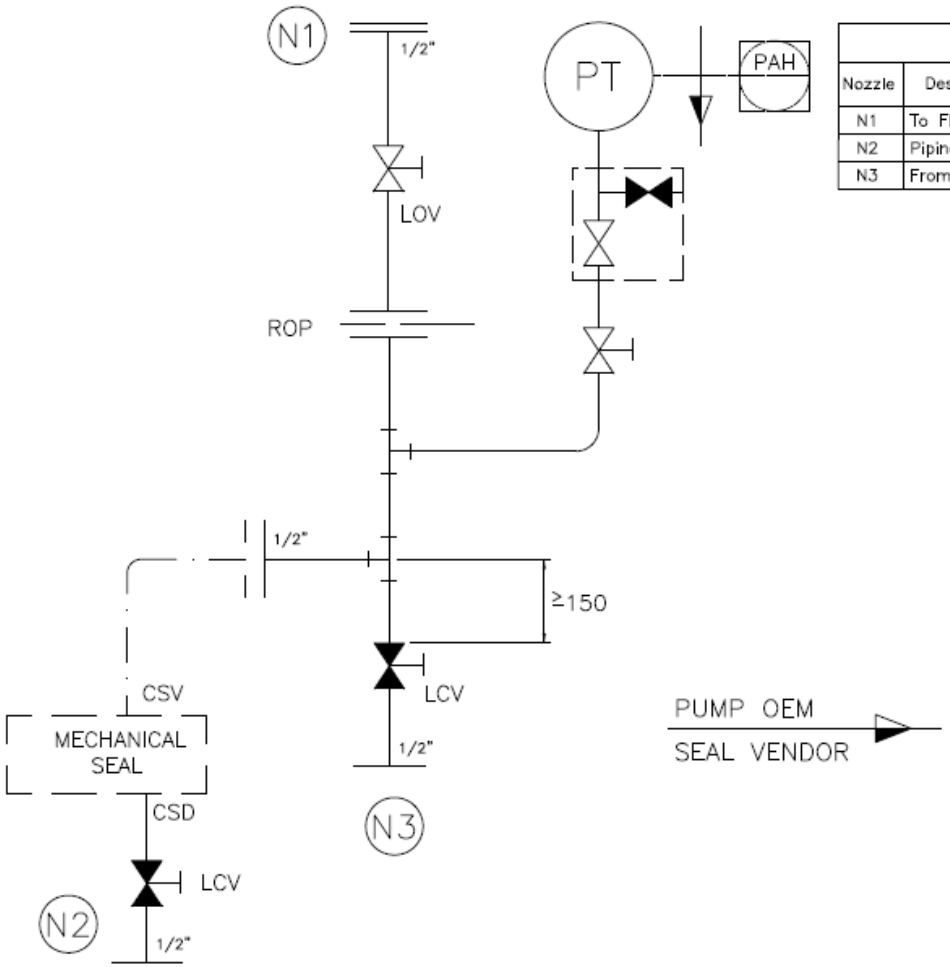
SKETCH FOR API PLAN 76



NOZZLE SCHEDULE (min)				
Nozzle	Description	Size mm (") & Pipe Sch	ASME Rating	Flange Type
N1	To Flare	DN15 (1/2") Sch 80	#300	SWRF
N2	Piping Drain	DN15 (1/2") Sch 80	#300	SWRF
N3	From Containment Seal Vent	DN15 (1/2") Sch 80	#300	SWRF

LEGEND	
PT	PRESSURE TRANSMITTER
ROP	RESTRICTION ORIFICE PLATE
LOV	LOCK OPEN VALVE
LCV	LOCK CLOSED VALVE
	GATE VALVE
	2–VALVE MANIFOLD

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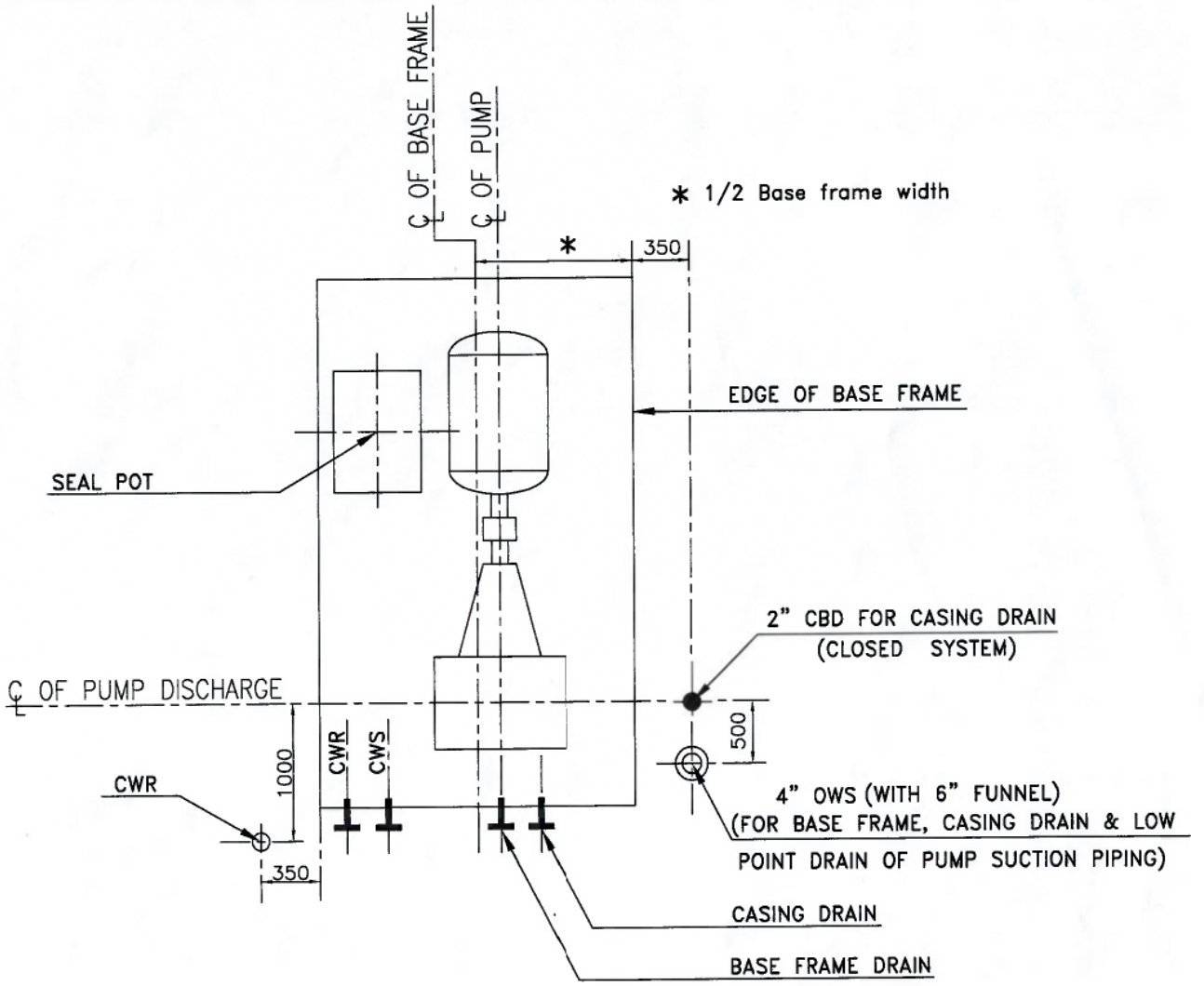
STANDARD FOR ORIENTATION OF SEAL POT & AUXILIARY CONNECTIONS OF CENTRIFUGAL PUMPS



APPLICABLE FOR PUMPS WITH

1. END SUCTION/TOP DISCHARGE
2. TOP SUCTION/TOP DISCHARGE
3. SIDE SUCTION/SIDE DISCHARGE

NOTES

1. Pump supplier to ensure that the locations / orientation of seal pot , Drain connections , CWS & CWR shall be as indicated in this drawing.
2. All dimensions are in mm, unless other wise specified.
3. Seal pot, CW supply/return, U/G points shall be mirror image for the pump tag nos identified during detail engineering, considering access/client requirements. Input shall be provided in MR.

LEGEND

- ● CBD : CLOSED BLOW DOWN
- ◎ OWS : OILY WATER SEWER
- CWS : COOLING WATER SUPPLY
- ○ CWR : COOLING WATER RETURN

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
3	09.10.25	REAFFIRMED & ISSUED AS STANDARD	SRG	PK	SH	MN
2	04.05.20	REAFFIRMED & ISSUED AS STANDARD	SG	SH	GB	SKS

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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

Electrical Standards Committee

Convenor: Mr. Harish Kumar

Members: Ms. Arvind NP Singh
Mr. Raman Sood
Mr. Rajiv Kumar Saha
Mr. Vijay Kumar
Ms. Shirali Aggarwal
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Mr. Ayush Mathur (Projects)
Mr. Rajesh Sinha (PDD)
Mr. G. Suresh (Inspection)

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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 with suitable paint.

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Joints between the heat exchanger and the main body of the motor shall be sealed by weather-proof gaskets.

6.6 Rotor

The rotor shall be of squirrel cage type, dynamically balanced to provide a low vibration level and a long service life to the bearings. The accepted values of vibrations for a motor at rated voltage and speed shall not exceed those given in the IS. The shaft ends shall be provided with suitably threaded hole or holes to facilitate the assembly or removal of couplings and bearing races.

6.7 Shaft extension

Motors shall be provided with a single, bare shaft extension with key way and key. Motor shaft shall be sized to withstand dynamic torque equal to 10 times the rated design torque.

6.8 Lifting hooks

All motors shall be provided with lifting facility (i.e. hooks etc.) of adequate capacity.

For motors provided with heat exchangers, lifting facility shall also be provided for the heat exchanger.

6.9 Earth terminals

Two earth terminals shall be provided on the frame of each motor at diametrically opposite points. Minimum size of the stud shall be 12 mm. Necessary nuts and spring washers shall be provided for earth connection. These earth terminals shall be in addition to the earth terminals provided in the terminal box for earthing of the armour.

7.0 CONTROL, ALARM AND TRIP DEVICES

All electrical contacts for the devices described below (e.g. at sections 7.3 & 7.4) shall have a current carrying capacity not lower than 5 A and a minimum interrupting capacity of 1 A at 220 V DC or 5 A at 240 V AC.

The contacts shall be located in explosion proof or totally sealed housing according to the type of motor enclosure. The cable ends shall be brought together to the terminal box. Any external connections between the housing containing the relay contacts and the terminal box shall be carried out by insulated copper wires in steel conduits or by PVC insulated, armoured, copper conductor cables with cable entries through double compression type cable glands.

7.1 Measurement of winding temperature

Motors with outputs greater than 750 KW or those provided with filters for cooling air irrespective of output shall be provided with platinum resistance temperature measuring devices of 100 ohms resistance at 0°C and a temperature co-efficient of 3.85×10^{-3} located in suitable positions to measure the winding temperature. A minimum of three (one per phase) detectors shall be provided between the coil sides to measure the winding temperature and three (one per phase), preferably at the base of the slots, to measure core temperature, each placed 120° apart. If RTD's at the base slot are not possible to be

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provided based on motor manufacturer specific design, 12 no's RTD's shall be provided between the coil side, to measure winding temperature. TETV motors may not be provided with core temperature detectors.

A separate terminal box shall be provided for the temperature detectors for hook up with a remote located control / monitoring unit.

7.2 Measurement of bearing temperature

Motors with self-lubricated bearing shall be provided with:

a) Two dial type and gas filled capillary type, indicating dial thermometers for checking of bearing temperatures.
b) For motors with output greater than 750 KW, a resistance type of temperature measuring device shall be provided for bearings with connections terminating in the common terminal box for winding temperature detectors.

7.3 Measurement of cooling medium for heat exchangers

Motors with forced ventilation and those with air water heat exchangers shall be provided with:

a) An airflow circulation indicator with electrical trip contacts that operate if the flow of cooling air is interrupted or is inadequate. If airflow indicator is not provided based on motor manufacturer specific design constraint, provision for alarm/trip of the motor shall be provided based on RTD.
b) A cooling water flow circulation indicator with electrical trip contacts, which close if the flow of cooling water is interrupted or is inadequate. The indicator shall be located on the discharge piping of the heat exchanger.

7.4 Pressurization Control Panel

All pressurized motors (Type Ex p) shall be provided with a control panel for controlling the initial purging and pressurization of the motor. The pressurization control panel shall be mounted on the motor itself and shall be suitable for the hazardous area classification specified in the motor data sheet. Purged control panel shall be powered through external supply to be made available by purchaser. Battery operated purge controller is not acceptable.

The panel shall be complete with but not limited to the following items:

- Timers
- Push buttons for purging/pressurization. (Manual push button shall override the auto selection parameters)
- Solenoid valves/dampers
- Indicating lamps for purging ON, purging OVER, pressurization ON & pressurization OVER etc.
- Claps regulator to compensate the pressure dip.
- Minimum & intermediate pressure sensor
- Pressure switches and flow switches with alarm and trip contacts.
- Low pressure alarm & trip contacts
- Intermediate pressure & pressurization completed contacts
- Purging started & purging completed contacts
- Power interlock/fail contact

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8.0 MISCELLANEOUS ACCESSORIES

8.1 Current transformers

Unless otherwise specified, motors rated 1500 KW and above shall have differential protection and shall be equipped with current transformers suitably designed for installation in the neutral terminal box.

Unless otherwise specified, the CTs shall be supplied along with the motor and mounted in the terminal box, which shall be suitable for housing the CTs and providing the necessary connections. CT terminals shall be brought out to a separate auxiliary terminal box of the same specification and grade of protection as the neutral/main terminal box.
Voltage rating of CT shall be same as voltage rating of motor, however window type CT with voltage rating up to 1100 V can be considered acceptable.

These transformers shall have a secondary current of 1 A, and the characteristics of the CTs (V_k, R_{CT} and I_m) shall be finalized at detailed engineering stage in consultation with the purchaser. CT ratio shall be as indicated in the motor data sheet.

Differential CTs wherever provided for hazardous area motors shall be Ex protected type.

8.2 Anti condensation heaters

All motors shall be provided with 240 V anti-condensation heaters, sized and located so as to prevent condensation of moisture during shut down periods. The heaters shall remain 'ON' when the motor is not in service and shall not cause damage to the windings.

Motors with heaters installed in hazardous atmospheres (Zone-1 or Zone-2), shall conform to the provisions of applicable IS/IEC standards and temperature classification specified in the motor data sheet.

The heater leads shall be brought out to a separate terminal box of the same specification and grade of protection as the main power terminal box.

A warning label with indelible red inscription shall be provided on the motor to indicate that the heater supply shall be isolated before carrying out any work on the motor.

8.3 Special tools and spanners

Motors with special features (e.g. motors with single bearing, explosion proof and increased safety motors etc.) shall be provided with a set of spanners and special tools, required for dismantling and maintenance of the motor.

8.4 Motors shall be supplied complete with double compression Nickel plated brass (or Aluminum, if specifically required) cable glands, crimp type tinned Cu cable lugs for all power, space heater and auxiliary cables (for the specified cable sizes) and first filling of lube oil for forced lubricated bearings.

8.5 Auxiliary motors, if any, shall be as per relevant Indian / International standards and shall be suitable for the hazardous classification as specified in the motor data sheet.

8.6 Name plates

A stainless-steel name plate manufactured from series 300 stainless steel and having information as per IS shall be provided on each motor. In addition to the motor rating

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plate, a separate number plate for motor tag number shall be fixed in a readily visible position. This number shall be as per the motor data sheets.

Additional information as stipulated in applicable Standards shall be included in the name plate for motors meant for use in hazardous atmospheres.

9.0 NOISE LEVEL

The permissible noise level shall not exceed the stipulations laid down in IS.

10.0 MOTOR VIBRATION

Motor vibrations at bearing housing shall be within the limits of IS, unless otherwise specified for the driven equipment. Limits of shaft vibration for motors with sleeve bearings shall be as per IEC-60034-14.

Two and four pole motors having sleeve bearings with forced oil lubrication shall be provided with proximity probes to measure the shaft vibration adjacent and relative to the bearings.

11.0 CRITICAL SPEEDS

The first actual critical speed of stiff rotors shall not be lower than 125% of the synchronous speed. For flexible rotors, this shall be between 60% and 80% of the synchronous speed. The second actual synchronous speed shall be above 125% of the synchronous speed.

12.0 PAINTING

All metal surfaces shall undergo manufacturer's standard cleaning /painting cycle. After preparation of the under surface, the equipment shall be painted with two coats of epoxy based final paint. Color shade of final paint shall be 632 of IS: 5/ RAL-7035. All unpainted steel parts shall be suitably treated to prevent rust formation. If these parts are moving elements, then these shall be greased.

13.0 INSPECTION, TESTING AND ACCEPTANCE

13.1 During fabrication, the equipment shall be subjected to inspection by EIL / Owner or by an agency authorised by the Owner, if specified / agreed in 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.

13.2 Hazardous area type test certificates & corresponding approval letter, BIS license etc. shall be shown to the inspection agency on demand during inspection. The certificates and BIS license must be valid at the time of dispatch.

13.3 Test certificates of bought out components shall be shown to the inspection agency on demand during inspection.

13.4 For VFD fed motors, all tests as specified in VFD specification shall be followed. Combined test for VFD and motor at vendor's works shall be carried out if specified in the Job Specification / datasheet.

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13.5 All equipments shall be subjected to various routine / acceptance tests as per Inspection & Test plan no. 6-81-1031.

14.0 CERTIFICATION

All hazardous area equipment shall have hazardous area test certificates and approvals as per following:

For Indigenous manufactured hazardous area equipment:

For all electrical items manufactured in India, the testing shall be carried out & test report issued by Indian test laboratory recognized by the Chief Controller of Explosives shall be furnished. For Ex protection Electric Apparatus having flameproof type protection, a copy of valid BIS license shall be furnished.

Alternatively, IECEx Certificate of Conformity, valid copy of IECEx Quality Assessment Report (summary) and IECEx Test Report shall be furnished.

For Imported hazardous area equipment:

For all electrical items manufactured outside India, test report issued by Indian test laboratory recognized by the Chief Controller of Explosives shall be furnished. For Ex protection Electric Apparatus having flameproof type protection, a copy of valid BIS license shall be furnished.

As an alternative option-1 to this, IECEx Certificate of Conformity, valid copy of IECEx Quality Assessment Report (summary) and IECEx Test Report shall be furnished.

As an alternative option-2 to this, EU Type Examination Certificate, which is applicable for manufacturers having manufacturing locations in countries covered under the European Union, valid copy of Production Quality Assessment / Assurance Notification shall be furnished.

All equipment i.e. 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.
For installations in India, PESO approval letter shall be provided.

15.0 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 transportation by ship/rail or trailer. The equipment shall be wrapped in polythene sheets before being placed in crates/cases to prevent damage to finish. Crates/cases shall have skid bottom for handling. Special notations such as 'Fragile', 'This side up', 'Centre of gravity', 'Weight', 'Owner's particulars', 'PO Nos.' etc. shall be clearly marked on the package together with other details as per purchaser order.

The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains/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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ऊर्जा दक्ष निम्न वोल्टेज प्रेरण मोटरों के लिए विनिर्देश

SPECIFICATION FOR ENERGY EFFICIENT LOW VOLTAGE INDUCTION MOTORS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
3	15.09.25	REVISED & ISSUED AS STANDARD SPECIFICATION	SS/RKR	ST	HK	MN
2	11.10.19	REVISED & ISSUED AS STANDARD SPECIFICATION	RKR	VKJ	SA	RKT
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0	20.04.09	ISSUED AS STANDARD SPECIFICATION	SD	BRB	JMS	ND

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Abbreviations:

AL	:	Aluminium
BIS	:	Bureau of Indian Standards
BS	:	British Standards
CEA	:	Central Electricity Authority
CIMFR	:	Central Institute of Mines and Fuel Research
CPRI	:	Central power research institute
CT	:	Current Transformer
CU	:	Copper
DGMS	:	Directorate General of Mines Safety
DOL	:	Direct On Line
EIL	:	Engineers India Limited
ERTL	:	Electronics Regional test laboratory
EU	:	European Union
FM	:	Factory Mutual
FRP	:	Fiber Reinforced Plastic
IEC	:	International Electro-technical Commission
IEEE	:	Institute of Electrical & Electronics Engineers
IP	:	Ingress Protection
IS	:	Indian Standard
JEC	:	Japanese Electro-technical Committee
KLPL	:	Karandikar laboratories Pvt. Ltd.
LCIE	:	Laboratoire Central des Industries Electriques
NEMA	:	National Electrical Manufacturers Association
PESO	:	Petroleum and Explosive Safety Organisation
PO	:	Purchase Order
PVC	:	Poly Vinyl Chloride
RPM	:	Revolutions per Minute
UL	:	Underwriter's Laboratories
VFD	:	Variable Frequency Drive
VDE	:	Verband Deutscher Elektrotechniker

Electrical Standards Committee

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1.0 SCOPE

This specification covers the design, manufacture, testing, packing and supply of energy efficient-High efficiency (IE2/IE3/IE4 as specified in data sheet) three phase medium voltage squirrel cage induction motors.

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 - 1076	:	Preferred numbers.
IS - 1231	:	Dimensions and output series of foot mounted induction motors-frame numbers 56 to 315 L.
IS - 1271	:	Electrical insulation- Thermal evaluation and designation.
IS - 2223	:	Dimensions of flange mounted AC Induction motors.
IS - 2253	:	Designation for types of construction and mounting arrangement of rotating electrical machines.
IS - 2254	:	Dimensions of vertical shaft motors for pumps.
IS - 4029	:	Guide for testing three phase induction motors.
IS - 6362	:	Designation of methods of cooling of rotating electrical machines.
IS - 8223	:	Dimensions and output series for rotating electrical machines.
IS - 8789	:	Values of Performance Characteristics for Three-Phase Squirrel Cage Induction Motors with Degree of Protection IP-2X.
IS - 9283	:	Motors for submersible pump sets.
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 – 12615	:	Line Operated Three Phase a.c. Motors (IE CODE) "Efficiency Classes and Performance Specification"
IS - 13529	:	Guide on effects of unbalanced voltages on the performance of three phase cage induction motors.
IS - 13555	:	Guide for selection and application of three phase induction motors for different types of driven equipment.
IS - 14568	:	Dimensions 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/IEC-60079-1:		Explosive Atmospheres-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/ IS 15999	:	Rotating Electrical machines
IS/IEC 61241:		Electrical apparatus for use in the presence of combustible dust
IS/IEC 60072-1:		Dimensions and output services for operating electrical machines Part-1 : Frame number 56-400 and flange number 55 to 1080

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.

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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.

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 ensure 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 atmosphere found in refineries, petrochemical, fertilizer 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 ± 10 % or
b) The frequency differing from its rated value by not more the ± 5 % or
c) Combined variation — The sum of absolute percent variations of (a) and (b) not exceeding 10 percent.

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 under full load after a momentary loss of voltage with the residual voltage being 100% and is in phase opposition to the applied voltage.
c) Minimum locked rotor thermal withstand time at rated voltage shall be 10 seconds under cold conditions and 8 seconds under hot conditions. In addition, Locked Rotor withstand time under hot conditions at 75% & 100% voltages, shall be minimum 1.4 times the starting time at the corresponding voltage.

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d) Unless otherwise specified, all motors shall be suitable for starting under specified load conditions with 75 % of the rated voltage at the motor terminals.

e) Motors shall be designed to allow the minimum number of consecutive starts indicated in Table below:

Starts	Min. no. of consecutive starts
No. of consecutive start-ups with initial temp. of the motor at ambient level (cold)	3
No. of consecutive start-ups with initial temp. of the motor at full load operating level (hot).	2

4.4 Direction of Rotation

Motors shall 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. Directional arrow should be manufactured from corrosion resistant material. When a motor is provided with bi-directional fans, a double-headed arrow should be provided.

Normally, clockwise rotation is desired as observed from the driving (coupling) end, when the terminals UVW are connected to a power supply giving a terminal phase sequence in the order UVW. Counter-clockwise rotation of the motor shall be obtained by connecting the power 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 any two external leads for obtaining the reverse phase sequence.

5.0 PERFORMANCE

5.1 Motors shall be rated for continuous duty (S_1), unless otherwise specified.

5.2 Unless specified, the starting current (as % rated current) shall be as per IS 12615, subject to IS tolerance

5.3 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 to clause 4.3 above of this specification. Unless otherwise specified the minimum pull-up torque of motors, at rated voltage & frequency shall be minimum 50% of the rated full load torque.

5.4 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 to clause 4.3 above of this specification.

5.5 Starting torque and minimum torque of the motor shall be compatible with the speed torque curve of the driven equipment under specified starting and operating conditions.

In case where characteristics of driven equipment are not available while selecting the motor, minimum starting torque shall be 110% of rated value for motors up to 75 kW and shall be 90% of rated value for motors above 75 kW.

5.6 The breakdown torque at the rated voltage shall be not less than 175% of the rated load torque with no negative tolerance. Unless otherwise agreed, the breakdown torque shall not exceed 350% of the rated load torque.

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In case of motors driving equipment with pulsating loads (e.g. reciprocating compressors, crushers, ball mills) the minimum value of pull out torque at 75% of the rated voltage shall be more than the peak value of pulsating torque and the current pulsation shall be limited to 40%.

5.7 Motors fed by variable frequency drive shall additionally meet the following requirements

a) The motor shall be converter grade motor suitable for operation with a solid-state power supply consisting of an adjustable frequency inverter for speed control and shall comply to IS 16724, IEC-60034-25 and relevant part of IS/IEC-60079.

b) The motor shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.

c) The motor shall be designed to operate continuously at any speed over the range (1-100%) of rated speed or as specified in data sheet.

d) Motor shall be provided with thermistor type temperature detector.

e) The motors shall be provided with Class 'F' insulation with temperature rise limited to Class 'B'.

f) Motor shall be designed suitable to deliver the torque required for complete speed torque characteristics of the load considering the voltage available at the motor terminals after taking into account supply voltage tolerances, voltage drop within VFD panel and voltage drop within cable as specified in VFD specification.

g) Motors required to be transferred to DOL by-pass mode shall be rated for specified variations in line voltage, frequency and starting current limitations as specified in data sheet.

h) The motor shall be constructed to withstand torque pulsations resulting from harmonics generated by the solid state power supply.

i) The motor insulation shall be designed to accept the applied voltage wave form, within the Vpeak and dv/dt limits as per IEC-61800-2 and 60034-25.

j) The motor vendor shall also coordinate with driven equipment vendor & VFD vendor and obtain requisite details for motor design.

k) Induced voltage at the shaft end of the motor at no load shall not exceed 250 mV rms for roller and ball bearings and 400 mV for sleeve bearings. The non driving end bearing shall be insulated from the motor frame to avoid circulating current. The insulated bearing end shield or pedestal shall bear a prominent warning. Insulated bearing (Non-Drive End) shall be provided irrespective of motor frame size.

l) Motor for hazardous area application shall have valid type test certificate issued by recognized independent test house certifying that motor is suitable for converter duty application. Corresponding statutory approval (e.g. PESO/DGMS etc.) as applicable for the specified location shall also be furnished for the hazardous area motor.

m) The motors shall be suitable for the current wave forms produced by the power supply including harmonics generated by the drive. The necessary coordination by motor manufacturers with drive manufacturers regarding harmonics generated by VFD shall be taken care and incorporated in motor design suitably.

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n) The motors shall be designed to operate continuously at any speed over the range as per process requirement with minimum range as 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, alternatively option of applying suitable de-rating may be considered.

o) The motors shall withstand torque pulsation resulting from harmonics generated by the solid state power supply.

p) The motors required to be transferred to DOL bypass mode shall be rated for specified variations in line voltage and frequency.

5.8 The minimum values for performance characteristics of these motors shall be as given in the tables 1, 2 & 3 of IS 12615 for IE2/IE3/IE4 motors, subjected to tolerance as per IS/IEC. Motors operated by frequency converters may have higher losses as compared to line (sinusoidal) power supply due to the harmonic voltage content. These motors must be tested on sinusoidal supply and efficiency must meet the declared efficiency class (which should not be lower than IE 2 class).

6.0 CONSTRUCTIONAL DETAILS

6.1 Windings

6.1.1 Unless otherwise specified, motors shall be provided with class `B' insulation as a minimum. In case of motors 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 winding shall be tropicalised. The windings shall preferably be vacuum impregnated. Alternately the windings shall be suitably varnished, baked and treated with epoxy gel for operating satisfactorily in humid and corrosive atmospheres.

6.1.3 Windings shall be adequately braced to prevent any relative movement during operation. In this respect, particular care shall be taken for the stator windings for direct-on-line starting squirrel cage motors. Insulation shall be provided between coils of different phases that lie together. Core laminations must be capable of withstanding burnout for rewind at 350 ºC without damage or loosening.

6.1.4 In case of motors driving equipment with pulsating loads, special care shall be taken for the joints of rotor bars and end rings to avoid premature failures due to induced fatigue stresses.

6.1.5 The windings shall be connected in delta. However, for motors rated 2.2 kW and below, star connection may be accepted. In case of motors with star-delta starting, the motor windings shall be fully insulated for delta connection.

6.1.6 The ends of the windings shall be brought out into a terminal box. These shall be terminated by means of terminals mounted on an insulating base made of non-hygroscopic and non-flammable material.

6.1.7 All motors shall be provided with six terminals and suitable links to connect them in star or in delta except for motors rated up to and including 2.2 kW which may be accepted with three terminals.

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6.2 Terminal Box and Cable Entries

6.2.1 Unless otherwise agreed, the terminal box shall be located on the right hand side as viewed from the driving (coupling) end. The terminal box shall have side cable entry from non-driving end. However, as a special case, terminal box located on top may also be accepted, particularly for hazardous area motors, in case manufacturer has only top mounted terminal box design which is duly tested/certified & approved by corresponding agency as mentioned in clause 11.0 below for installation in hazardous area. The terminal box design shall allow rotation in steps of 90°C to facilitate cable entry from any direction at site.

6.2.2 Terminal box cover shall be provided with handles to facilitate easy removal. However, for terminal box covers weighing less than 5 kg., terminal box covers without handles can be accepted.

6.2.3 The terminal box shall be provided entries for suitable cable glands corresponding to the size of the specified cable. Crimp type tinned Copper lugs and nickel-plated brass (or aluminum if specifically required), double compression type cable glands shall be supplied along with the motors for the specified cable sizes for power and space heater cables.

6.2.4 For flameproof motors, terminal box can be also provided in increased safety 'Exe' execution.

6.2.5 The terminals, cable lugs, terminal box, cable entries and cable glands shall be suitable for the minimum cables sizes as specified below for 2 pole, 4 pole or 6 pole motors:

Motor rating up to and including	Size of phase conductor (mm^2)
2.2 kW and below	2.5 cu
3.7 kW	6 cu
5.5 kW	10 cu
7.5 kW	16 cu
9.3 kW	16 cu
11.0 kW	16 cu
15.0 kW	50 Al.
18.5 kW	70 Al
22.0 kW	70 Al
30.0 kW	95 Al
37.0 kW	120 Al
45.0 kW	150 Al
55.0 kW	240 Al
75.0 kW	2x95 Al
90.0 kW	2x120 Al
110.0 kW	2x240 Al
125.0 kW/132 kW	2x240 Al
160.0 kW	2x240 Al

NOTE: - Exact cable size for the motor shall be informed during vendor drawing review. Vendor to provide required size of the terminal box.

6.2.6 Cable sizes for motors having synchronous speeds 750 RPM and below shall be as agreed between the purchaser and manufacturer.

6.3 Motor Casing and Type of Enclosure

6.3.1 The minimum degree of motor enclosures including terminal boxes and bearing housing shall be IP-55 as per IS/IEC.

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6.3.2 Motors for outdoor use shall be suitable for installation and satisfactory operation without any protective shelter or canopy. Motor casing shall be provided with a suitable drain for removal of condensed moisture except in case of flameproof motors (Type Ex d/Ex de).

6.3.3 All internal and external metallic parts, which may come into contact with cooling air, shall be of corrosion resistant material or appropriately treated to resist the corrosive agents, which may be present in the atmosphere. Screws and bolts shall be of rust proof material or protected against corrosion.

6.3.4 Unless otherwise agreed, motors shall have standard frame sizes (min.) for various output ratings as stipulated in IS/IEC.

6.4 Bearing and Lubrication

6.4.1 Motors shall have grease lubricated ball or roller bearings. In all cases, the bearings shall be chosen to provide a minimum L-10 rating life of 5 years, (40, 000 hours) 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 failure).

6.4.2 The bearings shall be adequate to absorb axial thrust produced by the motor itself or due to shaft expansion. Motors designed to handle external thrust from the driven equipment shall be supplied with a thrust bearing at the non-driving end.

6.4.3 In cases such as pumps for hot liquids where the driven equipment operates at high temperatures, bearings shall be cooled by a shaft-mounted fan. This shall ensure efficient ventilation of the bearing and disperse the heat transmitted from the driven equipment by conduction or convection.

6.4.4 Bearings shall be capable of grease injection from outside without removal of covers with motors in the running conditions. The bearing boxes shall be provided with necessary features to prevent loss of grease or entry of dust / moisture e.g. labyrinth seal/ oil seal/ V seal. Where grease nipples are provided, these shall be associated, where necessary, with appropriately located relief devices, which ensure passage of grease through the bearings.

6.4.5 Pre-lubricated sealed bearings may be considered provided a full guarantee is given for 4 to 5 years of trouble-free service without the necessity of re-lubrication.

6.5 Cooling System

All motors shall be self ventilated, fan cooled. Fans shall be corrosion resistant or appropriately protected. They shall be suitable for motor rotation in either direction without affecting the performance of the motor. If this is not possible for large outputs, it shall be possible to reverse the fan without affecting the balancing of the motor.

For motors operating in hazardous area, the fans shall be of an anti-static non-sparking material.

6.6 Rotor

The rotor shall be of squirrel cage type, dynamically balanced to provide a low vibration level and long service life for the bearings. Die cast aluminum rotors for motors in hazardous areas may be accepted provided the same are type tested and approved by competent authorities.

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6.7 Shaft Extension

Motors shall be provided with a single shaft extension with key-way and full key. Motor shaft shall be sized to withstand 10 times the rated design torque.

6.8 Lifting Hooks

All motors weighing more than 30 kg. shall be provided with lifting hooks of adequate capacity.

6.9 Earth Terminals

Two earth terminals located preferably on diametrically opposite sides shall be provided for each motor. Necessary nuts and spring washers shall be provided for earth connection.

7.0 MISCELLANEOUS ACCESSORIES

7.1 Anti-Condensation Heaters

All motors rated 30 kW and above shall be provided with 240 V anti-condensation heaters, sized and located so as to prevent condensation of moisture during shutdown periods.

For motors with heaters installed in hazardous atmospheres (Zone - 1 or Zone - 2), such heaters shall conform to the provisions of applicable Indian Standards and temperature classification specified in the motor data sheet.

The heater leads shall be brought out, preferably, to a separate terminal box which shall be of the same specification and grade of protection as the main terminal box.

A warning label with indelible red inscription shall be provided on the motor to indicate that the heater supply shall be isolated before carrying out any work on the motor.

7.2 Name Plates

In addition to the motor rating plate, a separate number plate for motor tag number shall be fixed in a readily visible position. This number shall be as per the motor data sheets. Nameplates and tag plates shall be of stainless steel material. Name plate shall include details as specified in IS 15999 Part 1 / IEC 60034 Part 1.

8.0 CRITICAL SPEEDS

The first actual critical speed of stiff rotors shall not be lower than 120 % of the synchronous speed. For flexible rotors this shall be between 60 % and 80 % of the synchronous speed; the second actual critical speed shall be above 120 % of the synchronous speed.

9.0 PAINTING

All metal surfaces shall undergo manufacturer's standard cleaning /painting cycle. After preparation of the under surface, the equipment shall be painted with two coats of epoxy based final paint. Color shade of final paint shall be 632 of IS: 5/ RAL-7031. All unpainted steel parts shall be suitably treated to prevent rust formation. If these parts are moving elements, then these shall be greased.

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10.0 INSPECTION AND TESTING

10.1 During fabrication, the equipment shall be subjected to inspection by EIL / Owner or by an agency authorised by the Owner, if specified / agreed in 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.

10.2 Type test certificates from CIMFR or equivalent test house, applicable PESO/ DGMS approval certificates, BIS license and original drawings referred in type test certificates shall be shown to the inspection agency on demand during inspection. The certificates and BIS license must be valid at the time of dispatch.

10.3 Test certificates of bought out components shall be shown to the inspection agency on demand during inspection.

10.4 Combined testing of LV motors along with their associated VFDs shall be carried out as a unit. During this testing, temperature rise and harmonics levels shall be measured to ensure they are within the permissible limits as per applicable standards. This test may not be required in case same make / type / rating of motor & VFD as a unit has been already tested and copy of test certificate is available which will be furnished for EIL/Owner's reference.

10.5 All equipments shall be subjected to various routine / acceptance tests as per Inspection & Test plan no. 6-81-1064.

11.0 CERTIFICATION

A copy of valid BIS license shall be furnished for energy efficient motors as per IS 12615.

All hazardous area equipment shall have hazardous area test certificates and approvals as per following:

For Indigenous manufactured hazardous area equipment:
For all electrical items manufactured in India, the testing shall be carried out & test report issued by Indian test laboratory recognized by the Chief Controller of Explosives shall be furnished. For Ex protection Electric Apparatus having flameproof type protection, a copy of valid BIS license shall be furnished as per IS/IEC 60079-1.

Alternatively, IECEx Certificate of Conformity, valid copy of IECEx Quality Assessment Report (summary) and IECEx Test Report shall be furnished.

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12.0 PACKING AND DESPATCH

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The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains/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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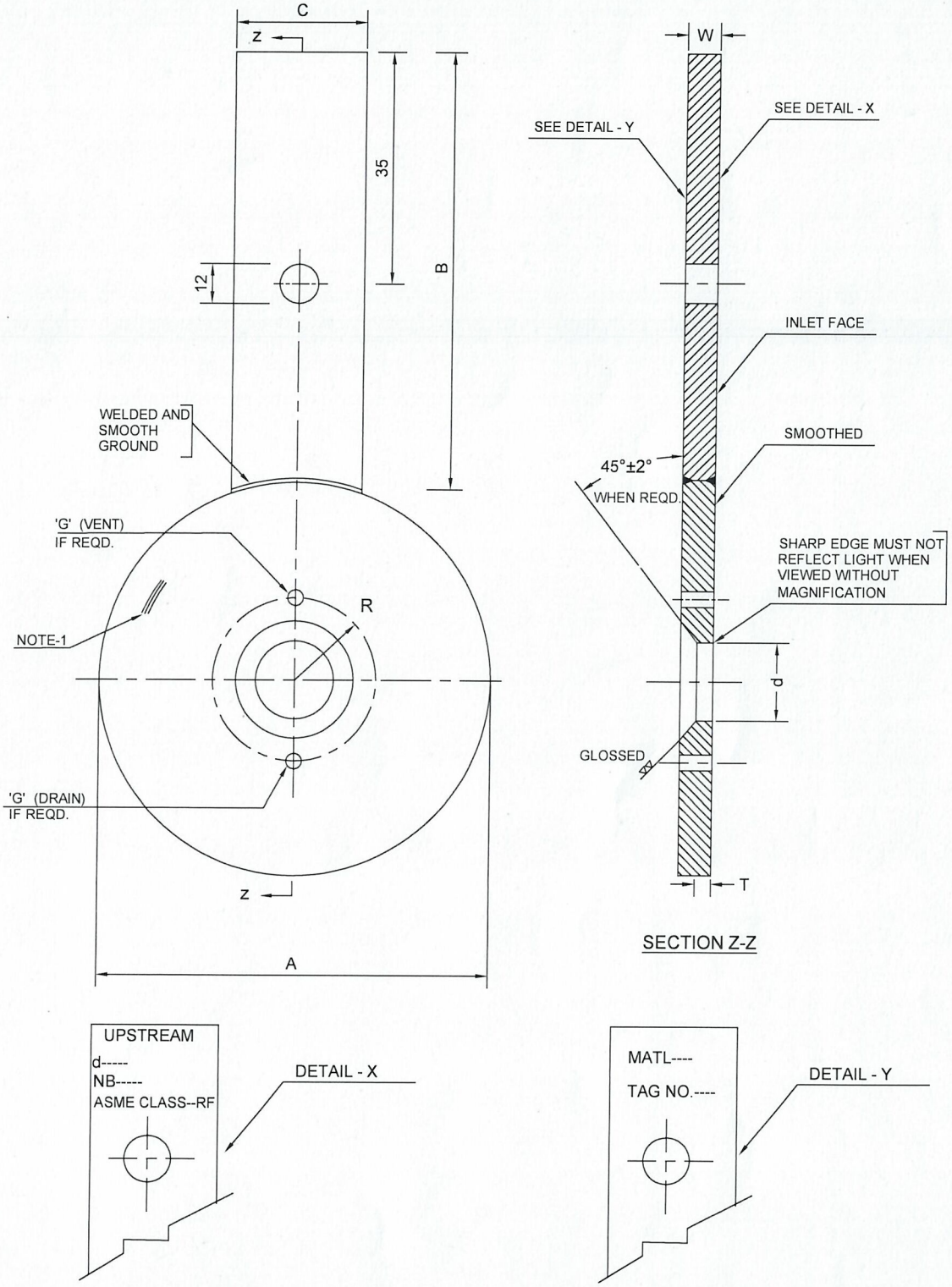
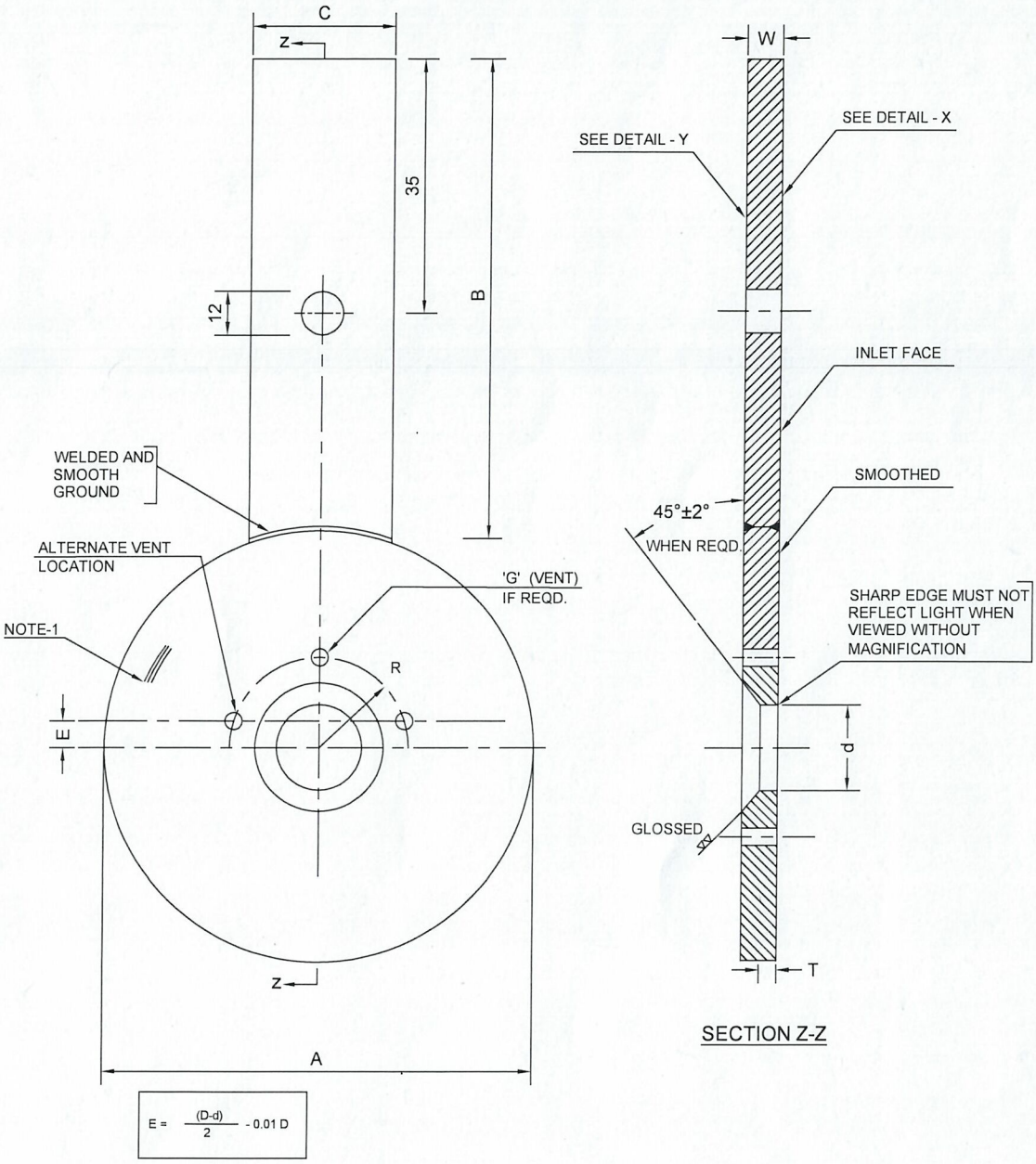


CONCENTRIC SQURAE EDGED ORIFICE PLATE

NOTES:-

1. SERRATION SHALL BE CONSIDERED ON THE ORIFICE PLATE NEAR THE GASKET ZONE.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman Approved by
6	23.03.26	REAFFIRMED & ISSUED	PK	AJS	RK	NK
5	12.02.21	REVISED & REISSUED	Manoj	JJ	MN	SM

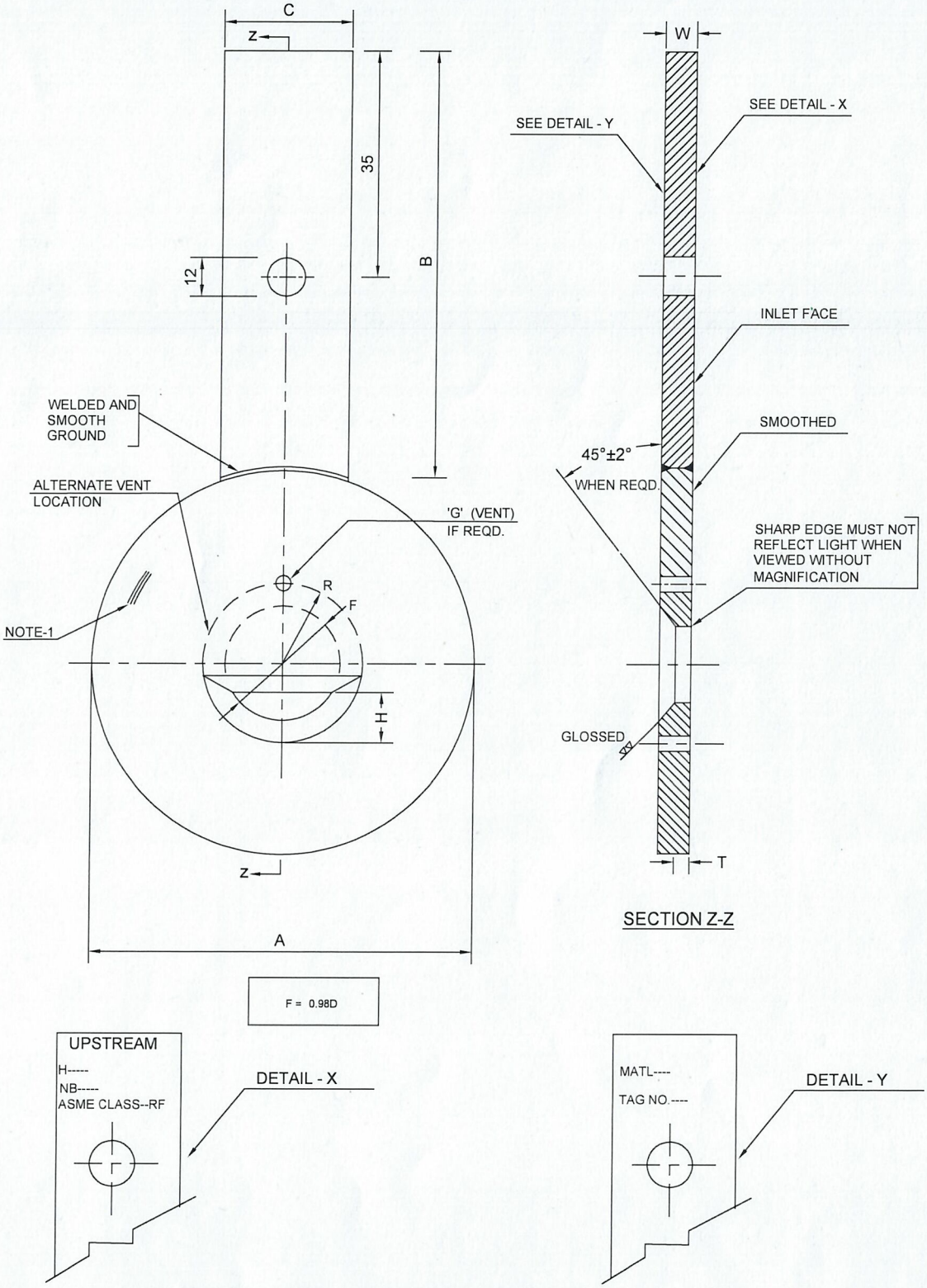


ECCENTRIC ORIFICE PLATE

NOTES:-

1. SERRATION SHALL BE CONSIDERED ON THE ORIFICE PLATE NEAR THE GASKET ZONE.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	23.03.26	REAFFIRMED & ISSUED	PK	AJS	RK	NK
5	12.02.21	REVISED & REISSUED	Manoj	JJ	MN	SM

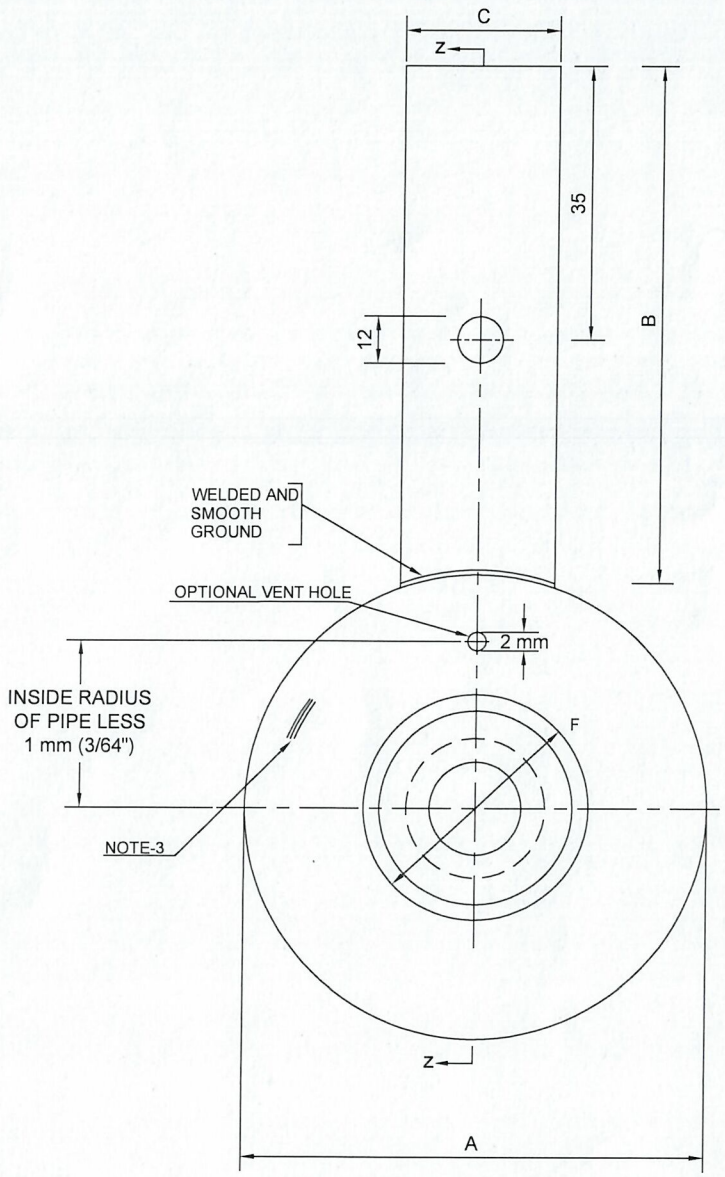


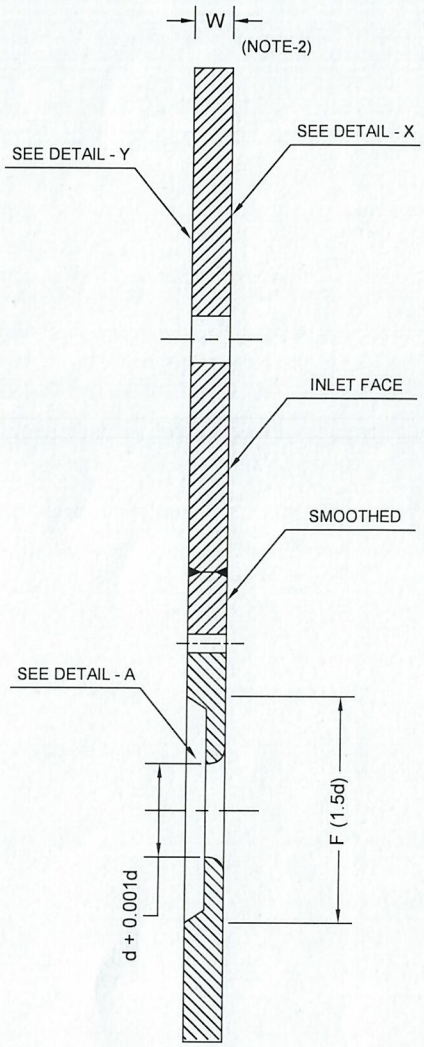
SEGMENTAL ORIFICE PLATE

NOTES:-

1. SERRATION SHALL BE CONSIDERED ON THE ORIFICE PLATE NEAR THE GASKET ZONE.

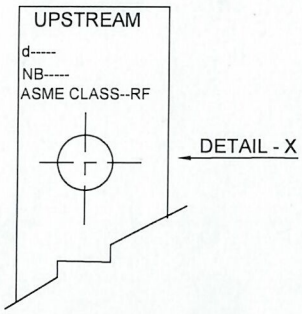
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman Approved by
6	23.03.26	REAFFIRMED & ISSUED	PK	AJS	RK	NK
5	12.02.21	REVISED & REISSUED	Manoj	JJ	MN	SM

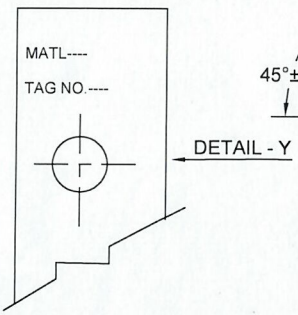


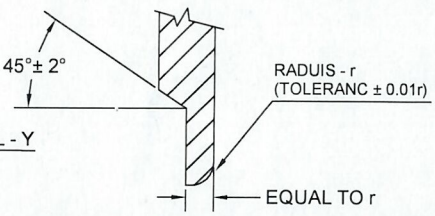


SECTION Z-Z

F = 1.5d BUT NOT GREATER THAN INTERNAL PIPE DIA "D"







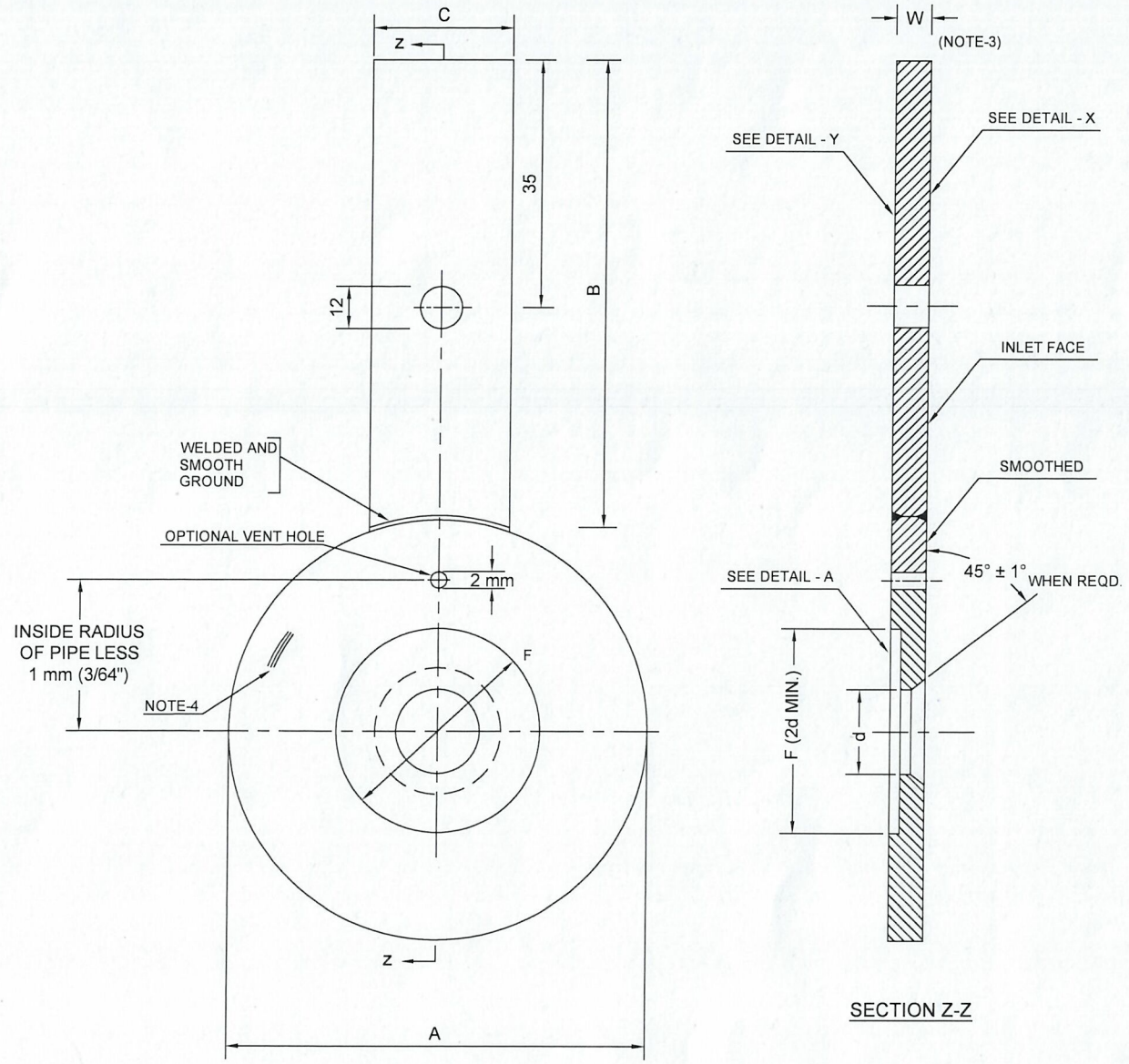
DETAIL - A

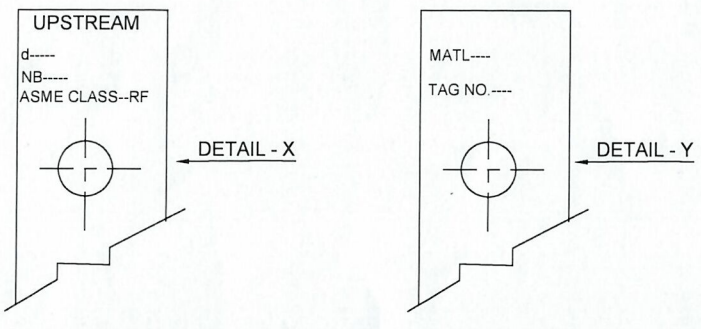
QUADRANT EDGE ORIFICE PLATE

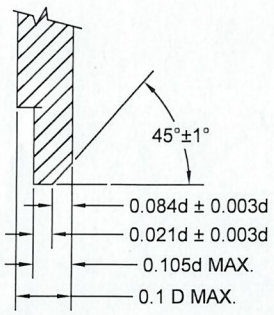
NOTES:-

1. DIMENSIONS A,B,C ARE SAME AS FOR SQUARE EDGE ORIFICE PLATES.
2. "W" SHALL NOT BE LESS THAN 2.54 mm AND SHALL NOT EXCEEDS 0.1D WHERE THE RADIUS 'r' OF THE UPSTREAM PROFILE EQUALS OR EXCEEDS 0.1D (WHERE IS THE CASE WHEN ß ≥ 0.571 OR m ≥ 0.325), "W" SHALL BE REDUCED FROM 'r' TO 0.1D BY REMOVING METAL FROM THE UPSTREAM FACE.
3. SERRATION SHALL BE CONSIDERED ON THE ORIFICE PLATE NEAR THE GASKET ZONE.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman Approved by
6	23.03.26	REAFFIRMED & ISSUED	PK	AJS	RK	NK
5	12.02.21	REVISED & REISSUED	Manoj	JJ	MN	SM







CONICAL ENTRANCE ORIFICE PLATE

NOTES:-

1. DIMENSIONS A,B,C ARE SAME AS FOR SQUARE EDGE ORIFICE PLATES.
2. DIMENSIONS d SHALL NOT BE LESS THAN 0.25" AND NOT GREATER THEN 0.316D.
3. DIMENSION "W" SHALL BE GENERALLY SAME AS FOR SQUARE EDGE ORIFICE PLATES AND SHALL NECESSARILY CONFORM TO FOLLOWING:
   "W" SHALL NOT EXCEED 0.1D WHERE D IS THE INTERNAL DIAMETER OF UPSTREAM PIPE LINE.
4. SERRATION SHALL BE CONSIDERED ON THE ORIFICE PLATE NEAR THE GASKET ZONE.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	23.03.26	REAFFIRMED & ISSUED	PK	AJS	RK	NK
5	12.02.21	REVISED & REISSUED	Manoj	JJ	MN	SM

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(ALL RATING AS PER ASME CLASS)

NB	A ± 0.40								RATING 125 TO 2500					
									≤ 315° c				> 315° c	
	RATING							W	TOLER.	T +0 -0.25		W	TOLER.	T +0 -0.25
mm (*)	125 150	250 300	400	600	900	1500	2500							
25 (1)	66.7	73.0	73.0	73.0	79.4	79.4	85.7	3.18			0.51	6.35		
40 (1 1/2)	85.7	95.3	95.3	95.3	98.4	98.4	117.5	3.18	+0.12		0.76	6.35		
50 (2)	104.8	111.1	111.1	111.1	142.9	142.9	146.1	3.18			0.79	6.35		
80 (3)	136.5	149.2	149.2	149.2	168.3	174.6	196.9	3.18	-0.25		0.79	6.35		
100 (4)	174.6	181.0	177.8	193.7	206.4	209.6	235.0	3.18			1.59	6.35		
150 (6)	222.3	250.8	247.7	266.7	288.9	282.6	317.5	3.18			1.59	6.35	+0.25	
200 (8)	279.4	308.0	304.8	320.7	358.8	352.4	387.4	6.35			3.18	9.52		
250 (10)	339.7	362.0	358.8	400.1	435.0	435.0	476.3	6.35		SEE NOTE -2	3.18	9.52		SEE NOTE -2
300 (12)	409.6	422.3	419.1	457.2	498.5	520.7	549.3	6.35			3.18	9.52		
350 (14)	450.8	485.8	482.6	492.1	520.7	577.9		6.35	±0.25		3.18	9.52		
400 (16)	514.4	539.8	536.6	565.2	574.7	641.4		6.35			6.35	9.52		
450 (18)	549.3	596.9	593.7	612.8	638.2	704.9		9.52			9.52	12.7		
500 (20)	606.4	654.1	647.7	682.6	698.5	755.7		9.52			9.52	12.7		
550 (22)	660.4	704.9	701.7	733.4				9.52			9.52	12.7		
600 (24)	717.6	774.7	768.4	790.6	838.2	901.7		9.52			9.52	12.7		

NB	B -0 +10							C ± 0.4	R
	RATING							RATING	
mm (*)	125 150	250 300	400	600	900	1500	2500	125 TO 400 / 600 TO 2500	
25 (1)	88	88	88	88	100	100	100	30	$R = \frac{(D-G)}{2}$
40 (1 1/2)									
50 (2)							114		
80 (3)									
100 (4)		100	100	100	114	114	127	40 / 50	
150 (6)						127			
200 (8)				114			158		
250 (10)						140	165		
300 (12)		114	114				177		
350 (14)					127	152			
400 (16)									
450 (18)	100	127	127	127	140	177			
500 (20)	144								
550 (22)									
600 (24)		40	140	140	165	203			

d		
FROM	TO	TOLER.
<6.350		0.007
6.350	9.526	0.013
9.526	12.700	0.015
12.701	15.875	0.020
15.876	19.050	0.023
19.051	22.225	0.025
22.226	25.400	0.030
25.401	31.750	0.036
31.751	38.100	0.043
38.101	44.450	0.051
44.541	127.000	0.064
>127.000		0.0005 x d

G		
≤ d		TOLER.
FROM	TO	±0.05
< 25.400	-	-
25.400	88.901	2.38
88.901	104.775	3.18
104.776	127.000	3.97
127.001	152.400	4.76
152.401	171.450	5.56
171.451	190.500	6.35
190.501	212.725	7.14
212.726	234.950	7.94
234.951	254.000	8.73
254.001	276.225	9.53
276.226	295.275	10.32
295.276	317.500	11.11
317.501	336.500	11.91
>336.500	-	12.70

LEGEND:-

D - INTERNAL DIAMETER OF THE PIPE
NB - NOMINAL BORE
d - ORIFICE BORE DIAMETER .
DIMENSIONS IN mm UNLESS OTHERWISE SPECIFIED.

NOTES:-

1. FOR BIDIRECTIONAL FLOW BEVELLING SHALL NOT BE PROVIDED. RESTRICTION ORIFICE PLATE SHALL NOT BE BEVELED AND THEY SHALL NOT HAVE WEEP HOLES.
2. VALUES OF 'T' SHOWN IN THIS STANDARD ARE VALID FOR THE CORRESPONDING 'W' AND d/D (ß) BETWEEN 0.25 AND 0.70 INCL. WHEN THE VALUES ARE NOT SHOWN AND FOR ß < 0.25 AND > 0.70. T SHALL BE CALCULATED EVERY TIME AND SHALL NOT BE HIGHER THEN THE SMALLER OF THE VALUES RESULTING FROM THE FOLLOWING RATIOS:-

ORIFICE PLATE DIMENSIONS

$\frac{d}{8}$, $\frac{D}{50}$, $\frac{D-d}{8}$

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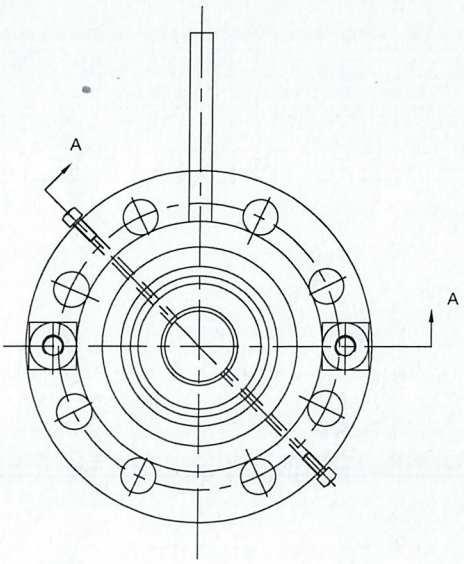
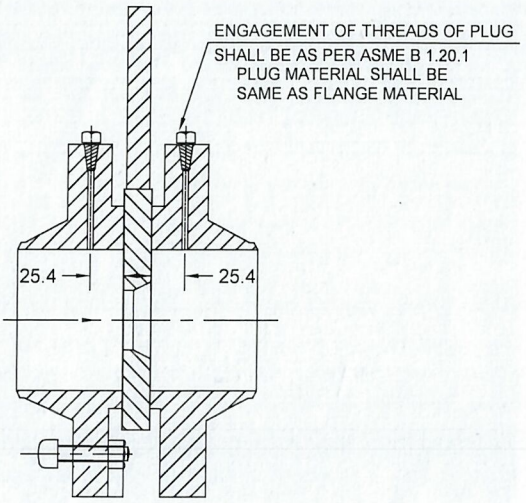
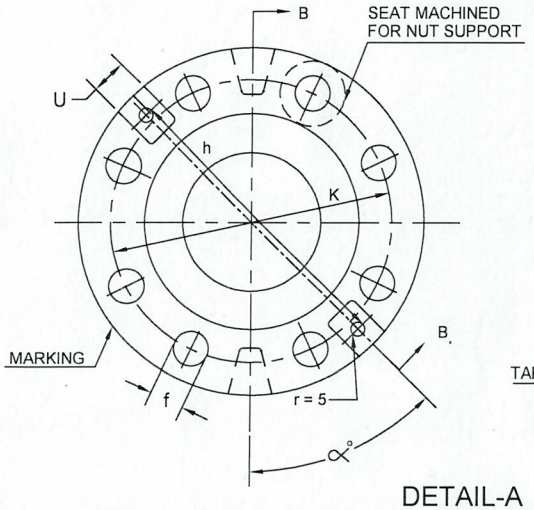
					Approved by	
6	23.03.26	REAFFIRMED & ISSUED	PK	AJS	RK	NK
5	12.02.21	REVISED & REISSUED	Manoj	JJ	MN	SM



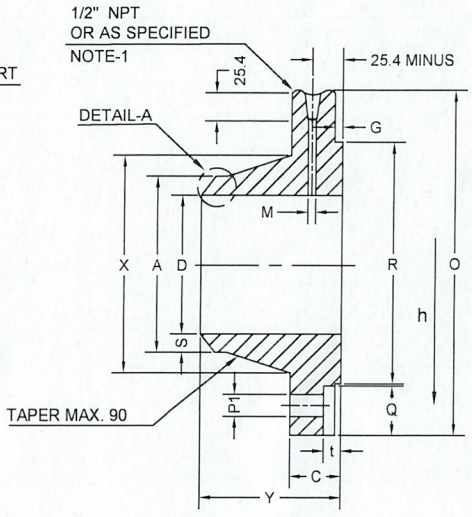


SECTION A-A



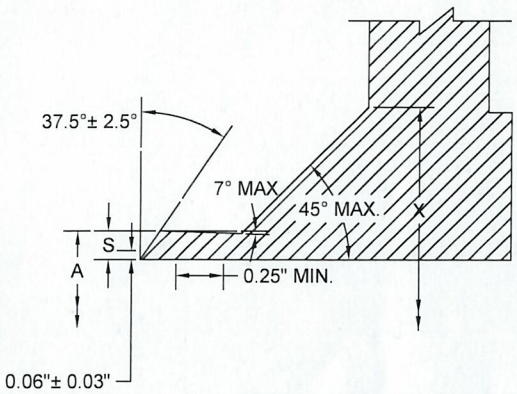
DETAIL-A

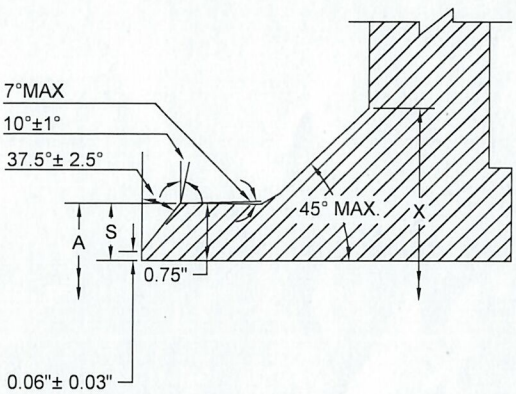
BEVEL FOR WALL THICKNESS (S)
0.19 INCH TO 0.88 INCH INCLUSIVE



SECTION B-B

BEVEL FOR WALL THICKNESS (S)
GREATER THAN 0.88 INCH.





WELD NECK RAISED FACE ORIFICE FLANGES

Notes:-

1. UNLESS OTHERWISE SPECIFIED PRESSURE TAP ORIENTATION SHALL BE AS FOLLOW :
> FOR TWO TAPS - 90 DEG . APART WITH ONE SET OF TAPS PLUGGED.
> FOR FOUR TAPS - EQUALLY SPACED APART IN THE SAME HALF SECTION OF THE FLANGE WITH TWO SETS OF TAPS PLUGGED .
> PLUG MATERIAL SHALL BE SAME AS FLANGE MATERIAL.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	23.03.26	REAFFIRMED & ISSUED	PK	AJS	RK	NK
5	12.02.21	REVISED & REISSUED	Manoj	JJ	MN	SM

DIMENSIONS (IN mm) - WELD NECK RAISED FACE ORIFICE FLANGES

FLANGE RATING	FLANGE NB mm (")	A	X	O	K	C	Y	f	R	G	NO. OF BOLT HOLES	M	h	P1	t	q	U	∝ °	WEIGHT kg.
300	25 (1)	33.5	54.0	124.0	88.9	38.1	82.6	17.5	50.8	1.6	4	6.4	102.2	12.7	9.5	21.8	19.1	82° 30'	8
	40 (1.5)	48.3	69.9	155.6	114.3	38.1	85.9	20.6	73.2	1.6	4	6.4	133.8	12.7	9.5	21.8	19.1	82° 30'	12
	50 (2)	60.5	84.1	165.1	127.0	38.1	85.9	17.5	92.1	1.6	8	6.4	141.3	14.3	12.7	23.8	20.6	45°	15
	80 (3)	88.9	117.5	209.6	168.3	38.1	88.9	20.6	127.0	1.6	8	9.5	185.7	14.3	12.7	23.8	20.6	45°	22
	100 (4)	114.3	146.1	254.0	200.0	38.1	92.1	20.6	157.2	1.6	8	12.7	230.2	14.3	12.7	23.8	20.6	45°	31
	150 (6)	168.4	206.4	317.5	269.9	38.1	100.1	22.4	215.9	1.6	12	12.7	293.7	14.3	12.7	23.8	20.6	60°	45
	200 (8)	219.2	260.4	381.0	330.2	41.3	111.2	25.4	269.9	1.6	12	12.7	351.6	15.9	15.9	29.4	25.4	60°	70
	250 (10)	273.1	320.7	444.5	387.4	47.8	117.5	28.6	323.9	1.6	16	12.7	411.6	19.1	19.1	32.9	28.6	67° 30'	100
	300 (12)	323.9	374.7	520.7	450.9	50.8	130.2	31.8	381.0	1.6	16	12.7	482.2	22.2	22.2	38.5	33.3	67° 30'	150
	350 (14)	355.6	425.5	584.2	514.4	54.0	142.9	31.8	412.8	1.6	20	12.7	545.7	22.2	22.2	38.5	33.3	72°	193
	400 (16)	406.4	482.6	647.7	571.5	57.2	146.1	35.1	469.9	1.6	20	12.7	603.6	25.4	25.4	44.1	38.1	72°	260
	450 (18)	457.2	533.4	711.2	628.7	60.5	158.8	35.1	533.4	1.6	24	12.7	667.1	25.4	25.4	44.1	38.1	75°	340
	500 (20)	508.0	587.4	774.7	685.8	63.5	162.1	35.1	584.2	1.6	24	12.7	730.6	25.4	25.4	44.1	38.1	75°	413
	550 (22)	558.8	641.4	838.2	743.0	66.7	165.1	41.3	641.4	1.6	24	12.7	783.4	31.8	31.8	54.8	47.6	75°	510
	600 (24)	609.6	701.7	914.4	812.8	69.9	168.3	41.3	692.1	1.6	24	12.7	854.1	34.9	31.8	60.3	52.4	75°	618

(ALL RATING AS PERASME CLASS)

NOTE:-

1. GASKET HARDNESS SHALL BE 20 BHN (MIN) LESS THAN FLANGE HARDNESS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Approved by Stds. Bureau Chairman
6	23.03.26	REAFFIRMED & ISSUED	PK	AJS	RK	NK
5	12.02.21	REVISED & REISSUED	Manoj	JJ	MN	SM

DIMENSIONS (IN mm) - WELD NECK RAISED FACE ORIFICE FLANGES

FLANGE RATING	NB mm (")	A	X	O	K	C	Y	f	R	G	NO. OF BOLT HOLES	M	h	P1	t	q	U	∝ °	WEIGHT kg.
600	25 (1)	33.5	54.0	124.0	88.9	38.1	82.6	17.5	50.8	1.6	4	6.4	102.2	12.7	9.5	21.8	19.1	82° 30'	8
	40 (1.5)	48.3	69.9	155.6	114.3	38.1	85.9	20.6	73.2	1.6	4	6.4	133.8	12.7	9.5	21.8	19.1	82° 30'	12
	50 (2)	60.5	84.1	165.1	127.0	38.1	85.9	17.5	92.1	1.6	8	6.4	141.3	14.3	12.7	23.8	20.6	45°	15
	80 (3)	88.9	117.5	209.6	168.3	38.1	88.9	20.6	127.0	1.6	8	9.5	185.7	14.3	12.7	23.8	20.6	45°	22
	100 (4)	114.3	152.4	273.1	215.9	44.5	108.0	25.4	157.2	6.4	8	12.7	234.6	22.2	14.7	38.5	33.3	45°	44
	150 (6)	168.4	222.3	355.6	292.1	54.0	123.8	28.6	215.9	6.4	12	12.7	311.5	25.4	21.1	44.1	38.1	60°	89
	200 (8)	219.2	273.1	419.1	349.3	61.9	139.7	31.8	269.9	6.4	12	12.7	375.0	25.4	21.1	44.1	38.1	60°	130
	250 (10)	273.1	342.9	508.0	431.8	69.9	158.8	35.1	323.9	6.4	16	12.7	463.9	25.4	21.1	44.1	38.1	67° 30'	204
	300 (12)	323.9	400.1	558.9	489.0	73.0	161.9	35.1	381.0	6.4	20	12.7	514.7	25.4	21.1	44.1	38.1	72°	245
	350 (14)	355.6	431.8	603.3	527.1	76.2	171.5	38.1	412.8	6.4	20	12.7	559.2	25.4	21.1	44.1	38.1	72°	312
	400 (16)	406.4	495.3	685.8	603.3	82.6	184.2	41.2	469.9	6.4	20	12.7	636.2	28.6	21.1	49.6	42.9	72°	428
	450 (18)	457.2	546.1	743.0	654.1	88.9	190.5	44.5	533.4	6.4	20	12.7	693.3	28.6	21.1	49.6	42.9	72°	525
	500 (20)	508.0	609.6	812.8	723.9	95.3	196.9	44.5	584.2	6.4	24	12.7	763.2	28.6	21.1	49.6	42.9	75°	650
	550 (22)	558.8	666.8	870.0	777.9	101.6	203.2	47.6	641.4	6.4	24	12.7	820.3	28.6	21.1	49.6	42.9	75°	797
	600 (24)	609.6	717.6	939.8	838.2	108.0	209.6	50.8	692.1	6.4	24	12.7	890.2	28.6	21.1	49.6	42.9	75°	926

(ALL RATING AS PERASME CLASS)

NOTE:-

1. GASKET HARDNESS SHALL BE 20 BHN (MIN) LESS THAN FLANGE HARDNESS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
6	23.03.26	REAFFIRMED & ISSUED	PK	AJS	RK	NK
5	12.02.21	REVISED & REISSUED	Manoj	JJ	MN	SM

Approved by

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DIMENSIONS (IN mm) - WELD NECK RAISED FACE ORIFICE FLANGES

FLANGE RATING	FLANGE NB mm (")	A	X	O	K	C	Y	f	R	G	NO. OF BOLT HOLES	M	h	P1	t	q	U	∝°	WEIGHT kg.
900	25 (1)	33.5	52.4	149.2	101.6	44.5	89.0	25.4	50.8	6.4	4	6.4	116.3	19.1	14.7	32.9	28.6	82° 30'	12
	40 (1.5)	48.3	69.9	177.8	124.0	44.5	95.3	28.6	73.2	6.4	4	6.4	144.9	19.1	14.7	32.9	28.6	82° 30'	16
	50 (2)	60.5	104.8	215.9	165.1	44.5	108.0	25.4	92.1	6.4	8	6.4	183.0	19.1	14.7	32.9	28.6	45°	29
	80 (3)	88.9	127.0	241.3	190.5	44.5	108.0	25.4	127.0	6.4	8	9.5	208.4	19.2	17.9	32.9	28.6	45°	34
	100 (4)	114.3	158.8	292.1	235.0	50.8	120.7	31.8	157.2	6.4	8	12.7	253.6	22.2	17.9	38.5	33.3	45°	57
	150 (6)	168.4	235.0	381.0	317.5	61.9	146.1	31.8	215.9	6.4	12	12.7	336.9	25.4	24.2	44.1	38.1	60°	118
	200 (8)	219.2	298.5	469.9	393.7	69.9	168.3	38.1	269.9	6.4	12	12.7	420.3	28.6	24.2	49.6	42.9	60°	190
	250 (10)	273.1	368.3	546.1	469.9	76.2	190.5	38.1	323.9	6.4	16	12.7	496.5	28.6	24.2	49.6	42.9	67° 30'	277
	300 (12)	323.9	419.1	609.6	533.4	85.7	206.4	38.1	381.0	6.4	20	12.7	560.0	28.6	24.2	49.6	42.9	72°	345
	350 (14)	355.6	450.9	641.4	558.8	92.1	219.1	41.3	412.8	6.4	20	12.7	591.7	28.6	24.2	49.6	42.9	72°	441
	400 (16)	406.4	508.0	704.9	616.0	95.3	222.3	44.5	469.9	6.4	20	12.7	655.2	28.6	24.2	49.6	42.9	72°	545
	450 (18)	457.2	565.2	787.4	685.8	108.0	235.0	50.8	533.4	6.4	20	12.7	732.6	31.8	27.4	54.8	47.6	72°	761
	500 (20)	508.0	622.3	857.3	749.3	114.3	254.0	54.0	584.2	6.4	20	12.7	802.5	31.8	27.4	54.8	47.6	75°	927
	600 (24)	609.6	749.3	1041.4	901.7	146.1	298.5	66.7	692.1	6.4	20	12.7	986.6	31.8	27.4	54.8	47.6	75°	1697

(ALL RATING AS PERASME CLASS)

NOTE:-

1. GASKET HARDNESS SHALL BE 20 BHN (MIN) LESS THAN FLANGE HARDNESS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
				Approved by		
6	23.03.26	REAFFIRMED & ISSUED	PK	AJS	RK	NK
5	12.02.21	REVISED & REISSUED	Manoj	JJ	MN	SM

DIMENSIONS (IN mm) - WELD NECK RAISED FACE ORIFICE FLANGES

FLANGE RATING	NB mm (")	A	X	O	K	C	Y	f	R	G	NO. OF BOLT HOLES	M	h	P1	t	q	U	∝ °	WEIGHT kg.
1500	25 (1)	33.5	52.4	149.2	101.6	44.5	89.0	25.4	50.8	6.4	4	6.4	116.3	19.1	14.7	32.9	28.6	82° 30'	12
	40 (1.5)	48.3	69.9	177.8	124.0	44.5	95.3	28.6	73.2	6.4	4	6.4	144.9	19.1	14.7	32.9	28.6	82° 30'	16
	50 (2)	60.5	104.8	215.9	165.1	44.5	108.0	25.4	92.1	6.4	8	6.4	183.0	19.1	14.7	32.9	28.6	45°	29
	80 (3)	88.9	133.4	266.7	203.2	54.0	123.8	31.8	127.0	6.4	8	9.5	228.2	22.2	17.9	38.5	33.3	45°	55
	100 (4)	114.3	161.9	311.2	241.3	60.3	130.2	34.9	157.2	6.4	8	12.7	272.7	22.2	17.9	38.5	33.3	45°	82
	150 (6)	168.4	228.6	393.7	317.5	88.9	177.8	38.1	215.9	6.4	12	12.7	349.6	25.4	24.2	44.1	38.1	60°	184
	200 (8)	219.2	292.1	482.6	393.7	98.4	219.1	44.5	269.9	6.4	12	12.7	433.0	28.6	24.2	49.6	42.9	60°	286
	250 (10)	273.1	368.3	584.2	482.6	114.3	260.4	50.8	323.9	6.4	12	12.7	534.6	28.6	24.2	49.6	42.9	60°	498
	300 (12)	323.9	450.9	673.1	571.5	130.2	288.9	54.0	381.0	6.4	16	12.7	623.5	28.6	24.2	49.6	42.9	67° 30'	760
	350 (14)	355.6	495.3	749.3	635.0	139.7	304.8	60.3	412.8	6.4	16	12.7	694.5	31.8	27.4	54.8	47.6	67° 30'	1053
	400 (16)	406.4	552.5	825.5	704.9	152.4	317.5	66.7	469.9	6.4	16	12.7	765.2	34.9	27.4	60.3	52.4	67° 30'	1406
	450 (18)	457.2	596.9	914.4	774.7	168.3	333.4	73.0	533.4	6.4	16	12.7	854.1	34.9	27.4	60.3	52.4	67° 30'	1836
	500 (20)	508.0	641.4	984.3	831.9	184.2	362.0	79.4	584.2	6.4	16	12.7	923.9	34.9	27.4	60.3	52.4	67° 30'	2324
	600 (24)	609.6	762.0	1168.4	990.6	209.6	412.8	92.1	692.1	6.4	16	12.7	1108.1	34.9	27.4	60.3	52.4	67° 30'	3749

(ALL RATING AS PERASME CLASS)

NOTE:-

1. GASKET HARDNESS SHALL BE 20 BHN (MIN) LESS THAN FLANGE HARDNESS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	23.03.26	REAFFIRMED & ISSUED	PK	AJS	RK	NK
5	12.02.21	REVISED & REISSUED	Manoj	JJ	MN	SM

TOLERANCES ALLOWED ON FLANGES ACCORDING TO ASME B16.36 / B16.5

DIMENSIONS mm (Inches)		TOLERANCE (Inches)
O	≤ 609.6 mm	± 1.59 *
	> 609.6 mm	± 3.18 *
C	NB ≤ 450 (18)	± 3.18 - 0
	NB > 450 (18)	+4.76 - 0
X	≤ 609.6 mm	± 1.59 *
	> 609.6 mm	± 3.18 *
A	NB ≤ 100 (4)	+ 2.38 - 0.79
	NB ≤ 150 (6)	+ 3.96 - 0.79
Y	NB ≤ 250 (10)	± 1.59
	NB ≤ 300 (12)	± 3.18
DRILLING	K	± 1.59
	CENTRES BETWEEN HOLES	± 0.79
R	FOR GV/CD < 6.35 mm	± 0.79
	FOR GV/CD ≥ 6.35 mm	± 0.40
ECCENTRICITY BETWEEN K AND R DIAMETERS		± 0.79
ECCENTRICITY BETWEEN K AND D DIAMETERS		± 0.79 *
ECCENTRICITY BETWEEN R AND D DIAMETERS		± 0.79 *
D	NB ≤ 150 (6)	± 0.12 *
	NB 200 &250 (8 &10)	± 0.12 - 0.25 *
	NB 300 (12)	± 0.12 - 0.38 *
	NB 350 &400 (14 &16)	± 0.12 - 0.50 *
	NB ≤ 450 (18)	± 0.12 - 0.76 *

*NOT COVERE D BY ASME B16.5

WELD NECK RAISED FACE ORIFICE FLANGES

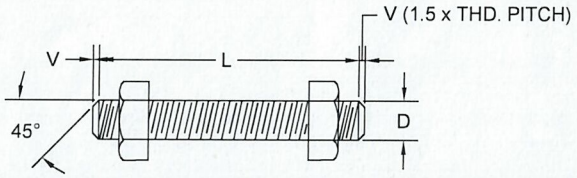
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	23.03.26	REAFFIRMED & ISSUED	PK	AJS	RK	NK
5	12.02.21	REVISED & REISSUED	Manoj	JJ	MN	SM

DIMENSIONS AS SHOWN

THREAD : ASME B 1.1
FOR D" ≤1 -UNC - 2A
FOR D" ≥1 1/8 - 8 UN - 2A

CONSTRUCTION

FORGED, BAR STOCK



D mm (Inches)	THREAD PITCH		V	2V *
15.9 (5/8)	UNC	2.309	3.46	7
19.0 (3/4)		2.54	3.78	7.5
22.2 (7/8)		2.822	4.23	8.5
25.4 (1)		3.175	4.76	9.5
≥ 28.6 (1 1/8)	8 UN	3.175	4.76	9.5

* APPROXIMATE VALUE OF THE TWO BEVELS

(ALL RATING AS PER ASME CLASS)

DIAMETER (NB,D) mm (INCHES) & LENTGH - (L) IN mm (NOTE-1)												
RATING		300			600			900			1500		
DIM.	NB	D		L	D		L	D		L	D		L
25	(1)	15.9	(5/8)	127	15.9	(5/8)	127	22.2	(7/8)	152	22.2	(7/8)	152
40	(1 1/2)	19.0	(3/4	133	19.0	(3/4)	133	25.4	(1)	159	25.4	(1)	159
50	(2)	15.9	(5/8)	127	15.9	(5/8)	127	22.2	(7/8)	152	22.2	(7/8)	152
80	(3)	19.0	(3/4)	133	19.0	(3/4)	133	22.2	(7/8)	152	28.6	(1 1/8)	184
100	(4)	19.0	(3/4)	133	22.2	(7/8)	152	28.6	(1 1/8)	178	31.7	(1 1/4)	203
150	(6)	19.0	(3/4)	133	25.4	(1)	178	28.6	(1 1/8)	203	34.9	(1 3/8)	266
200	(8)	22.2	(7/8)	146	28.6	(1 1/8)	203	34.9	(1 3/8)	229	41.3	(1 5/8)	298
250	(10)	25.4	(1)	165	31.7	(1 1/4)	222	34.9	(1 3/8)	241	47.6	(1 7/8)	343
300	(12)	28.6	(1 1/8)	178	31.7	(1 1/4)	229	34.9	(1 3/8)	260	50.8	(2)	381
350	(14)	28.6	(1 1/8)	191	34.9	(1 3/8)	248	38.1	(1 1/2)	282	57.1	(2 1/4)	418
400	(16)	31.7	(1 1/4)	203	38.1	(1 1/2)	266	41.3	(1 5/8)	295	63.5	(2 1/2)	456
450	(18)	31.7	(1 1/4)	209	41.3	(1 5/8)	286	47.6	(1 7/8)	333	69.8	(2 3/4)	503
500	(20)	31.7	(1 1/4)	216	41.3	(1 5/8)	298	50.8	(2)	355	76.2	(3)	548
600	(24)	38.1	(1 1/2)	241	47.6	(1 7/8)	337	63.5	(2 1/2)	445	88.9	(3 1/2)	623

TOLERANCE ON 'L'

L-LENGTH mm	≤ 305	310 to 455	≥ 455
TOLERANCE mm	- 0 + 1.6	- 0 + 3.2	- 0 + 6.4

STUD BOLT DETAILS FOR RAISED FACE FLANGES

NOTES:-

1. FOR BOLT DIAMETER 1" (25mm) & ABOVE IN EACH RATING, FOLLOWING SHALL BE CONSIDERED TO TAKE CARE OF BOLT TENSIONING.
(i) ONE EXTRA NUT SHALL BE CONSIDERED FOR EACH BOLT/STUD.
(ii) BOLT/STUD LENGTH SHALL BE INCREASED BY ONE DIAMETER.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman Approved by
6	23.03.26	REAFFIRMED & ISSUED	PK	AJS	RK	NK
5	12.02.21	REVISED & REISSUED	Manoj	JJ	MN	SM

DIMENSIONS :ASME B 18.2.1

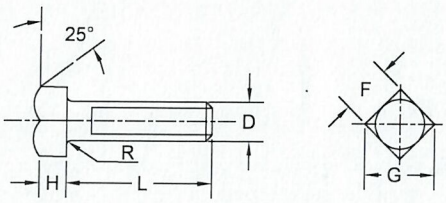
CONSTRUCTIONS FORGED, BAR STOCK

TOLERANCES : ASME B 18.2.1 ASME B1.1

THREAD : ASME B 1.1

FOR D" ≤1 -UNC - 2A

FOR D" ≥1 1/8 - 8 UN - 2A



D mm (Inches)		F	G mm		H mm	R mm
			MAX.	MIN.		
9.5	(3/8)	14.3	20.2	19.0	6.4	0.8
11.1	(7/16)	15.9	22.5	21.0	7.5	0.8
12.7	(1/2)	19.1	26.9	25.3	8.3	0.8
15.9	(5/8)	23.8	33.7	31.6	10.7	1.6
19.1	(3/4)	28.6	40.4	37.9	12.7	1.6
22.2	(7/8)	33.3	47.1	44.2	15.1	1.6
25.4	(1)	38.1	53.9	50.6	16.7	2.4
28.6	(1 1/8)	42.9	60.6	56.9	19.1	2.4
31.8	(1 1/4)	47.6	67.4	63.2	21.4	2.4
38.1	(1 1/2)	57.2	80.8	75.8	25.4	2.4

(ALL RATING AS PER ASME CLASS)

DIAMETER (NB,D): mm (INCHES) AND LENTGH - (L) IN mm												
RATING		300			600			900			1500		
DIM.	NB	D		L	D		L	D		L	D		L
25	(1)	9.5	(3/8)	75	9.5	(3/8)	75	15.9	(5/8)	90	15.9	(5/8)	90
40	(1 1/2)	9.5	(3/8)	75	9.5	(3/8)	75	15.9	(5/8)	90	15.9	(5/8)	90
50	(2)	11.1	(7/16)	85	11.1	(7/16)	85	15.9	(5/8)	100	15.9	(5/8)	100
80	(3)	11.1	(7/16)	85	11.1	(7/16)	85	15.9	(5/8)	100	19.1	(3/4)	115
100	(4)	11.1	(7/16)	85	19.1	(3/4)	100	19.1	(3/4)	110	19.1	(3/4)	120
150	(6)	11.1	(7/16)	90	22.2	(7/8)	115	22.2	(7/8)	130	22.2	(7/8)	160
200	(8)	12.7	(1/2)	100	22.2	(7/8)	130	25.4	(1)	140	25.4	(1)	170
250	(10)	15.9	(5/8)	110	22.2	(7/8)	135	25.4	(1)	145	25.4	(1)	190
300	(12)	19.1	(3/4)	115	22.2	(7/8)	140	25.4	(1)	155	25.4	(1)	215
350	(14)	19.1	(3/4)	120	22.2	(7/8)	140	25.4	(1)	165	28.6	(1 1/8)	235
400	(16)	22.2	(7/8)	130	25.4	(1)	155	25.4	(1)	170	31.8	(1 1/4)	255
450	(18)	22.2	(7/8)	130	25.4	(1)	160	28.6	(1 1/8)	200	31.8	(1 1/4)	275
500	(20)	22.2	(7/8)	140	25.4	(1)	165	28.6	(1 1/8)	205	31.8	(1 1/4)	295
550	(22)	28.6	(1 1/8)	155	25.4	(1)	180	-	-	-	-	-	-
600	(24)	31.8	(1 1/4)	160	25.4	(1)	185	28.6	(1 1/8)	240	31.8	(1 1/4)	315

SEMI-FINISHED, SQUARE HEAD, FULL THREAD, JACK SCREW

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	23.03.26	REAFFIRMED & ISSUED	PK	AJS	RK	NK
5	12.02.21	REVISED & REISSUED	Manoj	JJ	MN	SM

INSTRUMENT CONNECTION ON VESSEL, STANDPIPES AND TANKS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
			Approved by			
7	10.01.24	REVISED AND REISSUED	AJS	AR	MN	MN
6	13.02.20	REVISED AND REISSUED	MN	JJ	RG	RKT
5	10.10.19	REVISED AND REISSUED	MN	AJS	RG	RKT
4	27.01.15	REVISED AND REISSUED	MN	RKG	RG	SC
3	11.02.13	REVISED AND REISSUED	MN	RG	RP/JMS	DM

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SR. NO	TYPE OF INSTRUMENTS	UNCLADDED EQUIPMENTS		CLADDED /LINED EQUIPMENTS		INSTRUMENT CONNECTION
		EQUIPMENT/STANDPIPE CONNECTION	FIRST BLOCK VALVE	EQUIPMENT/STANDPIPE CONNECTION	FIRST BLOCK VALVE	
1.	EXTERNAL DISPLACER LEVEL INSTRUMENT ON EQUIPMENT	2" FLGD.	2" FLGD.	3" FLGD.	3" FLGD.	2"/3" FLGD.
2.	EXTERNAL DISPLACER LEVEL INSTRUMENT ON STANDPIPE	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.
3.	EXTERNAL GUIDED WAVE LEVEL INSTRUMENT ON EQUIPMENT	2" FLGD.	2" FLGD.	3" FLGD. (4" NOTE-11)	3" FLGD. (4" NOTE-11)	2"/3" FLGD (4" NOTE-11)
4.	EXTERNAL GUIDED WAVE LEVEL INSTRUMENT ON STANDPIPE	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.
5.	EXTERNAL MAGNETIC LEVEL INSTRUMENT/ GAUGE ON EQUIPMENT	2" FLGD.	2" FLGD.	3" FLGD. (4" NOTE-11)	3" FLGD. (4" NOTE-11)	2"/3" FLGD. (4" NOTE-11)
6.	EXTERNAL MAGNETIC LEVEL INSTRUMENT/ GAUGE ON STANDPIPE	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.	2" FLGD.
7.	EXTERNAL BALL FLOAT LEVEL INSTRUMENT ON VESSEL	2" FLGD.	2" FLGD.	3" FLGD.	3" FLGD.	1" SW
8.	EXTERNAL BALL FLOAT LEVEL INSTRUMENT ON STANDPIPE	1" SW/BW #	1" SW/BW #	1" SW/BW #	1" SW/BW #	1" SW
9.	INTERNAL DISPLACER / FLOAT LEVEL INSTRUMENTS	4" FLGD	-	4" FLGD	-	4" FLGD.
10.	INTERNAL GUIDED WAVE LEVEL INSTRUMENT ON EQUIPMENT	4" FLGD.	-	4" FLGD.	-	4" FLGD.
11.	MAGNETIC LEVEL INSTRUMENT/ GAUGE (INTERNAL - TOP MOUNTED)	4" FLGD.	-	4" FLGD.	-	4" FLGD.
12.	LEVEL GAUGE ON VESSEL	2" FLGD.	2" FLGD.	3" FLGD (4" NOTE-11).	3" FLGD .(4" NOTE-11)	¾" SCRD.
13.	LEVEL GAUGE ON STANDPIPE	¾" SW/BW #	¾" SW/BW #	¾" SW/BW #	¾" SW/BW #	¾" SCRD.
14.	SPECIAL LEVEL INSTRUMENT ON EQUIPMENT (CAPACITANCE PROBE/ULTRASONIC PROBE/R.F.PROBE)	2" FLGD.	-	3" FLGD.	-	2"/3" FLGD.
15.	D.P. INSTRUMENT/ GAUGES ON VESSEL	2 " FLGD.	2 " BW/FLGD #	3" FLGD.	3" FLGD.	½ " SCRD.
16.	D.P. INSTRUMENT/ GAUGES ON STANDPIPE	¾" SW/BW #	¾" SW/BW #	¾" SW/BW #	¾" SW/BW #	½ " SCRD.
17.	DIAPHRAGM SEAL D.P. INSTRUMENT/ GAUGES ON VESSEL	3" FLGD.	3" FLGD.	3" FLGD. (4" NOTE-11)	3" FLGD (4" NOTE-11)	3" FLGD (4" NOTE-11)

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SR. NO	TYPE OF INSTRUMENTS	UNCLADDED EQUIPMENTS		CLADDED /LINED EQUIPMENTS		INSTRUMENT CONNECTION
		EQUIPMENT/STANDPIPE CONNECTION	FIRST BLOCK VALVE	EQUIPMENT/STANDPIPE CONNECTION	FIRST BLOCK VALVE	
18.	EXTENDED DIAPHRAGM SEAL D.P. INSTR/ GAUGE ON VESSEL	3" FLGD. (4" NOTE-11) (NOTE-1)	-	4" FLGD. (NOTE-1)	-	3" FLGD. (4" NOTE-11) (NOTE-1)
19.	DIP TUBE LEVEL INSTRUMENT	6 " FLGD.	½ " SW (BY INST)	6" FLGD.	½ " SW (BY INST)	½ " SCRD
20.	TANK LEVEL INSTRUMENT (MECHANICAL)	1½ " FLGD	1½ " FLGD (BY INST)	-	-	½ " SCRD
21.	TANK LEVEL INSTRUMENT (SERVO) ON ATMOSPHERIC TANKS (NOTE-7,10)	6" FLGD.	-	-	-	6" FLGD
22	TANK LEVEL INSTRUMENT (SERVO) FOR PRESSURISED EQUIPMENT (NOTE-7,10)	6" FLGD.	6" FLGD. (BY INST)	6" FLGD.	6" FLGD. (BY INST)	6" FLGD
23.	TANK LEVEL INSTRUMENT (RADAR) ON ATMOSPHERIC TANK (GENERAL SERVICE WITH DESIGN TEMP ≤ 110 DEG C) (NOTE-8,10)	8" FLGD.	-	-	-	8" FLGD.
24.	TANK LEVEL INSTRUMENT (RADAR) ON ATMOSPHERIC TANK (VISCOUS SERVICE WITH DESIGN TEMP >110 DEG C)	24" FLGD	-	-	-	24" FLGD
25.	TANK LEVEL INSTRUMENT (RADAR) FOR PRESSURISED EQUIPMENTS (NOTE-9,10)	8" FLGD.	-	8" FLGD.	-	8" FLGD.
26.	TANK LEVEL INSTRUMENT – CAPACITANCE / ULTRASONIC/ RF TYPE ON ATMOSPHERIC TANKS/PRESSURISED EQUIPMENTS	2" FLGD.	-	3" FLGD.	-	2" /3" FLGD.
27.a	TUNING FORK LEVEL INSTRUMENT ON TANK	3"-FLGD	-	-	-	3" FLGD
27.b	TUNING FORK LEVEL INSTRUMENT ON VESSEL/PIPE	2" FLGD	-	3" FLGD	-	2" OR 3" FLGD.
27.c	TUNING FORK LEVEL INSTRUMENT ON SILOS	3" FLGD	-	-		3" FLGD
28.	PRESSURE INSTRUMENT/ GAUGE ON VESSEL	2" FLGD	2 " BW/ FLGD #	3" FLGD. (4" NOTE-11)	3" BW/FLGD. # (4" NOTE-11)	½ " SCRD

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SR. NO	TYPE OF INSTRUMENTS	UNCLADDED EQUIPMENTS		CLADDED /LINED EQUIPMENTS		INSTRUMENT CONNECTION
		EQUIPMENT/STANDPIPE CONNECTION	FIRST BLOCK VALVE	EQUIPMENT/STANDPIPE CONNECTION	FIRST BLOCK VALVE	
29.	PRESSURE INSTRUMENT/ GAUGE ON STANDPIPE	¾" SW/BW #	¾" SW/BW #	¾" SW/BW #	¾" SW/BW #	½ " SCRD
30.	DIAPHRAGM SEAL PRESSURE INSTRUMENT /GAUGE ON VESSEL	2 " FLGD	2 " FLGD	3" FLGD. (4" NOTE-11)	3" FLGD. (4" NOTE-11)	2"/3" FLGD.(4" NOTE-11)
31.	THERMOWELL ON EQUIPMENT	2 " FLGD	-	3" FLGD.	-	2 " FLGD/ 3" FLGD
32.	MULTI-POINT TEMPERATURE ELEMENTS FOR ATMOSPHERIC TANKS	3"FLGD.	-	3" FLGD.	-	3" FLGD
33.	MULTI-POINT TEMPERATURE ELEMENTS FOR PRESSURISED EQUIPMENTS	3"FLGD.	-	3" FLGD.	-	3" FLGD
34.	STANDPIPE (RATING UP TO 600#)	2"FLGD.	-	3" FLGD.	-	-
35.	STANDPIPE (RATING > 600#)	3"FLGD.	-	3" FLGD.	-	-
36.	LEVEL INSTRUMENT (NON-CONTACT RADAR) ON PROCESS VESSELS/ BURIED EQUIPMENT. (NOTE-6)	6" FLGD.				6" FLGD

NOTES: 1 O.D OF EXTENDED DIAPHRAGM OF INSTRUMENT SHALL BE SELECTED TO SUIT NOZZLE I.D OF EQUIPMENT.

2 ALL FLANGES/SW RATING SHALL BE AS PER PIPING SPECIFICATION UNLESS PROJECT SPECIFICATION REQUIRES MIN. 300#.

3 IN CASE OF DIRECT MOUNTED FLANGED INSTRUMENTS AND WHERE FLANGED TYPE FIRST ISOLATION VALVE ARE PROVIDED, STUD/BOLTS & NUTS AND GASKETS SHALL BE IN PIPING SCOPE.

4 INSTALLATION OF STLL WELLS FOR TANK LEVEL INSTRUMENTS IN TANKS ARE IN TANK VENDOR'S SCOPE.

5 FOR ANY OTHER INSTRUMENTS NOT REFERED ABOVE THE CONNECTION DETAILS SHALL BE AS PER PROJECT REQUIREMENT.

6 6" NOZZLE SHALL BE CONSIDERED IN VESSEL WITH CS METALLURGY SCH 160. STILLWELL SIZE SHALL BE 4" SCH. 40S WITH SS METALLURGY AND SHALL BE IN VESSEL VENDOR SCOPE ALONG WITH DATUM PLATE OF SS METALLURGY ON STILL WELL BOTTOM. LONG STUD &NUT SHALL BE IN RADAR VENDOR SCOPE

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7 STILLWELL SIZE SHALL BE 12" OF CS METALLURGY SCH. 40 AND SHALL BE IN TANK / EQUIPMENT VENDOR SCOPE.

8 8" TANK NOZZLE SHALL BE OF CS METALLURGY WITH SCH 60 (WHEN TANK ROOF CORROSION ALLOWANCE 1 MM) / SCH 80 (WHEN TANK ROOF CORROSION ALLOWANCE 3 MM) AND STILLWELL SIZE SHALL BE 8" SCH. 60 (WHEN TANK ROOF CORROSION ALLOWANCE 1 MM) / SCH 80 (WHEN TANK ROOF CORROSION ALLOWANCE 3 MM) WITH CS METALLURGY AND SHALL BE IN TANK / EQUIPMENT VENDOR SCOPE ALONG WITH DATUM PLATE OF CS METALLURGY ON STILL WELL BOTTOM.

9 8" TANK NOZZLE SHALL BE OF CS METALLURGY AND STILLWELL SIZE SHALL BE 6" OR 4" SCH. 40S WITH SS METALLURGY SHALL BE IN TANK VENDOR SCOPE ALONG WITH DEFLECTOR PLATE OF SS METALLURGY INCLINED AT 45 DEG FROM HORIZONTAL ON STILL WELL BOTTOM. LONG STUD & NUT SHALL BE IN THE RADAR VENDOR SCOPE.

10 WHERE ATMOSPHERIC TANK METALLURGY IS OTHER THEN CS, THEN NOZZLE, STILL WELL AND DATUM PLATE (AS APPLICABLE) SHALL BE PROVIDED WITH METALLURGY AS PER TANK MOC

11 4" FLANGED CONNECTION FOR GLASS FLAKE REINFORCED LINED EQUIPMENTS

AS PER PIPING SPECIFICATION/PROJECT PHILOSOPHY.

GENERAL NOTE: IN CASE OF LICENSOR SPECIFIC SIZE REQUIREMENT, THE SAME SHALL BE FOLLOWED

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INSTRUMENT CONNECTION ON PIPES

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	26.12.24	RE-AFFIRMED AND REISSUED	MN/RS	AJS	MN	MN
5	10.10.19	REVISED AND REISSUED	MN	AJS	RG	RKT
4	27.01.15	REVISED AND REISSUED	MN	RKG	RG	SC
3	11.02.13	REVISED AND REISSUED	MN	RG	RP/JMS	DM
2	13.04.07	REVISED AND REISSUED	MN	TGM	HCJ	VC

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(A) BARE PIPES

S. NO	TYPE OF INSTRUMENTS		WHERE PIPING CLASS RECOMMENDS SCRD CONNECTION			WHERE PIPING CLASS RECOMMENDS SW/BW # CONNECTION			WHERE PIPING CLASS RECOMMENDS FLGD CONNECTION		
			PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION
1	FLOW METER ORIFICE	≤ 600#	½" SCRD*	½" SCRD*	½" SCRD	½" SCRD*	½" SW	½" SCRD	½" SCRD*	½" FLGD	½" SCRD
		> 600#	-	-	-	¾" SCRD**	¾" BW	½" SCRD	¾" SCRD**	¾" FLGD	½" SCRD
2	FLOWMETER VENTURI/NOZZLE	≤ 600#	½" FLGD	½" FLGD	½" SCRD	½" FLGD	½" FLGD	½" SCRD	½" FLGD	½" FLGD	½" SCRD
		> 600#	-	-	-	¾" FLGD	¾" FLGD	½" SCRD	¾" FLGD	¾" FLGD	½" SCRD
3	FLOW METER ORIFICE (DIAPH.SEAL)	≤ 600#	½" SCRD*	½" SCRD*	3"FLGD	½" SCRD*	½" SW	3" FLGD	½" SCRD*	½" FLGD	3"FLGD
		> 600#	-	-	-	¾" SCRD**	¾" BW	3" FLGD	¾" SCRD**	¾" FLGD	3"FLGD
4	FLOW METER VENTURI/NOZZLE (DIAPH.SEAL)	≤ 600#	½" FLGD	½" FLGD	3" FLGD	½" FLGD	½" FLGD	3" FLGD	½" FLGD	½" FLGD	3"FLGD
		> 600#	-	-	-	¾" FLGD	¾" FLGD	3" FLGD	¾" FLGD	¾" FLGD	3"FLGD
5	FLOW METER AVERAGING PITOT TUBE		3" FLGD	3" FLGD (BY INST)	3" FLGD+	3" FLGD	3" FLGD (BY INST)	3" FLGD	3" FLGD	3" FLGD (BY INST)	3" FLGD+
6	DIFFERENTIAL PRESSURE (DP) INSTRUMENTS <5>		¾" SCRD*	¾" SCRD*	½" SCRD.	¾" SW/BW#	¾" SW/BW#	½" SCRD	¾" FLGD	¾" FLGD	½" SCRD
7	DIAPHGRAM SEAL D.P. INSTRUMENTS <5>		3" FLGD.	3" FLGD.	3" FLGD.	3" FLGD.	3" FLGD.	3" FLGD	3" FLGD.	3" FLGD.	3" FLGD.
8	PRESSURE INSTRUMENTS <5>		¾" SCRD*	¾" SCRD*	½" SCRD.	¾" SW/BW#	¾" SW/BW#	½" SCRD	¾" FLGD	¾" FLGD	½" SCRD
9	DIAPHGRAM SEAL PRESSURE INSTRUMENTS (FLGD.)		1 ½" FLGD.	1 ½" FLGD.	1 ½" FLGD.	1 ½" FLGD.	1 ½" FLGD.	1 ½" FLGD.	1 ½" FLGD.	1 ½" FLGD.	1 ½" FLGD.
10	THERMOWELL	≤600#	1 ½" FLGD.	-	1 ½ " FLGD	1 ½" FLGD.	-	1 ½ " FLGD	1 ½" FLGD.	-	1 ½ " FLGD
		>600#	2" FLGD.	-	2" FLGD	2" FLGD.	-	2" FLGD	2" FLGD.	-	2" FLGD

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(B) CLADDED\CEMENTED\LINED PIPES

S. NO	TYPE OF INSTRUMENTS		WHERE PIPING CLASS SPECIFIES CLADDED PIPES			WHERE PIPING CLASS SPECIFIES CEMENT LINED PIPES			WHERE PIPING CLASS SPECIFIES RUBBER/TEFLON LINED PIPES		
			PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION	PROCESS CONNECTION	FIRST BLOCK VALVE	INSTRUMENTS CONNECTION
1	FLOW METER ORIFICE	≤ 600#	½" SCRD*	½" SCRD*	½" SCRD	½" SCRD*	½" SW/BW	½" SCRD	1" FLGD	1" FLGD	½" SCRD
		> 600#	¾" SCRD**	¾" SW/BW	½" SCRD	-	-	-	-	-	-
2	FLOW METER ORIFICE (DIA-PHGRAMSEAL)	≤ 600#	½" SCRD*	½" SCRD*	3" FLGD	½" SCRD*	½" SW/BW	3" FLGD	1" FLGD	1" FLGD	3" FLGD
		> 600#	¾" SCRD**	¾" SCRD*	3" FLGD	-	-	-	-	-	-
3	FLOW METER ++ AVERAGING PITOT TUBE		3" FLGD	3" FLGD (BY INST)	3" FLGD+	3" FLGD	3" FLGD (BY INST)	3" FLGD+	3" FLGD	3" FLGD (BY INST)	3" FLGD+
4	DP INSTRUMENTS <5>		¾"SW/BW#	¾"SW/BW#	½" SCRD.	3" FLGD	¾" FLGD	½" SCRD	1½" FLGD	1 ½" FLGD	½" SCRD
5	DIAPHGRAM SEAL D.P. INSTRUMENTS <5>		3" FLGD.	3" FLGD.	3" FLGD	3" FLGD	3"FLGD	3" FLGD	3" FLGD.	3" FLGD.	3" FLGD.
6	PRESSURE INSTRUMENTS <5>		¾"SW/BW#	¾"SW/BW#	½" SCRD.	3" FLGD	¾"SW/BW	½" SCRD	1" FLGD	1" FLGD	½" SCRD
7	DIAPHGRAM SEAL PRESSURE INSTRUMENTS (FLGD) <5>		1 ½" FLGD.	1 ½" FLGD.	1 ½" FLGD.	3" FLGD	1 ½"FLGD	1 ½" FLGD	1 ½" FLGD	1 ½" FLGD	1 ½" FLGD
8	THERMOWELL		3" FLGD.	-	3 " FLGD	3" FLGD	-	3" FLGD	3" FLGD	-	3" FLGD

NOTES:
1. FOR ANY OTHER INSTRUMENTS NOT REFERRED ABOVE THE CONNECTION DETAILS SHALL BE AS PER INDIVIDUAL REQUIREMENT.
2. ALL FLANGES/SW RATING SHALL BE AS PER PIPING SPECIFICATION.
3. IN CASE OF DIRECT MOUNTED FLANGED INSTRUMENTS AND WHERE FLANGED FIRST ISOLATION VALVE ARE PROVIDED, STUD/BOLTS & NUTS AND GASKETS SHALL BE IN PIPING SCOPE.
4. INSTALLATION OF ALL IN LINE INSTRUMENTS SHALL BE IN PIPING SCOPE.
5. PRESSURE INSTRUMENTS INCLUDE PRESSURE TRANSMITTERS AND PRESSURE GAUGES.

* SEAL WELDING REQUIRED.
\# AS PER PIPING SPECIFICATION.
** STRENGTH WELD
\+ CONNECTIONS FOR D.P. INSTRUMENT ½" SCRD
++ WELDOLET, FLANGE, BOTTOM SUPPORT SHALL BE SUPPLIED BY INSTRUMENT VENDOR. HOWEVER ERECTION BY MECHANICAL CONTRACTOR.

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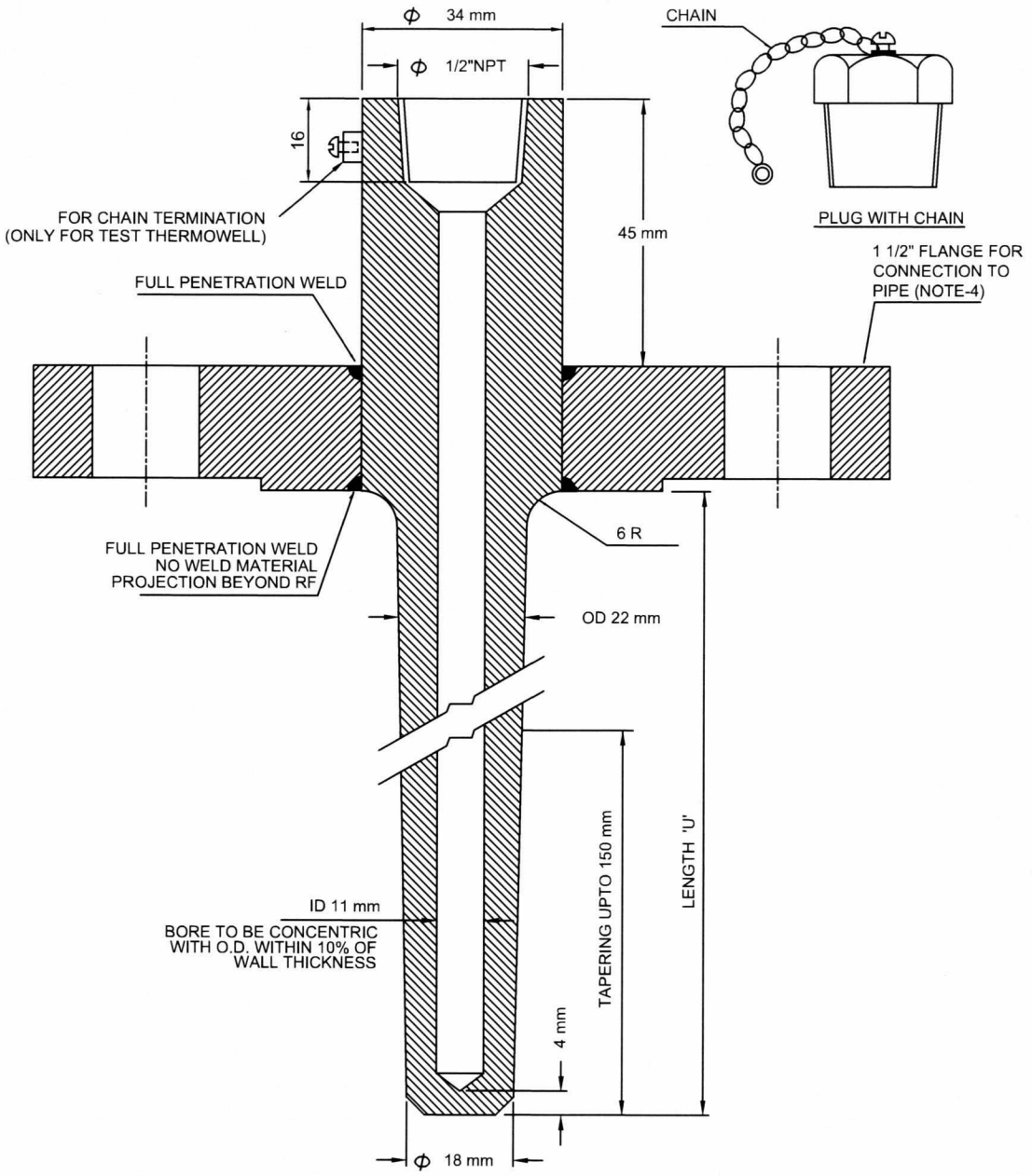

NOTES -

1. THIS STANDARD IS APPLICABLE FOR ;
   a) TEMPERATURE GAUGES, BEADED TEMPERATURE ELEMENTS AND DUPLEX TEMPERATURE ELEMENTS.
   b) THERMOWELL UPTO 1500 CLASS AS PER ASME OR EQUIVALENT WITH RF AS PER SPECIFICATIONS/PMS.
2. DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS. OTHER TESTING REQUIREMENT AS PER PMS.
3. CHAIN AND PLUG SHALL BE APPLICABLE ONLY FOR TEST THERMOWELLS.
4. FLANGE SIZE SHALL BE 2" FOR RATING (AS PER ASME CLASS) >600 OR THERMOWELL CONNECTION ON UNCLADDED EQUIPMENT. FOR CLADDED EQUIPMENT FLANGE SIZE SHALL BE 3"

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	14-11-23	REVISED & REISSUED	Kushal/RSC	AJS	MN	MN
4	25-04-18	REAFFIRMED & REISSUED	Manoj	MN	RG	RN

Approved by

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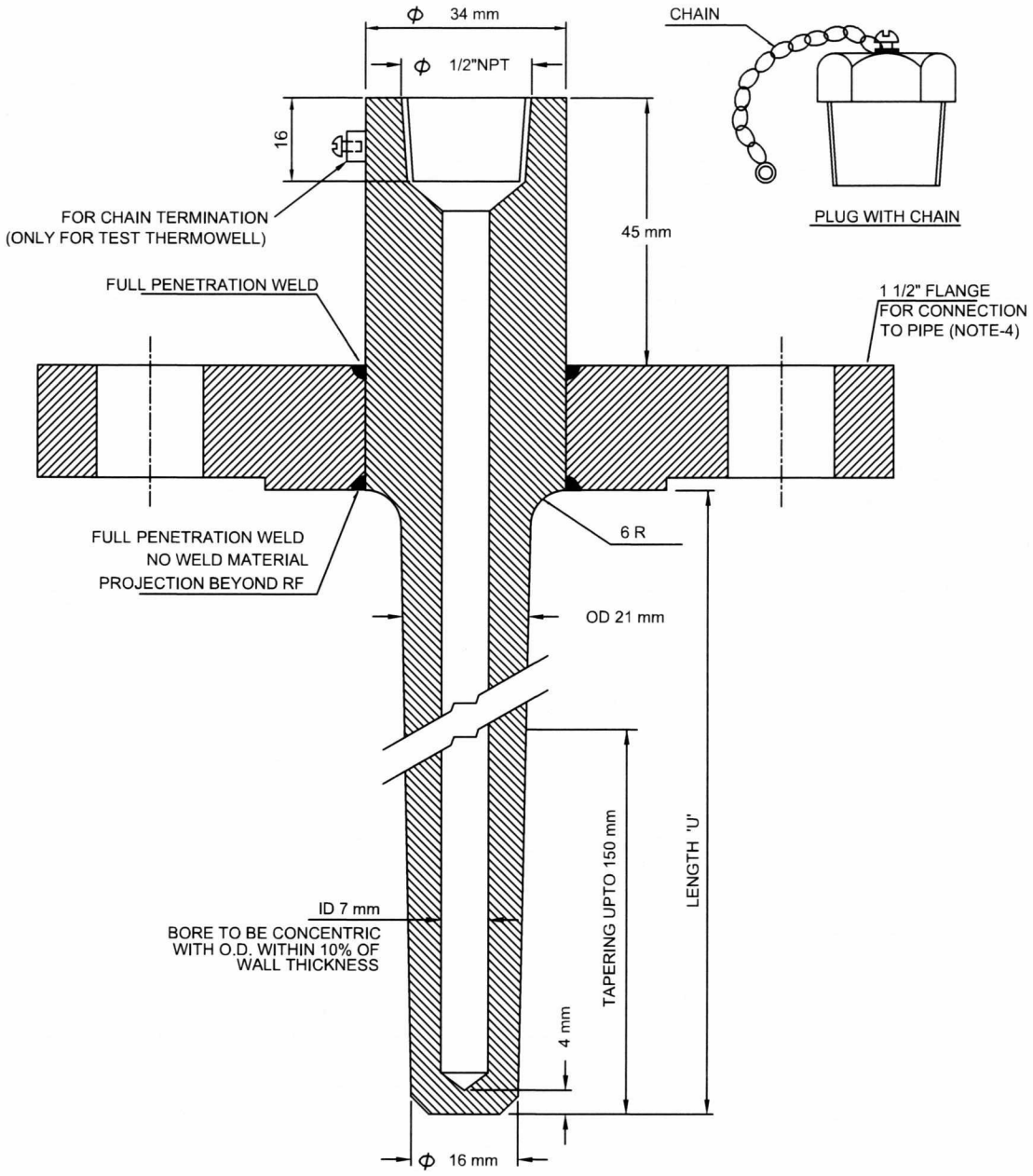

NOTES -

1. THIS STANDARD IS APPLICABLE FOR ;
   a) SINGLE TEMPERATURE ELEMENT.
   b) THERMOWELL UPTO 1500 CLASS AS PER ASME OR EQUIVALENT WTIH RF AS PER SPECIFICATIONS/PMS.
2. DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS. OTHER TESTING REQUIREMENT AS PER PMS.
3. CHAIN AND PLUG SHALL BE APPLICABLE ONLY FOR TEST THERMOWELLS.
4. FLANGE SIZE SHALL BE 2" FOR RATING (AS PER ASME CLASS) >600 OR THERMOWELL CONNECTION ON UNCLADDED EQUIPMENT. FOR CLADDED EQUIPMENT FLANGE SIZE SHALL BE 3"

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	14-11-23	REVISED & REISSUED	Kushal/RSC	AJS	MN	MN
4	25-04-18	REAFFIRMED & REISSUED	Manoj	MN	RG	RN

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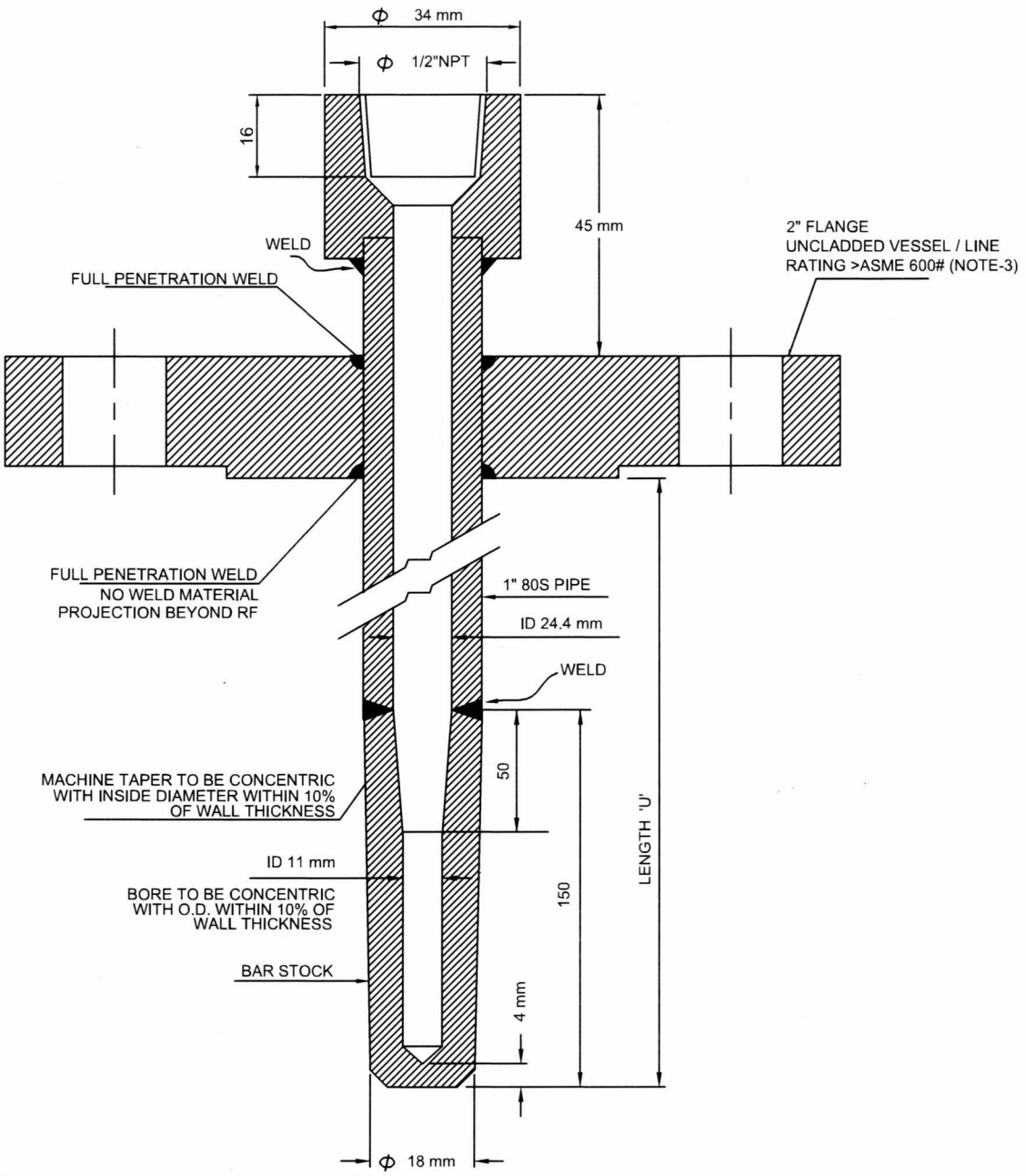
BUILT-UP THERMOWELL



NOTES:-

1. THIS STANDARD IS APPLICABLE FOR ;
   a) TEMPERATURE GAUGES, BEADED TEMPERATURE ELEMENTS AND DUPLEX TEMPERATURE ELEMENTS.
   b) THERMOWELL UPTO 1500 CLASS AS PER ASME OR EQUIVALENT WITH RF AS PER SPECIFICATIONS/PMS.
2. DP TEST SHALL BE CARRIED OUT FOR ALL WELD JOINTS. OTHER TESTING REQUIREMENT AS PER PMS.
3. FLANGE SIZE SHALL BE 3" FOR CLADDED EQUIPMENT, FLANGE SIZE SHALL BE 1.5" FOR LINE UP TO ASME CLASS 600#.

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by: Stds. Committee Convenor	Approved by: Stds. Bureau Chairman
5	14-11-23	REVISED & REISSUED	Kushal/RSC	AJS	MN	MN
4	25-04-18	REAFFIRMED & REISSUED	Manoj	MN	RG	RN

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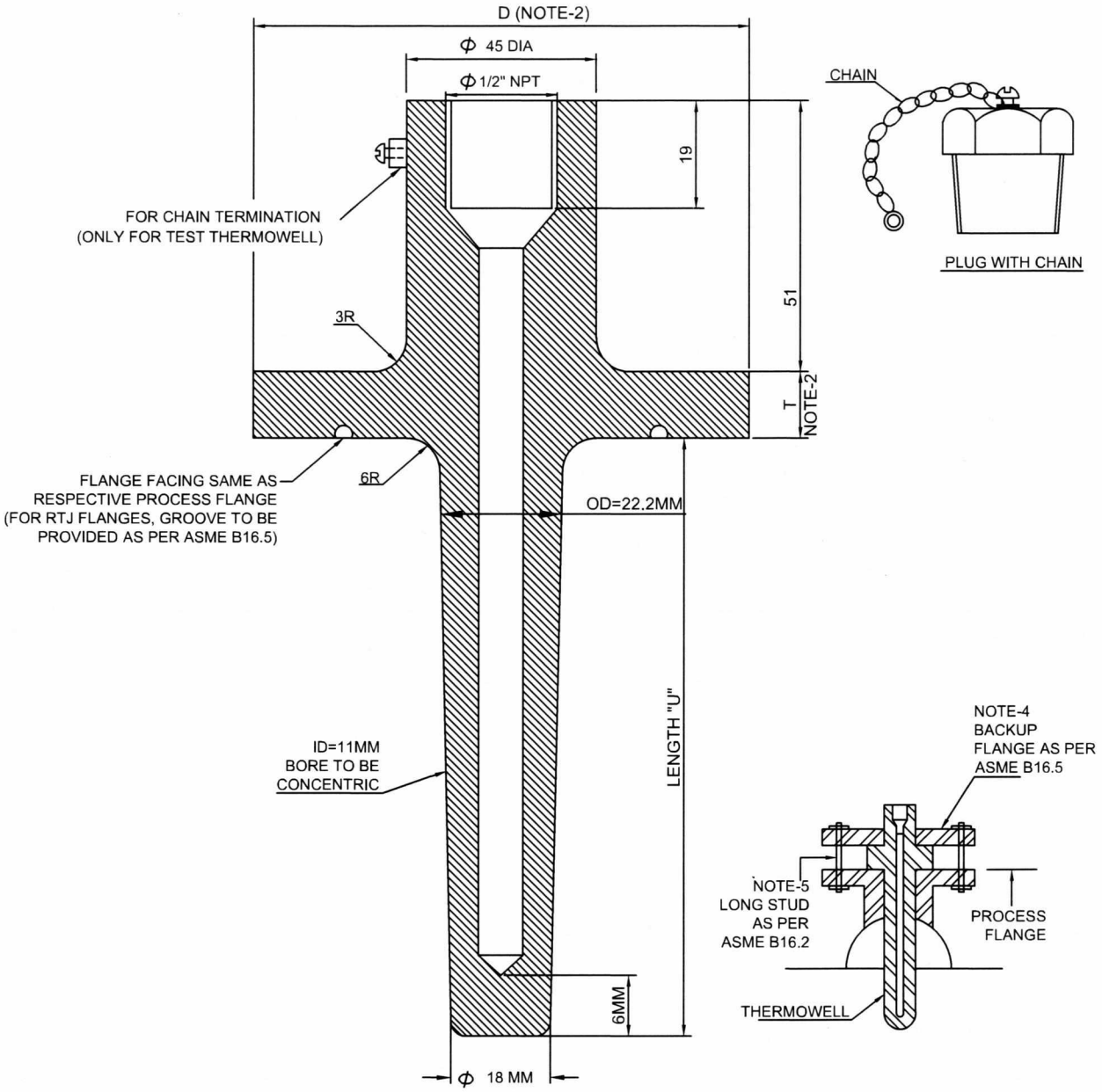
VANSTONE THERMOWELL BARSTOCK TAPERED



NOTES -

1. ALL DIMENSIONS ARE IN "MM". FIGURES IN BRACKETS ARE IN INCHES.
2. THE COLLAR SHOULD BE EQUAL TO RF DIA "R" FOR RF FACING WELD AND COLLAR DIA SHOULD BE DIA "K" AS PER ASME B16.5. THE COLLAR THICKNESS SHOULD BE 15MM FOR RF FACING UP TO 1500# AND 20MM FOR RF UPTO 2500# FLANGE END FOR ALL RATING OF RTJ FLANGE
3. THERMOWELLS SHALL BE HYDROSTATICALLY TESTED INTERNALLY FOR RESPECTIVE PRESSURE RATING.
4. VENDOR SHALL SUPPLY ASME BACK-UP FLANGE WITH A HOLE OF I.D. TO SUIT 45MM O.D. OF THERMOWELL WITH EACH THERMOWELL. THIS BACK UP FLANGE IS TO BE MOUNTED ON THE THERMOWELL ON THE OTHER SIDE OF PROCESS FLANGE. THE BACKUP FLANGE MATERIAL SHALL BE AS PER DATA SHEET.
5. SPECIAL LONG STUDS WITH NUTS TO FIX THE THERMOWELL WITH PROCESS FLANGE AND BACK-UP FLANGES SHALL BE SUPPLIED ALONG WITH EACH TAG.
6. FLANGE SIZE & RATING AS PER DATA SHEET.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	14-11-23	ISSUED AS STANDARD	Kushal/RSC	AJS	MN	MN

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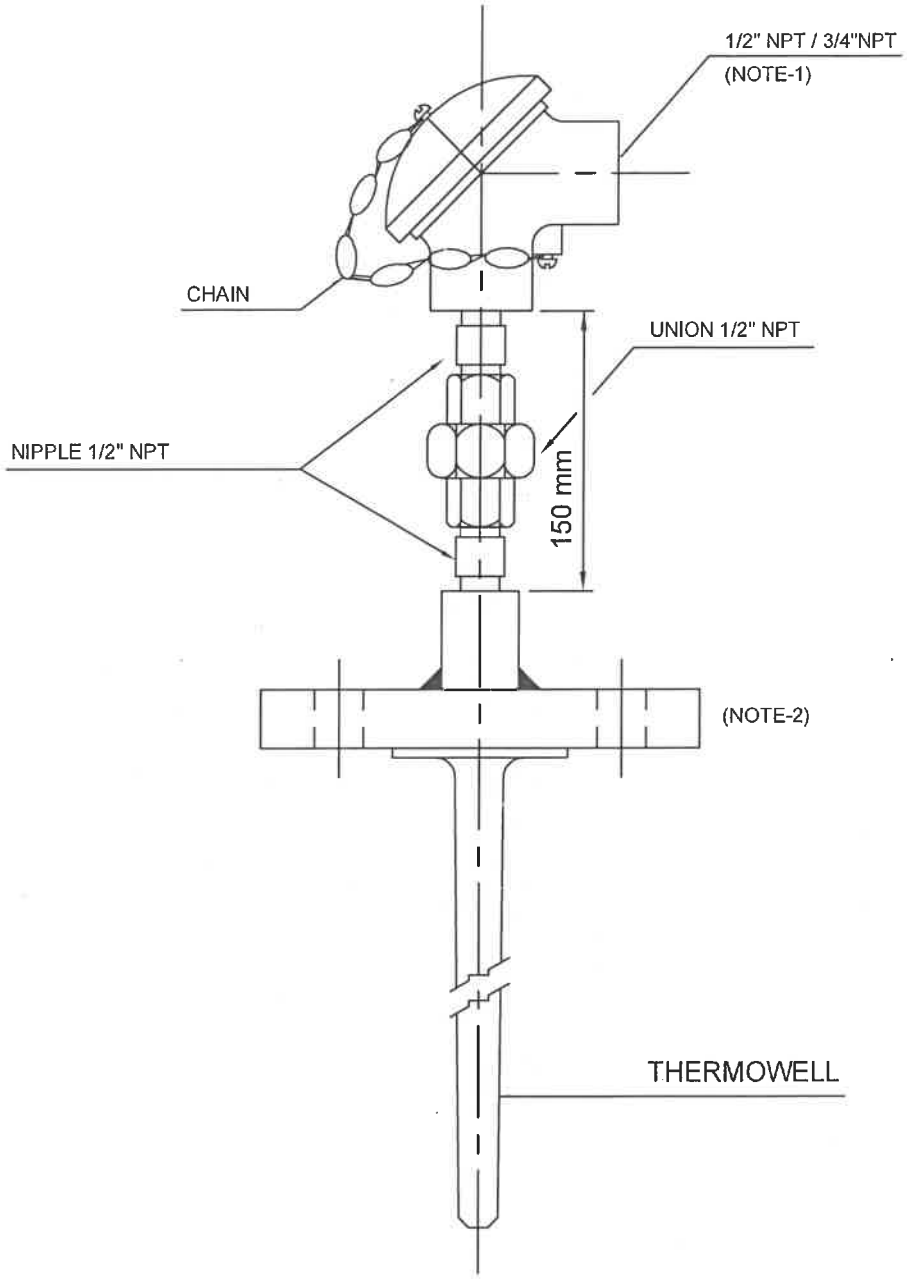

NOTE -
1. IN THE CASE OF DUPLEX THERMOCOUPLE/RTD, TWO INDEPENDENT 3/4"(NPT) CABLE ENTRIES SHALL BE PROVIDED.
2. FLANGE TYPE, SIZE AND RATING SHALL BE AS PER DATA SHEET.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	21.10.24	Reaffirmed & Reissued As Standard	Sonu	AJS	MN	MN
5	10.10.19	Reaffirmed & Reissued As Standard	Manoj	MN	RG	RN

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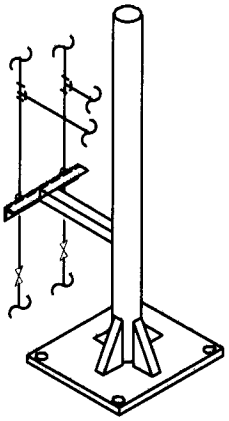
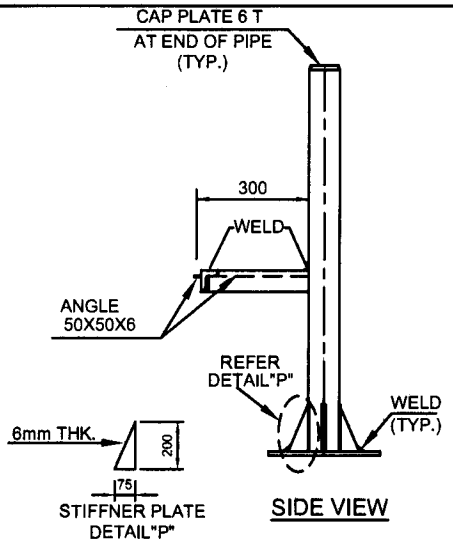
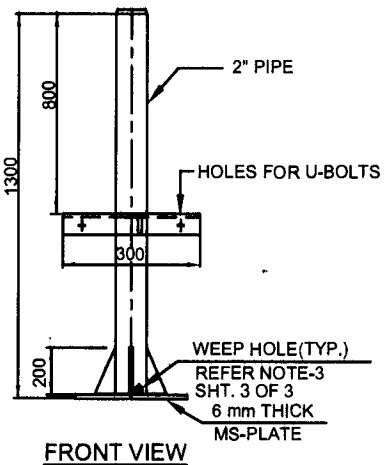
TYPE 11 — SINGLE INSTRUMENT SUPPORT - GENERAL ARRANGEMENT



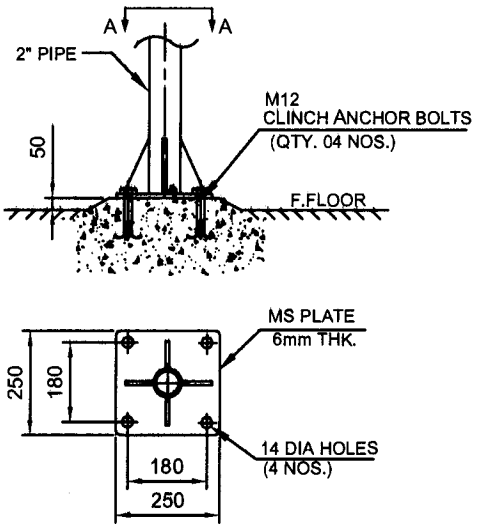


SIDE VIEW



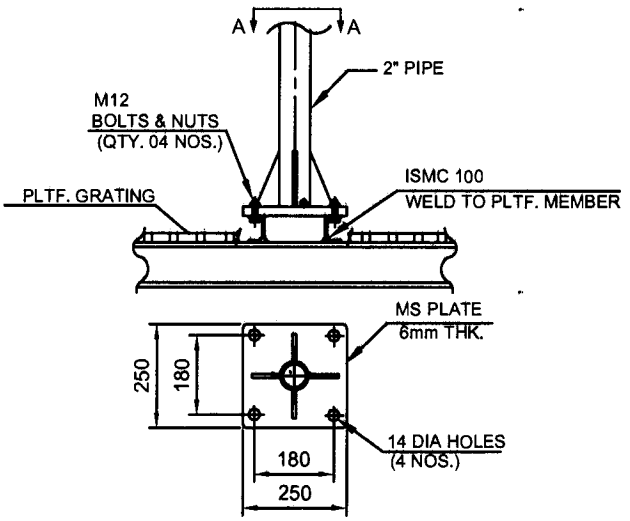
FRONT VIEW

TYPE 11-1



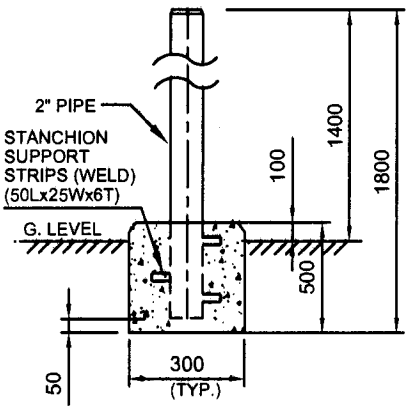
VIEW A-A
PAVED AREA MOUNTING

TYPE 11-2



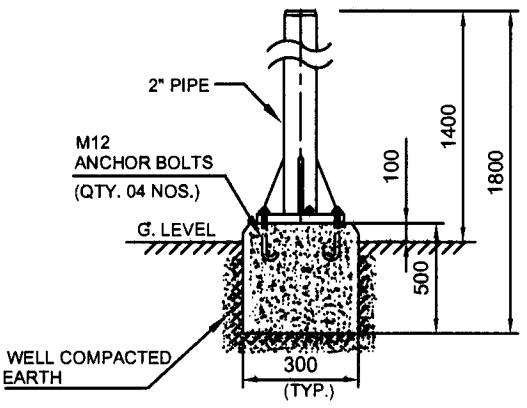
VIEW A-A
PLATFORM MOUNTING

TYPE 11-3



UNPAVED AREA MOUNTING
(WITH INTEGRAL CONC. BLOCK)

TYPE 11-4



UNPAVED AREA MOUNTING
(WITH SEPARATE CONC. BLOCK)

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	22.03.22	Revised & Reissued	SM / Manoj	AS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

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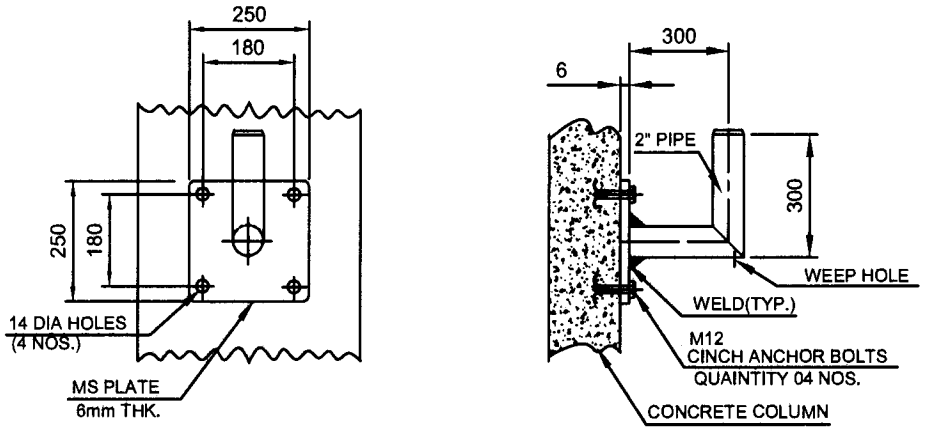
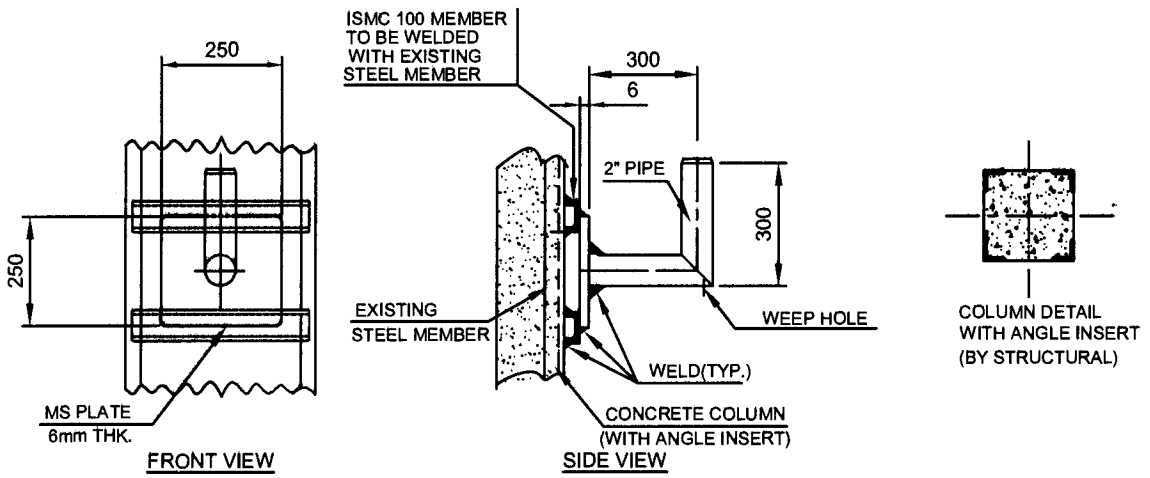
TYPE 12 CONCRETE COLUMN MOUNTING



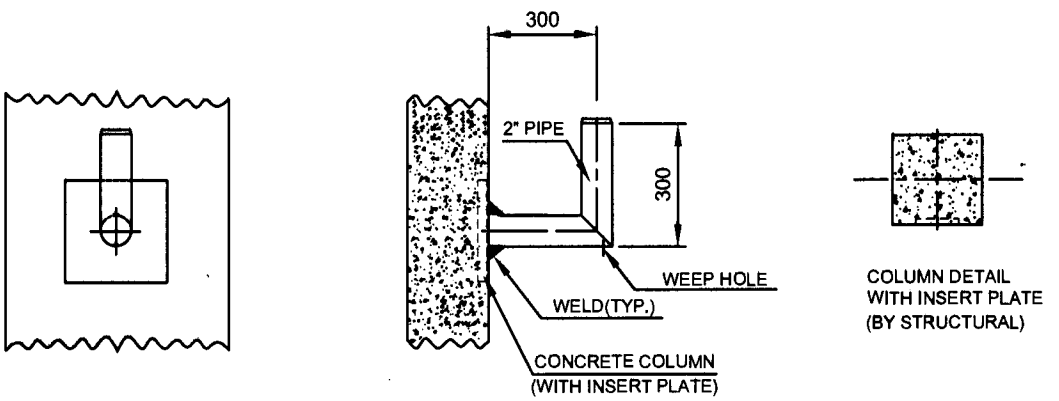
FRONT VIEW SIDE VIEW

TYPE 13 CONCRETE COLUMN (WITH ANGLE INSERT) MOUNTING



FRONT VIEW SIDE VIEW

TYPE-14 CONCRETE COLUMN (WITH INSERT PLATE) MOUNTING



FRONT VIEW SIDE VIEW

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	22.03.22	Revised & Reissued	SM / Manoj	AS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

Approved by

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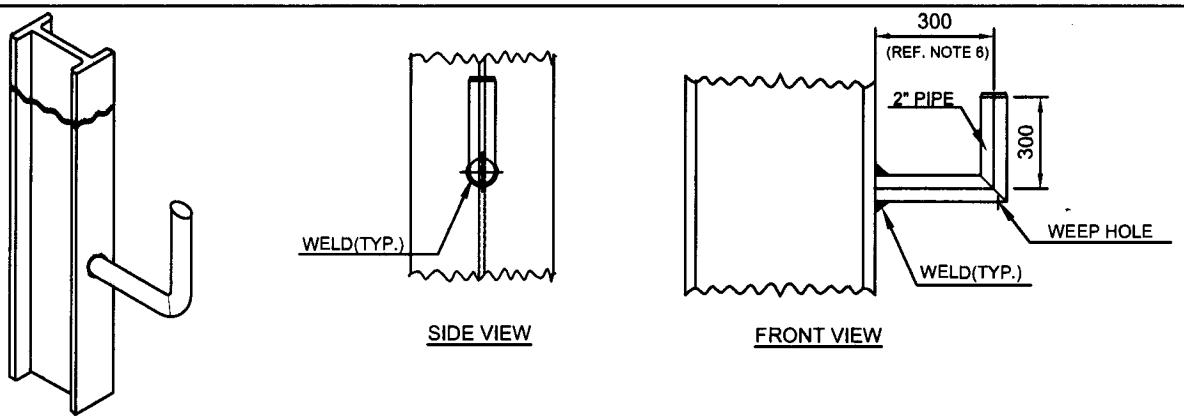
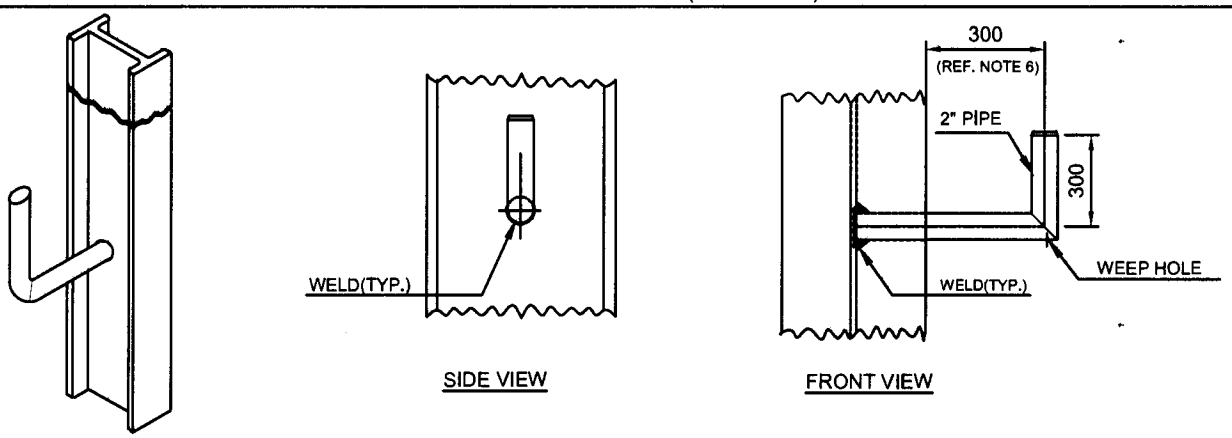
TYPE 15 STEEL COLUMN MOUNTING (FLANGE FACE)

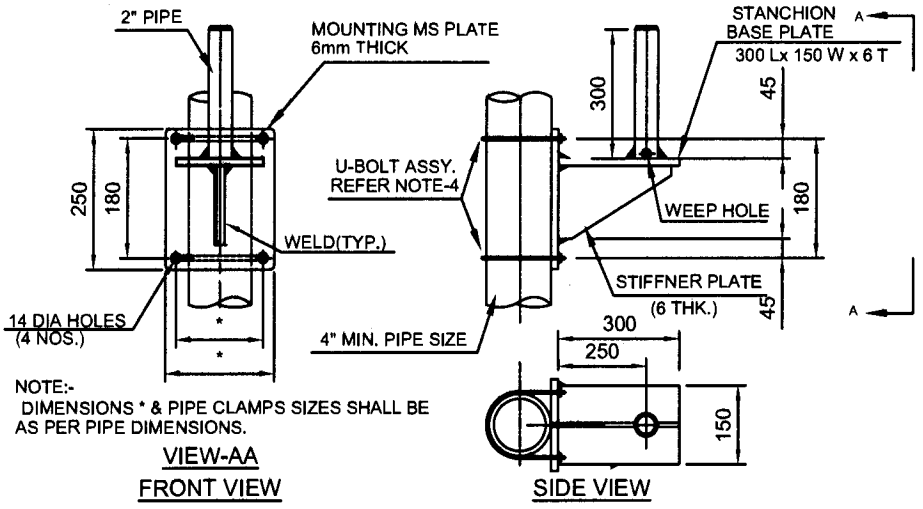


TYPE 16 STEEL COLUMN MOUNTING (WEB FACE)

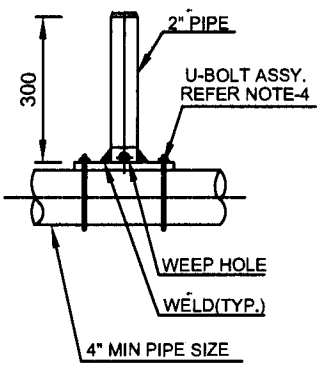


TYPE 17 PIPE BRACKET MOUNTING

TYPE 17.1 (VERTICAL PIPE)



TYPE 17.2 (HORIZONTAL PIPE)



(HORIZONTAL PIPE)

NOTES:-

1. ALL DIMENSIONS ARE IN M.M. UNLESS OTHERWISE SPECIFIED.
2. PIPE MATERIAL SHALL BE IS:1239 HEAVY GRADE AS A MINIMUM.
3. 6 mm DIA WEEP HOLE SHALL BE PROVIDED AT LOW POINT.
4. U-BOLT ASSEMBLY SHALL BE OF MINIMUM M12 SIZE WITH NUTS AND SPRING WASHERS.
5. ALL WELD SHALL BE 3mm FILLET WELD FULL STRENGTH.
6. ADD 50mm WHERE-EVER FIRE INSULATION IS PROVIDED.
7. BOLT SHALL BE TURNED FROM M.S. ROUNDS CONFIRMING TO IS : 432 GRADE 1.
8. NUTS AND WASHERS SHALL CONFIRM TO IS : 1363 AND IS : 3138.
9. GALVANISED PLATES SHAL BE CONSIDERED FOR MOUNTING OF INSTRUMENT SUPPORT ON PIPES.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	22.03.22	Revised & Reissued	SM / Manoj	AS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

Approved by

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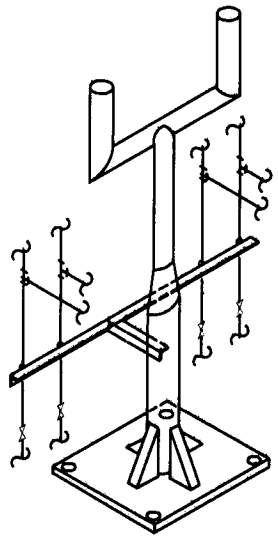
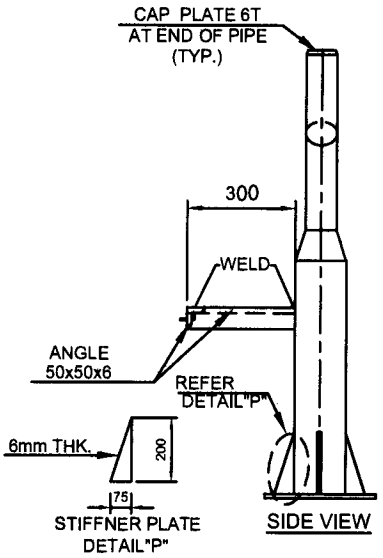
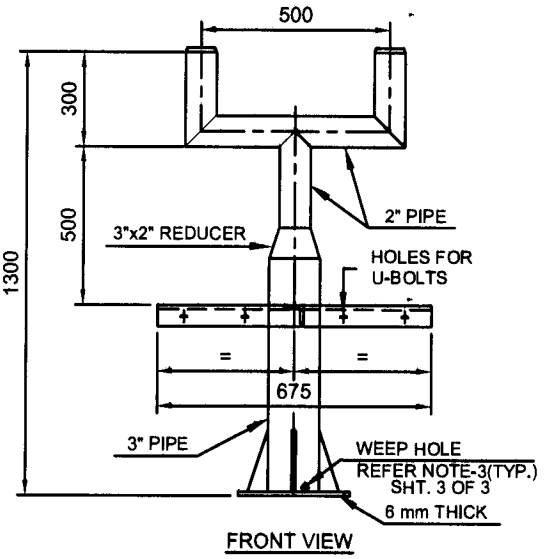
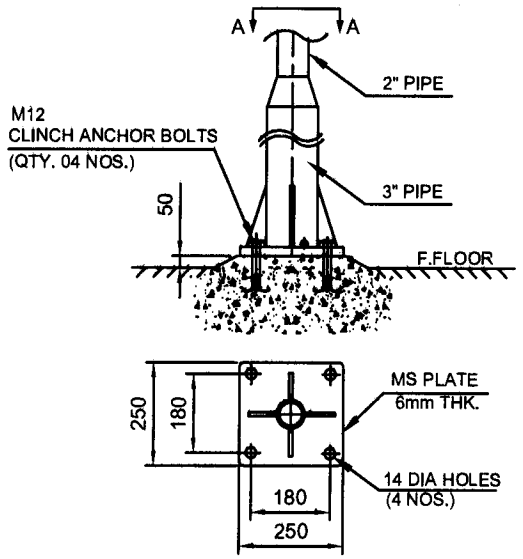
TYPE 21 TWO INSTRUMENTS SUPPORT - GENERAL ARRANGEMENT





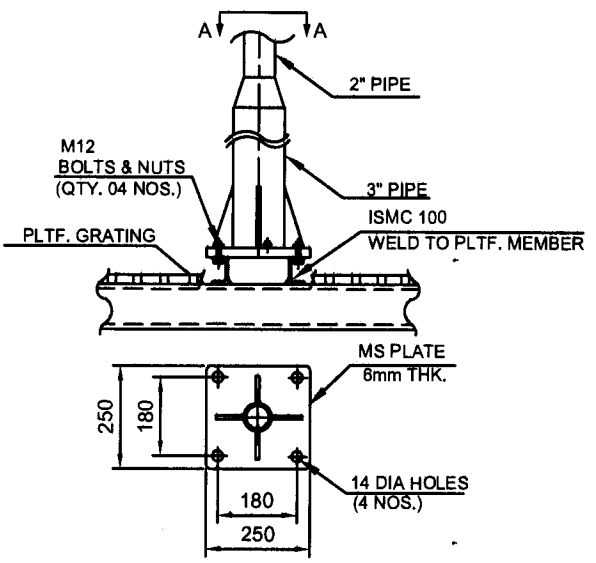


TYPE 21-1



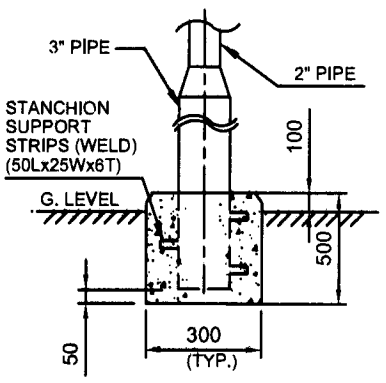
PAVED AREA MOUNTING

TYPE 21-2



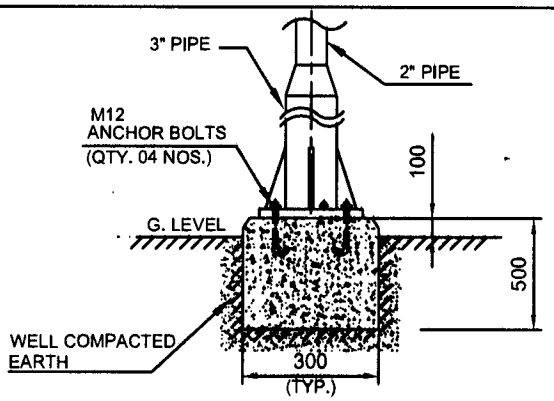
PLATFORM MOUNTING

TYPE 21-3



UNPAVED AREA MOUNTING
(WITH INTEGRAL CONC. BLOCK)

TYPE 21-4



UNPAVED AREA MOUNTING
(WITH SEPARATE CONC. BLOCK)

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	29.03.22	Reaffirmed & Reissued	SM / Manoj	AS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

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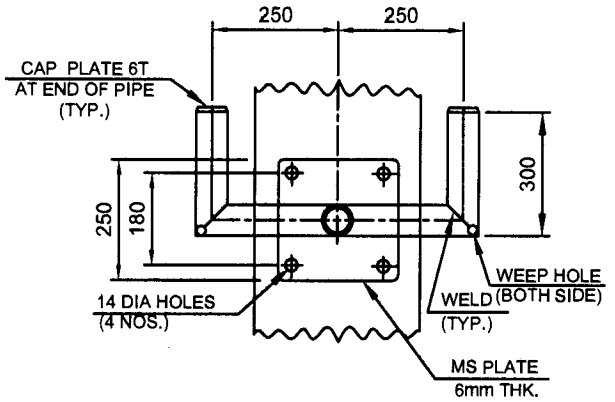
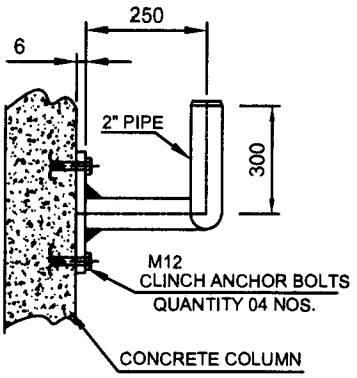
TYPE 22 CONCRETE COLUMN MOUNTING

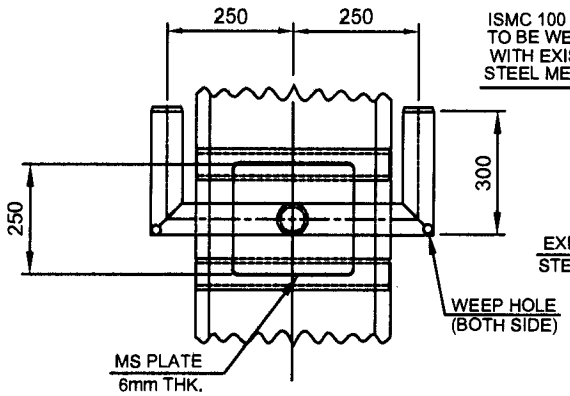


FRONT VIEW

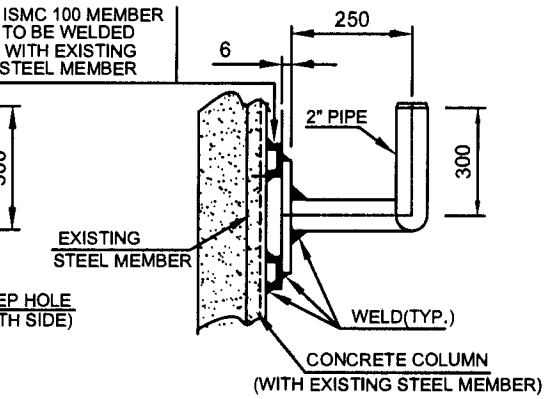


SIDE VIEW

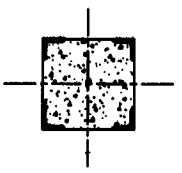
TYPE 23 CONCRETE COLUMN (WITH ANGLE INSERT) MOUNTING



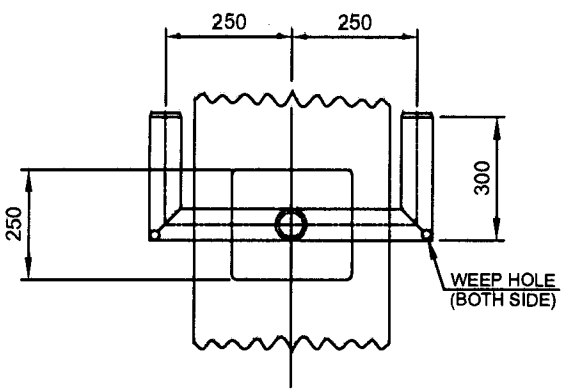
FRONT VIEW



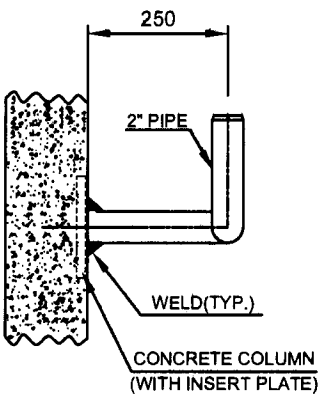
SIDE VIEW



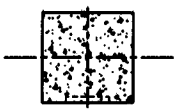
TYPE 24 CONCRETE COLUMN (WITH INSERT PLATE) MOUNTING



FRONT VIEW



SIDE VIEW



Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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4	29.03.22	Reaffirmed & Reissued	SM / Manoj	AS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

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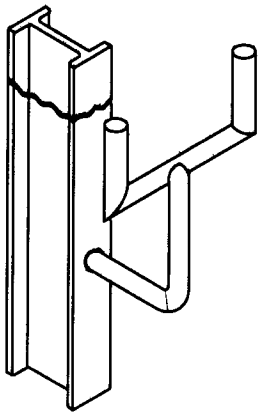
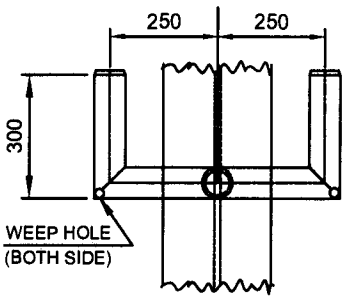
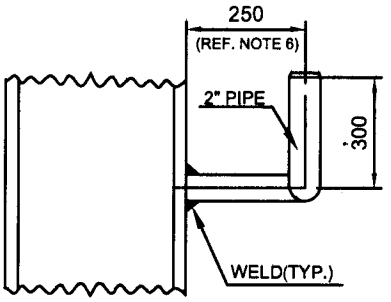
TYPE 25 STEEL COLUMN MOUNTING (FLANGE FACE)



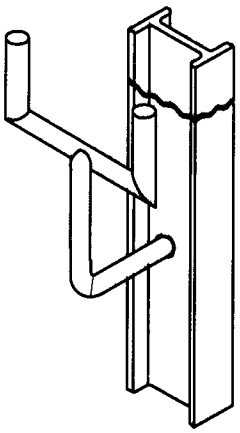


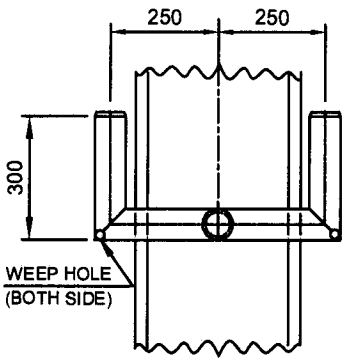
FRONT VIEW



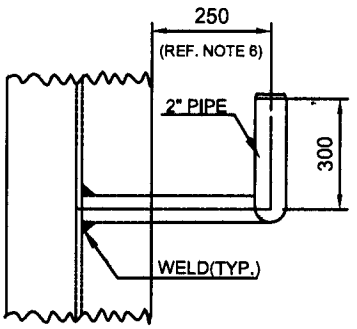
SIDE VIEW

TYPE 26 STEEL COLUMN MOUNTING (WEB FACE)





FRONT VIEW



SIDE VIEW

NOTES:-

1. ALL DIMENSIONS ARE IN M.M. UNLESS OTHERWISE SPECIFIED.
2. PIPE MATERIAL SHALL BE IS:1239 HEAVY GRADE AS A MINIMUM.
3. 6 mm DIA WEEP HOLE SHALL BE PROVIDED AT LOW POINT.
4. U-BOLT ASSEMBLY SHALL BE OF MINIMUM M12 SIZE WITH NUTS AND SPRING WASHERS.
5. ALL WELD SHALL BE 3mm FILLET WELD FULL STRENGTH.
6. ADD 50mm WHERE-EVER FIRE INSULATION IS PROVIDED.
7. BOLT SHALL BE TURNED FROM M.S. ROUNDS CONFIRMING TO IS : 432 GRADE 1.
8. NUTS AND WASHERS SHALL CONFIRM TO IS : 1363 AND IS : 3138.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	29.03.22	Reaffirmed & Reissued	SM / Manoj	AS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

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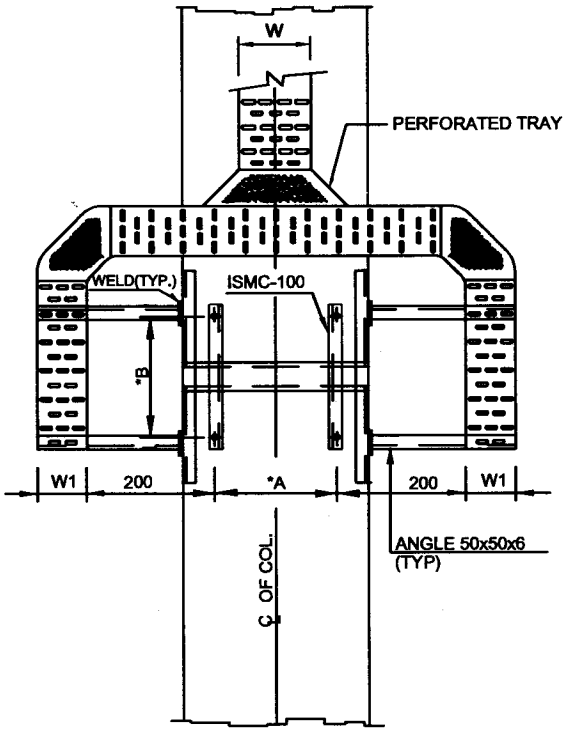
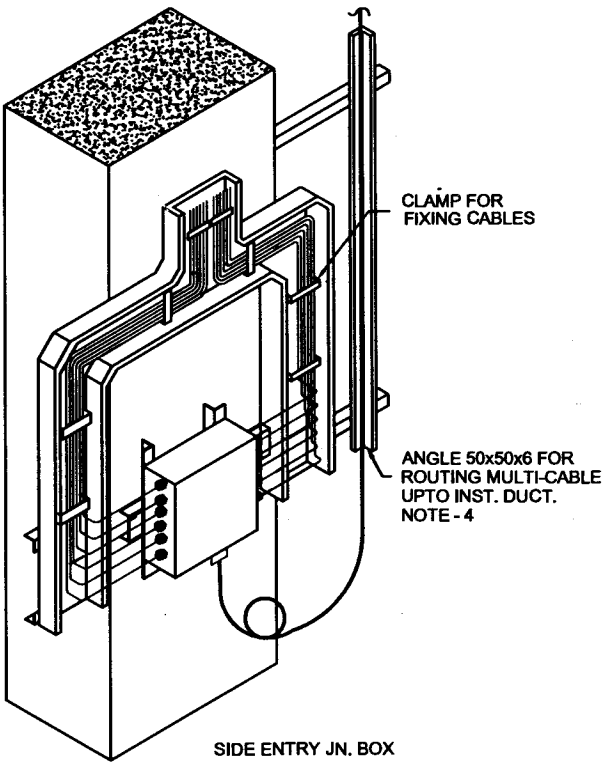
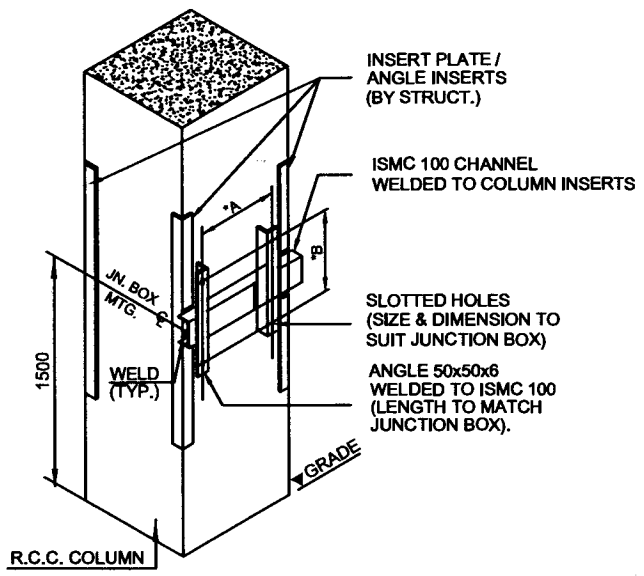
TRAY ARRANGEMENT FOR JUNCTION BOXES



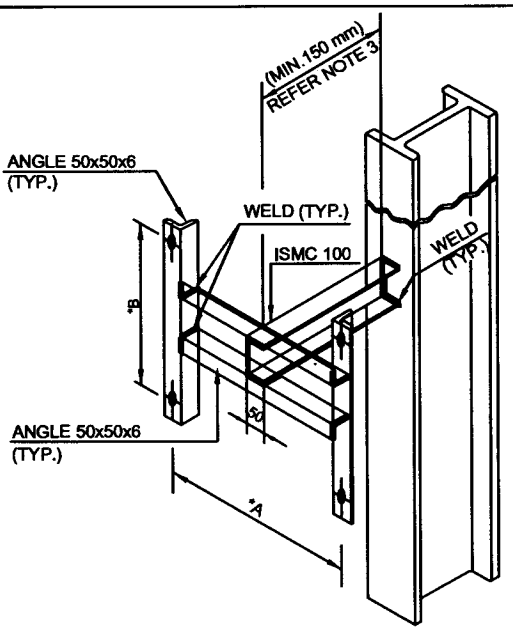
CABLE ROUTING FOR JUNCTION BOXES.



JN. BOX MOUNTING FRAME (R.C.C. COLUMN)



JN. BOX MOUNTING FRAME (STEEL COLUMN)



* DIMENSION 'A and B' TO SUIT JUNCTION BOX.

NOTE:
1. ALL DIMENSIONS ARE IN mm.
2. CLAMP MULTICABLE ON ANGLE WITH 25mm WIDE PVC COVERED ALLUMINIUM STRIP.
3. ADD 50 mm WHERE-EVER FIRE INSULATION IS PROVIDED.
4. COMMON TRAY FOR MULTIPLE MULTICABLE CAN BE USED FOR JBs LOCATED TOGETHER. TRAY HEIGHT SHALL BE MINIMUM 40 mm FOR RUNNING MULTIPAIR.

TRAY WIDTH

JN. BOX	W	W1
12 PAIR	300	150
8 TRIAD	300	150
6 PAIR	150	100

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					Approved by	
4	03.11.21	Revised & Reissued	Saurav	~~AJS~~	MN	SM
3	28.03.17	Revised & Reissued	Manoj	MN	RG	RN

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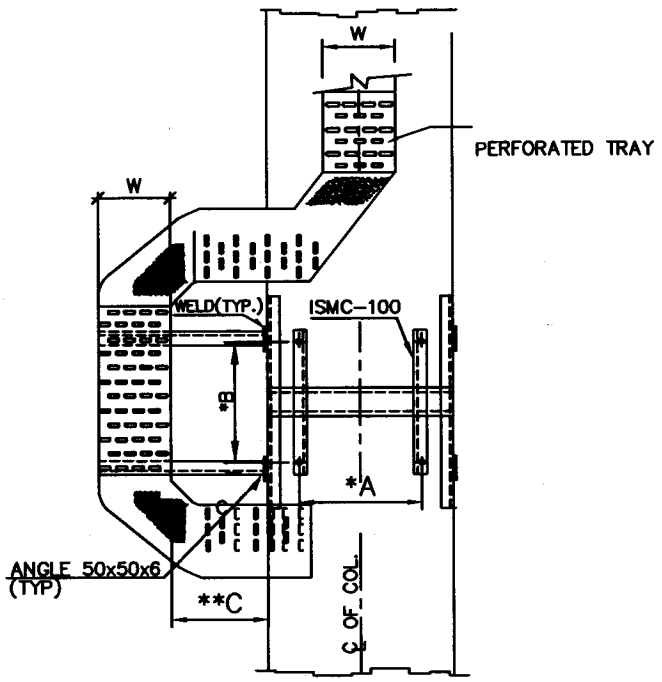
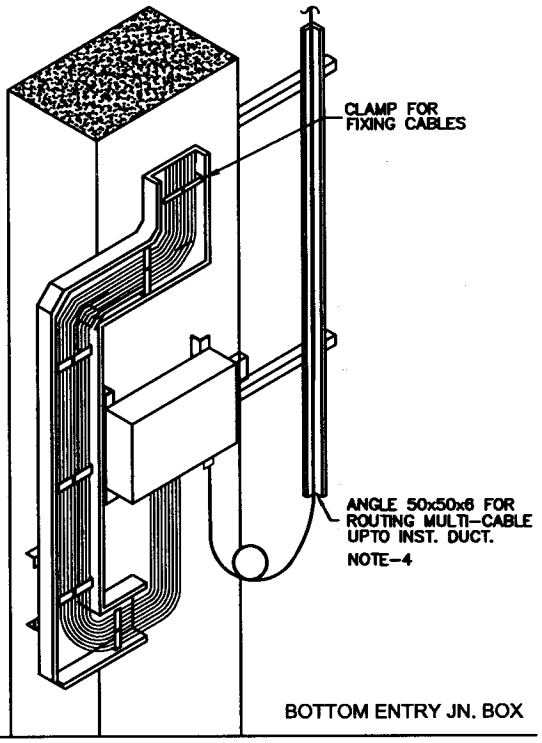
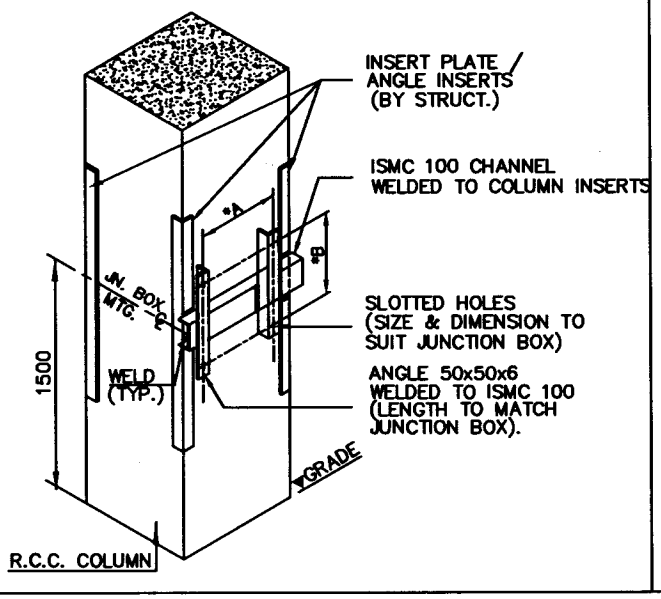
TRAY ARRANGEMENT FOR JUNCTION BOXES



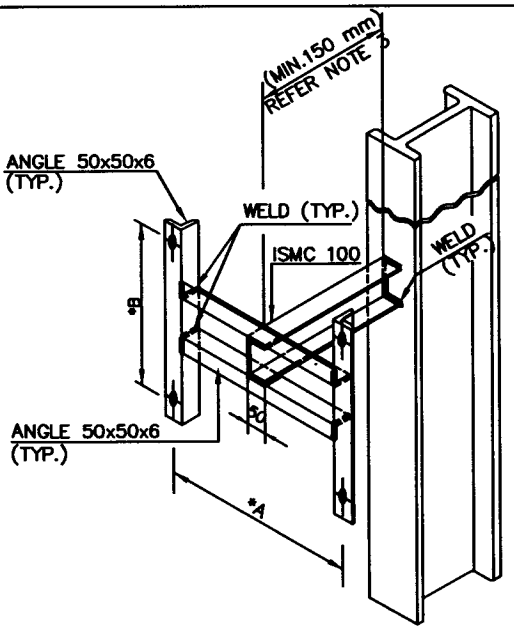
CABLE ROUTING FOR JUNCTION BOXES.



JN. BOX MOUNTING FRAME (R.C.C. COLUMN)



JN. BOX MOUNTING FRAME (STEEL COLUMN)



* DIMENSION 'A and B' TO SUIT JUNCTION BOX.

** DIMENSION 'C' SHALL BE 150 TYPICAL, MAY VARY TO SUIT THE REQUIREMENT.

TRAY WIDTH

JN. BOX	W
12 PAIR	300
8 TRIAD	300
6 PAIR	150

NOTE:
1. ALL DIMENSIONS ARE IN mm.
2. CLAMP MULTICABLE ON ANGLE WITH 25mm WIDE PVC COVERED ALLUMINIUM STRIP.
3. ADD 50 mm WHERE-EVER FIRE INSULATION IS PROVIDED.
4. COMMON TRAY FOR MULTIPLE MULTICABLE CAN BE USED FOR JBs LOCATED TOGETHER. TRAY HEIGHT SHALL BE MINIMUM 40mm FOR RUNNING MULTIPAIR.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	03.11.21	Revised & Reissued	Saurav	AJS	MN	SM
3	28.03.17	Revised & Reissued	Manoj	MN	RG	RN

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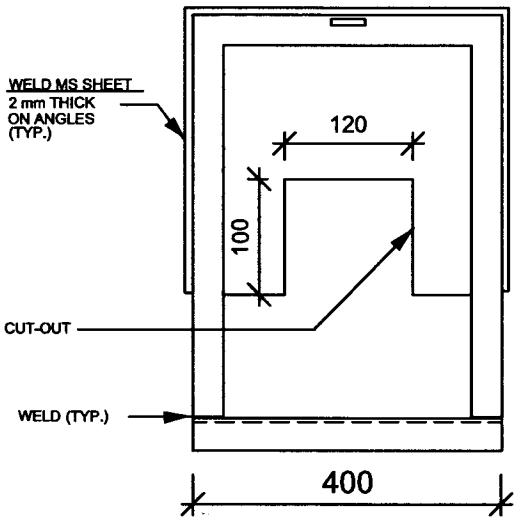
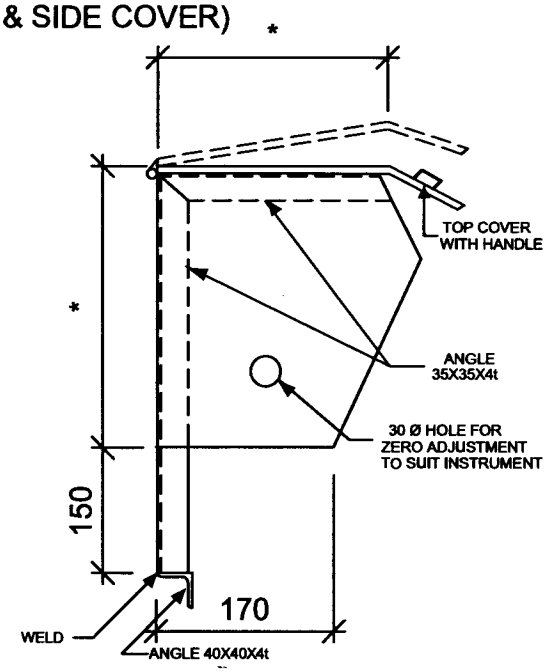
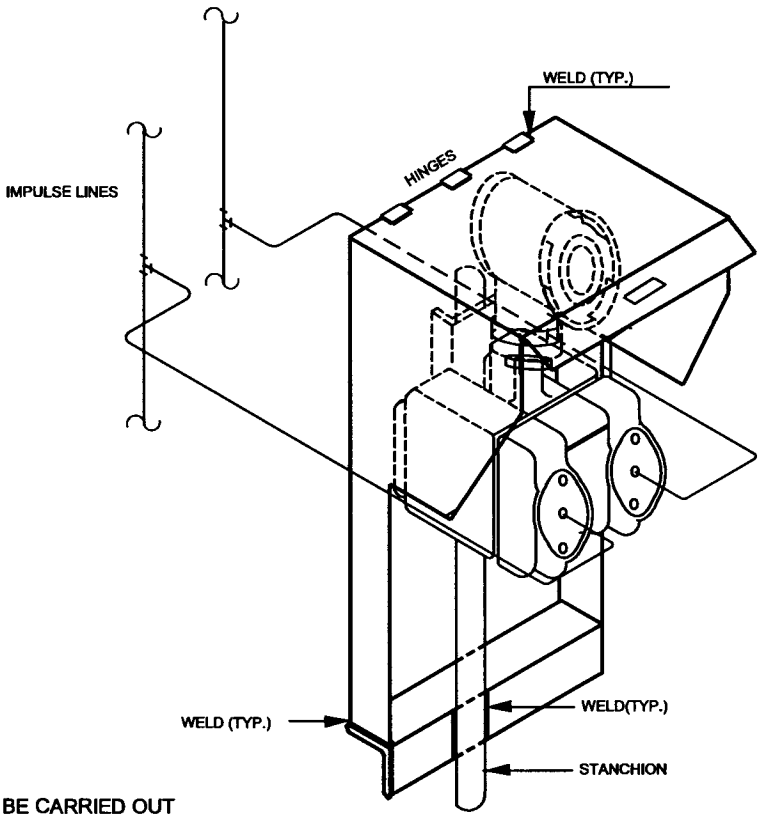
TYPE : MS PAINTED (TOP & SIDE COVER)



TOP VIEW



SIDE VIEW



FRONT VIEW

NOTES :

1. ALL DIMENSIONS ARE IN mm
2. * TO SUIT INSTRUMENT DIMENSIONS
3. HINGES SHALL BE OF STAINLESS STEEL.
4. A MINIMUM OF TWO COATS PAINTING SHALL BE CARRIED OUT AFTER A MINIMUM OF ONE COAT OF RED OXIDE ZINC CHROMATE PRIMER. THE COLOUR OF THE PAINT SHALL BE AS PER IS-5.
5. ALL EDGES/CORNERS SHALL BE PROPERLY SMOOTHENED AND ENSURE THAT NO SHARP EDGES EXIST.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	17.08.21	Revised & Reissued	Saurav	AJS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

Approved by

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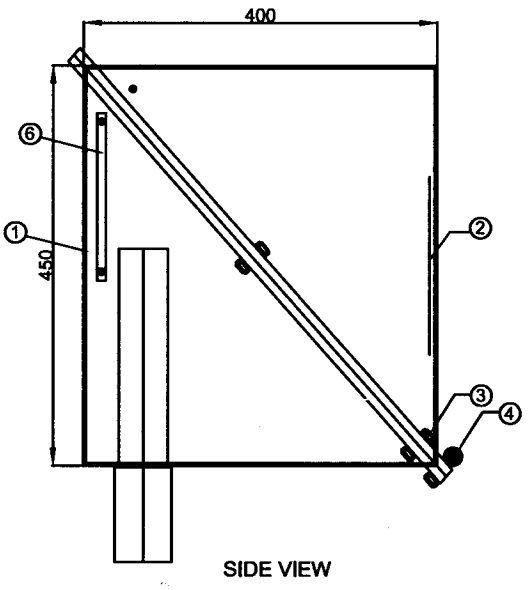
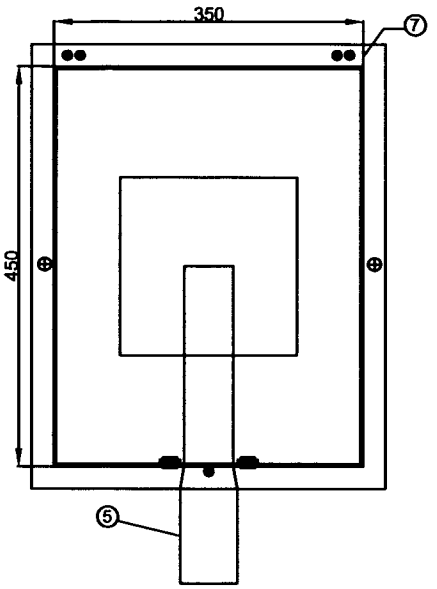
TYPE : FRP CANOPY (ALL SIDE CLOSED) - FIELD INSTRUMENTS



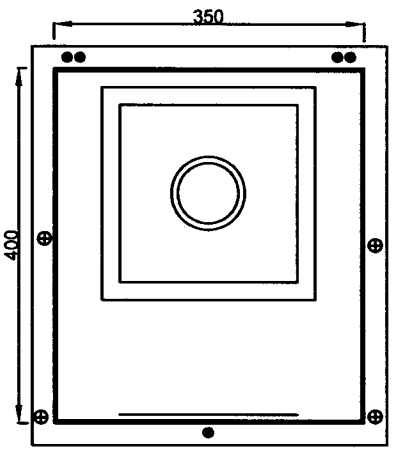
SIDE VIEW



FRONT VIEW

SPECIFICATIONS	
FRP Enclosure	Resin: Iso-phthalic fire retardant UV resistant polyester as per IS-10192
Glass Content	Min. 60%
Flammability	Rating Class I, as per IS 6746
Pigments	Resin pigmented grey
Thickness	3mm, +1.0mm / -0.25mm
Finish	Smooth Outside Finish in Glaze & Gloss
Colour	RAL 7040 PU (GREY)
Window	3mm thick acrylic window for viewing
Others	Canopy shall have chemical resistance, high mechanical strength, antistatic and low moisture absorption.

ITEM	DESCRIPTION
①	FRP Canopy of internal size 394mm (D) x 444mm (H) x 344mm (W)
②	Acrylic window of clear size 200mm x 200mm Abrasion Resistant, Impact Anodized
③	SS knob with plastic butterfly grip
④	SS knob
⑤	SS Clamp • ID X L: 56mm x 225mm; Thickness: 2.0mm • ID X L: 64mm x 65mm; Thickness: 2.0mm • Plate Size: 200mm x 200mm x 2.0mm • Holes: For M6 SS Bolts
⑥	Lid holding clamp, SS
⑦	SS hinges with SS screws



TOP VIEW

(Canopy bottom Cut-out for entry)

NOTE :

1. THIS IS TYPICAL DRAWING. THE DIMENSIONS SHALL BE FIRMED UP WITH THE ACTUAL INSTALLATION OF FIELD INSTRUMENTS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	17.08.21	Revised & Reissued	Saurav	AJS	MN	SM
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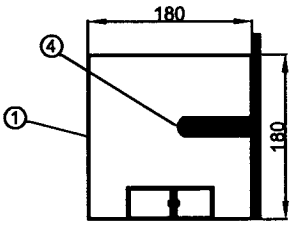
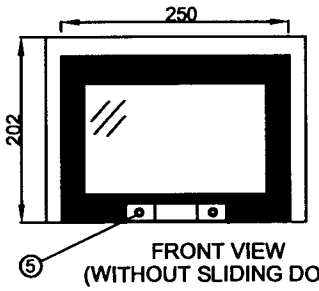
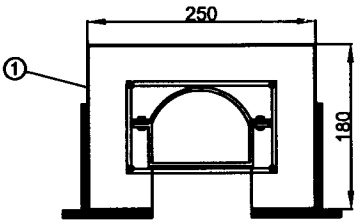
TYPE: FRP CANOPY (ALL SIDE CLOSED) - NECK MOUNTED INSTRUMENTS



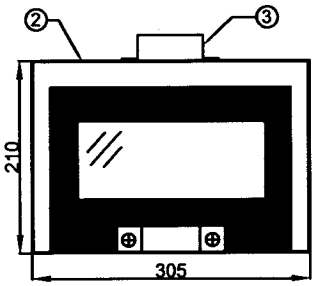
SIDE VIEW
(WITHOUT SLIDING DOOR)



FRONT VIEW
(WITHOUT SLIDING DOOR)



BOTTOM VIEW
(CANOPY BOTTOM SLOT FOR ENTRY WITH SS CLAMP AND SCREW SET)



FRONT VIEW
(WITH SLIDING DOOR)

SPECIFICATIONS	
FRP Enclosure	Resin: Iso-phthalic fire retardant UV resistant polyester as per IS-10192
Glass Content	Min. 60%
Flammability	Rating Class I, as per IS 6746
Pigments	Resin pigmented grey
Thickness	3mm, +1.0mm / -0.25mm
Finish	Smooth Outside Finish In Glaze & Gloss
Colour	RAL 7040 PU (GREY)
Sliding Door	3mm, with smooth aluminium (light grey) sliding channel
Window	3mm thick acrylic window for viewing, 200mm(W) x 100mm(H) Abrasion resistant, Impact Anodized
Dimension	Overall dimesional tolerance shall be +/-6 mm
Others	Canopy shall have chemical resistance, high Mechanical strength. Antistatic and low moisture absorption.

ITEM	DESCRIPTION
①	FRP Canopy of internal size 177mm(D) x 177mm(H) x 244mm(W)
②	FRP Sliding door of external size 25mm(D) x 210mm(H) x 305mm(W)
③	SS handle, riveted to door
④	Neoprene rubber channel gasket, 2 nos , shall confirm to ASTM D395- 18 requirements
⑤	SS Clamp • ID X L: 62mm x 30mm; Thickness:2.0mm • Plate Size: 160mm x 100mm x 1.5mm • Holes: For M6 SS Bolts

NOTE :

1. THIS IS A TYPICAL DRAWING. THE DIMENSIONS SHALL BE FIRMED UP WITH THE ACTUAL INSTALLATION OF FIELD INSTRUMENTS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	17.08.21	Revised & Reissued	Saurav	AJS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

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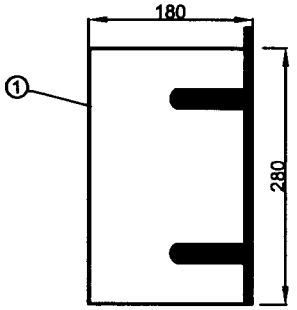
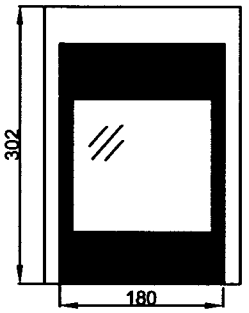
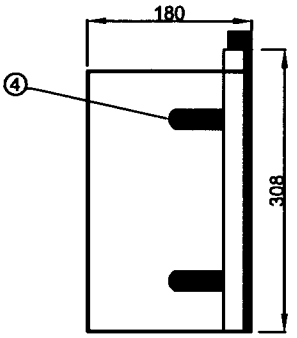
TYPE: FRP CANOPY (ALL SIDE CLOSED) - TEMPERATURE TRANSMITTER AND LOOP POWERED INDICATOR



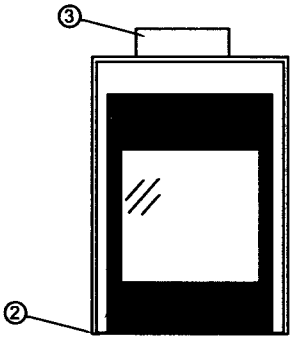
SIDE VIEW
(WITHOUT SLIDING DOOR)



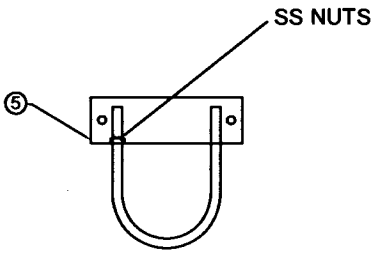
FRONT VIEW
(WITHOUT SLIDING DOOR)



SIDE VIEW
(WITH SLIDING DOOR)



FRONT VIEW - WITH SLIDING DOOR
(CANOPY BOTTOM OPEN FOR
CABLE ENTRY)



SS U- CLAMP
WITH ANGLE

SPECIFICATIONS	
FRP Enclosure	Resin: Iso-phthalic fire retardant UV resistant polyester as per IS-10192
Glass Content	Min. 60%
Flammability	Rating Class I, as per IS 6746
Pigments	Resin pigmented grey
Thickness	3mm, +1.0mm / -0.25mm
Finish	Smooth Outside Finish in Glaze & Gloss
Colour	RAL 7040 PU (GREY)
Sliding Door	3mm, with smooth aluminium sliding channel
Window	3mm thick acrylic window for viewing, 150mm x 150mm Abrasion resistant, Impact Anodized
Dimension	Overall dimesional tolerance shall be +/-6 mm
Others	Canopy shall have chemical resistance, high mechanical strength, antistatic and low moisture absorption.

ITEM	DESCRIPTION
①	FRP Canopy of internal size 177mm(D) x 277mm(H) x 174mm(W)
②	FRP Sliding door of external size 25mm(D) x 310mm(H) x 190mm(W)
③	SS handle, riveted to door
④	Neoprene rubber channel gasket, 2 nos shall confirm to ASTM D395-18 requirements
⑤	SS U- Clamp • ID X L: 60mm x 85mm; Thickness:6.0mm • Angle Size: 30mm x 30mm x 3.0mm • Holes: For M6 SS Bolts 2 SS Hardware for tightening with canopy, M6

NOTE :

1. THIS IS A TYPICAL DRAWING. THE DIMENSIONS SHALL BE FIRMED UP WITH THE ACTUAL INSTALLATION OF FIELD INSTRUMENTS.

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3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

Approved by

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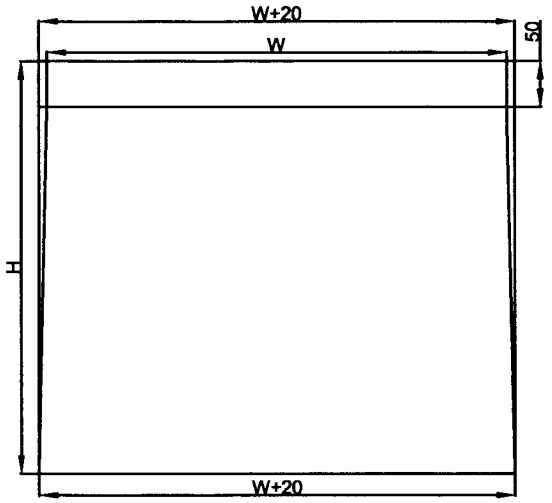
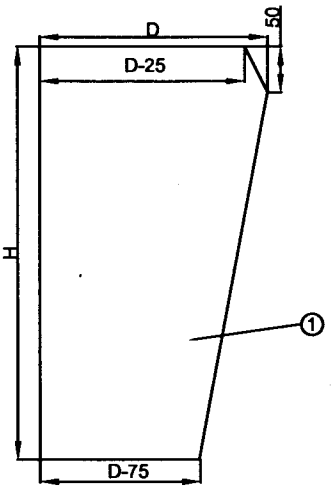
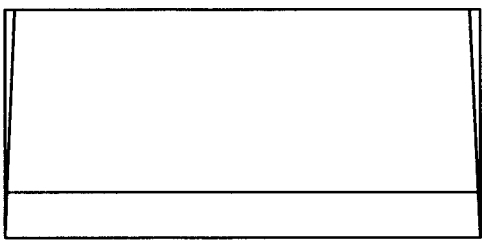
TYPE: FRP CANOPY FOR JUNCTION BOX - FRONT SIDE OPEN



FRONT VIEW



SIDE VIEW



TOP VIEW

SPECIFICATIONS	
FRP Enclosure	Resin: Iso-phthalic fire retardant UV resistant polyester as per IS-10192
Glass Content	Min. 60%
Flammability	Rating Class I, as per IS 6746
Pigments	Resin pigmented grey
Thickness	3mm, +1.0mm / -0.25mm
Finish	Smooth Outside Finish in Glaze & Gloss
Colour	RAL 7040 PU (GREY)
Others	Canopy shall have chemical resistance, high strength, antistatic and low moisture absorption.

ITEM	DESCRIPTION
①	FRP Junction box canopy of size 250mm(D) x 450mm(H) x 500mm(W)
	Cable entry from bottom side
D	250mm
H	450mm
W	500mm

NOTE :

1. THIS IS A TYPICAL DRAWING. THE DIMENSIONS SHALL BE FIRMED UP WITH THE ACTUAL INSTALLATION OF JUNCTION BOX AND ITS SIZE.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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4	17.08.21	Revised & Reissued	Saurav	AJS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

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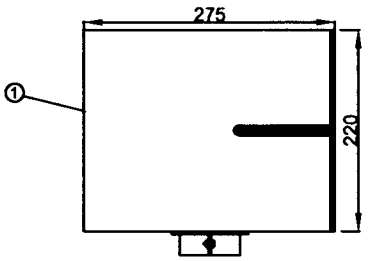
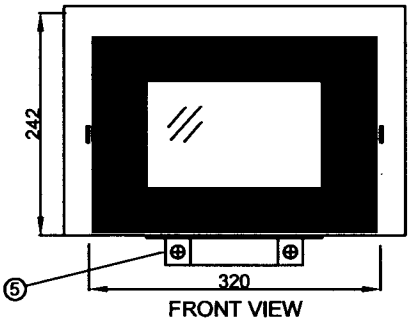
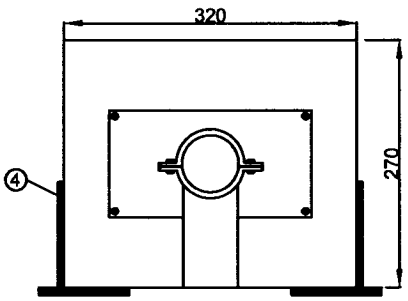
TYPE : FRP CANOPY (ALL SIDE CLOSED) - GUIDED WAVE , MASS FLOW METER



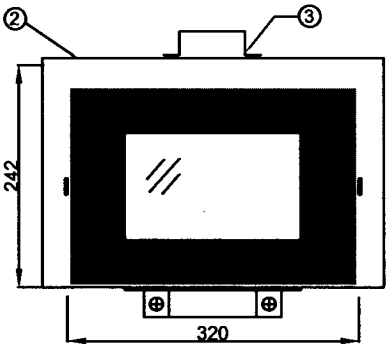
SIDE VIEW
(WITHOUT SLIDING DOOR)



FRONT VIEW
(WITHOUT SLIDING DOOR)



BOTTOM VIEW
(CANOPY BOTTOM SLOT FOR ENTRY
WITH SS CLAMP AND SCREW SET)



FRONT VIEW
(WITH SLIDING DOOR)
(CANOPY BOTTOM SLOT FOR ENTRY)

SPECIFICATIONS	
FRP Enclosure	Resin: Iso-phthalic fire retardant UV resistant polyester as per IS-10192
Glass Content	Min. 60%
Flammability	Rating Class I, as per IS 6746
Pigments	Resin pigmented grey
Thickness	3mm, +1.0mm / -0.25mm
Finish	Smooth Outside Finish in Glaze & Gloss
Colour	RAL 7040 PU (GREY)
Sliding Door	3mm, with smooth aluminium sliding channel
Window	3mm thick acrylic window for viewing, 150mm(W) x 100mm(H) Abrasion Resistant, Impact Anodized
Dimension	Overall dimesional tolerance shall be +/-6 mm
Others	Canopy shall have chemical resistance, high mechanical strength, antistatic and low moisture absorption.

ITEM	DESCRIPTION
①	FRP Canopy of internal size 269mm(D) x 214mm(H) x 314mm(W)
②	FRP Sliding door of external size 25mm(D) x 250mm(H) x 375mm(W)
③	SS handle, riveted to door
④	Neoprene rubber channel gasket, 2 No.s shall confirm to ASTM D395-18 requirements
⑤	SS Clamp • ID X L: 55mm x 25mm; Thickness:2.0mm • Plate Size: 150mm x 100mm x 1.5mm • Holes: For M6 SS Bolts 2 SS bolt set for tightening , M6

NOTE :
1. THIS IS A TYPICAL DRAWING. THE DIMENSIONS SHALL BE FIRMED UP WITH THE ACTUAL INSTALLATION OF INSTRUMENTS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	17.08.21	Revised & Reissued	Saurav	AJS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

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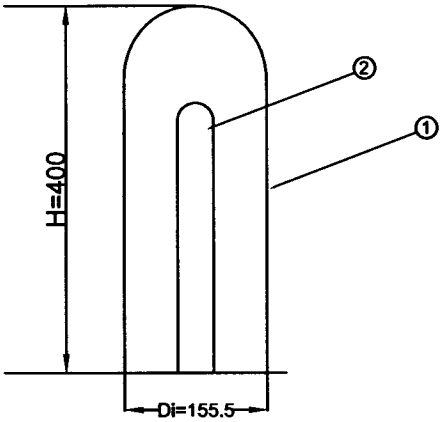
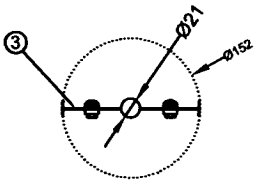
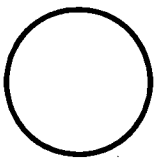
TYPE : FRP CANOPY FOR RTD / THERMOCOUPLE



FRONT VIEW



SS HOLDING CLAMP



BOTTOM VIEW

SPECIFICATIONS	
FRP Enclosure	Resin: Iso-phthalic fire retardant UV resistant polyester as per IS-10192
Glass Content	Min. 60%
Flammability	Rating Class I, as per IS 6746
Pigments	Resin pigmented grey
Thickness	3mm
Finish	Smooth Outside Finish
Colour	Grey, PU, RAL 7040 (GREY)
Dimension	Overall dimensional tolerance shall be +/- 6mm
Quantity	As required
Others	Canopy shall have chemical resistance, high mechanical strength, antistatic and low moisture absorption.

ITEM	DESCRIPTION
①	FRP Canopy of size 161.5mm(OD) x 400mm(H)
②	Neoprene channel type gasket shall confirm to ASTM D395-18 requirements
③	SS clamp • Thickness tolerance of +/- 0.2 mm • Taper maximum 2 Deg. • Size of slot 32mm wide x 300mm

NOTE :

1. THIS IS A TYPICAL DRAWING. THE DIMENSION SHALL BE FIRMED UP WITH THE ACTUAL INSTALLATION OF THERMOCOUPLE / RTD ASSEMBLY.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	17.08.21	Revised & Reissued	Saurav	AJS	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RG	RN

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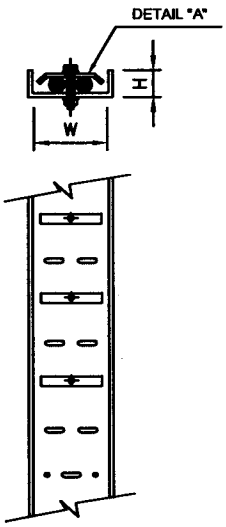
PERFORATED TRAY SUPPORTS AND CABLES CLAMPING DETAILS

STANDARD No.

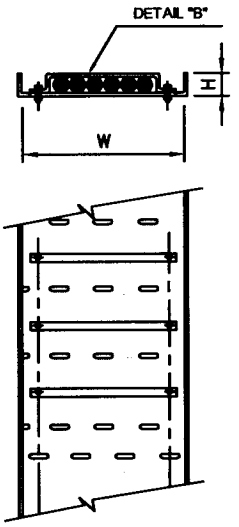
7-52-0107 Rev. 4

CABLE CLAMPING ON PERFORATED TRAYS (GALVANISED MILD STEEL / ANODIZED ALUMINIUM)

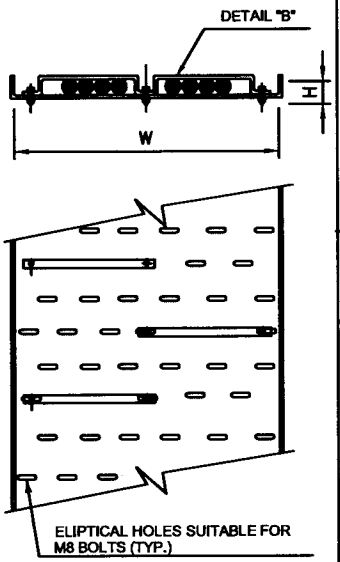
SINGLE CLAMPING FOR TWO CABLES



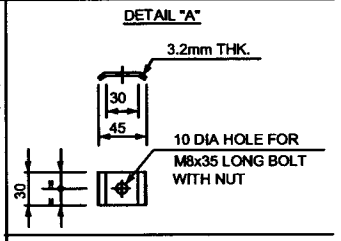
SINGLE CLAMPING FOR MULTIPLE CABLES

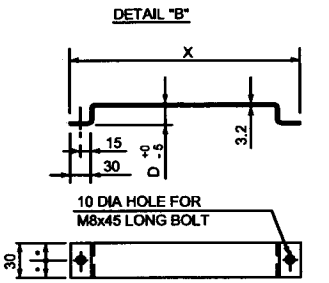


DUAL CLAMPING FOR MULTIPLE CABLES



CABLE CLAMPS DETAIL





"WHERE "W" DENOTES THE INSIDE WIDTH OF TRAY

D = CABLE OVERALL DIA.

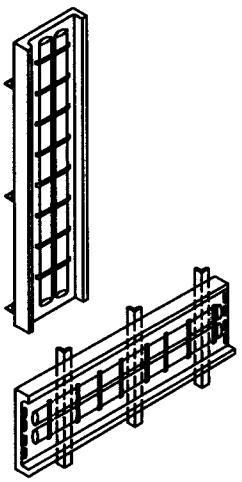
WHERE

X = W-10 FOR SINGLE CLAMPING

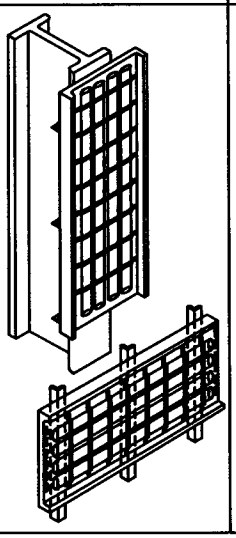
= $\frac{W}{2}$ - 10 FOR DUAL CLAMPING

PERFORATED TRAY - SUPPORTING DETAILS

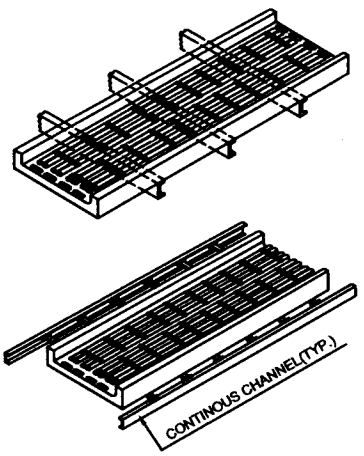
TRAY ROUTING EDGEWISE HOR. / VER. RUNS



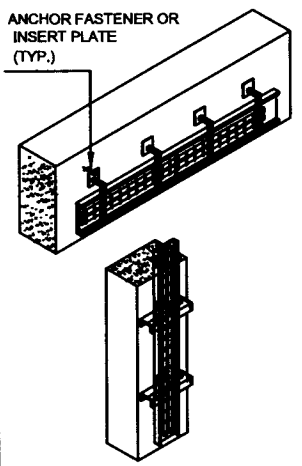
TRAY ROUTING EDGEWISE IN HOR. / VER. RUNS



TRAY ROUTING WIDTHWISE IN HORIZONTAL RUNS



TRAY ROUTING CONCRETE BEAM/COLUMN IN HOR. / VER. PLANE



NOTES :-

1. ALL DIMENSIONS ARE IN mm.
2. PERFORATED TRAYS SHALL BE SUPPORTED AT EVERY 1000 mm (TYP.) INTERVAL FOR HORIZONTAL AS WELL AS VERTICAL RUNS USING MINIMUM ANGLE SIZE AS 50x50x6 OR CONTINOUS CHANNEL SUPPORT MC50
3. CLAMPING OF CABLES ON PERFORATED TRAYS SHALL BE AT EVERY 500 mm ON VERTICAL RUNS AND EVERY 1000 mm ON HORIZONTAL RUNS.
4. PERFORATED TRAYS SHALL BE SUPPLIED WITH CLAMPS, BOLTS/NUTS AND DOUBLE WASHERS OF GALVANISED MILD STEEL DR ALUMINIUM AS PER TRAY MATERIAL.
5. GALVANISING SHALL BE AS PER IS 4759 (66 µm/ 460 g / m2) AND ALUMINIUM ANODIZING SHALL BE MINIMUM 20µm THICK.
6. THE PERFORATED TRAY THICKNESS SHALL BE 2.5 mm.
7. TRAY STANDARD LENGTH SHALL BE 2.5 mtr.

CAPACITY OF PERFORATED TRAYS

TRAY WIDTH (W)	FLANGE HEIGHT (H)	NO. OF CABLES		
		1 PAIR/ 1 TRIAD	6 PAIR/ 6 TRIAD	12 PAIR/ 8TRIAD
60	30	2	1	-
60	40	-	-	1
100	40	4	2	2
150	40	6	4	3
300	40	15	8	6

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Approved by

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अवरोधक ऑरिफिस प्लेटो के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR RESTRICTION ORIFICE PLATES

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	04.07.25	Revised and Reissued as Standard Specification	RB/RSC	RK	MN	MN
5	08.01.21	Revised and Reissued as Standard Specification	DK	JJ	MN	SM
4	09.11.15	Revised and Reissued as Standard Specification	RS	RKG	RG	SC
3	29.11.10	Revised and Reissued as Standard Specification	RS	RG	TGM/JMS	ND
2	02.05.05	Revised and Reissued as Standard Specification	AR	TGM	PM	VJN

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Abbreviations:

AARH	: Arithmetic Average Roughness Height
ASTM	: American Society for Testing and Materials
PMI	: Positive Material Identification
RTJ	: Ring Type Joint

Instrumentation Standards Committee

Convener: Mr. Mainak Nandi

Members:
Mr. Arupjyoti Saikia
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4.0 INSPECTION AND TESTING 7

5.0 SHIPPING 7

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1.0 GENERAL

1.1 Scope

1.1.1 This specification, together with the data sheets, describes the requirement for the design, materials, nameplate marking, inspection, testing and shipping of restriction orifice plates and multistage restriction orifice assemblies.

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

ASME	American Society of Mechanical Engineers	
	B 16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
	B16.34	Valves Flanged, Threaded and Welding End
	B 36.10	Welded and Seamless Wrought Steel Pipe.
EN	European Standards	
	10204	Inspection Documents for Metallic Products
ISO	International Organisation for Standardisation	
	5167-1	Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full - General Principles and requirement
	5167-2	Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full - Orifice Plates

Flow Measurements Engineering Handbook by R.W. Miller

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

a) Statutory Regulations

b) Job Specifications / Data Sheets

c) Standard specification

d) Codes and standards

1.1.4 In addition to compliance to purchaser's specification in totality, vendor's extent of responsibility shall include the following:

a) Purchaser's data sheets specify the material for restriction orifice plates. Unless specifically indicated otherwise, alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for its compatibility with the specified fluid and operating conditions.

b) Purchaser's data sheets indicate the thickness of the restriction orifice plate. If found necessary, vendor may provide higher thickness restriction orifice plate considering process conditions, specified in the purchaser's datasheets.

c) Sizing of the multistage restriction orifice plate assembly and the number of stages to meet the process conditions specified in purchaser's data sheet.

1.2 Bids

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

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

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1.3 Drawings and Data

1.3.1 Detailed drawings, data, specification sheet and manuals shall be submitted by vendor as per vendor data requirement attached with Requisition.

1.3.2 Final documentation consisting of design data, installation manual, operation and maintenance manual etc., shall be submitted by the vendor after placement of purchase order as per vendor data requirement attached with Requisition.

2.0 DESIGN AND CONSTRUCTION

2.1 Unless otherwise specified, restriction orifice plates shall be concentric square edge type and shall be manufactured as per standard drawing number 7-52-0041 with thickness as per data sheets. However, restriction orifice plates shall not be bevelled and they shall not have weep holes. Serration shall be considered on the restriction orifice plate near the gasket zone.

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

2.3 Minimum bore diameter for the restriction orifice plate shall be 1.6 mm.

2.4 The sizing calculation for restriction orifice and multiple restriction orifice assembly shall be furnished by vendor for EIL review during detail engineering. The minimum required thickness for the restriction orifice shall be calculated as per R.W. Miller. Thickness of restriction orifice plates shall be as per data sheets or sizing calculations, whichever is higher.

2.5 Restriction orifice plate with thickness greater than 12 mm, vendor's scope shall include long stud bolts for bolting in between Purchaser's flanges.

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

2.7 Where the restriction orifice plate is to be mounted between ring-type joint flanges, vendor shall supply the plate alongwith a plate-carrying holder with Octagonal Ring. Flange assembly including studs, nuts & gasket shall be supplied by vendor in case specified in Purchase datasheets.

2.8 The upstream face of the orifice plate shall be as per ISO-5167 or any other standard indicated in the purchaser's datasheet.

2.9 The downstream face of the plate should be flat and smooth and shall not have roughness and scores that can be ascertained by touch or sight.

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

2.11 Whenever multi-orifice plate assembly is specified, the following to be considered by the vendor:

a) Vendor shall supply complete assembly with orifice plates, spool piece and flanges duly welded.

b) The orifice plate design shall be either concentric or eccentric type.

c) The number of stages of orifice plates shall be calculated by vendor based upon the process data indicated in the purchaser's data sheet.

d) In addition to the plates installed inside the spool piece, 2 nos. of additional blind plates of the same thickness and material shall be supplied so that the same in case required for additional pressure drop shall be installed at the multi-orifice spool end flange for bolting with Purchaser's mating flange.

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2.12 For multiple restriction orifice assembly, the number of stages / plates and thickness of the plates shall be decided by vendor to meet process conditions. However minimum two number of stages shall be provided by vendor for such tags irrespective of the sizing requirements. Vendor to note that while sizing, pressure drop achieved in the first stage shall not be more than 50% of the total pressure drop. The complete system shall be supplied with flanged end connections in fully assembled condition.

2.13 Flange Assembly

2.13.1 Unless otherwise specified, Multiple Restriction orifice flanges shall be fabricated in accordance with the standards mentioned in the specification sheets.

2.13.2 Flange and Spool piece bore diameter shall be the same as pipe's internal diameter.

2.13.3 Unless otherwise specified, the following shall govern: -

a) Flanged end connections shall be as per ASME B 16.5.

b) Grooves of the ring type joint flanges shall be octagonal as per ASME B16.20.

c) Flange face finish shall be as per ASME B 16.5. The face finish as specified in the data shall be as follows:

125 AARH: 125 to 250 micro inch AARH
63 AARH: 32 to 63 micro inch AARH

2.14 Wherever, RTJ flanges have been mentioned in the data sheet for pressure rating more than 600 class as per ASME, standard 7-52-0042 shall be followed

3.0 NAMEPLATE

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

a) Tag no. as per purchaser's data sheets.

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

c) Orifice plate and assembly material of construction

d) Bore diameter

e) Upstream indication

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

a) Tag number as per purchaser's datasheet

b) Manufacturer's name / trade mark

c) Nominal end connection size and rating

d) Orifice plate and Flange assembly material to ASTM specification

e) Number of orifice plate stages

f) Upstream indication

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4.0 INSPECTION AND TESTING

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

PMI on all incoming material shall be carried out as per Inspection and Test Plan as applicable.

5.0 SHIPPING

5.1 Bore edge of each Restriction orifice plate shall be protected with suitable rigid recycled plastic protective casing as practically possible.

5.2 Each Restriction orifice plate shall be packed inside thick recycled polythene bags with suitable protective packing outside. Each plate shall be packed separately.

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

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STANDARD SPECIFICATION FOR SPECIAL LEVEL INSTRUMENTS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
					Approved by	
5	09.02.22	Revised and Reissued as Standard Specification	PR/MK	SMK	MN	SM
4	27.03.17	Revised and Reissued as Standard Specification	JT	MN	RG	RN
3	18.04.11	Revised and Reissued as Standard Specification	MN	RG	RP/ JMS	DM
2	07.03.06	Revised and Reissued as Standard Specification	AM	TGM	PM	VJN
1	01.10.96	Revised and Reissued as Standard Specification	RK	BRS	RB	AS

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Abbreviations:

AARH	:	Arithmetic Average Roughness Height
AC	:	Alternating Current
DC	:	Direct Current
DPDT	:	Double Pole Double Throw
FISCO	:	Fieldbus Intrinsic Safety Concept
HART	:	Highway Addressable Remote Transducer
LCD	:	Liquid Crystal Display
NPS	:	Nominal Pipe Size
NPT	:	National Pipe Thread
RAM	:	Random Access Memory
SPDT	:	Single Pole Double Throw
TDR	:	Time Domain Reflectometery
WC	:	Water Column

Instrumentation Standards Committee

Convener: Mr. Mainak Nandi

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

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5.0 SHIPPING 11

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1.0 GENERAL

1.1 Scope

1.1.1 This standard specification, together with the data sheets, covers the requirements for the design, materials, nameplate marking, inspection, testing and shipping of special level instrument.

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

ASME	American Society of Mechanical Engineers	
	B 1.20.1	Pipe Threads, General Purpose (Inch)
	B 16.5	Pipe Flanges and Flanged Fittings NPS½ through NPS24
	B 16.20	Metallic Gaskets for Pipe Flanges, Ring Joint, Spiral wound and Jacketed.
	B31.1	Power Piping Code
ASME	BPVC-I	Rules for Construction of Power Boilers
	(PG 60.1)	Design and Application Requirements for Miscellaneous Pipe, Valves and Fittings (Water Level Indicators)
EN	European Standards	
	10204	Inspection Documents for Metallic Products
IS/IEC	Indian Standards/International Electro Technical Commission	
	IS/IEC 60079	Electrical Apparatus for Explosive Gas Atmospheres.
	IS/IEC 60529	Degree of Protection Provided by Enclosures (IP Code).
	IEC 60587	Electrical insulating materials used under severe ambient conditions-Test methods for evaluating resistance to tracking and erosion
	IEC-61000-4	Electromagnetic Compatibility (EMC)-Testing and measurement techniques.
	IEC 61158	Industrial communication networks - Fieldbus specifications
ITK	Interoperability Test Kit (Latest Version)	

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

a) Statutory Regulations

b) Data Sheets

c) Standard Specification

d) Codes and Standards

1.1.4 In addition to compliance to purchaser's specifications in totality, vendors' extent of responsibility shall include the following:

a) Purchaser's data sheets specify the minimum acceptable materials of body measuring element and accessories. Alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the indicated fluid and its operating conditions.

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b) Selection of proper level instrument from the vendor's standard manufacturing range, which is compatible with the process fluid and its operating condition.

c) Selection of proper type of wave-guide for guided wave radar type of instruments suitable for the specified application.

1.2 Bids

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

1.2.2 Whenever a detailed technical offer is required, vendor's quotation shall include the following:

a) Detailed specification sheet for each item, which shall provide information regarding type, material of construction, performance specification, model number etc. of the offered special level instrument. The material specification and the units of measurement for various parts in vendor's specification sheets shall be to the same standards as those indicated in purchaser's data sheets.

b) Electrical wiring diagram, mounting details and earthing requirements for the offered level instruments.

c) Type of cabling required and the maximum permissible cable length between the sensor and remote electronics.

d) Proven references for each offered model number in line with clause 1.2.3 of this specification.

e) A copy of approval from local statutory authority, as applicable, such as Petroleum and Explosives Safety Organisation (PESO) Nagpur or Director General of Mines Safety (DGMS) in India, for the electronic instruments installed in electrically hazardous area along with;

i) Test certificate from recognised house Central Institute of Mining and fuel Research (CIMFR) / Electronics Regional Testing Laboratory (ERTL) etc. for flameproof enclosure and/or intrinsic safety, as specified in the datasheets, for the specified hazardous protection class as per relevant Indian standard for all Indian manufactured equipments or equipments requiring Director General of Mines Safety (DGMS) approval.

ii) Certificate of conformity from agencies like Laboratorie Central Des Industries Electriques (LCIE), British Approval Service for Electrical Equipment in Flammable Atmospheres (Baseefa), Physikalisch-Technische Bundesanstalt (PTB), Canadian Standards Association (CSA), Underwriter's Laboratories (UL), Factory Mutual (FM) for compliance to ATEX or other equivalent recognised standards for all equipments manufactured outside India.

f) Deviation on technical requirements shall not be generally entertained. In case vendor has some valid technical reason for not complying with the specific requirements due to superior alternatives and materials, tag wise deviation list must be provided along with the technical justification.

g) Catalogues giving detailed technical specifications, model decoding details and other related information for each type of special level instrument covered in the bid.

h) Two years operational spares for each model of instruments offered in the bid, which shall include sensor, electronic module, local indicator, o-ring/gasket set etc. as a minimum.

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i) Any special tools and tackles required for maintenance work. In case no special tools are necessary for the offered instruments, vendor must certify the same in their offer.

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

1.2.4 Whenever specified, vendor must furnish tested values of failure rates, probability of failure on demand and test interval for the safety integrity level analysis in line with SIL level specified in datasheet.

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

1.3 Drawings and Data

1.3.1 Detailed drawings, data, catalogues and manuals required shall be submitted by the vendor as per vendor data requirement sheets attached with the requisition.

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

a) Specification sheet for each special level instrument (including probe insertion length) and its accessories.

b) Certified drawing for each instrument, which shall provide dimensional detail (probe, remote electronics etc.), internal construction, part list and material of construction etc.

c) Wiring diagram and earthing details for each level instrument.

d) Mounting details for probe unit and remote electronics.

e) Calibration procedures including replacement of its internal parts.

f) Copy of type test certificates

g) Copy of test certificates for all the tests indicated in clause 4.0 of this specification

2.0 DESIGN AND CONSTRUCTION

2.1 Sensor/probe

2.1.1 Vendor shall select the probe length and diameter based on the application and process parameters. The type and material of construction of special level instrument shall be as specified in purchaser's datasheet.

2.1.2 Probe shall be of flanged construction with material of construction of flange as specified in purchaser's data sheet. In case of welded flanged connection design, the weld joint shall be of radiography quality.

2.1.3 Probe shall be of rugged construction without any mechanical moving part and shall not be affected by abrasion because of fluid turbulence. The probe design shall ensure that the

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deposits, dust, noise, foam or turbulence in the fluid shall not affect the performance of the offered level instruments.

2.1.4 In case of internal probes, the accessories like Centering weight etc. shall be provided by vendor.

2.1.5 Unless otherwise specified, the following shall govern:

a) Threaded end connections shall be to NPT as per ASME B1.20.1.

b) Flanged end connections shall be as per ASME B 16.5.

c) Flange face finish shall be as per ASME B16.5. The face finish shall be as follows:

125 AARH : 125 to 250 micro inch AARH

63 AARH : 32 to 63 micro inch AARH

d) Grooves of ring type joint flanges shall be octagonal as per ASME B 16.20.

2.1.6 Sensor/Probes installed in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or equivalent non-toxic reagent. End connection shall be blinded/plugged after the degreasing process in order to avoid entrance of grease or oil particles.

2.2 Instrument Electronic

2.2.1 Special level Instrument electronics shall be compatible with the associated level probe and shall comprise of pre-amplifier, converter, transmitter, switching amplifier etc. as applicable for the specified application. Vendor shall ensure that the input/output signals and performance characteristics of individual item supplied as a part of each special level instrument are compatible with each other.

2.2.2 The instrument electronics shall be integral with the probe. Where remote mounted converter/transmitter is offered in place of integral electronics a minimum of 10 meters of interconnecting cable shall be included.

2.2.3 Instrument electronics shall be of microprocessor based state-of-the-art technology, which shall be capable of being configured locally, either using an integral keypad or through a universal handheld configurator.

2.2.4 Instrument electronics shall be in compliance with the electromagnetic compatibility requirements specified in IEC 61000-4 standard.

2.2.5 Whenever specifically indicated in purchaser's datasheets, the meter electronics shall be provided with in-built lightning and power supply surge protectors. The transient protection shall meet the requirements specified in IEC 60587.

2.2.6 Power Supply

a) Two wire transmitters shall be preferred, wherein no separate power feeder shall be considered. However, if separate power supply is required, purchaser will provide one number of power supply feeder e.g. 110V/240V AC,50 Hz. as specified in datasheet, at the transmitter. Further distribution if any shall be taken care of by vendor. Accessories like cable glands, conduits and junction boxes as required to interconnect transmitter signal cables and power supply cables etc., shall be supplied by the vendor.

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b) Supply voltage fluctuation of ±10 percent from the specified value and supply frequency fluctuation of ±3 Hz from the specified value shall not affect the instrument performance.

2.2.7 Terminals and Enclosure

2.2.7.1 Proper terminal blocks shall be provided in the transmitter unit for the termination of purchaser's cables. Flying leads shall not be provided. Separate terminal blocks shall be provided for power and signal connections.

2.2.7.2 All terminals shall be clearly identified and polarity shall be permanently marked.

2.2.7.3 Separate cable entries shall be provided for signal and power cables. The cable entry sizes shall be ½" NPT (F) for signal and ¾" NPT (F) for power.

2.2.7.4 The instrument/ Illuminator enclosure, housing the electrical parts shall be certified for the area classification indicated in the purchaser's data sheets. Unless otherwise specified, the enclosure shall conform to the following standards, as a minimum;

Weatherproof housing	IP 65 as per IS/IEC-60529.
Flameproof housing	Flameproof/ Ex(d) as per IS/IEC-60079.

Flameproof housing shall also be made weatherproof.

2.2.8 Converter/Transmitter

2.2.8.1 Electronic transmitter shall generally operate at nominal voltage of 24V DC and shall be protected against short circuit and reverse voltage.

2.2.8.2 Electronic transmitters with two-wire system shall be suitable for delivering rated current to an external loop resistance of at least 600ohm when powered with 24 V DC.

2.2.8.3 The span of the transmitter shall be field adjustable. In case separate device is required to make such a change, the same shall be included as per clause 2.2.3 of this specification.

2.2.8.4 Integral output meter with LCD display shall be provided for all transmitters/convertors. Local indication of the output meter must be digital and in engineering units.

2.2.8.5 Smart and Fieldbus based Transmitters.

a) Smart and fieldbus-based transmitters shall be two wire microprocessor-based type. These shall have a non-volatile memory, storing, complete sensor characterization and configuration data of the transmitter. All necessary signal conversions and output generation with the required protocol shall be carried out in the transmitter electronics.

b) The configurational 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, vendor to ensure that battery drain alarm is provided as diagnostic maintenance message.

c) Transmitter shall also run complete diagnostic subroutines and shall provide diagnostic alarm messages for sensor as well as transmitter healthiness.

d) Transmitter protocol shall ensure the following features:

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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 or integral facia.

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

e) In addition to the requirements specified above, fieldbus-based transmitter shall meet the following requirements:

i) All instruments must satisfy the requirements of the fieldbus registration laboratory with applicable checkmark like foundation fieldbus, profibus PA, or as specified in the purchaser's data sheets.

ii) All instruments shall have two analog input blocks, as a minimum. In addition, when specified the transmitter shall also have PID controller block.

iii) All instruments must be interoperable and shall have valid interoperability test clearance like ITK latest version for foundation fieldbus or equivalent for profibus PA as applicable, or as specified in the purchaser's data sheets.

iii) The fieldbus instruments shall support peer-to-peer communication.

iv) The field bus instruments in hazardous area shall be certified as per entity concept or shall be FISCO approved as per the requirements specified in the purchaser's specification.

v) All instruments shall support EDDL or FDT/DTM requirements, as specified in data sheets.

vi) Internal Software shall be configured by the vendor including the following information.
- Serial Number
- Device Tag (Tag No.)
- Process Description

vii) All instruments shall be capable of supporting incremental Device Descriptor (DD) for extra functionality and/or software revisions in Device Memory.

2.2.9 Switching Amplifier

a) The switches shall have DPDT (or two SPDT) contact unit each rated to 24VDC, 2A, 110VDC, 0.2A and 240V AC, 5A. Contacts used in intrinsically safe application shall be certified for these applications. Separate cable entry shall be provided for the Switching Amplifier.

b) The unit shall have repeatability better than ± 1.0%.

2.3 Guided Wave Radar type Level Instrument

2.3.1 The instrument shall work on TDR principle and shall be capable of measuring level of process fluid of dielectric constant as low as 1.9.

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Wherever dielectric constant is not specified in the datasheets, vendor supplied instrument shall be suitable for dielectric constant of 1.9 and minimum difference of 10 in dielectric constants of both medium in interface application.

2.3.2 The type of wave guide i.e. coaxial/twin rod/single rod shall be selected by the vendor based on the specified application, unless otherwise specific type is asked in the requisition.

2.3.3 The instrument probe length shall be selected based on the minimum and maximum levels indicated in the purchaser's data sheet.

2.3.4 External type guided wave radar instrument shall have external chamber/cage with 2" flanged end connections. The chamber/cage shall also have ¾" NPT vent and drain connection.

2.3.5 The instrument shall meet the following performance requirement:

a) Accuracy inclusive of linearity, repeatability and hysteresis shall be better than ±3.0 mm.

b) Repeatability of level instrument shall be better than ±3.0 mm.

c) Response time (i.e. 63.2% response) shall be better than 1 second.

2.4 Ultrasonic Type Level Instrument

2.4.1 Probe shall be selected to ensure that distance between the probe and the maximum level of interest specified in the data sheet is more than the blocking distance of the probe.

2.4.2 The instrument shall meet the following performance requirements:

a) Accuracy inclusive of linearity, repeatability and hysteresis shall be better than ±0.25% of measuring range.

2.5 Radio-Frequency / Capacitance Type Level Instruments

2.5.1 The type of probe shall be selected by vendor based on the specified application.

2.5.2 The instrument probe length shall be selected by vendor based on the specified level measurement range.

2.5.3 The instrument shall meet the following performance requirements:

a) Accuracy of the instrument inclusive of repeatability, linearity and hysteresis shall be ± 0.5% of the specified level measurement range.

2.5.4 The material of construction of the probe shall be stainless steel 316/ 316L with insulation of PTFE as a minimum. Insulation material shall be selected by vendor based on the specified process conditions.

2.5.5 For non-metallic equipment or equipment lined internally with insulation material, probe having suitable ground reference shall be provided.

2.6 Steam Drum Level Instruments

2.6.1 **Conductivity Type Level Instrument -Electronic Water Level Indicator (EWLI)**

a) Water Column along with the Probe Assembly shall be designed for steam drum design pressure and design temperature.

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b) The Water column shall be equipped with Conductivity level probes installed on the Water column, covering the entire Steam Drum Liquid Level range as specified in datasheet with a Probe pitch / resolution of 50mm of total range or better. Vendor to select and engineer the number of probes required accordingly. However, probes must be available on the water column at the trip levels and alarm levels.

c) Water column shall be a high volume column made from thick-walled extruded section to minimise fluid temperature loss so as to consequently minimise the error between actual drum level and indicated column level as a result of density error. Maximum observed error shall be 1.5" or less under all operating conditions without any level compensation.

d) The probe seats shall be machined into the column. Probes shall be fitted and sealed to the Water Column by a proven method. The Probe construction shall be blowout proof.

e) The material of construction of the probe shall be stainless steel 316/ 316L as a minimum to minimize corrosion.

f) Probes shall be able to detect water of extremely low conductivity (of the order of less than 1 μmho/cm) and shall be able to operate at low voltages (≤ 10 V) to permit checking of the probes without disconnecting the electronics.

g) Variation in conductivity w.r.t change in drum pressure from start-up to operation and shutdown shall not affect the probes ability to detect the presence of water or steam.

h) The detection module shall be designed so that each probe is equipped with its own individual detection circuit. Failure of one probe or one circuit in the system shall result in the loss of only that particular circuit/ Probe and not affect the other circuits or probes.

i) For each Conductivity Level Instrument, one no. Electronic Bi-colour Level Indicator shall be supplied along with the electronic Level detection module located at field near water column and another electronic Bi-colour Level Indicator shall be supplied for mounting at Control Room.

j) The electronic Level detection module shall be able to provide stepped 4~20mA DC output covering the specified level range which can be used by the purchaser for generating the bi-colour level indication graphic in DCS.

k) All cables between probes, electronic level detection module and local Bi-colour EWLI shall be in the scope of vendor.

2.6.2 Bi-Color Level gauge

a) Bicolor level gauges shall be in accordance with ASME BPVC-I, PG 60.1. Gauge shall be supplied fully assembled with illuminator, bi-color gauge chamber, power supply, gauge cocks, circulating tie-bar assembly, nipples, valves and fittings.

b) Gauge and cock shall utilize only asbestos free gaskets, which are suitable for the process fluid and its operating condition.

c) Gauge Cocks shall be of quick closing, offset type with bolted bonnet, outside screw and with renewable seats.

d) Unless otherwise specified, all moving and wetted internals like ball check seat, stem etc. shall be SS 316 Stainless Steel, as a minimum.

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e) Top and Bottom connection shall be Expansion Contraction type and shall be provided with an expansion loop at the top.

f) Gauge Glasses shall be of the mechanical and thermal shock resistant type. Glass material shall be toughened borosilicate or equivalent with mica shield for protection against erosion.

g) Illuminator shall consist of vertical row of reflector type spotlights (LED or high intensity lamps) and a colour screen containing two strips of red and green glasses.

h) Illuminator lamps shall operate on 240 V, 50Hz, Non-UPS single phase supply. The incoming power terminals shall be suitable for cable connection upto 4.0 mm2 size.

3.0 NAME PLATE

Each special level instrument shall have a stainless-steel nameplate attached firmly to it a visible place, furnishing the following details:

a) Tag number / Item Description as per purchaser's data sheet.

b) Manufacturer's serial number and model number.

c) Manufacturer's name/trade mark

d) Nominal end connection size and rating.

e) Body material.

f) Calibrated range.

g) Area classification in which the instrument can be used.

4.0 INSPECTION AND TESTING

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

5.0 SHIPPING

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

5.2 Instruments shall be supplied individually, in sealed plastic bags.

5.3 Proper care shall be taken in shipping instrument probe/sensor. All such items shall be suitably protected to avoid damage.

5.4 All special level instruments in oxygen and chlorine service shall be separately packed along with a certificate indicating 'CERTIFIED FOR OXYGEN / CHLORINE SERVICE', as applicable.

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विक्रेता कार्यशाला में सकारात्मक सामग्री पहचान के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR POSITIVE MATERIAL IDENTIFICATION (PMI) AT SUPPLIER'S WORKS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	23.12.21	REVISED AND RE-ISSUED	HKM	CS	RK	S Majumdar
3	19.09.16.	REVISED AND RE-ISSUED	TKK	HP	RKS	RN
2	20.10.11	REVISED AND RE-ISSUED	RKS	SCG	AKC	DM
1	15.07.08	REVISED AND RE-ISSUED	NKR	SSL	SKP	VC
0	07.12.00	ISSUED AS STANDARD SPECIFICATION	AKC	AKB	AKB	MI

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Abbreviations:

API	:	American Petroleum Institute
AS	:	Alloy Steel
HIC	:	Hydrogen Induced Cracking
LSTK	:	Lump Sum Turn Key
NACE	:	National Association of Corrosion Engineers
PMI	:	Positive Material Identification
RTJ	:	Ring Type Joint
Sch	:	Schedule
SS	:	Stainless Steel
TPI or TPIA	:	Third Party Inspection Agency

Inspection Standards Committee

Convenor: Mr. Rajeev Kumar

Members: Mr. Rajesh Sinha
Mr. Himangshu Pal
Mr. R. Muthuramalingam (RPO Representative)
Mr. Chandrashekhar
Mr. Avdhesh Agrawal
Mr. P V Satyanarayana (Engg. Representative)
Mr. Mahendra Mittal

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1.0 SCOPE

1.1 This specification applies to the requirements for Positive Material Identification (PMI) to be performed at the Supplier's works on Metallic Materials procured either directly by the Owner/EIL/ LSTK contractor or indirectly through the sub-Suppliers.

1.2 This specification covers the procedures and methodology to be adopted to assure that the chemical composition of the material is consistent with the material specifications as specified in purchase documents using 'Alloy Analyzer' at the time of final inspection before dispatch.

1.3 The scope of this specification shall include but shall not be limited to Positive Material Identification (PMI) to be performed on Materials listed below:

1.3.1 For alloy Steel materials as below:

- Alloy Steel Pipes including Clad Pipes
- Alloy Steel Flanges & Forgings
- Alloy Steel Fittings including Clad Fittings
- Alloy Steel Fasteners
- Alloy Cast & Forged steel valves
- Alloy Steel Instrumentation Items (Control Valves, Safety Valves etc.)
- Longitudinal Pipe & Fittings Welds.
- Gaskets (for Ring Type Joints)

1.3.2 For Carbon Steel materials as below:

- All Carbon Steel Piping items under NACE or HIC or H2 or Wet Hydrogen Sulfide (H_2S), Hydrofluoric acid (HF), Sulfuric acid (H_2SO_4) services etc.
- Carbon Steel flanges and valves (Rating 900# and above)
- LTCS items

Following items shall be excluded from scope of PMI examination.

- Gaskets other than for Ring Type Joints
- Internal Components of Valves

1.4 All grades of material supplies including Stainless Steels shall be liable for PMI test at site. In case of any defective materials being found at site, the Supplier shall be responsible to effect replacement of such defective materials at project site without any delays to the satisfaction of EIL site RCM (Resident Construction Manager).

2.0 REFERENCE DOCUMENTS

2.1 API Recommended Practice 578 (Third Edition, Feb 2018) - Material Verification Program for New and Existing Alloy Piping Systems.

3.0 DEFINITIONS

3.1 **Supplier:** Any Supplier or Manufacturer on whom an order is placed for the supply of referred items. This definition shall also include any sub-Supplier or manufacturer on whom a sub-order is placed by the Supplier.

3.2 **Inspection Lot:** A group of items offered for inspection covered under same size, Heat and Heat treatment lot.

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3.3 **Alloy Material:** Any metallic material (including welding filler materials) that contains alloying elements such as Chromium, Nickel, Molybdenum or Vanadium, which are intentionally added to enhance mechanical or physical properties and/or corrosion resistance.

4.0 PMI EXAMINATION

4.1 The Supplier shall submit a procedure of PMI to comply with the requirements of this Specification. Approval of PMI Procedure shall be obtained from Owner / EIL / TPIA prior to commencing manufacture / inspection of product.

4.2 PMI examination of materials is independent of any certification, markings or colour coding that may exist and is aimed at verifying that the alloy used are as per specified grades.

4.3 The Supplier shall identify all incoming alloy materials and maintain full traceability of all alloy
materials, including all off-cuts. Transfer of identification marks shall be undertaken prior to cutting to ensure maintenance of identification on off-cuts.

4.4 The Supplier shall ensure that all alloy materials are segregated and stored in separately identified locations to prevent the mix up of materials of different alloy specifications or alloy material with carbon steel. Non ferro-magnetic materials shall be segregated at all times from ferro-magnetic materials.

4.5 PMI examination is subject to surveillance inspection by Owner / EIL / TPIA.

5.0 ACCEPTABLE METHODS FOR PMI

5.1 The method used for PMI examination shall provide a quantitative determination of the alloying elements like Chromium, Nickel, Molybdenum or Vanadium in Alloy Steel items.

5.2 Instruments or methods used for PMI examination shall be able to provide quantitative, recordable, elemental composition results for positive identification of alloying elements present.

5.3 The acceptable instruments for alloy analyzer shall be either "Portable X-Ray fluorescence" or "Optical Emission" type each capable of verifying the percentage of alloy elements within specified range.

5.4 Chemical spot testing, magnets, alloy sorters and other methods using eddy current or triboelectric testing methods are not acceptable for PMI examination.

5.5 The PMI instrument used shall have the sensitivity to detect the alloying elements in the specified range.

5.6 All PMI instruments shall have been serviced within a 6 month period of the time of use to verify the suitability of batteries, sources etc., and the data of the last service shall be stated on the PMI Report Form (Sample enclosed).

5.7 Each analyzer must be calibrated according to the manufacturer's specification at the beginning and end of each shift. Instrument must be checked against known standard for each alloy type to be inspected during the shift.

5.8 Certified samples, with full traceability, of a known alloy materials shall be available for use as a random spot check on the instrument calibration.

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5.9 The surfaces to be examined shall be prepared by light grinding or abrasive paper and solvent cleaner. Evidence of Arc burn resulting from examination shall be removed by light grinding or abrasive paper. No permanent marks, which are injurious to the usage of product in service, are acceptable.

5.10 Alloy Steel ring type joint Gaskets shall be inspected by using portable X-Ray fluorescence instrument.

5.11 Testing shall be done as per the procedures outlined by the manufactures of alloy analyzer being used. Modification of these procedures if any must be approved by Owner/EIL.

5.12 The persons performing PMI shall demonstrate their capabilities to the satisfaction of Owner/EIL/TPIA visiting engineer. If the Supplier has qualified operator on their rolls, he may perform the examination. Otherwise PMI examination shall be sub-contracted to an independent testing agency approved by EIL.

5.13 Whenever material is identified as not meeting requirements by the visiting engineer a rejection note shall be issued.

6.0 EXTENT OF PMI EXAMINATION

Following sampling plans shall be applicable for PMI examination of various items.

A. Flanges, Fittings Valves, RTJ Gaskets - 100% by Supplier and 10% @ random witness by EIL/TPIA

B. Pipes - 100% (for pipes procured from traders)
2 random samples drawn from each Size/Heat/Lot (for pipes procured directly from mills)

C. Fasteners -

Lot Size	**Sample Size for** EIL/TPIA	Sample size for Supplier
Upto 100	2% (Min 2)	Min 10%
101 to 500	1% (Min 3)	Min 10%
501 and above	0.5% (Min 5)	Min 10%

Note:

a. For Welded Pipes and Fittings and flanges like Fig 8, Spacer and blinds etc. PMI shall be performed on Base Metal as well as weldments.

7.0 ACCEPTANCE CRITERIA

7.1 Base Metal

PMI test results showing presence of characteristic elements upto 10% less than the minimum specified value in the material specification and upto 10% more than the maximum specified value in the material specification shall be acceptable.

7.2 Deposited Weld Metal

For deposited weld metal using welding consumables matching with base metals, the recorded presence of characteristic elements upto 12.5% less than the minimum specified value in the

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welding consumable specification and upto 12.5% more than the maximum specified value in the welding consumable specification shall be acceptable.

8.0 REJECTION CRITERIA

8.1 If PMI test results fall outside the acceptable range as specified in 7.0 above, the supplier shall obtain a quantitative check analysis performed by a laboratory acceptable to Owner / EIL / TPIA for a complete chemical analysis. Alternatively, the item can be tested with a spark analyser for verification. Results of this analysis shall be submitted to Owner / EIL / TPIA for final decision.

Decision of Owner / EIL / TPIA shall be final in this regard.

8.2 If any sample drawn to PMI test on the basis of percentage selection as per 6.0 above, fails to meet specification requirements, 100% of items of lot shall be tested for PMI by supplier. Any failure thereafter during sample check shall mean rejection of whole lot.

9.0 RECORDING AND DOCUMENTATION

The results of PMI examination shall be recorded in a Report Format as enclosed with this specification.

10.0 MARKING

10.1 All alloy materials tested by PMI shall be identified using either of the following methods by indicating "PMI OK"

a) Bar Code/Hologram Sticker
b) A low stress stamp marking

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	POSITIVE MATERIAL IDENTIFICATION REPORT BULK MATERIALS							Page of
Project:		Client						Job No.
PMI Report No.		Supplier/Sub-Supplier						
Purchase Order No.		Testing Agency						
Purchase Requisition No:		PMI Location						
Bulk Item Type (as per Requisition)								
Material Specification/Grade Number of items in Lot								
Requisition Item No./ Description		Major content, Weight Percent						Remarks Accept/Reject
Element	Cr	Ni	Mo	V	Ti *	Cb/ Nb **	Mn ***	
Specified Range								
Actual observations 1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
Instrument Type / ID Last Service Date		Inspection Agency						Witnessed By

* To be reported in case of SS321 Material
** To be reported in case of SS347 Material
*** To be reported in case of LTCS Material

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इंस्ट्रूमेंट ट्यूबिगं के लिए निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN FOR INSTRUMENT TUBING

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	27.05.20	Revised and Reissued	NP	RS	RKS	SKS
3	21.11.13	Revised and Reissued	MJ	RS	AKC	SC
2	22.03.12	Revised and Reissued	MJ	GS	AKC	DM
1	05.05.08	Revised and Reissued	SA	SKD	SKP	VC
0	29.11.02	Issued for implementation	RG	AKC	AKB	GRR

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Abbreviations

CEIL	:	Certification Engineers International Limited	MOC	:	Material of Construction
DT	:	Destructive Testing	OD	:	Outer Diameter
EIL	:	Engineers India limited.	PO	:	Purchase Order
EPC	:	Engineering Procurement Construction	PVC	:	Polyvinyl Cloride
IC	:	Inspection Certification	PR	:	Purchase Requisition
IRN	:	Inspection Release Note	QC	:	Quality Control
ITP	:	Inspection and Test Plan	SS	:	Stainless Steel
Lab.	:	Third Party Laboratory	TC	:	Test Certificate
Mfr	:	Manufacturer	TPI or TPIA	:	Third Party Inspection Agency
MTC	:	Material Test Certificates	VDR	:	Vendor Data Requirement

Inspection Standards Committee

Convenor : Mr. R.K. Singh

Members :

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. Chandrashekhar
Mr. R. Muthuramalingam	Mr. Avdhesh Agrawal	Mr. Mahendra Mittal
Mr. Arupjyoti Saikia(Engg.)		

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1.0 SCOPE

This Inspection and Test Plan covers the minimum inspection and testing requirements for Instrument Tubing.

2.0 REFERENCE DOCUMENTS

PO/PR / Standards referred there in /Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**	--	--	--	--	--	--
2.0	**Material Inspection**						
2.1	Incoming Material like : Mother Pipes, Bars/Billets etc.	Chemical & Mechanical Properties, Heat Treatment as applicable	100%	MTC/ Lab. TC	H	H	R
3.0	**In process Inspection**						
3.1	Cold drawing / Pilger operations, Heat treatment etc.	Dimensions, Finish, Temperature records	100%	Supplier's Test Records	-	H	-
4.0	**Final Inspection**						
4.1	Final Inspection	• Visual check • Dimensional test. • Chemical & Mechanical Properties • Hydrostatic test (for SS & Bare Copper tubes). • Pneumatic test (for PVC coated Copper tubes) • Ball Test (for Copper tubes)	100%	Supplier's Internal Test Records / Supplier's Inspection Witness Record	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		• Eddy Current Examination of Copper/ SS tubes. • Product markings on tubes / label. • Hardness/ Tension test for SS tube.					
5.0	**Packing**						
5.1	Packing	• Visual • Suitable protection to prevent entry of foreign material. • Proper packing to prevent damage during transportation	100%	Packing list / Supplier's Records	-	H	-
6.0	**Documentation**						
6.1	Documentation and IC/IRN	• Traceability of records • Review of Internal Test Reports, MTC • Issuance of IC/IRN.	100%	Supplier's Test Records / IC/IRN	-	H	H
6.2	Final Document submission (if applicable)	Compilation of Inspection reports ,drawings, etc as per VDR / PR	100%	Final data folder / Completeness certificate	-	H	H

Legends: H- Hold (Do not proceed without approval), R-Review, RW-Random witness (As specified or 10 % - Samples must include minimum 1 No. of each type), W-Witness (Give due notice, work may proceed after scheduled date).

NOTES :

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents.
3. For EPC Jobs, Scope of Inspection shall be under TPIA only, unless specified otherwise.

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INSPECTION AND TEST PLAN FOR INSTRUMENT VALVES AND MANIFOLDS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	27.05.20	Revised and Reissued	NP	RS	RKS	SKS
3	21.11.13	Revised and Reissued	MJ	RS	AKC	SC
2	22.03.12	Revised and Reissued	MJ	GS	AKC	DM
1	05.05.08	Revised and Reissued	SA	SKD	SKP	VC
0	29.11.02	Issued for implementation	RG	AKC	AKB	GRR

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Abbreviations

CEIL	:	Certification Engineers International Limited	MOC	:	Material of Construction
DT	:	Destructive Testing	OD	:	Outer Diameter
EIL	:	Engineers India limited.	PO	:	Purchase Order
EPC	:	Engineering Procurement Construction	PR	:	Purchase Requisition
IC	:	Inspection Certification	QC	:	Quality Control
IRN	:	Inspection Release Note	SS	:	Stainless Steel
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
Lab.	:	Third Party Laboratory	TPI or TPIA	:	Third Party Inspection Agency
Mfr	:	Manufacturer	VDR	:	Vendor Data Requirement
MTC	:	Material Test Certificates			

Inspection Standards Committee

Convenor : Mr. R.K. Singh

Members :

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. Chandrashekhar
Mr. R. Muthuramalingam	Mr. Avdhesh Agrawal	Mr. Mahendra Mittal
Mr. Arupjyoti Saikia(Engg.)		

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1.0 SCOPE

This Inspection and Test Plan covers the minimum inspection and testing requirements for Instrument Valves and Manifolds.

2.0 REFERENCE DOCUMENTS

PO/PR / Standards referred there in /Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**	--	--	--	--	--	--
2.0	**Material Inspection**						
2.1	Incoming Material like Forgings, Bar-stock , Ingots, Billets etc.	Chemical & Mechanical Properties, Heat Treatment as applicable	100%	MTC/ Lab. TC	H	H	R
3.0	**In process Inspection**						
3.1	Machining of components and assembly	Visual, Dimension	100%	Supplier's Test Records	-	H	-
4.0	**Final Inspection**						
4.1	Final Inspection	• Visual • Dimensional Check • Bill of Material for Mounting Brackets & Accessories • Functional Check. • Hydrostatic Test for shell and seat. • Pneumatic test for shell and seat.	100%	Supplier's Internal Test Records / Supplier's Inspection Witness Record	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.2	Submission of certificates/Document	• Type tests for each type of valve and manifold as per Standard: MSS-SP-99.	Prototype for each model	Statutory Approval Certificates / Type TC	-	H	R
5.0	**Painting**						
5.1	Painting and Packing	• Visual • Suitable protection to prevent entry of foreign material. • Cleaning for oxygen and chlorine services, if applicable. • Proper packing to prevent damage during transportation	100%	Packing list / Supplier's Records	-	H	-
6.0	**Documentation**						
6.1	Documentation and IC/IRN	• Review of Internal Test Reports, MTC • Issuance of IC/IRN.	100%	Supplier's Test Records / IC/IRN	-	-	H
6.2	Final Document submission	Compilation of Inspection reports ,drawings, etc as per VDR / PR	100%	Final data folder / Completeness certificate	-	H	H

Legends: H- Hold (Do not proceed without approval), R-Review, RW-Random witness (As specified or 10 % - Samples must include minimum 1 No. of each type), W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents
3. For EPC Jobs, Scope of Inspection shall be under TPIA only, unless specified otherwise.

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विशेष स्तरीय इन्स्ट्रूमेंटों
के लिए
निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
SPECIAL LEVEL INSTRUMENTS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
3	27.05.2020	Revised and Reissued	NP	RS	RKS	SKS
2	21.11.2013	Revised and Reissued	MJ	RS	AKC	SC
1	22.03.2012	Revised and Reissued	MJ	GS	AKC	DM
0	01.12.2008	Issued for implementation	SA	SKD	SKP	VC

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Abbreviations

ATEX	:	Atmosphère Explosibles
BASEEFA	:	British Approval Service for Electrical Equipment in Flammable Atmospheres
CEIL	:	Certification Engineers International Limited
CIMFR	:	Central Institute of Mining & Fuel Research
CSA	:	Canadian Standards Association
DGMS	:	Directorate General of Mines Safety
DP/DPT	:	Dye Penetrant Testing
EIL	:	Engineers India Limited.
EPC	:	Engineering Procurement Construction
ERTL	:	Electronics Regional Test Laboratory
FF	:	Fieldbus Foundation
FISCO	:	Fieldbus Intrinsically Safe Concept
FM	:	Factory Mutual
HART	:	Highway Addressable Remote Transducer
IC	:	Inspection Certification
IEC	:	International Electrotechnical Commission
IP	:	Ingress Protection
IR	:	Insulation Resistance
IRN	:	Inspection Release Note
ITP	:	Inspection and Test Plan
Lab.	:	Third Party Laboratory
LCIE	:	Laboratorie Central Des Industries Electriques
LPT	:	Liquid Penetrant Testing
Mfr	:	Manufacturer
MTC	:	Material Test Certificates
MOC	:	Material of Construction
NDT	:	Non Destructive Testing
NEMA	:	National Electrical Manufacturers Association
No.	:	Number
PESO	:	Petroleum and Explosives Safety Organisation
PMI	:	Positive Material Identification
PO	:	Purchase Order
PQR	:	Procedure Qualification Record
PR	:	Purchase Requisition
PTB	:	Physikalisch-Technische Bundesanstalt
PWHT	:	Post Weld Heat Treatment
QC	:	Quality Control
RT	:	Radiography Test
SIL	:	Safety Integrity Level
SS	:	Stainless Steel
TC	:	Test Certificate
TPI or TPIA	:	Third Party Inspection Agency
UL	:	Underwriter's Laboratories
VDR	:	Vendor Data Requirement
WPS	:	Welding Procedure Specification
WPQ	:	Welders Performance Qualification

Inspection Standards Committee

Convenor : Mr. R.K. Singh

Members :

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. Chandrashekhar
Mr. R. Muthuramalingam	Mr. Avdhesh Agrawal	Mr. Mahendra Mittal
Mr. Arupjyoti Saikia(Engg.)		

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1.0 SCOPE

This Inspection Test Plan covers the minimum inspection and testing requirements for Special level instruments.

2.0 REFERENCE DOCUMENTS

PO/PR / Standards referred there in /Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**	--	--	--	--	--	--
1.1	WPS/PQR/WPQ	Welding procedure Qualification for welds (as applicable)	100%	WPS PQR WPQ	--	H	W (New) R (Existing)
2.0	**Material Inspection**						
2.1	Raw materials for Chamber(Cages) /Sensor Assembly such as : Pipe, Flanges, Fittings etc	Chemical & Mechanical Properties, Heat treatment, Hardness etc. as applicable	100%	MTC / Lab. TC/ Mfr's TC	H	H/R	R
2.2	Bought out Material : Sensors, probes, Transmitters, converters, Switching Amplifiers etc.	• Make , Model , specification • Performance check	100%	MTC / Supplier's TC	H	H	R
3.0	**In process Inspection**						

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.1	Fabrication of Chamber/ Cage	• Visual & Dimensional, • PWHT as applicable • Hydro static Pressure withstand test. • NDT(RT, DP/DPT/LPT) as applicable • Hardness Test on welds as applicable	100%	Mfr's TC/ NDT reports./ PWHT Chart	H	R	R
3.2	Special Level Instruments assembly	Visual. Dimensional,	100%	Supplier's Test Records	-	H	-
4.0	**Final Inspection**						
4.1	Final Inspection (Acceptance Tests)	• Visual checks. • Dimensional checks • Hydrostatic Pressure withstand test on Cages /Chambers as applicable • Check marks of Fieldbus registration for FF Instruments. • Performance check on Transmitters. • Communication, Configuration, and diagnostic checks for Smart and Field bus based instruments with help of Hand Held Configurator. • Effect of power supply variation check . • Load driving capability check as applicable. • Check for accessories and Spares	100%	Supplier's Records / Witness Inspection Reports	-	H	RW

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.2	Submission of certificates / Documents	• For Electrically Hazardous Area : a. Indigenous Items: Certificate from CIMFR/ Karandikar Lab. / ERTL and valid BIS License & corresponding valid PESO Certificate for the requisite Hazardous Area Classification b. Imported items: Certificates from testing agency like LCIE, BASEEFA, FM, UL, PTB, CSA etc. for compliance to ATEX or equivalent recognized standards & corresponding Valid PESO Certificate for the requisite Hazardous Area Classification c. For projects related to mining, approval from DGMS-India required • Degree of protection(IP) certificate for Instrument enclosures and housing for Electronics/Electrical Parts. • SIL Certification(If Specified) • Certification of Fieldbus Instruments as per entity concept or FISCO. • Certificate for electromagnetic compatibility and transient protection as per IEC 61000-4 • Interoperability test certificate for field bus/Profibus transmitters	Prototype for each model	Statutory Approval Certificates / Type Test Certificates	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	**Painting**						
5.1	Painting and Packing	• Visual • Suitable protection to prevent entry of foreign material. • Proper packing to prevent any damage during transportation • Cleaning for oxygen and chlorine service	100%	Packing list / Supplier's Records	-	H	-
6.0	**Documentation**						
6.1	Documentation and IC/IRN	• Review of Internal Test Reports/Certificates, MTC. • Issuance of IC/IRN	100%	Supplier's Test Records / IC/IRN	-	H	H
6.2	Final Document submission (if applicable)	Compilation of Inspection reports ,drawings, etc as per VDR / PR	100%	Final data folder / Completeness certificate	-	H	H

Legends: H- Hold (Do not proceed without approval), R-Review, RW-Random witness (As specified or 10 % - Samples must include minimum 1 No. of each type), W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents.
3. For EPC Jobs, Scope of Inspection shall be under TPIA only, unless specified otherwise.

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स्वचालित नियंत्रण वाल्व/रेगुलेटर के लिए निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN FOR SELF ACTUATED CONTROL VALVES/REGULATORS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5	28.05.20	Revised and Reissued	NP	RS	RKS	SKS
4	01.08.16	Revised and Reissued	MM	TKK	RKS	SC
3	21.11.13	Revised and Reissued	MJ	RS	SCG	SC
2	22.03.12	Revised and Reissued	MJ	GS	AKC	DM
1	10.06.08	Revised and Reissued	SA	SKD	SKP	VC
0	09.12.02	Issued for implementation	RG	AKC	AKB	GRR

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Abbreviations

AS	:	Alloy Steel
CEIL	:	Certification Engineers International Limited
DP/DPT	:	Dye Penetrant Testing
EIL	:	Engineers India limited.
EPC	:	Engineering Procurement Construction
FCRI	:	Fluid Control Research Institute
IC	:	Inspection Certification
IRN	:	Inspection Release Note
ITP	:	Inspection and Test Plan
Lab.	:	Third Party Laboratory
LPT	:	Liquid Penetrant Testing
Mfr	:	Manufacturer
MTC	:	Material Test Certificates
MOC	:	Material of Construction
MPT/MT	:	Magnetic Particle Testing
NABL	:	National Accreditation Board for Testing and Calibration Laboratories
No.	:	Number
PMI	:	Positive Material Identification
PO	:	Purchase Order
PQR	:	Procedure Qualification Record
PR	:	Purchase Requisition
PTB	:	Physikalisch-Technische Bundesanstalt
PWHT	:	Post Weld Heat Treatment
QC	:	Quality Control
RT	:	Radiography Test
SIL	:	Safety Integrity Level
SS	:	Stainless Steel
TC	:	Test Certificate
TPI or TPIA	:	Third Party Inspection Agency
VDR	:	Vendor Data Requirement

Inspection Standards Committee

Convenor : Mr. R.K. Singh

Members :

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. Chandrashekhar
Mr. R. Muthuramalingam	Mr. Avdhesh Agrawal	Mr. Mahendra Mittal
Mr. Arupjyoti Saikia(Engg.)		

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1.0 SCOPE

This Inspection and Test Plan covers the minimum inspection and testing requirements for Self Actuated Control Valves / Regulators.

2.0 REFERENCE DOCUMENTS

PO/PR / Standards referred there in /Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**	--	--	--	--	--	--
2.0	**Material Inspection**						
2.1	Incoming materials like Forgings & Castings for Body / Bonnet, Trim material, Piping Items, Fittings, Springs, Piston/ Cylinders, Pilots etc.	• Mechanical & Chemical properties, heat treatment as applicable, • RT for body casting as applicable	100%	MTC/ Lab. TC / RT Reports/ Mfr'sTC	H	H	R
3.0	**In process Inspection**						
3.1	Machining of components	Visual, Dimensions	100%	Supplier's Test Records	-	H	-
4.0	**Final Inspection**						
4.1	Final Inspection	• Visual check . • Dimensional Verification. • Component Verification. • Hydro test (body). • Set pressure test & Functional test. • Seat leakage test.	100%	Supplier's Internal Test Records/ Inspection Witness Record	-	H	RW

Signature Not Verified
Digitally signed by MOHIT KUMAR GAUTAM
Date: 2026.05.06 16:48:58 IST
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