TENDER No.: 96800000M1A

DESIGN, SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF LPG AMINE CONTACTOR FOR LPG AMINE ABSORBER SYSTEM IN PFCC UNIT AT MRPL, MANGALURU, KARNATAKA

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MANGALORE REFINERY AND PETROCHEMICALS LIMITED

EPCM SERVICES FOR INSTALLATION OF LPG AMINE ABSORBER SYSTEM IN PFCC UNIT AT MRPL, MANGALURU

MATERIAL REQUISITION FOR LPG AMINE CONTACTOR (DA-33211)

			Roshan Kumar	ANUP KUMAR SINGH	Harpreet Singh
0	01.07.21	Issued for Quotation	ROK	APH	HAS
Rev.	**Date**	**Description**	**Prpd.**	**Chkd.**	**Appd.**

Triune Energy Services Pvt. Ltd. New Delhi	MATERIAL REQUISITION FOR LPG AMINE CONTACOR	**Document Number**	**Rev.**
		9680-02-MR-201	0
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Excel

LIST OF ATTACHMENTS

S.No.	Documents Attached			Revision Index				
	Title	Document No.	Total Sheets	0				
1	Job Specification for LPG Amine Contactor	9680-02-JS-201	15	0				
2	Supplier data requirements for LPG Amine Contactor	9680-02-SDR-201	4	0				
3	Inspection Requirement Table	9680-02-IRT-201	2	0				
4	ITP Pressure Vessel	17-ITP-M-001	5	2				
5	Mechanical Design Basis	9680-02-DB-001	86	A				
6	Mechanical Data Sheet	9680-02-DS-C-01	2	0				
7	Process Data Sheet	9680-01-DS-DA-33211	5	1				
8	Standard Specification fo Painting	9680-03-TS-003 **(Note-1)**	-	-				
9	Specification of Positive Material Identification	9680-03-TS-004	12	0				
10	Specification for Piping Support Design	9680-03-TS-007	104	0				
11	Project Spare Parts Philosophy	EDB 0013	12	1				
12	Vessel Tolerances	02-CS-001	3	2				
13	Skirt Base Details	02-CS-003	2	2				
14	Skirt Opening Details	02-CS-004	2	2				
15	Manhole with Davit	02-CS-006	2	2				
16	Ladder Rungs for Manhole, Demister	02-CS-007	1	2				
17	Nozzle Reinforcement and Projection	02-CS-008	1	2				
18	Standard Bolt Hole Orientation	02-CS-009	1	2				
19	Internal Flanges	02-CS-010	1	2				
20	Vortex Breaker	02-CS-011	1	2				
21	Inlet Deflector Baffle	02-CS-012	1	2				
22	Pipe Davit	02-CS-014	3	2				
23	Fire Proofing and Insulation Supports for Vertical Vessel	02-CS-016	2	2				
24	Manufactures Name Plate- Vessel	02-CS-018	1	2				
25	Earthing Lug	02-CS-019	1	2				

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S.No.	Documents Attached			Revision Index				
	Title	Document No.	Total Sheets	0				
26	S.R. Nozzle Neck	02-CS-020	1	2				
27	Details of Forged Nozzles	02-CS-021	1	2				
28	Details of Man Hole Davit for S.R. Nozzle	02-CS-022	1	2				
29	Typ. Weld Details	02-CS-023	2	2				
30	Stiff. for nozzles 2 Inch NB. and below	02-CS-025	1	2				
31	Alloy Liner Details	02-CS-027	1	2				
32	Lifting Trunnions	02-CS-032	1	2				
33	Template	9680-02-OT-001	1	0				
34	Detail of Steel Ladder	05-CS-212	4	4				
35	Standard Detail of Circular and Rectangular Platforms	05-CS-265	1	0				
36	List of Deviation	-	1	-				
37	List of Start up & Commissioning Spares	-	1	-				
38	List of 2 Year Operational Spares	-	1	-				
39	List of Special Tools & Tackles	-	1	-				
40	List of Mandatory Spares	-	1	-				
41	Vendor Weight Control Data Sheet.	-	1	-				
42	Nozzle Orientation Dwg.	HOLD	-	-				
43	Piping Cleats Details	HOLD	-	-				
44	Platform/Ladder Cleats Details	HOLD	-	-				
Note-1 : Painting spec to be provided later with an addendum to MR for bidder's compliance								

MANGALORE REFINERY AND PETROCHEMICAL LIMITED

EPCM SERVICES FOR INSTALLATION OF LPG AMINE ABSORBER SYSTEM IN PFCC UNIT AT MRPL, MANGALURU

JOB SPECIFICATION

FOR

LPG AMINE CONTACTOR

0	24.06.21	Issued for Quotation	ROK	APH	HAS
Rev.	**Date**	**Description**	**Prpd.**	**Chkd.**	**Appd.**

Triune Energy Services Pvt. Ltd. New Delhi	**Job Specification For LPG Amine Contactor**	**Document Number**	**Rev**
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1.0 INTRODUCTION

MRPL has installed Petrochemical Fluidized Catalytic Cracking (PFCC) unit with a capacity of 2.2 MMTPA. The unit was commissioned in 2014. The process technology was licensed by M/s. Technip Stone and Webster. While processing feed with higher Sulphur content in PFCCU, higher H2S is expected in LPG stream. A New LPG Amine Treatment unit shall be installed to remove the hydrogen sulfide present in the LPG and to minimize the spent caustic generation in existing caustic treatment system.

BDEP was prepared by Technip Stone and Webster and MRPL has selected Triune Engineering Services to provide EPCM services.

2.0 DEFINITIONS

Company / Owner:	Mangalore Refinery and Petrochemicals Limited (MRPL)
Licensor:	Technip FMC
EPCM:	Triune Energy Services Pvt Ltd. (TESPL)
Vendor:	Party with which purchaser has an arrangement for the design, engineering, manufacturing and supply of the items as per this specification.
Sub Vendor:	Party with which Vendor has an arrangement for manufacture and supply etc. of components and / or services.

3.0 INTENT

3.1 The intent of this specification is to define the total responsibility of residual design, engineering, procurement of material with test certificates, manufacturing, assembly, inspection & testing, surface preparation & painting, packaging, guarantee (Performance & Mechanical), supply & transportation at site of following equipment by vendor in compliance with Data sheets, Mechanical Design Basis, project specifications, construction standards and other documents & forms attached with requisition.

This specification with attachments is not to be interpreted as limiting whereby the Vendor is relieved of meeting the requirements specified in Requisition. Any change from Licensor datasheet shall be reported to Owner/ EPCM before proceeding with the Job.

Sr. No.	Description	Orientation	Tag Nos.	Quantity
1	LPG Amine Contactor along with internals & attachments (internal & external)	Vertical	DA-33211	1 no.

3.2 Vendor shall perform residual engineering and design of LPG Amine Contactor. The Vendor shall have single point responsibility to ensure that the residual mechanical design, column internals design, materials, engineering, procurement & testing of materials, method of fabrication, assembly, inspection, testing, painting, packing & transportation and supply, conforming to all applicable codes/ standards, specifications, datasheets and other attachments to this requisition.

3.3 This specification brings out broadly the requirements given in the project specifications, data sheets and other applicable codes / standards referred / attached with the requisition.

3.4 It will be the responsibility of vendor to furnish a complete, safe & defect free equipments. Compliance with this specification shall not relieve vendor from the responsibilities of furnishing equipment and accessories of proper design & performance (Column Internals), materials and workmanship to meet the intended purpose of the project.

4.0 STATUTORY AND REGULATORY AUTHORITY REQUIREMENT

All statutory and regulatory requirement, as applicable, for design, manufacturing of LPG Amine Contactor shall be complied by vendor in order to meet environmental norms.

5.0 ORDER OF PRECEDENCE

In case of any conflict in the requirements specified in the documents attached and / or referenced in the requisition, in general, the following order of precedence of documents accompanying the requisition shall govern:

- Statutory/Regulatory Requirements.
- Licensor datasheet
- Mechanical Data Sheet
- This Specification.
- Other referred/ attached project specification.
- Referred Codes and Standards.

Vendor shall bring to notice of the EPCM / Owner, such conflicts in writing for clarification and confirmation. EPCM / Owner's interpretation in this regard shall be final and binding on the Vendor.

6.0 APPLICABLE CODES AND STANDARDS

LPG Amine Contactor shall be designed, manufactured & assembled, painted, inspected and tested in accordance with the requirements of this specification, data sheet, other referenced specifications and referred international codes & standards /recommended practices together with all current applicable regulations mentioned in the requisition.

Where no code or standard is specified in the Data Sheet, Project Specification and other reference documents, the vendor shall propose applicable codes and/ or

standards on which the vendor's design and manufacturing is based, for review and approval by Owner/ EPCM.

For applicable project specifications, standard specifications, construction standards and other documents, refer list mentioned elsewhere in requisition.

The following is the broad list of applicable International / National Codes & Standards (as on award of job) shall be applicable and made part of this specification.

Code / Standard	Description
ASME Sec. VIII, Div. 1	Design Code - LPG Amine Contactor
ASTM	American Society of Testing and Materials (ASTM)
ASME Sec II	For material specification
ASME Sec. IX	For welding
ASME Sec. V	Non Destructive Examination
ASME B31.3	Chemical Plant and Petroleum Refinery Piping.
ASME B16.20	Metallic Gaskets for Pipe Flanges, Ring joint, spiral wound and Jacketed.
ASME B16.5	Pipe Flanges and pipe Fittings (NPS 1/2 through NPS 24 Metric/Inch Standard)
ASME B46.1	Surface Texture (Surface Roughness, Waviness, and Lay)
NACE MR 0103	Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments.
API-RP 945	Avoiding Environmental Cracking in Amine Units
WRC 537 / 107/ 297	Nozzle load analysis on equipment nozzles
IS: 875 Part III	Wind Load
IS: 1893	Seismic Load

7.0 SCOPE OF SUPPLY AND WORK

7.1 Vendor's scope of supply and work includes, but not limited to, residual mechanical design, column internal design including performance & hydraulic guarantee, material procurement with test certificates, fabrication & assembly, stage wise & final inspection and testing (including NDTs, Hydro test, Pneumatic test), Surface preparation & painting, packaging, preparation for shipment & supply for LPG Amine Contactor as per data sheets, specifications & standards, codes & other project specifications etc. referenced/ attached with this requisition.

7.2 Vendor's scope of supply & services includes, but not limited to, the following items:

i. Complete process & hydraulic design of LPG Amine Contactor internals to arrive on number, type & height of packing required, to guarantee the pressure drop and flexibility of the packing zone, including the packing itself, the packing support and the distributors as per licensor datasheet requirement. Basic dimension (TL-TL Length & Inner Dia.) of Column is final, Internal Vendor to carry out the internal design considering the same.

ii. Supply of LPG Amine Contactor Column in compliance with all Data sheet, Licensor specification, other referenced/attached Specifications/standard, applicable standards and codes mentioned in this requisition.

iii. Supply of Packing, liquid distributer, packing support, bed limiter, Vortex breakers and other internals in compliance with Data sheets, Licensor specification, other referenced/attached Specifications/standard, applicable standards and codes mentioned in this requisition.

iv. Supply & design of all Internal and external accessories indicated on MDS/PDS & specifications.

v. All parts directly welded to equipment.

vi. Cladding and weld overlay as per Specifications / Code

vii. Bolts/nuts, gaskets for internals supplied by column vendor

viii. Support skirt with anchor bolts, nuts and washers (Hot Dip Galvanized) as per mechanical data sheet (supply by others).

ix. Name plate & bracket support.

x. Anchor Bolts template for skirt base ring (supply by others).

xi. Fireproofing cleats, if required

xii. Fireproofing (By others)

xiii. Supply of Lifting trunnion, tailing lug, Earthing lug, Manhole davit, Pipe davit / Top davit, Internal ladder rungs, Fire proofing nuts / support etc.

xiv. Blind flanges together with bolts, nuts and gaskets as applicable.

xv. Fitting for transportation (Clips, Transport saddles etc.)

xvi. Temporary Steel Blind Flanges together with Bolts, Nuts etc. for Transportation

xvii. Residual Mechanical design calculation of Contactor Column including lifting trunnion, tailing lug with Column erection calculation, strength calculation for internals attachment etc on reputed engineering design software such as PV Elite, Compress or equivalent.

xviii. Preparation of general arrangement drawing, detail fabrication drawing showing each component details (i.e. MOC, Internals, supports of internals, welding details, nozzles, name plate, external support detail, earthing lug, lifting lug etc.), empty, operating & hydro test weight with COGs and foundation loads/moments, etc.

xix. Material procurement with test certificates.

xx. PWHT, stress relieving, impact testing, radiography, hydrotest as per applicable design code, specifications referenced/attached with requisition.

xxi. Post Forming Heat Treatment and PWHT (where ever applicable)

xxii. Acid pickling and passivation for all stainless steel surfaces in accordance with specification/code

xxiii. All required NDT & activities to meet requirements of Datasheet, Specifications, Codes and Local regulation and laws such as Stress relief, Normalizing, Impact test, UT, RT, DP/MP, PWHT, MT etc. with tests reports

xxiv. Rust preventive work

xxv. Dynamic Analysis under Transverse Wind Induced Vibration

xxvi. Trial assembly of Column Packing at vendor's shop.

xxvii. Installation & assembly of internals after column erection is in Vendor scope. The price of Installation & assembly of internals shall be included in vendor's base offer.

xxviii. Inspection and testing certificates.

xxix. Approval of residual mechanical design calculations & fabrication drawings from EPCM / Company.

xxx. Submission of all drawings/ documents as per this specification, other specifications and Supplier Data Requirement attached with this requisition.

xxxi. ITP attached with MR gives overall guidelines. The Vendor shall develop ITP for each equipment with respect to all specific requirements as applicable to ensure compliance with code, specification and Inspection requirement table attached with this MR. Vendor's ITP is subject to approval by EPCM / Owner.

xxxii. Third party inspection (TPI) by EPCM / Owner appointed/approved TPI agency. However Vendor to provide requisite facilities to carry out the same at Vendor/ sub-vendor premises.

xxxiii. Mandatory, start-up and commissioning spares shall be minimum as per EDB-0010 (Design Basis for Static Equipments) and EDB-0013 (Design Basis for Spare Parts). List of these spares shall be submitted along with proposal.

xxxiv. List of recommended spares with price for two years (2 years) of smooth, continuous & normal operation shall be submitted along with proposal. Validated period for the price shall also to be mentioned in the price list.

xxxv. Vendor to consider 100 Kgs in base offer for the external welded attachments (i.e. Platform / Ladder cleats, piping cleats, fire proofing cleats etc. as applicable). For Addition & deletion vendor to provide per Kg rate for the same.

xxxvi. Vendor to provide unit rate for addition/deletion of Nozzles from size 2" NB WNRF up to 24" NB WNRF for class 300# and 600# rating nozzles.

xxxvii. Special tools & tackles, as required. List shall be submitted along with proposal.

xxxviii. Surface preparation and painting as per Painting Specification attached with requisition.

xxxix. Marking, packing and preparation for shipment.

xl. Quality Assurance and Quality Control Program.

xli. Overall time schedule

xlii. Residual Mechanical design, material & workmanship guarantees.

xliii. Process & hydraulic guarantee.

xliv. Supply of equipment along with other materials to purchaser designated place. Transportation of the column shall be supplied in the single piece up to the site designated place.

xlv. Vendor to provide the separate cost for the base price of equipment & separate price of equipment transportation up to the site / purchaser designated place, including the transportation route survey from the Vendor shop to the MRPL site. This includes survey of the overhead bridges of ISBL (MRPL site)

xlvi. Preparation of transportation drawing with calculation showing all forces and moments applicable on Contactor Column during transportation considering low bed hydraulic operating trailer and other requirement as per transportation route survey. Same shall be submitted by Vendor along with the Bid

8.0 TECHINCAL & DESIGN REQUIREMENTS

8.1 LPG Amine Contactor shall be designed as per requirements of latest ASME Sec. VIII Div. 1.

8.2 Material of construction for equipment shall be as per Data sheet, standards/ specifications attached with requisition. Vendor may propose superior alternative material; however final decision shall be by Owner / EPCM.

8.3 All material used shall be new and of first quality and shall be duly supported with material test certificates from the original material manufacturer. Complete chemical composition of all elements including the impurities shall be reported in the test certificates.

8.4 All necessary accessories such as supports, blind flanges, test gaskets, bolts, nuts etc. shall be provided and supplied by the Vendor for testing of LPG Amine Contactor in Vendor's shop and for subsequent testing by Owner at site, whenever required.

8.5 All sharp corners, edges, inside / outside the vessel shall be rounded off.

8.6 Nozzle welding shall be set in type with full penetration weld. Reinforcement pad to nozzle welding shall be full penetration complete with fillet weld.

8.7 All welds shall be full penetration weld and back chipped to sound metal from other side in case other side is inaccessible, root run shall be made by TIG welding.

8.8 Reinforcement pads (as applicable) for nozzles and for internal or external structural attachments to vessel shells shall be provided with 1/4" NPT vent hole and shall be pneumatically tested at a pressure of 1.05 Kg/cm2 (g). External vent holes shall be plugged with a plastic sealant / corrosion resistant hard grease after the vessel has been tested.

8.9 Unless otherwise specified, Heat treatment for equipment, wherever applicable shall be done in the single heat.

8.10 No welding is permitted after PWHT / Stress reliving.

8.11 Allowable stress intensity factor for comparison of stresses at the juncture of nozzle & shell and reinforcement pad edge, as applicable, due to piping loads / moments shall be taken from ASME Sec. VIII Div.2.

8.12 Equipment shall be provided with suitable bracing / stiffeners to avoid any damage during transportation and erection at site. (Vendor shall furnish the details for EPCM / Company approval).

8.13 All process nozzles shall be capable of withstanding the piping loads.

8.14 Local Load analysis for all process nozzles shall be carried out as per WRC 537/107 / 297. Unless otherwise specified standard piping load shall be considered as mentioned in Mechanical Design Basis (9680-02-DB-001)

8.15 Wind load and Seismic loads shall be considered during design of Equipment as per codes & standards specified elsewhere in this specification.

8.16 Site conditions such as ambient data, basic wind speed etc. shall as specified elsewhere in this requisition.

8.17 Manufacturing activities shall start only after approvals are obtained by vendor for documentation requiring EPCM approval and/or Owner's approval.

8.18 Welding wherever carried out shall be done by qualified and ASME approved welders using the suitable fillers and fluxes.

8.19 All non-pressure parts welded to the pressure parts, such as clips, supports etc. shall be of same material as that of the pressure parts. Otherwise a pad of same MOC as that of pressure part with at least 25mm wider and longer than the attachment and shall be provided between pressure part and its attachment.

8.20 Equipment shall be hydrotested as per design code in such a way that during hydrotest, tensile stress in the equipment and its supports shall not exceed 90% the

yield strength of the material. Provision of local support to reduce the hydrotest stresses is not acceptable. Unless otherwise specified, duration of hydrotest shall be one-hour minimum. After hydrotest equipment shall be fully drained and dried by means of blowing dry air. Equipment shall be checked for corroded condition in erected condition at site.

8.21 Water used for hydrotest shall be of potable quality & should contain rust inhibitor (e.g. 0.2% of Sodium nitrate), Test water should not contain chloride contents more than 30ppm.

8.22 Vendor shall be responsible for taking adequate preventive measures to ensure the quality and finish of materials and to avoid any rusting.

8.23 Lifting lugs shall be designed considering impact factor of minimum 2.

8.24 Cladding / Weld overlay shall be as per Mechanical Design Basis (9680-02-DB-001) & Data sheets.

9.0 PROTECTIVE COATING

Surface preparation and painting shall be carried out as per painting specification attached with requisition.

10.0 INSPECTION AND TESTING

10.1 Vendor shall be responsible for the Quality assurance and Quality control for LPG Amine Contactor.

10.2 Vendor shall refer 'Inspection Requirement table' attached with the requisition for inspection and test requirements.

10.3 Vendor shall generate Inspection and Test Plan (ITP) covering complete details of all required inspection and tests in consolidated form, within two (2) weeks of placement of Purchase Order/ Letter of Intent and shall obtain Owner/ EPCM approval. Vendor shall prepare 'Inspection & Test plan' for the equipment and sub-vendor items under his supply scope covering all required inspection and tests in line with the requirements specified in data sheets, job specification and other specification attached/referred in the requisition. Procurement and manufacturing activities shall only be taken up by vendor after approval of ITP from EPCM/Owner.

10.4 Vendor shall be responsible for carrying out all required inspection, tests and checks as per the approved ITP. However the following are the minimum test required for LPG Amine Contactor:-

- Radiography as mentioned in data sheet / specifications attached with requisition.
- NDE tests (PMI, DP, MP, UT, Hardness, Radiography)
- Visual inspection for dimensional check, nozzles, equipment support, etc.
- Material test certificate review.
- Pneumatic test of all reinforcement pads.
- Hydrotest of complete equipment.

- PWHT
- Impact test, as applicable.
- Other test as mentioned in attachment of requisition.

10.5 Vendor shall coordinate / cooperate with EPCM / Owner's inspector / Inspection agencies during equipment inspection procedure. Vendor shall carryout various tests as per approved ITP.

10.6 Owner / its authorized representative shall have access to inspect the equipment at any stage during manufacture. Owner shall specify hold points / witness points while approving ITP. During inspection, material certificates, shop test data, certificates for bought out components and other relevant information shall be furnished for Owner's perusal so as to ascertain that the specifications and quality are complied with.

10.7 Vendor shall have the responsibility of providing requisite facilities including all necessary equipment & accessories to the Owner/ Owner's representative for carrying out the inspection at vendor's/ sub-vendor's premises.

10.8 Vendor shall ensure that a written advance notice reaches the Owner at least 15 days prior to the equipment getting ready for inspection and testing and a written reconfirmation reaches the Owner at least 7 days prior to actual date of inspection/ test.

10.9 The witnessing and/or acceptance of inspection and tests by Owner or their authorized representatives shall not relieve the vendor from his responsibilities of furnishing proper equipment nor shall it relieve the vendor / Vendor of any guarantees/ warrantees or other contractual obligations.

11.0 DEVIATION

Vendor shall make all possible efforts to comply with the requirements of this requisition. In case deviation is considered essential by the vendor, these shall be clearly brought out with reasons/recommendations and furnished in consolidated form in the format "List of Deviation" attached with requisition for EPCM/owner's review and acceptance. Owner's interpretation in this regard shall be final and binding on the vendor. Deviations to the requirement of requisition shall not be permitted except for those accepted in writing by EPCM/Owner.

12.0 SPARE PARTS AND SPECIAL TOOLS

12.1 Start-up and Commissioning Spares

Vendor to provide all required Installation, Start-up and Commissioning Spares for each equipment. List of these spares shall be submitted in the attached format along with proposal. The price for these spares shall be included in vendor's base offer. Any shortfall of these spares during installation, start-up & commissioning shall be replenished by the vendor without any cost & time implication to Owner. Minimum spare shall be as per EDB-0010 (Design Basis for Static Equipments) and EDB-0013 (Design Basis for Spare Parts).

However, Vendor to supply minimum as spares as follows:

Bolts/Nuts (Internals):	10% of total for each type/size (min. 10 no. of each size)
Clamps assemblies (Internals):	10% of total for each type/size (min. 10 no. of each size)
Gasketing or tapes (Internals):	100% of each type/size
Tower Packing:	10% of each type and size
Gaskets:	100% (For Manways and nozzles with blind Flange)
Bolting:	10% (Min. two in each size) of Installed fasteners

12.2 **Mandatory Spares**

All required mandatory spares shall be supplied by vendor for equipment being supplied by them as per the requirements specified in EDB-0010 (Design Basis for Static Equipments) and EDB-0013 (Design Basis for Spare Parts). List of all these spares shall be submitted in the attached format along with proposal. The price for these spares shall be included in vendor's base offer.

However, Vendor to supply following minimum as mandatory spares:

Bolts/Nuts (Internals):	10% of total for each type/size (min. 10 no. of each size)
Clamps assemblies (Internals):	10% of total for each type/size (min. 10 no. of each size)
Gasketing or tapes (Internals):	100% of each type/size
Tower Packing:	25% of each type and size
Gaskets:	200% for each installed gasket
Bolting:	10% (Min. two in each size) of Installed fasteners

12.3 **Two (2) Years Normal Operational Spares**

Vendor to recommend and furnish only the list of spares with price required for two (2) year normal, smooth and safe operation of the each equipment. Separate quote for these spares is required along with proposal. Validity period for price of these spares shall also to be mentioned.

12.4 All spare parts shall be wrapped and packaged to preserve the parts as in original condition. The same parts shall be properly tagged using stainless steel tags and coded so that later identification as to their intended equipment usage will be easily facilitated.

12.5 All items supplied shall be packaged separately and clearly marked as “Spare Parts”. Packing lists shall be furnished complete and in detail so that parts can be handled without uncrating.

12.6 Vendor shall provide a list of relevant special tools & tackles for installation and maintenance of the LPG Amine Contactor, as applicable. List of special tools shall be submitted along with proposal. The price of these special tools & tackles (if required) shall be included in vendor’s base offer

13.0 PACKING AND FORWARDING

13.1 All items and materials supplied shall be wrapped and suitably protected to prevent any damage during transportation. Vendor shall ensure rust preventive work as applicable. Equipments which are transported by sea shall have sea-worthy packing. Packing should be suitable for the specified duration in the existing climatic conditions at the site. Packing list shall be attached at the outside of the crate as per standard practice and one packing list shall be placed inside the box. Column shall be transported in single piece.

13.2 All nozzles and similar openings shall be covered by wooden or metal blanks and securely bolted, using suitable gasket material, to ensure a watertight joint. All the threaded connections (as applicable) must be plugged or capped.

13.3 Unless otherwise specified, the shipment shall be protected for outdoor storage of 6 months at site. If any extra precaution is required for storage beyond 6 months the same shall be explicitly indicated in the operation and maintenance manuals.

13.1 Packaging of spare parts shall be suitable for long period storage and same shall be indicated in the vendor’s proposal with special instructions, if any, required to facilitate the same.

13.4 The package along with spares and other accessories shall be transported at site as per the instructions of the Owner.

14.0 VENDOR DATA REQUIREMENTS

14.1 Vendor shall include in his scope, all documents and drawings required during detail engineering as minimum mentioned in Supplier Data requirement (SDR) and other specification attached with the requisition.

14.2 Vendor shall submit consolidated document list/ schedule for all drawings/documents indicating title, document number, submission dates and category such as review/approval/information, within 2 weeks after receiving the order, for review to Owner/EPCM.

14.3 The Vendor drawings/ documents shall be reviewed by Owner/ EPCM/ its authorized representative. Vendor shall ensure to comply with all the requirements of Owner and shall incorporate all required changes based on their comments without any cost and / or delivery implications to the Owner.

14.4 Vendor to note that drawings and document shall also be submitted for review to Owner/EPCM as per the requirement specified in the requisition. Owner/EPCM comments shall be incorporated without any cost and time implication to Owner.

14.5 As built drawings, inspection and test reports and other relevant documents, as covered in Supplier Data Requirements shall be submitted as part of Equipment Data Folder.

14.6 All drawings/documents shall be thoroughly checked and duly signed before submission to Owner / EPCM. Unchecked drawings and documents without revisions clearly marked shall be returned unapproved.

14.7 Owner / EPCM approval of Vendors drawing/ documents shall not relieve the Vendor / Vendor of his contractual obligations / responsibilities.

14.8 Vendor shall be responsible for any discrepancies, errors or omissions in the drawings/ documents prepared by vendor, even if these have been approved / reviewed by the EPCM / Owner. Review of Vendor's documents by EPCM / Owner does not relieve Vendor of his responsibility for correctness of design and supply. If any such errors or omissions are discovered later, that shall be made good, by vendor, at his sole expense.

14.9 All documents, drawings, manuals, reports and written instructions shall be in the English language. Metric System units shall be used, unless otherwise specified.

14.10 Unless otherwise specified, Vendor shall furnish minimum three number of DVD/CD containing soft copy of Manufacturer's Data Book and 6 complete set in hard binders of Manufacturer's Data Book including certified prints, data for all items and test reports. Index of Manufacturer's Data Book shall be submitted for review to Owner.

14.11 For drawing, data sheet and all graphic works latest version of AUTOCAD and for all texts, MS Word shall only be used.

14.12 Document/drawing numbering and document/drawing templates shall be as applicable for this project and provided by Owner/EPCM to successful vendor.

14.13 Vendor drawings/documents shall indicate the following as minimum:

i) Owner, EPCM, Vendor Name with Logo
ii) Project No.
iii) Client's Purchase Order No.
iv) Drawing Number
v) Rev. number with revision history
vi) Revision marking
vii) Reference Document No. etc.

15.0 GUARANTEE / WARRANTY

15.1 The Vendor shall be completely responsible for the compliance to licensor data sheet, MDS, this specifications requirement, other referenced standard &

specification, code requirements, residual mechanical design, hydraulic of internals (process design), detailed engineering, fabrication, materials and workmanship of the LPG Amine Contactor as per the stipulations of the requisition and its attachments. In this regard, it may be noted that review by Owner/EPCM shall not relieve the Vendor of his responsibility of meeting all requirements and ensuring satisfactory performance of the equipment. Performance guarantee shall be as per Process Data Sheets & licensor specification enclosed with requisition.

15.2 Vendor shall replace all material and/or part (at his expense) that are found to be faulty or which do not meet the specified requirements during the guarantee period. In case the need arises, Vendor shall also depute an experienced service representative to supervise the necessary repairs and replacements. The guarantee period shall be as specified in the commercial document.

MANGALORE REFINERY AND PETROCHEMICALS LIMITED

EPCM SERVICES FOR INSTALLATION OF LPG AMINE ABSORBER SYSTEM IN PFCC UNIT AT MRPL, MANGALURU

SUPPLIER DATA REQUIREMENTS FOR LPG AMINE CONTACTOR

Rev.	Date	Description	Prpd.	Chkd.	Appd.
0	24.06.21	Issued for Quotation	ROK	APH	HAS

SUPPLIER DATA REQUIREMENT

GENERAL INSTRUCTIONS

1 **LANGUAGE**

All Correspondences, drawings, calculations, engineering data etc. shall be in English.

2 **MEASUREMENT UNITS**

All dimensions shown on documents (such as lengths, diameters, elevations, thicknesses, corrosion allowances etc.) and all other data (such as pressures, temperatures, weights, volumes etc.) shall be in metric, except that for pipe sizes and ratings, where customary units shall be used.

3 **DOCUMENT IDENTIFICATION**

All documents including those of sub-suppliers' shall be identified with the following label located in or adjacent to supplier's standard title box showing document no.,revision,date, signatures etc.

4 **REVISION IDENTIFICATION**

All revisions shall be identified with proper revision marks.

6 **PRINT / SOFT COPIES**

a) All drawings shall be prepared on Auto CAD and drawn to scale to the maximum extent possible.

b) All final documents in CD are required to be submitted.

Remarks:

Rem.1 :- Supplier data / documents requirement mentioned in this document is minimum. During detailed design / review any other document / data etc required related to processing of the job for completion of engineering activity as required shall be furnished by bidder on request.

SUPPLIER DATA REQUIREMENT

Sl.No	Description	With Bid (Note-1)	After Notification Of Award (Note-1)					
			For Review		For Infor. / Records		With Data Book (Final)	
			Soft Copy	Wks.	Soft Copy	Wks.	Soft / Hard Copy	Wks.
1	Overall delivery schedule (indicating engineering, procurement, manufacturing / fabrication, inspection/ testing & shipment)	-	-	-	✓	2	-	-
2	List of deviations, if any, to documents enclosed in MR, referred standard / specifications	✓	-	-	-	-	-	-
3	Vendor reference list for the items	✓	-	-	-	-	-	-
4	Progress reports	Monthly						
5	QA & QP, Inspection test plan (ITP)	✓	✓	2	-	-	✓	*
6	Start up and Commissioning Spare Part List	✓	-	-	✓	4	✓	*
7	List of Special tools and tackles, if required.	✓	-	-	✓	4	✓	*
8	Spare parts list required for 2 year normal operation.	✓	-	-	✓	4	✓	*
9	Mandatory spare part list	✓	✓	4	-	-	✓	*
10	Vendor Drawing/document schedule, Engineering/ Procurement/ Manufacturing schedule.	-	-	-	✓	2	✓	-
11	List of sub-vendor's items.	-	-	-	✓	2	-	-
12	Preliminary GA Drawing indicating sketch of equipment, design parameters, general notes, nozzle table, MOC of major components, weights - empty, operating & hydrotest with COGs, foundation loads / moments.	✓	-	-	-	-	-	-
13	Transportaion drawing along with the route survey report	✓	-	-	-	-	-	-
14	Mechanical Design Calculation (i.e. Residual Design & Engineering Calculation {strength calculation, support calculation, transportation calculation, WRC analysis, lifting/tailing lug etc}.)	-	✓	4	-	-	✓	*
15	Vendor Datasheet / Specification for Internal Packings		✓	4	-	-	✓	*
16	Internals Design Calculation (Mechanical & Performace).		✓	4	-	-	✓	*
17	Detail drawings of Internals & Attachments		✓	4	-	-	✓	*
18	General Arrangement Drawing indicating sketch of equipment, design parameters, general notes, nozzle table, nozzle orientation, reference drawings, MOC of major components, weights - empty, operating & hydrotest with COGs, foundation loads / moments etc.	-	✓	4	-	-	✓	*

SUPPLIER DATA REQUIREMENT

Sl.No	Description	With Bid (Note-1)	After Notification Of Award (Note-1)					
			For Review		For Infor. / Records		With Data Book (Final)	
			Soft Copy	Wks.	Soft Copy	Wks.	Soft / Hard Copy	Wks.
19	Fabrication drawing showing each component detail, all welded joints, internals & internals arrangement detail, internal & external attachments details, bill of material, fireproofing cleats/ring/nuts details, Ladder/Plattform & Piping Cleat attachment details, name plate drawing, Anchor bolt template drawing, foundation support location and details etc.	-	✓	4	-	-	✓	*
20	Procedure for Hydrostatic test duly approved by inspecting authority	-	-	-	✓	6	✓	*
21	Welding procedures and performance records duly approved by inspecting authority and welder qualification records	-	-	-	✓	8	✓	*
22	Installation, Operation, Maintenance Index & Manual.	-	-	-	✓	10	✓	*
23	Surface Preparation and Painting Procedure	-	-	-	✓	6	✓	*
24	Heat treatment Procedures duly approved by inspecting authority	-	-	-	✓	6	✓	*
25	Test reports, Material Certificates & Test Certificates etc. duly stamped by inspecting authority	-	-	-	-	-	✓	*
26	Site Preservation Procedure	-	-	-	✓	6	✓	*
27	Packaging & Rust prevention procedure	-	✓	8	-	-	✓	*
28	Packaging and forwarding instructions	-	✓	8	-	-	✓	*
29	Guarantee / Warranty certificate	-	-	-	-	-	✓	*
30	As-built drawings and documents	-	-	-	-	-	✓	*
31	Equipment Data Folder	-	-	-	-	-	✓	*
	(*) Note - 3							

Notes:

1) **Drawings / Documents marked with "✓" shall be furnished by the bidder.**
2) **In addition to above documents specified, Vendor to submit others documents specified in applicable specification attached/ referred in the material requisition.**
3) **-'*' Final Documents shall be submitted within 2 (two) weeks of completion of final inspection & testing. Final documentation shall be submitted in hard copy (Six prints of each drawing / document) and Soft copy (2 nos. CDs/DVDs).**
4) **Post order, drawings / documents review shall commence only after approval of Document Control Index (DCI).**
5) **Bill of material shall form part of the respective drawings.**
6) **Bidder shall also submit the drawings / documents as specified in other department's SDR or requirements given in Data sheet / specifications.**

MANGALORE REFINERY AND PETROCHEMICALS LIMITED

EPCM SERVICES FOR INSTALLATION OF LPG AMINE ABSORBER SYSTEM IN PFCC UNIT AT MRPL, MANGALURU

INSPECTION REQUIREMENT TABLE FOR LPG AMINE CONTACTOR

0	24.06.21	Issued for Quotation	ROK	APH	HAS
Rev.	**Date**	**Description**	**Prpd.**	**Chkd.**	**Appd.**

Triune Energy Services Pvt. Ltd. New Delhi	**INSPECTION REQUIREMENT TABLE FOR LPG AMINE CONTACTOR**	**Document Number**	**Rev.**
		9680-02-IRT-201	**0**
		Sheet 1 of 2	

Excel

INSPECTION REQUIREMENT TABLE

Req. No.	**9680-02-IRT-201**	**Job No.**	**9680**
Project	**EPCM SERVICES FOR INSTALLATION OF LPG AMINE ABSORBER SYSTEM IN PFCC UNIT AT MRPL, MANGALURU**	**Item**	**LPG AMINE CONTACTOR (DA-33211)**
Purchaser	**-**	**Owner**	**MANGALORE REFINERY AND PETROCHEMICALS LIMITED**

INSPECTION CATEGORY-B

ACTIVITY	1. Inspection by MRPL / MRPL appointed TPI Agency	2. Inspection by EPCM	3. Inspection by Vendor / Sub-Vendor	4. Certificates / Data to be Submitted by Vendor / Sub-Vendor for Review/Approval	Stages of Inspection Involved
BEFORE START OF FABRICATION					
1	A	A	H	X	Quality Plan (QP)
2	R	R	H	X	Review of Material test certificates, Material Identification
3	R	R	H	X	Review of Welding documents like WPS, PQR, Welders qualification records and NDT, personnel qualification record
4	R	R	H	X	Review of certificates for sub-ordered items
CHECKS AND TESTS DURING MANUFACTURING					
5	R	R	H	X	Verification of availability of WPS, PQR, WPQ.
6	R	R	H	X	Material Traceability of All Materials
7	R	R	H	X	Visual inspection (i.e. Overall dimensions, thickness, profiles, thinning of dished end and fouling of internal / external attachments etc.)
8	R	R	H	X	NDT tests (DP, MP, UT, PMI, Hardness, Radiography) and reports.
9	R	R	H	X	Conformation to codes, standards & Approved drawings
10	R	R	H	X	Weld Joint fit-up inspection
11	R	R	H	X	Weld Visual Inspection
12	R	R	H	X	Intermediate & Final Inspection Cladding & Weld overlay
13	R	R	H	X	Heat treatment procedures, Heat charts and Hardness testing on welding (as required).
14	R	W	H	X	Inspection of internals including packing, internals assembly, internal / external parts.
15	R	W	H	X	Pneumatic test of RF pads
16	R	W	H	X	Hydrostatic test (before painting).
FINAL ASSEMBLY					
17	R	W	H	X	Trail assembly of internals
18	R	R	H	X	Surface preparation and Painting as per Owner's painting specifications.
19	R	R	H	X	Spares parts, Special tools (if any)
20	R	R	H	X	Review of items for cleanliness, openings covered or plugged, rust preventatives applied.
21	R	R	H	X	Review of equipment thorough dryness, clean & free from loose scale and any foreign material before shipment.
22	R	R	H	X	Final Package inspection for completeness during / after packaging-tagging, preservation, packing including spares
23	R	R	H	X	Final Documentation review and issue of inspection release note.

Legend:

H - Hold
A - Approval
RW- Random Witness
IRN- Inspection Release Note
W - Witness
TPI- Approved Third Party inspection agency
I - Information
R - Review
X - Submission of Supporting Documents
CA - Certifying Agency
IMIR- Inward material inspection report

Note: 1 - Inspection Categories

Cat. A : Stage wise and final inspection shall be carried out by EPCM for the items categorized in this category. In addition MRPL appointed TPI agency will also carry out final stages of inspection as indicated in QP. Inspection report/ Release notes shall be submitted to MRPL / EPCM to obtain clearance of Inward Material Inspection Report (IMIR). Vendor will forward approved IMIR to CA/MRPL.

Cat. B : Stage wise and final inspection shall be carried out by EPCM for items under this category as per approved QP. Inspection report/ Release notes shall be submitted to MRPL / EPCM to obtain clearance of Inward Material Inspection Report (IMIR). Vendor will forward approved IMIR to CA/MRPL.

Cat. C : Items under this category shall be inspected by EPCM. Inspection report/ Release notes shall be submitted to MRPL / EPCM to obtain clearance of Inward Material Inspection Report (IMIR). Vendor will forward approved IMIR to CA/MRPL.

SHOP FABRICATED PRESSURE VESSELS

1 THIS INSPECTION AND TEST PLAN(ITP) GIVES OVERALL GUIDELINES. THE VENDOR SHALL DEVELOP ITP FOR EACH EQUIPMENT WITH RESPECT TO ALL SPECIFIC REQUIREMENT AS APPLICABLE TO ENSURE COMPLIANCE WITH CODE, SPECIFICATION AND/ OR CONTRACTUAL REQUIRMENTS. VENDOR'S ITP IS SUBJECT TO APPROVAL BY TESPL & CLIENT.

2 VENDOR SHALL CARRYOUT 100% INSPECTION FOR COMPLIANCE WITH REQUIREMENTS OF PURCHASE ORDER AT EVERY STAGE OF MANUFACTURING AND SHALL MAINTAIN RECORDS/ DOCUMENTS OF ALL THE INSPECTION/ TESTS CARRIED OUT.

THE VENDOR SHALL SATISFY HIMSELF ABOUT THE ACCEPTABILITY OF THE ITEM BEFORE OFFERING THE ITEM FOR INSPECTION BY TESPL.

3 AS NOTATIONS FOLLOWED IN ITP ARE AS BELOW.

P- P=INSPECTION AGENCY WHICH PERFORMS THE TEST & CARRYOUT INSPECTION.
W- W=INSPECTION AGENCY WHICH WITNESS THE TEST & CARRY OUT INSPECTION.
V=INSPECTION AGENCY WHICH VERIFY/ REVIEW THE DOCUMENTS.
I- 1=VENDOR/ SUB VENDOR, 2=TESPL/ TPI, 3=CLIENT.
IR- IR=INSPECTION REPOR TC=TEST CERTIFICATE.

4 EXTENT OF INSPECTION BY CLIENT SHALL BE AS DEFINED IN THE SPECIFIC PURCHASE ORDER. CLIENT RESERVE THE RIGHT TO REVIEW/ INSPECT/ WITNESS ANY STAGE OF INSPECTION.

5 CATEGORY-A; THIRD PARTY INSPECTION AGENCY(TPI) APPOINTED BY LSTK CONTRACTOR SHALL CARRY OUT STAGE WISE & FINAL INSPECTION INCLUDING REVIEW OF RECORDS. PMC/ OWNER SHALL WITNESS INSPECTION OF CRITICAL STAGES & FINAL INSPECTION.

CATEGORY-B; THIRD PARTY INSPECTION AGENCY(TPI) APPOINTED BY LSTK CONTRACTOR SHALL CARRY OUT STAGE WISE & FINAL INSPECTION INCLUDING REVIEW OF RECORDS. PMC/ OWNER SHALL WITNESS FINAL INSPECTION & REVIEW OF RECORDS.

CATEGORY-C; THIRD PARTY INSPECTION AGENCY(TPI) APPOINTED BY LSTK CONTRACTOR SHALL CARRY OUT FINAL INSPECTION

Rev.	Date	Description	Prpd.	Chkd.	Appd.
2	14.02.2013.	Revised due to change of name of organization & issued for implementation	SOAR	UCV	RPS
1	21.05.2009	Revised due to change of name of organization & issued for implementation	U.C.V.	SGJ	RPS
0	08.06.2000	Issued for Implementation.	Mukesh	Sayal	P.K.Sayal

SL.NO	COMPONENT & OPERATION	CHARACTERISTICS TO BE CHECKED	CLASSIF-ICATION	TYPE OF CHECK	QUANTUM OF CHECK BY TESPI	REF. DOCUMENT/ ACCEPTANCE NORMS	TYPE OF RECORDS	INSPECTION AGENCY		
								P	W	V
1.0	RAW MATERIAL									
1.1	PRESSURE PARTS (SHELL PLATE, DISH-ED ENDS, PIPES, NOZZLES, FLANGES & FITTINGS.)	A)PHYSICAL & CHEMICAL PR-OPERTIES	MAJOR	IDENTIFICATI-ON & COREL.	100%	RELEVANT STD & SPECS.	TC	1	2	
		B) SURFACE DEFECTS	MAJOR	VISUAL	100%	RELEVANT STD & SPECS.	IR	1	2	
		C)DIMENSIONS	MAJOR	MEASUREMENT	100%	RELEVANT STD & SPECS.	IR	1	2	
		D) TRANSFER OF MATERIAL IDENTIFICATION MARKING	MAJOR	VISUAL	100%	RELEVANT STD & SPECS.	IR	1	2	
1.2	NON PRESSURE PARTS	A)PHYSICAL & CHEMICAL PR-OPERTIES	MINOR	IDENTIFICATI-ON & COREL.	RANDOM	RELEVANT STD & SPECS.	TC	1		2
		B)SURFACE DEFECTS	MINOR	VISUAL	RANDOM	RELEVANT STD & SPECS.	IR	1		2
		C)DIMENSIONS	MINOR	MEASUREMENT	RANDOM	RELEVANT STD & SPECS.	IR	1		2
2.0	IN PROCESS CONTROL									
2.1	WELDING	WPS, PQR, WQT, BATCH CERTI-FICATES OF CONSUMABLE, BAKING OF ELECTRODE, PRE HEAT, ETC.	MAJOR	REVIEW/ TESTI-NG.	100%	ASME SEC-IX.	FORMATS	1	2	2
2.2	DISHED ENDS AFTER FORMING & PWHT	DIMENSIONS & SURFACE DEFECTS	MAJOR	MEASURMENT	100%	APPD. DRGS.	IR	1	2	
		DP AT KNUCKLE PORTION	MAJOR	PT	100%	ASME SEC-V				
2.3	FIT UP OF L-SEAM, NOZZLES TO FLA-NGES & SHELL, SKIRT TO SHELL, RF PADS, SADDLES, INTERNALS & EXTERNALS	DIMENSIONS & ALIGNMENTS	MAJOR	MEASURMENT & VISUAL	100%	APPD DRGS, CODES & SPEC.	IR	1	2	

SL.NO	COMPONENT & OPERATION	CHARACTERISTICS TO BE CHECKED	CLASSIFICATION	TYPE OF CHECK	QUANTUM OF CHECK BY TESPI	REF. DOCUMENT/ ACCEPTANCE NORMS	TYPE OF RECORDS	INSPECTION AGENCY		
								P	W	V
2.4	BACK GOUGING/ GRINDING DOUB-LE SIDED WELDED JOINTS	FREE FROM DEFECTS AND UNSOUND WELD MATL.	MAJOR	PT	RANDOM	APPD DRGS, WPS, CODES & SPECS.	IR	1	2	
2.5	WELDS	SOUNDNESS	MAJOR	VISUAL	100%	APPD. DRGS, CODES & SPEC.	IR	1	2	
				RT	100%	APPD. DRGS, CODES & SPEC.	IR	1		2
				PT/ MT	RANDOM	APPD. DRGS, CODES & SPEC.	IR	1	2	
				UT	100%	APPD. DRGS, CODES & SPEC.	IR	1	2	
				HARDNESS	RANDOM	APPD. DRGS, CODES & SPEC.	IR	1	2	
				AIR LEAK TEST OF RF PAD	100%	APPD. DRGS, CODES & SPEC.	IR	1	2	
				MECH TEST ON PROD TEST COUPONS	100%	APPD. DRGS, CODES & SPEC.	IR	1	2	
				VERIFICATION OF WELDERS STAMP	RANDOM	APPD. DRGS, CODES & SPEC.	IR	1	2	
2.6	PWHT	A)COMPLETENESS OF ALL WELDING WORK	MAJOR	VISUAL & REVI-EW OF DOCUM-ENTS	100%	APPD. DRGS, CODES & SPEC.	IR	1		2
		B)LOCATION OF THERMOCOPLES	MAJOR	VISUAL	100%	PWHT PROCEDURE	IR	1	2	

SL.NO	COMPONENT & OPERATION	CHARACTERISTICS TO BE CHECKED	CLASSIFICATION	TYPE OF CHECK	QUANTUM OF CHECK BY TESPI	REF. DOCUMENT/ ACCEPTANCE NORMS	TYPE OF RECORDS	INSPECTION AGENCY		
								P	W	
		C)CORRECTNESS OF PWHT CYCLE	MAJOR	REVIEW & SIGN-ING OF PWHT CHART BEFORE UNLOADING FROM FURNACE	100%	PWHT PROCEDURE	TIME-TEMP. CHART	1		
		D)NDT AFTER PWHT	MAJOR	RT, PT	100%	APPD. DRGS, CODES & SPEC.	IR	1	2	
				UT, MT & HARDNESS TEST		APPD. DRGS, CODES & SPEC.	IR	1	2	
				(IF APPLICABLE)		APPD. DRGS, CODES & SPEC.	IR	1	2	
3.0	FINAL INSP.									
3.1	COMPLETED EQUIPEMENT	DIMENSIONS, NOZZLE ORIE-NTATION/ LOCATION	MAJOR	MEASUREMENT	100%	APPROVED DRGS.	IR	1	2	
		SURFACE & WELD CHECK	MAJOR	VISUAL	100%	APPD. DRGS, CODES & SPEC.	IR	1	2	
3.2	HYDROSTATIC TEST									
	TEST MEDIA	CHLORIDE CONTENT OF WATER	MAJOR	REVIEW/ TESTIN(	100%	APPD. DRGS, CODES & SPEC. APPD. PROCEDURE.	IR	1		
	TEST GAUGES	CALIBRATION OF TEST GAUGES	MAJOR	REVIEW/ TESTIN(	100%	SPECS.	IR	1		
	PRESSURISATION	LEAK TIGHTNESS	CRITICAL	VISUAL	100%	APPD. DRGS, CODES & SPEC.	IR	1	2	

SL.NO	COMPONENT & OPERATION	CHARACTERISTICS TO BE CHECKED	CLASSIFICATION	TYPE OF CHECK	QUANTUM OF CHECK BY TESPI	REF. DOCUMENT/ ACCEPTANCE NORMS	TYPE OF RECORDS	INSPECTION AGENCY		
								P	W	
3.3	PRE DESPATCH	INSIDE/ OUTSIDE CLEANING AFTER HYDROTEST AND PICKLING/ PASSIVATION OF SS EQUIPMENTS	MAJOR	VISUAL	100%	APPD. DRGS, CODES & SPEC.	IR	1	2	
		PAINTING(SURFACE PREPAR-ATION, DFT, WORKMANSHIP)	MAJOR	VISUAL	100%	APPD. DRGS, CODES & SPEC.	IR	1	2	
		NAME PLATE DATA CHECK & STAMPING OF INSPECTOR STAMP	MAJOR	VISUAL	100%	APPD. DRGS, CODES & SPEC.	IR	1	2	
		MANUFACTURER DATA REPORT	MAJOR	REVIEW	100%	APPD. DRGS, CODES & SPEC.	REPORT	1	2	
		DESPATCH CLEARANCE NOTE	MAJOR		100%	PURCHASE ORDER	REPORT	2		

MANGALORE REFINERY AND PETROCHEMICAL LIMITED

EPCM SERVICES FOR INSTALLATION OF LPG AMINE ABSORBER SYSTEM IN PFCC UNIT AT MRPL, MANGALURU

MECHANICAL DESIGN BASIS

A	04.06.2021	ISSUED FOR COMMENTS/APPROVAL	ROK	APH	HAS
Rev.	**Date**	**Description**	**Prpd.**	**Chkd.**	**Appd.**

Triune Energy Services Pvt. Ltd. New Delhi	MECHANICAL DESIGN BASIS	**Document Number**	**Rev**
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ATTACHMENTS:

ATTACHMENTS-A DESIGN BASIS FOR STATIC EQUIPMENTS EDB-0010

ATTACHMENTS-B DESIGN BASIS FOR ROTATING EQUIPMENTS EDB-0008

1.0 EXECUTIVE SUMMARY

This document specifies the minimum requirements for the design of Mechanical Equipment for MRPL LPG Amine Absorber System.

2.0 PROJECT DESCRIPTION

MRPL has installed Petrochemical Fluidized Catalytic Cracking (PFCC) unit with a capacity of 2.2 MMTPA. The unit was commissioned in 2014. The process technology was licensed by M/s. Technip Stone and Webster. While processing feed with higher Sulphur content in PFCCU, higher H2S is expected in LPG stream. A New LPG Amine Treatment unit shall be installed to remove the hydrogen sulfide present in the LPG and to minimize the spent caustic generation in existing caustic treatment system.

BDEP was prepared by Technip Stone and Webster and MRPL has selected Triune Engineering Services to provide EPCM services.

3.0 BASIS FOR DESIGN

This project is a Brown field project coming in the PFCC unit of the MRPL refinery. To maintain the consistency in the design with exiting unit, the existing design basis (EDB-0010 & EDB-0008) will be used. Certain Additions / modifications / deletions as required for the project are noted below.

3.1 NEW ADDITIONS TO EDB-0010 (Attachment-A)

Section-A Part-2: New Clause Addition

2.25 (New)

Local Load Analysis:

Local Load analysis for all process nozzles shall be carried out as per WRC 537/107 / 297. Unless otherwise specified, the following force and moments shall be considered for WRC analysis:-

Forces:

Radial Force (FA)	= K * 67.5 * D Kgf
Longitudinal Force (FL)	= K * 100 * D Kgf
Circumferential Force (Fφ)	= K * 100 * D Kgf

Moments:

Torsional Moment (MT)	= K * 12.5 * D2 Kgf.m
Longitudinal Moment (ML)	= K * 10 * D2 Kgf.m
Circumferential Moment (Mφ)	= K * 7.5 * D2 Kgf.m

Where, K = 1 for 150 # and 300 #
K = 1.25 for 600 # and above classes
D = Nominal size of nozzle in inches

3.10 (New)

Cladding / Weld overlay:

(a) Where clad plate is employed as material of construction, it shall conform to the following requirements:

(i) Clad plate made either by the reduction roll bonding or explosion bonding process or weld overlay is acceptable.
(ii) Clad plate must meet requirements of SA263, SA264 or SA265, as applicable.
(iii) Ultrasonic inspection shall be carried out in accordance with SA 578, Acceptance Level S-6.
(iv) Unless otherwise specified, undiluted thickness of cladding at every portion including repair of cladding by weld overlay portion shall be 3 mm minimum.
(v) Plates shall be scanned on at least three edges and one across the width of the plate. Mill shall furnish a report, showing an outline of the plate and the points at which reading were taken, together with results.
(vi) Clad-restoring & weld overlay, as a minimum shall be qualified as per ASME SEC IX.

(b) Disbonding of clad with base material during forming shall be avoided All knuckle zone of dish end shall be 100% ultrasonically tested for lack of bond.

(c) The alloy cladding shall be cut back at all seams to permit back welding of the base metal. Weld metal shall be ground flush and fully covered with the applicable weld deposit. The weld joint in base plate shall be 100% Dye Penetrate (DP) tested for detection of cracks and flaws before welding from clad side. The weld deposit shall be at least as thick as the cladding.

(d) The cladding or lining material for manhole and nozzle necks, manholes cover plates and all components in contact with working fluid shall be of same material as that used for the shell.

(e) Nozzle shall be weld overlaid / cladded depending upon size of nozzles & economy. Clad/overlaid thickness at any portion of nozzle shall not be less than as that of clad minimum thickness requirement for vessel. Nozzles made of solid alloy material as that of clad/lining alloy material shall not be acceptable, unless agreed by Purchaser/ its representative, in place of clad/overlaid nozzles.

(f) The calculation for the required thickness shall not take credit for cladding or lining, material thickness.

(g) The weld overlay shall be relatively smooth with no notches and undercuts that would act as stress raisers. All cracks, fissures and circular defects greater than 1/16'' diameter shall be removed. Repaired areas shall be again DP checked. Weld overlay shall be applied to base metal which has been grit blasted and is smooth and clean so as to ensure full bonding.

(h) All weld overlay, whether manual or by automatic procedure, shall be liquid dye penetrate examined in accordance with the methods described in ASTM E-165. When the overlay involves two passes (i.e. layers) and the procedure uses intermediate heat treatment with cooling to room temperature prior to applying the second layer, each layer shall be examined. Where overlay is to be machined (such as in nozzles and flange facing), machined surface shall be DP examined. If 100% of overlay is examined prior to the final post weld heat treatment, the overlay shall be spot examined (not less than 10% of the surface) after heat treatment.

3.2 REPLACEMENT AND ADDITIONS TO EDB-0010 (Attachment-A)

The below listed clauses of Engineering Design basis for Mechanical has been replaced/added to suit the requirement of LPG Amine Absorber Unit.

Replacement- Following clause has been replaced with existing clause of the design basis.

None

Addition- Following text has been added in the existing clause of the design basis

IN ATTACHMENT-A OF DESIGN BASIS

Clause of Section-A Part-2: Addition

2.11.1. Saddle bolt holes shall have slotted holes at one end of the vessel to provide for thermal expansion.

2.15.4. As per UG-44 of ASME Sec.VIII Div.1

3.3 CLAUSES NOT RELEVANT TO THIS PROJECT TO EDB-0010 (Attachment-A)

Below listed clauses will not be relevant for MRPL LPG Amine Absorber unit, but can be referred if required:

Clause of Section-A Part-1	**Description**
A.	Storage Tanks
C.	Air Cooler
D.ii.	For Tanks
D.iii.	For Mounded Storage Vessels
D.iv.	For Reactors
D.v.	For Heat Exchangers
D.vi.	For Air Coolers
ANNEXURE-1	To Engineering Design Basis (EDB) Questionnaire
Clause of Section-A Part-2	**Description**
2.1.d.	Tanks & Spheres
2.1.e.	Reactors
2.1.f.	Shell & Tube Heat Exchangers
2.1.g.	Air Cooled Heat exchangers
2.10.	Capacity
2.12.2.b.	High pressure reactor manholes
2.12.2.c.	For storage tanks minimum number of manholes
2.13.	Floating Roof
2.20.	MP connection for PG/TI

2.22.	Heat Exchangers
2.23.	Air Coolers
3.1.	LPG Storage Spheres/Mounded Bullets
3.3.	Storage Tanks
3.4.	Mounded Bullet
3.5.	Reactors
3.6.	Heat Exchangers
3.7.	Air Coolers
3.8.	Fiber-reinforced plastics Pressure Vessels
3.9.1.	Shell & Tube And Air Cooled Heat Exchangers
Clause of Section-B	**Description**
3.0)	Usage of Existing Internals
Clause of Section-C	**Description**
10.0)	Flare Stack Components

3.4 CLAUSES NOT RELEVANT TO THIS PROJECT TO EDB-0008 (Attachment-B)

Below listed clauses will not be relevant for MRPL LPG Amine Absorber unit, but can be referred if required:

Clause of Section-A Part-1	**Description**
1.17.2.	Compressors
1.17.3.	Steam Turbine Generators
1.17.4.	Diesel / Gas Engine & Gas Turbine
1.18.2.c.	Centrifugal Compressor
1.18.2.d.	Plant & Inst. Air Compressor
1.18.2.e.	Reciprocating Compressor
1.18.2.f.	STG/GTG
1.20.	Heat Exchangers
2.1.	Centrifugal Compressors (Process Service)
2.2.	Reciprocating Compressors
2.3.	Rotary Type Positive Displacement Compressor
2.5.	Diaphragm Compressors
2.6.	Pack Integrally Geared Centrifugal Air Compressor
2.7.	Reciprocating Compressor (Utility and Instrument Air)
2.8.	Positive Displacement (Roots Type) Blower
2.9.	Special-Purpose Steam Turbine
2.10.	General-Purpose Steam Turbine

2.11.	Gas Turbine
2.14.	Fans Centrifugal/F.D./I.D. Fans
2.18.	Special Purpose Gear Units

ATTACHMENT-A

MRPL Engineering Design Basis

For

Static Equipments

(COLUMNS, VESSELS, TANKS, HEAT EXCHANGERS, BASKET & CARTRIDGE FILTERS, TRAYS & TOWER INTERNALS)

Rev. No	Date	Purpose
0	08/01/16	Issued for Design

CONTENTS

FOREWORD

This document, titled ENGINEERING DESIGN BASIS, is intended to be a communication link between consultant and the owner to firm up the Engineering Design Parameters for a particular project, before the actual start of engineering activities. Whereas the design basis shall provide for consultant, requisite technical information to complete the engineering design / specification on a once through basis with a minimum of revisions, for the owner, this would present a general idea of standard design criteria/ philosophy followed in engineering byconsultant.

This document is divided into three Sections.

SECTION – A (Columns, Vessels, Tanks & Heat Exchangers) : This Section is divided into two parts.

- **PART- 1 : Comprising of a Questionnaire in which owners preferences and site dependent details on certain technical parameters as requested had been furnished by the owner. Incase of conflict, same takes precedence over the standard design criteria/ philosophy covered in part 2.**
- **PART – 2` : Describes the standard design criteria / philosophy intended to be followed in engineering.**

SECTION – B (Trays and Tower Internals) : This Section describes the design criteria / philosophy intended to be followed by consultant for engineering of Trays, Packings& Tower Internals.

SECTION - C (Mechanical Equipment) : This Section describes the design criteria / philosophy intended to be followed by CONSULTANT for various mechanical items described therein.

In case the owner has any specific instructions on this design criteria / philosophy he is requested to furnish these instructions in writing separately with cross reference to section and clause in question as an 'Addendum' to design philosophy in the format available at the end of this document.

This complete Engineering Design Basis document consisting of Section-A (Including both PART - 1 and PART – 2), Section-B and Section-C along with addendum if any shall be duly signed and returned by the owner before the start of Engineering by CONSULTANT. Major/ significant changes to this document received after the start of the project may result in the change of schedule and/ or additional engineering effort.

SECTION-A

(COLUMNS, VESSELS, TANKS & HEAT EXCHANGERS)

PART - 1

(OWNER'S REQUIREMENTS)

VESSELS, STORAGE TANKS AND HEAT EXCHANGERS

A) Storage Tanks

1.	Type of EFR (For Tank Dia.> 60m)	□ Siingle Deck	√ Double Deck	□ Any Other (Specify)
2.	Type of Internal Floating Roof	□ Pan@	√ Pontoon Type Single Deck	□ Double Deck
3.	Type of EFR Sealing arrangement	□ Single Seal (Primary)	√ Double Seal (Primary + Secondary)	
4.	Primary Drain	□ Articulated pipes with swivel joint	√ Coflexip pipe or √ Mesa Pipe	□ Articulated pipe with HMT PIVOT master
5.	Primary Seal	√ Foam Seal	□ Liquid Filled Endless Seal	□ Mechanical Seal
6.	Tank Bottom	√ Cone up	□ Cone down (For ATF as per OISD)	
7.	External Painting	√ CONSULTANT Specifications (Modified)	□ Owner's Specifications	
8.	Painting of Internal Surfaces	√ CONSULTANT Specifications (Modified)	□ Owner's Specifications	
9.	Internal Floating Roof Material	□ SS	√ CS	
10.	Type of Floating Roof (for conversion of existing cone roof to covered floating roof)	√Aluminium □ Not Applicable	□ SS	□ CS
11.	Requirement of primary drain for internal floating roof tanks.	√ Yes	□ No	
12	Platform/Steps	□ Chequered plate	√ Grating (Electro forged and bolted Type)	

13.	Steps/Platforms If grating	□	Painted	√	Galvanized incl. Bolting.	
14.	Hand Railing on Tanks	√	GI Pipe bolted to stairways, bolting also hot dip galvanized.	□	CS with Painting	
15.	Clean out Doors	√	For tanks of all product	□	For tanks of specific product, if so indicate products.	
16.	Minimum size of					
	i) Shell manholes	□	20"	√	24"	□ 30"
	ii) Roof manholes	□	20"	√	24"	□ 30"
17.	Supporting Arrangement for Cylindrical Column ≤ 1000 mm dia.	□	Self Supported	√	Structurally guided by super imposed structure.	
18.	Cathodic Protection For Tankôs bottom	√	Required (Unless tanks are placed directly on concrete foundations/ pile caps with no intervening earth Filling)	□	Not Required	
19.	Camouflage painting requirement meeting Defense / Strategic Location for Storage Tanks	□	Required	√	Not Required	
20.	Under tank leak detection and subgrade protection	√	Required for H_2SO_4, acetic acid service, caustic service.	□	Not Required	
21.	Emergency overflow slots for internal floating roof tanks (MRPL to specify product wise)	√	Required for non-pressure type tanks	□	Not Required	

@ In Pan type floating roof, primary drain can not be provided. Hence not recommended for accidental water loading.

* EFR External floating roof
* FR Floating Roof

Note: Recommendations of latest OISD standards and Jaipur Committee (M.B.Lal) to be followed.

B) **Vessels/ Reactors**

1.	High Pressure Reactors and Vessels	□	Forged Construction	√	Plate Construction. (Limited to 150 mm thickness)*	
2.	For SS Lined Reactors & Vessels	□	Weld deposit construction	√	Clad plate construction (Limited to 100 mm thickness)*	
3.	Buried Vessel Installation, Painting and Cathodic Protection (Refer Annexure-1 to Engineering Design Basis (EDB) Questionnaire	□	Option -1	□	Option - 2	√ Option - 3
4.	Mounded LPG Storage Bullet					
	i) Depth of mound above vessel	√	1 metre	□	0.75 m	
	ii) Explosion load consideration	√	Yes (As per CONSULTANT Standard)	□	No	

C) **Air Cooler**

i) Air Cooler fan blade material	□	Aluminium	√	Solid GRP

ii) Roof on air cooler tube bundle □ Required √ Not Required

D) **Any other specific requirements of Owner (*)**

i) For Vessels _____

ii) For Tanks _1. When steam coils are provided, base plate of coil supports shall be fully welded to bottom plate.(There shall be a 5mm gap between U clamp and pipe for thermal expansion).
2. SA240 TP316 plate of suitable thickness shall be provided at all roof support leg resting position on bottom plate.

iii) For Mounded Storage Vessels _____

iv) For Reactors _____

v) For Heat Exchangers _____

vi) For Air Coolers _____

√ Denotes applicability

* **From economics point of view.**

ANNEXURE - 1 TO ENGINEERING DESIGN BASIS (EDB) QUESTIONNAIRE

OPTION-1

- The vessel should be located in a RCC pit and sand packed with vibro compression, with 100 mm thickness of lean concrete on top. The pit shall have a minimum clearance of 2 meter all around the vessel.

- Surface preparation and paint systems for different temperature ranges shall be as per the recommendations given below.

- Cathodic protection system shall be provided.

OPTION - 2

- The vessel should be located in a RCC pit and sand packed with vibro compression, with 100 mm thickness of lean concrete on top. The pit shall have a minimum clearance of 500 mm all around the vessel.

- Surface preparation and paint systems for different temperature ranges shall be as per the recommendations given below.

- No Cathodic protection.

OPTION - 3

- The vessel should be located in a open RCC pit and shall be provided with Shed & Ejector. The pit shall have a minimum clearance of 1000 mm all around the vessel.

- Surface preparation and paint systems for different temperature ranges shall be as per the recommendations given below.

- No Cathodic protection.

SURFACE PREPARATION AND PAINT SYSTEM FOR OPTION- 1, 2 & 3

1.0 **SURFACE PREPARATION**

Blast cleaning to Sa 2½ finish of ISO 8501-1 or SSPC-SP-10 or SIS-05-5900 with a surface profile of 35-50 microns of trough to peak.

2.0 **PAINT SYSTEM**

2.1 **Design Temperature : - 40º C to 80º C**

1 coat of (F-9) Inorganic Zinc Silicate primer @ 65-75 microns DFT/coat + 3 coats of (F-7) High Build Coal Tar epoxy coating cured with polyamine hardner @ 100 microns DFT/coat.

Total Dryfilm thickness: 65 + 3 x 100 = 365 microns minimum.

2.2 **Design Temperature: - 40º C to 150º C**

1 coat of (F-9) Inorganic Zinc Silicate primer @ 65-75 microns DFT/coat + 3 coats of High Build Coal Tar epoxy coating cured by Polyamine hardner (EPILUX 555 from M/s. Berger Paints Ltd or its equivalent approved by CONSULTANT) suitable up to continuous dry temperature of 150º C @ 100 microns DFT/Coat.

Total Dry film thickness (DFT) : = 365 microns minimum.

2.3 **Design temperature: - 100º C to 400º C**

1 coat of (F-9) Inorganic Zinc Silicate primer @ 65-75 microns DFT/coat + 1 coats of Epoxy Siloxane Coating Amer Coat 738 from M/s. Ameron products. USA @ 250 microns DFT/Coat.

Total DFT : 75+250 = 325 microns minimum

PART - 2

(DESIGN PHILOSOPHY)

CONTENTS:

ANNEXURE – I : MATERIAL SELECTION

1.0 REFERENCED PUBLICATIONS

a) **Codes And Standards**

The following codes and standards in their latest edition including latest addenda as on the date of first issue of this design basis shall be followed unless otherwise specified in the requisition for the design, fabrication, inspection and testing of Vessels, Columns, Reactors, Spheres, Storage Tanks, Steel Silos, Bins, Hoppers, Steel Flare/Vents Stacks & heat exchangers:

ASME SEC. VIII DIV.1	For Pressure Vessels, Heat Exchangers
IS 2825	For Presure Vessels
ASME SEC. VIII DIV.2	For Pressure vessels and heat exchangers (Selectively for high pressure/high thickness)
ASME SEC. VIII DIV.3	For Very High Pressure
ASME SEC. VIII DIV.2/PD 5500	For Storage Spheres
ASME SEC. X	For Fiber-reinforced plastic Vessels
API 650/IS:803	For Atmospheric Storage Tanks
API 620	For Low Pressure Storage Tanks
API 620/BS 7777	For Cryogenic Storage Tanks (Double Wall)
IS : 9178/DIN 1055	For Silos, hoppers and bins
IS : 6533	For steel vent stacks etc.
ASME SEC. VIII DIV.1	For workmanship of Vessels not categorized under any other code.
BS : 4994/ASME SEC. X	FRP vessels and Tanks
ISO R831/IBR	For Steam producing equipment, steam storage, catch water vessels, condensate flash drums and similar vessels and BFW Heaters
OISD-STD 150/ PD 5500/ASME SEC. VIII DIV.2	For Mounded Vessel
ASME B 96.1	Welded Aluminium Alloy Storage Tanks
ASME SEC. II	For material specification
ASTM/IS	For material specification
IS:875/SITE DATA	For wind load consideration
IS:1893/SEISMIC DESIGN BASIS	For seismic design consideration
ASME SEC. IX	For welding.
ASME B 16.5	For flanges

ASME B 16.47	For large diameter flanges
ASME B 16.20	For gaskets
TEMA (CLASS-R)	For shell and tube Exchanger
API 661	For Air Cooled Exchanger
IS 800	For Air Cooled Exchanger Structural Design

b) **Statutory Provisions** :

National laws and statutory provisions such as Indian Boiler Regulation, CPCB and Department of Explosives, Nagpur, India together with any local by-laws for the state (KSPCB etc..) shall be complied with. Static and Mobile Pressure Vessel (SMPV) rules, Petroleum rules, Factory Acts and Rules, Environmental Protection Act & Rules etc. as applicable shall also be complied with.

c) **Publications**

NACE MR 0103	Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments.
NACE RP 0296	Guidelines for Detection, Repair and Mitigation of Cracking of Existing Petroleum Refinery Pressure Vessels in Wet H_2S Environment.
NACE TM 0284	Evaluation of Pipeline and Pressure Vessel Steel for Resistance to Hydrogen Induced Cracking.
API-950	Survey of Construction Materials and Corrosion in Sour Water Stripper.
API-RP 945	Avoiding Environmental Cracking in Amine Units
NACE TM 0177	Laboratory Testing of Metals for Resistance to Sulphide Stress Cracking in Hydrogen Sulphide Environment.
WRC Bulletin #107	Local Stresses in Spherical & Cylindrical Shells due to External Loadings.
WRC Bulletin #297	Local Stresses in Cylindrical Shells due to External Loadings on Nozzles.
NACE-RP-0472	Methods and Controls to Prevent in-Service Environmental Cracking of Carbon Steel Weldments in Corrosive Petroleum Refining Environments.

2.0 DESIGN PHILOSOPHY / GENERAL CRITERIA

All design calculations shall be performed considering all applicable loads for Erection, Operating and Hydrotest conditions.

2.1 Equipment Sizing

a)	All Columns	Based on inside diameter
b)	All Clad/Lined Vessels	Based on inside diameter

c)	Vessels (Thickness 50mm)	Based on inside diameter
d)	Tanks & Spheres	Based on inside diameter
e)	Reactors	Based on inside diameter
f)	Shell & Tube Heat Exchangers	Based on inside diameter (Based on OD for exchangers fabricated from pipe).
g)	Air Cooled Heat Exchangers	Based on nozzle size and no. of tube rows

2.2 **Minimum Shell/Head Thickness**

Minimum thickness of equipment wall/components shall be as given below :

a) For carbon and low alloy steel vessels - 6mm (Including corrosion allowance not exceeding 3.0 mm), but not less than that calculated as per following

FOR DIAMETERS LESS THAN 2400 mm

$$\text{Wall thickness} = \frac{\text{Dia.}}{1000} + 1.5 + \text{Corrosion Allowance (if any)}$$

FOR DIAMETERS 2400 mm AND ABOVE

$$\text{Wall thickness} = \frac{\text{Dia.}}{1000} + 2.5 + \text{Corrosion Allowance (if any)}$$

All dimensions are in mm.

b) For stainless steel vessels and high alloy vessels - 3 mm, but not less than that calculated as per following for diameter more than 1500mm.

$$\text{Wall thickness (mm)} = \frac{\text{Dia.}}{1000} + 2.5 + \text{Corrosion Allowance (if any)}$$

c) Vertical vessel with Height (TL to TL) / Diameter ratio greater than 5 shall be considered as tall column and shall be designed accordingly. (Refer Clause 3.2)

d) For carbon steel, stainless steel, low alloy steel columns/towers & high alloy steel columns/tower - 5mm (excluding corrosion allowance)

e) For shell & tube heat exchangers, minimum thickness shall be as per TEMA.

f) For Air Cooled heat exchangers, minimum thickness shall be as per API 661, however minimum tube sheet thickness shall be 22.mm (excluding corrosion allowance).

2.3. **Equipment End Closures:**

- Unless otherwise specified Deep Torispherical Dished End with 80 % crown radius and 15% knuckle radius or alternatively 2:1 semi Ellipsoidal Dished End shall be used for pressure vessels & heat exchangers. Seamless dished end shall be used for specific services whenever specified by process licensor.

- Hemispherical Ends shall be considered when the thickness of shell exceeds 70 mm.
- Flat Covers may be used for atmospheric Vessels

- Pipe Caps may be used for vessels diameter ∗ 600mm having no internals.

- Flanged Covers shall be used for Vessels/Columns of Diameter ∗ 900mm having internals.

- All columns below 900 mm shall be provided with intermediate body flanges. Numbers of intermediate flanges shall be decided based on column height and type of internals.

2.4 **Design Pressure**

Unless otherwise specified elsewhere design pressure shall be calculated as per the following.

a) **When operating pressure is up to and including 70 Kg./cm^{2}g.**

Design pressure shall be equal to operating pressure plus 10% (minimum 2 Kg./cm^{2}g)

b) **When operating pressure is over 70 Kg./cm^{2}g**.

Design pressure shall be equal to operating pressure plus 5% (minimum 7 Kg./cm^{2}g).

c) Design pressure calculated above shall be at the top of vertical equipment or at the highest point of horizontal equipment.

d) The design pressure at any lower point is to be determined by adding the maximum operating liquid head and any pressure gradient within the equipment (differential pressure as mentioned in Process Data Sheet and catalyst loadings).

e) Equipment operating under vacuum/Partial Vacuum shall be designed for an external pressure of 1.055 Kg./cm^{2}g.

f) Equipment shall be designed for steam out conditions as specified by process data sheet/piping.

g) Minimum design pressure shall be 3.5 Kg./Cm^{2}g for any equipment.

h) Pressure chambers of combination units including heat exchanger shall be designed for testing independently without pressure in the adjacent chamber in corroded condition.

2.5 **Test Pressure**

a) Equipment shall be hydrostatically tested in the fabricator's shop as per design code.

b) Equipment open to atmosphere shall be tested by filling with water to the top.

c) 1. Pressure Chambers of combination units that have been designed to operate independently shall be hydrostatically tested to code test pressure as separate equipment i.e. each chamber shall be tested without pressure in the adjacent chamber unless otherwise specified in equipment data sheet.

2. When pressure chambers of combination units have their common elements designed for maximum differential pressure, the common elements shall be subjected to test pressure equivalent to the differential pressure multiplied by a factor as per applicable design code.

3. Coils shall be tested separately to code test pressure.

d) Unless otherwise specified in applicable design code allowable stress during hydrotest in tension shall not exceed 90% of yield point.

e) Storage tanks shall be tested as per applicable code.

2.6 **Design Temperature**

Unless otherwise specified elsewhere, design temperature shall be as per the following.

a) For vessels operating at 0 ºC and over:-

Design temperature shall be equal to maximum operating temperature plus 15 ºC subject to a minimum of 65 ºC.

b) **For Vessels operating below 0 ºC**.

Design temperature shall be equal to lowest operating temperature.

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

2.7 **Corrosion Allowance :**

Unless otherwise specified elsewhere, minimum corrosion allowance shall be considered as follows:

-	Carbon Steel equipment	:	3.0 mm *
-	Low alloy steel equipment	:	1.5 mm* (3 mm for shell & tube exchangers)
-	Stainless steel equipment	:	NIL
-	Clad equipment	:	NIL (3 mm cladding minimum)
-	Lined equipment	:	3.0 mm (plus lining)
-	CS Storage Tank bottom most shell course and bottom plate	:	3.0 mm
-	CS Storage Tank shell (other courses)	:	1.5 mm
-	Storage tank Fixed roof/ Floating Roof	:	As specified in process data sheet.
-	CS BurriedVessels (External)	:	1.5 mm
-	CS Spheres	:	1.5 mm

* Except for tubes

For alloy lined or clad equipment, no corrosion allowance is required on the base metal. The cladding or lining material shall be in no case less than 3.0 mm thickness and the same shall be considered as corrosion allowance for the purpose of stress analysis.

Corrosion allowance for nozzles and manhole neck shall be at least equal to that specified for the equipment. No Corrosion allowance is required for gasket seating face of girth flanges. However, for non standard blind flanges of channel covers the corrosion allowance will be applied.

2.8 **Wind Consideration**

Wind load for equipment including anchor chair shall be calculated on the basis of IS 875.

a) Drag coefficient for cylindrical vessels shall be 0.7 minimum.
b) Drag coefficient for spherical vessel shall be 0.6 minimum considering:

K_1 = 1.0 (for 50 years life)

K_2 = Factor based on category 3 (for units) and factor based on category 2 (for off sites)

K_3 = Factor based on site topography = 1.0

Contingency factor of 1.1 shall be used on wind pressure

2.9 **Earthquake Consideration:**

Earthquake loads shall be calculated in accordance with site spectra curve using response spectra method with 2% damping.

2.10 **Capacity**

2.10.1 **Tank**

- Capacity shall be specified as Nominal capacity and stored capacity.
- Nominal capacity for fixed roof tanks shall be volume of cylindrical shell.
- Stored capacity for fixed roof tanks shall be equal to nominal capacity minus free board volume (equivalent to 500mm of shell height).
- Nominal capacity (also the stored capacity) for floating roof tanks shall be volume of cylindrical shell minus free board volume (equivalent to 1500mm of shell height).
- Nominal capacity (also the stored capacity) for fixed cum floating roof tanks shall be volume of cylindrical shell minus free board volume (equivalent to 2500mm to 3000mm of shell height for tanks with vent / overflow slot in shell.).

2.10.2 **Bullets (above ground or under ground)**

- Nominal capacity is the geometric capacity of Bullet.
- Stored capacity shall be 85% of nominal capacity.

2.10.3 **Sphere**

- Nominal capacity is the geometric capacity of Sphere.
- Stored capacity shall be 85% of nominal capacity.

2.11 **Supports**

2.11.1 Skirt supports shall be provided for all tall columns {Refer Cl. 2.2 (c)} and reactors. However, small vertical equipment may be supported on legs (pipe or structural section) or brackets. All horizontal vessels and exchangers shall be supported on two saddles.

2.11.2 All Cr-Mo steel reactors shall be supported on skirts.
Welding of external clips on Cr-Mo steel Reactors shall be avoided wherever possible.

2.11.3 **Skirt Thickness**

The thickness for the skirts inclusive of corrosion allowance shall be the maximum of following:

a) 6 mm.
b) Thickness required by analysis.
c) 30 mm or 1/3 of the vessel wall thickness whichever is lower.

Corrosion allowance of total 1mm minimum shall be considered for skirt unless otherwise specified in the project specifications to achieve final thickness of skirt shell.

2.11.4 All columns with diameter 1000 mm and more shall be self supporting.

2.11.5 All columns with diameter less than 1000 mm shall be supported by superimposed structure around the column covering the entire height. Guy wires are not permitted to be used for supporting any equipment.

2.11.6 In specific cases, columns having diameter less than 1000 mm and total L/D ratio not exceeding 10 may be self supported.

2.11.7 Flare and Vent stacks shall be supported structurally by super imposed structure all around for the entire height.

2.11.8 Storage spheres shall be supported on pipe legs with tie rod bracing and turn buckles.

2.11.9 Buried vessels shall be suitably anchored to prevent the uplift due to under ground water. Anchor bolts shall have corrosion allowance of 6 mm on diameter. Buried vessels shall be rested on concrete saddles with anchoring bracket at the center line of the vessel.

2.11.10 All skirt supported columns/equipments with height 20 m and above (irrespective of weight) and weight 50 MT and above (irrespective of height) are to be provided with tailing lug.

2.12 **Nozzles and Manholes :**

2.12.1 Nozzles:

a) Nozzle rating for all the pressure containing equipment (Vessels, Reactors, heat exchangers, Air Coolers etc.) shall be min 300 #.

b) Minimum nozzle sizes shall be as below:
- Process & Instrument Nozzles on Unclad Vessesl : 1 ½ inch NB

- Process & Instrument Nozzles on Cladded Vessels : 3 inch NB

2.12.2 **Manholes:**

a) Vessels and columns with diameter up to 1000 mm shall be provided with 450 NB manhole. Vessels and columns with diameter greater than 1000 mm and up to 1500 mm shall be provided with 500 NB manhole. However, if required, vessels and columns with diameter 1500 mm and above may be provided with 600 NB manhole.

b) High pressure reactor manholes shall be on I.D. basis. Size shall be as per Licensor drawing.

c) For storage tanks minimum number of manholes (Size 600mm) shall be as follows :

TANK DIAMETER	SHELL MANHOLE	FLUSH TYPE CLEAN OUT DOORS	ROOF MANHOLE (NOTE 1)
Diameter. ≤ 12 m	1	NIL	1
12 m < Diameter ≤ 45 m	2	1	2
45 m < Diameter ≤ 61 m	3	2	2
Diameter. > 61 m	4	2	2

Notes: 1) In the deck of floating roof tank one number additional 30" NB manhole with internal ladder shall be provided on floating roof as per fabricatorôs standard.
2) Tank Manholes including bolting and gaskets shall be as per API 650.

d) Clean out doors shall be provided as per MRPLôs / process requirements and Size of clean out doors fittings for tanks shall be 36" (900 mm) x 48" (1200mm).

2.13 **Floating Roof :**

2.13.1 Unless otherwise specified floating roof shall be of following construction.

TANK DIAMETER(D)	TYPE OF FLOATING ROOF	
	(a) External	(b) Internal
D ≤ 12 m	Double Deck Type	Double Deck
12 m < D ≤ 60 m	Pontoon Type	Pontoon type, Single Deck
D>60 m	Double Deck Type	Double Deck

2.14 **Minimum Nozzle Size For Vessels And Their Basis:**

- Minimum Nozzle Size : 40 NB
- Minimum Nozzle Size for Clad Equipment : 80 NB*

- Safety Valve Nozzle : Based on I.D.
- Self Reinforced Nozzle neck : Based on I.D.

* Except for MP connection on heat exchanger nozzle where it will be 50 ID LWN.

2.15 **Flanges**

2.15.1 Nozzle flanges up to 600 NB shall be as per ASME/ANSI B16.5 and above 600 NB shall be as per ASME/ANSI B 16.47 (SERIES 'B') except that for high pressure heat exchanger. Non standard flanges shall be designed as per ASME Sec. VIII Div. 1

2.15.2 Unless otherwise specified, W.N. Flanges shall be used for all classes.

2.15.3 Unless otherwise specified, all girth flanges and intermediate body flanges shall be of weld neck type only.

2.15.4 Flange rating shall be established based on design pressure, design temperature and considering all external loads (moments and axial force).

2.15.5 For high pressure (> 60 bar) and high temperature service, flange bolting shall be through the use of torqued or tensioned bolts. No manual bolting is envisaged.

2.16 **Internals :**

Unless otherwise specified removable internals shall be bolted type and material of bolting shall be stainless steel TP 304. For shell & tube heat exchangers, floating head bolting shall be compatible to shell material. Bolting SA 193 Gr. B7M/2HM shall be used as a minimum.

2.17 **Pipe Davit :**

i) Vertical Vessel/Column having safety valve size 80 NB and above and or having internals, shall be provided with pipe davit.

ii) Exchanger davits shall be provided for flat channel cover and all types of shell covers.

2.18 **Vent/Drain/Ventilation Nozzle Connections :**

i) Vessel shall be provided with one number vent/drain connection as per following unless otherwise specified in process data sheet:

Vessel Volume (V), m^3	Length of (Horizontal Vessel) (L),mm	Vent Nozzle	Drain Nozzle	Ventilation Nozzle
V ≤6.0	-	40 NB	40 NB	-
6.0 < V ≤15	-	50 NB	40 NB	-
V > 15	-	50 NB	80 NB	-
-	3000mm<L<4500 mm		-	100 NB

-	4500mm<L< 7500 mm	-	150 NB
-	L>7500mm	-	200 NB

Vertical vessel not having any nozzle on the top shall be provided with 50 NB nozzle for conducting hydrotest in vertical conditions.

ii) Exchanger shall be provided with vent and drain connection as per P&ID or 40 NB vent / drain nozzle connection with blind flange etc. if not shown in P&ID (Separate vent and drain will not be provided if vented / drained by other nozzle). For clad exchangers, minimum size of vent and drain nozzle connection shall be 50 mm ID LWN.

2.19 **Spares:**

2.19.1 **Mandatory Spares**

i) Vessels & Columns

Gaskets	:	Two sets for each installed gasket.
Fasteners	:	10% (Minimum two in each size) of installed fasteners other than standard sizes of B7/2H
Sight/Light Glass	:	4 sets for each installed glass.

ii) Shell & tube Exchangers: 400% Gaskets
20% Bolting (Min. 4 studs and 8 nuts per joint)

iii) Air Coolers : 400% gasket for header cover & nozzles with blind flange
200% gaskets for plugs
20% plug
100% belts
100% bearings
10% complete bearing blocks or one minimum
20% Bolts & Nuts for all nozzle with BF & Cover plate
One set of Diaphragm Actuator with positioner for each type of auto variable pitch fan
(Alternatively vendor recommended spares for his type of auto variable pitch fans)

2.19.2 **Commissioning Spares**:

i) Reactors and Columns :

	Gaskets	:	100 % (For Manways, Interconnecting Nozzles, and nozzles with blind Flange).
	Fasteners	:	10% (Minimum two in each size) of installed fasteners.
ii)	Shell & tube Exchangers	:	200% Gaskets
iii)	Air Coolers		
	Plug/ Header Gaskets	:	30 % (Min 1 no) of Installed quantity)
	Plugs	:	10 %
	Belts	:	100 %

2.19.3 Special Tools:

i)	Air Coolers	:	Scissor lift platform shall be provided for each tag number i.e. EC-XXXXX A-L (1 number)
ii)	Recators/Vessels/Heat Exchangers/Air Coolers	:	Any Special tools recommended by the equipment manufacturer*

2.19.3 Instrumentation - Static Equipments:

i) Nozzle Requirement & location shall be confirmed with Process & Instrumentation.

ii) All Instrument Nozzle Locations shall be accessible by platforms (Platform Grating shall be located so that tappings/instrument nozzles are 500 to 1000 mm above the top of grating).

iii) Instrument Nozzles shall be min 300# (max being refined by process pressure and temperature conditions). This shall be ensured for low pressure vessels also. 150# Nozzle Flanges/tappings shall not be provided.

iv) Minimum stub lengths of 200 mm shall be provided external to the vessel for all instruments tappings .

v) Refer Annexure-II for instrument connections on Static equipments.

Annexure-II

INSTRUMENT CONNECTIONS ON VESSELS, STANDPIPES AND TANKS

S. NO,	TYPE OF INSTRUMENTS	VESSEL / STANDPIPE	FIRST BLOCK VALVE	INSTRUMENT
		CONNECTION		CONNECTION
1	EXTERNAL BALL FLOAT LEVEL INSTRUMENT ON VESSEL	2" FLGD.	2" FLGD.	1" S.W.
2	EXTERNAL BALL FLOAT LEVEL INSTRUMENT ON STANDPIPE	1" S.W./FLGD. *	1" S.W. /FLGD. *	1" S.W.
3	INTERNAL BALL FLOAT LEVEL INSTRUMENT	4" FLGD.	-	4" FLGD.
4	LEVEL GAUGE ON VESSEL	2" FLGD.	2" FLGD.	3/4" SCRD.
5	LEVEL GAUGE ON STANDPIPE	3/4' S.W./FLGD. *	3/4" S.W./FLGD. *	3/4" SCRD.
6	D.P. INSTRUMENT ON VESSEL	1 1/2" FLGD.	1 1/2" FLGD.	1/2" SCRD.
7	D.P. INSTRUMENT ON STANDPIPE	3/4' S.W./FLGD. *	3/4" S.W./FLGD. *	1/2" SCRD.
8	DIAPHRAGM SEAL D.P. INSTRUMENT ON VESSEL	3" FLGD.	3" FLGD.	3" FLGD.
9	EXTENDED D. P. INSTRUMENT ON VESSEL	4" FLGD.	-	4" FLGD.
10	DIP TUBE LEVEL INSTRUMENT	11/2ò FLGD.	1/2" SW (BY INST.)	1/2ò SCRD.
11	TANK LEVEL INSTRUMENT (MECH.) ATM. PRESSURISED	1 1/2" FLGD.	- 1 1/2" FLGD. (BY INST.)	1/2" SCRD.
12	TANK LEVEL INSTRUMENT (SERVO) ATM. PRESSURISED	6" FLGD.	- 6" FLGD. (BY INST.)	6" FLGD.
13	PRESSURE INSTRUMENT ON VESSEL	1 1/2" FLGD.	1 1/2" FLGD.	1/2" SCRD.
14	DIAPHRAGM SEAL PRESSURE INSTRUMENT ON VESSEL (SCRD.)	1 1/2" FLGD.	1 1/2" FLGD.	1/2" SCRD.
15	DIAPHRAGM SEAL PRESSURE INSTRUMENT ON VESSEL (FLGD.)	1 1/2" FLGD.	1 1/2" FLGD.	1 1/2" FLGD.
16	THERMOWELL	1 1/2" FLGD.	-	1 1/2" FLGD.
17	STANDPIPE	2" FLGD.	-	-

NOTES:

1. FOR ANY OTHER INSTRUMENT NOT REFERRED ABOVE, THE CONNECTION DETAILS, SHALL BE AS PER INDIVIDUAL REQUIREMENT.
2. ALL FLANGE/SW RATINGS SHALL BE AS PER PIPING SPECIFICATION. (MIN 300#)
3. IN CASE OF DIRECT MOUNTED FLANGED INSTRUMENTS AND WHERE FLANGED FIRST ISOLATION VALVES ARE PROVIDED, BOLTING AND GASKET SHALL BE IN PIPING SCOPE.

* AS PER PIPING SPECIFICATION.

INSTRUMENT CONNECTIONS ON PIPING

S. NO.	TYPE OF INSTRUMENTS	WHERE PIPING CLASS PRESCRIBES SCREWED CONNECTIONS	WHERE PIPING CLASS PRESCRIBES S.W. CONNECTIONS	WHERE PIPING CLASS PRESCRIBES FLANGED CONNECTIONS						
		PROCESS CONN.	1st BLOCK VALVE	INSTRUMENT CONN.	PROCESS CONN.	1st BLOCK VALVE	INSTRUMENT CONN.	PROCESS CONN.	1st BLOCK VALVE	INSTRUMENT CONN.
1	ORIFICE FLOWMETER	1/2" SCRD.	1/2" SCRD.	1/2" SCRD.	1/2" SCRD. *	1/2" S.W.	1/2" SCRD.	1/2" SCRD. *	1/2" FLGD.	1/2" SCRD.
2	AVERAGING PITOT TUBE	1 1/2" FLGD.	1 1/2" FLGD. (BY INST.)	1 1/2" FLGD.+	1 1/2" FLGD.	1 1/2" FLGD. (BY INST.)	1 1/2" FLGD.+	1 1/2" FLGD.	1 1/2" FLGD. (BY INST.)	1 1/2" FLGD.+
3	PRESSURE INSTRUMENT	3/4" SCRD.	3/4" SCRD.	1/2" SCRD.	3/4" S.W.	3/4" S.W.	1/2" SCRD.	3/4" FLGD.	3/4" FLGD.	1/2" SCRD.
4	DIAPHRAGM SEAL PRESSURE INSTRUMENT (SCRD.)	3/4" SCRD.	3/4" SCRD.	1/2" SCRD.	3/4" S.W.	3/4" S.W.	1/2" SCRD.	3/4" FLGD.	3/4" FLGD.	1/2" SCRD.
5	DIAPHRAGM SEAL PRESSURE INSTRUMENT (SCRD.)	1 1/2" FLGD.	1 1/2" FLGD.	1 1/2" FLGD.	1 1/2" FLGD.	1 1/2" FLGD.	1 1/2" FLGD.	1 1/2" FLGD.	1 1/2" FLGD.	1 1/2" FLGD.
6	THERMOWELL	1 1/2" FLGD.	-	1 1/2" FLGD.	1 1/2" FLGD.	-	1 1/2" FLGD.	1 1/2" FLGD.	-	1 1/2" FLGD.

NOTES -

1 ΓRUMENT NOT REFERRED ABOVE, THE CONNECTION DETAILS SHALL BE AS PER INDIVIDUAL REQUIREMENT.

2 ALL FLANGE/SW RATINGS SHALL BE MIN 300#.

3 IN CASE OF DIRECT MOUNTED FLANGED INSTRUMENTS AND WHERE FLANGED FIRST ISOLATION VALVES ARE PROVIDED, BOLTIN

4 INSTALLATION OF ALL IN LINE INSTRUMENTS SHALL BE IN PIPING SCOPE.

* SEAL WELDING REQUIRED.

+ CONNECTIONS FOR D.P. INSTRUMENT 1/2" SCRD.

INSTRUMENT CONNECTION ON FIRED HEATER

S. NO.	TYPE OF INSTRUMENTS	VESSEL/LINE CONNECTION	FIRST BLOCK VALVE	INSTRUMENT CONNECTION
1	FLOW ELEMENT - AVG. PITOT TUBE (ON DUCT)	1 1/2" FLANGED	1 1/2" FLANGED (BY INST.)	1/2" NPT (F)
2	FLOW ELEMENT - VENTURI TUBE (ON DUCT)	1/2" S.W.	1/2" S.W.	1/2" NPT (F)
3	PRESSURE INSTRUMENT (ON HEATER)	1 1/2" FLANGED	1 1/2" FLANGED	1/2" NPT (F)
4	PRESSURE INSTRUMENT (ON COIL)	1 1/2" FLANGED	1 1/2" FLANGED	1/2" NPT (F)
5	DRAFT GAUGE (REFER TYPICAL BELOW)	1 1/2" FLANGED	1 1/2" FLANGED	1/2" NPT (F)
6	TEMPERATURE INSTRUMENT (ON HEATER)	1 1/2" FLANGED		1 1/2" FLANGED
7	TEMPERATURE INSTRUMENT (ON COIL)	1 1/2" FLANGED		1 1/2" FLANGED
8	SKIN THERMOCOUPLE	1" PIPE		
9	FLUE GAS ANALYSER	4" FLANGED	4" FLANGED	4" FLANGED

NOTES:

1. PRESSURE RATING OF FLANGE CONNECTION SHALL BE 150# FOR INSTRUMENTS MOUNTED DIRECTLY ON HEATER.
2. PRESSURE RATING OF FLANGE CONNECTION ON TUBE SIDE SHALL BE MIN 300#.
3. ALL PRESSURE & FLOW INSTRUMENTS SHALL HAVE MECHANICAL ISOLATION VALVES IN ADDITION TO INSTRUMENT ISOLATION & VENT/DRAIN VALVES.

2.20 MP Connection for PG/TI

i)	Shell & Tube heat exchangers	:	**For Clad Exchangers** One no. 50mm ID LWN nozzle with BF on each inlet/outlet nozzle of size 6òNB & 8òNB. For 10ò NB and above two nos. shall be provided. **Others (Non Clad)** One no. 40NB nozzle with blind on each inlet / outlet **Stacked Exchangers** Only one MP connection with blind in one of the intermediate nozzles. Rating shall be same as process nozzle
ii)	Air Cooler:		One on one of the inlet& one on one of the outlets of each header, size 40NB nozzle with BF etc. If it is not possible to provide on process nozzle then it shall be provided on header. Rating shall be same as process nozzle.

2.21 **Important Considerations**

- Vessels and columns shall be designed considering maximum operating liquid head in addition to design pressure.
- All columns and vessels shall be capable of withstanding water full condition during system testing.
- In addition, all vertical vessels, columns and Horizontal vessels shall be designed so as to permit site testing of the equipment with water at the test pressure on the top of the equipment considering 33% of design wind load. The design shall be based on fully corroded condition.
- All equipment foundation shall be designed and constructed for water full condition when equipment is new with 33% of design wind load.
- Vessels and columns shall be tested at shop hydrostatically at pressure calculated as per applicable code in new and cold condition.
- Seismic design shall be carried out based on site spectra.
- Design of components not covered in IBR (Indian Boiler Regulations) shall be in accordance with ASME SEC VIII DIV I.

- All stress analysis, local load analysis etc. shall be carried out for critical equipments only.
- All nozzle necks, all nozzle flanges and blind flanges shall be of weld deposit construction for clad equipments. Loose liners are not permitted.
- All vertical equipment shall be provided with two lifting lugs. Lifting lugs shall be designed with impact factor of two.
- Mechanical design of self supporting Tall Columns /Tower shall be carried out for various load combinations as per Clause 3.2
- Material of various parts of equipment shall be selected as per Table given in Annexure-I unless otherwise stated on process data sheet.
- Stress analysis shall be carried out for nozzle to shell junction using maximum shear stress theory for vessels and columns. Allowable stress intensity shall be as per ASME SEC VIII Div 2.
- Stress analysis of shell to skirt junction shall be carried out using maximum shear stress theory for vessels and columns designed as per ASME SEC VIII DIV 2. In case skirt shell joint is of butt welded construction, the same shall be 100 % radiographed.
- Projection of vacuum stiffening rings, on insulated vessel shall be less than insulation thickness wherever possible. Alternatively, the stiffening rings shall be covered with insulation & cladding.Annular space shall be provided between the insulation support rings and shell and shall be designed to avoid CUI.

2.22 **Heat Exchangers**:

1. Tube Sheet type for floating head and U tube heat exchanger
   Non extended for floating head.
   Extended for Stab in bundles only of 'B' type stationary head of U tube exchangers
2. Testing accessories for shell and tube Heat Exchanger
   1 Testing rings shall be provided on all floating 'S' & 'T' head type exchangers.
   2 Dummy shell shall be provided for fixing test ring for exchangers such as kettle type or floating head without shell covers (TEMA 'AHT' or 'AKT') or stab in bundle where shell design pressure is higher than tube side pressure
   3 Test flanges shall be provided
   i For exchangers with removable bundle and bonnet type channel
   ii For exchanger with removable bundle and channel with flat cover if tube side pressure is greater than shell side pressure.
   4 Minimum number of test rings/ test flanges/ dummy shells shall be at least one per set of three bundles.
   5 For shell side interconnected and stacked exchangers the minimum number of test rings shall be equal to the number of exchangers in one stack.

		6	For 'U' tube & removable bundle exchanger, number of test flanges shall be equal to number of exchangers in one stack.
3.	Cathodic Protection		Anodes and painting shall be provided wherever specified in thermal data sheets.
4.	Maximum Tube-bundle Weight		As per thermal design basis.
5	Gaskets		Spiral Wound or Cam Profile only
6.	Clear distance between edge of foundation and back of girth flange.		300 mm

2.23 **Air Coolers**

1.	Noise level	:	The noise level shall be limited to 85 dB(A) max. measured at a distance of one meter from the bundle at the header access platform walkways and one meter from the bay limit on motor maintenance platform. The noise level within the air cooler bay shall be 90 dB(A) maximum, at locations defined as per API.
2.	Type of Belts	:	Toothed timing belts, Oil resistant in accordance with BS 903 part A16, as well as fire resistant and anti static "FRAS" conforming to BS 3790.
3.	Access Platform for cooler	:	Shall be provided on all the four sides at header box elevation, (width - 900 mm) with stairs on one side and ladder on other side.
4.	Maintenance Platform for fans and motors	:	Refer 2.19.3 (i).
5.	Protective Covering (for finned tubes) on bundle top	:	By heavy duty wire mesh.
6.	Hot dip galvanizing of air cooler structurals	:	As per structural design basis.
7.	Final Painting of header box	:	All header boxes shall be finally painted at vendorôs shop.
8.	Vibration Measurement	:	Accelerometer of 100 mV/G shall be mounted on the fan bearing housing and cabled to a junction box at a accessible location and provided with MIL-C-5015 2 pin connector/BNC.

3.0 DESIGN CRITERIA / REQUIREMENTS - SPECIFIC APPLICATIONS

3.1 LPG Storage Spheres/Mounded Bullets

- The design pressure shall be established based on the composition and vapour pressure of stored product at design temperature, but in no case it shall be less than 14.50 Kg./cm^2g at the top of the sphere for LPG Sphere/Mounded Bullets.

- Selection of material of construction for various LPG Storage applications shall be as per following :

  a) For marketing and similar application (where H_2S is not present) : SA-516 Gr 70(IT) /SA 537 CL.1(IT)/EQV.

  b) For refinery and gas processing plants (where H_2S presence cannot be ruled out) : SA-516 Gr 60 (IT)/EQV.

- All LPG spheres/LPG Bullets shall be post weld heat treated irrespective of storage application and adopted shell thickness.

3.2 Tall Columns

Vertical vessel with Height (TL to TL) / Diameter ratio greater than 5 shall be considered as tall column.

Mechanical design of self supporting tall column and its anchorage block shall be carried out considering combination of various loads.

3.2.1 Loadings

The loadings to be considered in designing a self supporting tall column/tower shall include:

(i) Internal and or external design pressure specified on process data sheets.

(ii) Self weight of column inclusive of piping, platforms, ladders, manholes, nozzles, trays, welded and removable attachments, insulation and operating liquid etc. The weight of attachments to be considered shall be as per Table-I enclosed.

(iii) Other loadings as specified in UG-22 of ASME Code Sec. VIII Div.1, wherever applicable.

(iv) Seismic forces and moments shall be computed in accordance with IS 1893 (latest edition) unless otherwise specified in project specification. Unless otherwise specified importance factor and damping coefficient shall be considered as 2 and 2% respectively. Soil /foundation factor shall be considered based on soil/foundation of the equipment.

(v) Basic wind pressure and wind velocity (including that due to winds of short duration as in squalls) for the computation of forces/moments and dynamic analysis respectively shall be in accordance with IS 875 (latest edition). Additional wind loading on column due to external attachments like platforms, ladders, piping and attached equipment should be given due consideration.

(vi) Loadings resulting in localised and gross stresses due to attachment or mounting of reflux/reboiler, condenser, etc.

3.2.2 **Loading Condition**

Analysis shall be carried out for following conditions :

(i) Erection Condition — Column (uncorroded) erected on foundation, without insulation, platforms, trays etc. but with welded attachments plus full wind on column.

(ii) Operating Condition — Column (in corroded condition) under design pressure, including welded items, trays, removable internals, piping, platforms, ladder, reboiler mounted on column, insulation and operating liquid etc. plus full wind on insulated column with all other projections open to wind, or earthquake forces.

(iii) Test Condition — Column (in corroded condition) under test pressure, filled with water plus 33% of specified wind load on uninsulated column including all attachments shall be considered.

(iv) Earthquake And Wind Shall Be Considered Not Acting Concurrently.

3.2.3 **Deflection of Column**

Maximum allowable deflection at top of column shall be equal to height of the column divided by 200 up to a maximum of 300 mm.

(i) If the deflection of column exceeds the above allowable limit, the thickness of skirt shall be increased as first trial upto a maximum value equal to the column thickness and this exercise shall be stopped if the deflection falls within allowable limit.

(ii) If the above step is inadequate, skirt shall be gradually flared to reduce the deflection. Flaring of skirt shall be stopped if the deflection falls within limits or half angle of cone reaches maximum limit of 9.

(iii) If the above two steps prove inadequate in limiting the deflection within allowable limits, the thickness of shell courses shall be increased one by one starting from bottom course above skirt and proceeding upwards till the deflection falls within allowable limits.

3.2.4 **Stress Limits**

The stresses due to pressure, weight, wind/seismic loads shall be combined using maximum principal stress theory for ASME Section VIII Div.I. Thicknesses are accordingly chosen to keep the stresses within limits as per Table-2.

3.2.5 **Skirt Support Base**

Base supporting including base plate, anchor chairs, compression ring, foundation bolting etc. shall be designed based on over-turning moment (greater of seismic or wind). A minimum number of 8 foundation bolts shall be provided. Nos. of foundation bolts shall be in multiple of four.

3.2.6 **Minimum Hydrotest Pressure**

Minimum Hydrotest Pressure (in Horizontal position) shall be equal to Q x design pressure x temperature correction factor, as specified in ASME Code Section VIII Div.I /Div.2, at top of column unless specified otherwise, where Q is a factor depending on code of construction.

3.2.6 **Dynamic Analysis of Column/Tower**

Dynamic analysis of each column shall be carried out for stability under transverse wind induced vibrations as per standard design practice.

3.3 **Storage Tanks**

3.3.1 All storage tanks shall be designed as per code considering liquid height upto top curb-angle of shell.

3.3.2 Tanks shell thickness calculation shall be carried out by the one (1) - foot method as per API 650 for tank diameters less than and equal to 60m (200 feet).

3.3.3 Maximum height of unstiffened shell shall be calculated based on the corroded thicknesses of shell courses. Section modulus of wind girders shall also based on corroded thickness of shell courses.

3.3.4 Seismic design as per API 650 (Appendix-E) is mandatory for storage tanks.

3.3.5 Annular bottom plates shall be provided for all storage tanks 12 metre diameter and above.

3.3.6 Anchor bolts shall be provided based on design considering wind/seismic loads, uplift due to internal pressure etc. However, tanks having diameter ∗ 10 meter shall be provided with anchor bolts and shall be spaced at approximately 1.8M of circumference.

3.3.7 Tanks having design temperature more than 100 ºC shall have thermal isolation barrier (suitable fire bricks) between tank bottom and foundation.

3.4 **Mounded Bullet**

Mechanical design of mounded bullet shall be carried out considering combination of various loads.

3.4.1 **Loading**

Because of critical relationship between the foundation and vessel design, construction of sand-bed / foundation and settlement shall be strictly monitored during various stages of construction, vessel hydrotest etc. Following loading shall be considered for design:

a) Operating Condition:

Self weight of vessel (but corroded thickness), mound load, foundation/ sand-bed reaction, liquid weight, earthquake loading, differential settlement, design pressure, longitudinal frictional load due to thermal and pressure expansion, explosion pressure on mound (if specified).

b) Hydro Test Condition

Self weight of vessel, mound load (in case of health check-up), foundation / sand-bed reaction, water weight, differential settlement, test pressure, longitudinal frictional load due to thermal and pressure expansion.

3.4.2 **Stress Analysis**

Detail stress analysis shall be carried out by using finite Element Method, Stiffness matrix method or any other relevant structural mechanics approach. Used software must be properly validated giving references of similar installations for which the package has been used.

3.4.3 Cathodic Protection

Impressed current cathodic protection system shall be designed and installed as per the CONSULTANT Specification.

3.4.4 External Coating

Applied protection shall be fully tested for absence of holidays using high voltage spark tester.

3.4.5 **Internal Coating**

Bottom 90 degree of internal surface of vessel shall be coated with anti-corrosion coating suitable for stored product.

3.4.6 **Location / Spacing of Vessels**

Minimum spacing of vessels and other safety regulation shall be as per OISD - STD- 150.

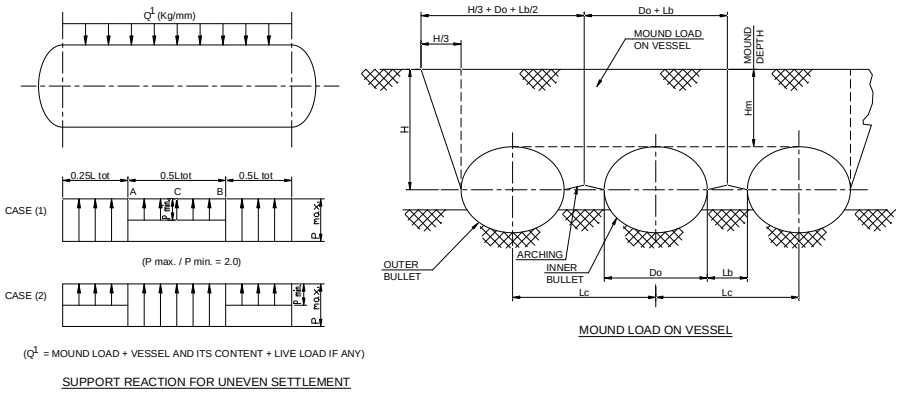
3.4.7 **Mound Load**

a) Weight of mound shall be calculated for saturated mound and specific gravity of mound shall be taken not less than 2.0 for this purpose. Load of mound on a vessel shall be calculated with arching effect.

b) Mound depth above top of the vessel shall not be less than 1 metre.

3.4.8 **Load due to Uneven Settlement**

a) To make allowance in the design for effect of tolerances in alignment of shell section,



unevenness in sand-bed, etc. a maximum/minimum reaction may be assumed as given below.

b) Based on soil investigation along with vessel axis, sub grade modules of soil / bed shall be calculated. Value of Pmax/Pmin may be reduced to 1.30 provided foundation is constructed and differential settlement is ensured by the contractor and demonstrated during hydrotest.

c) Sand-bed should be properly prepared and compacted to obtain effective angle of support at least 1208 and differential settlement should not be more than 40 mm between mid-point of vessel and end-point of vessel.

d) During initial hydrotest condition sand bed contact angle may be taken as 60deg without mound over vessel if such condition arise during construction and hydrotesting of vessel.

3.5 **Reactors**

a) The design shall be done based on Process Licensor's Specifications.

b) Material selection shall be strictly be as per Licensor's Specification.

c) Minimum thickness as per Licensor's Specification shall be adhered to.

d) MDR & UDS as per ASME Code shall be obtained by the Fabricator for Reactors designed and stamped as per ASME SEC. VIII Div. II.

e) FEM Analysis shall be done for all Process nozzles, shell to head junction Y shaped skirt, welded/weld overlayed support rings and any other stressed point as defined in Licensor's specification.

f) All internals shall have minimum thickness as given in Process Licensor's Specification and shall be designed for loads defined in Licensor's drawings.

g) Thermal analysis for HOT box shall be conducted.

h) Reactors as well internals shall be fabricated by Process Licensor's approved Vendors.

i) Lifting arrangement shall be as defined by Process Licensor's drawings

j) Floating type insulation supports shall generally be provided wherever feasible.

3.6 **Heat Exchangers**

Mechanical design of heat exchangers shall preferably be done by software developed by CONSULTANT. It complies with TEMA & ASME Sec. VIII Division 1 and also has certain practices built in over and above these codes based on CONSULTANT's experience. Further CONSULTANT specifications shall supplement various Code's requirements to assure better quality.

For Vendor designed equipment, mechanical design shall be done by internationally wetted software complying with the code requirement.

One exchanger from each type and each manufacturer shall be hydrotested in-situ at site. In addition, in case, time gap between last hydro test is more than 6 months, then also exchangers are to be rehydrotested. After hydrotest, water draining and thorough drying shall beensured.

3.7 **Air Coolers**

Mechanical design of air coolers shall preferably be done by a software developed by CONSULTANT. It complies with ASME Sec. VIII Division 1 and also has certain practices built in over and above this code based on CONSULTANT's experience. Further CONSULTANT specifications shall supplement various codes requirements to assure better quality.

For Vendor designed equipment, mechanical design shall be done by internationally wetted software complying with the code requirement.

3.8 **Fiber-reinforced plastics Pressure Vessels**

The use of fiber-reinforced plastics (FRP) for the manufacture of pressure vessels presents unique materials considerations in the design, fabrication, and testing of these vessels. FRP can be used for handling different types of liquid including acids. The General requirements for equipmentôs fabricated using FRP are given below.

i. Materials:

a) The entire material requirement with respect to the FRP shall be followed as per requirement of PART RM of ASME sec X. The composite material will often have directional properties which shall be considered in design. General specifications for the basic materials (fiber reinforcement and resin) shall be mentioned for determination of elastic properties for the composite material (laminate) produced.

b) Metallic materials, when used in conjunction with reinforced fiber laminates, are required to meet ASME Boiler and Pressure Vessel Code specifications, Section VIII, Division 1. That Section must be used for the design, fabrication, quality control, and inspection of such metallic parts. However, for hydrostatic leakage testing, these metallic materials that complete the vessel are required to meet Section X requirements.

ii. Design :

a) Adequacy of specific designs shall be qualified by one of two basic methods (these two methods shall not be intermixed):

- Class I Design ð qualification of a vessel design through the pressure testing of a prototype;
- Class II Design ð mandatory design rules and acceptance testing by nondestructive methods.

b) Class I designs based on the qualification of a prototype vessel require that the minimum qualification pressure of the prototype be at least six times the design pressure. The maximum design pressure shall be limited to 150 psi (1 MPa) for bag-molded, centrifugally cast, and contact-molded vessels; 1500 psi (10 MPa) for filament-wound vessels; and 3000 psi (20 MPa) for filament-wound vessels with polar boss openings.

c) Class II designs based on mandatory design rules and acceptance testing must comply with Article RD-11 and Article RT-6 of ASME Sec X. The maximum design pressure allowed under this procedure shall be as specified in RD-1120.

d) Spherical heads or elliptical heads having an ellipse ratio greater than 2:1 shall not be used. Spherical heads can be used when the material has isotropic properties. Elliptical heads are preferred when the material has anisotropic properties.

e) The maximum design, operating, and test temperatures of Class I vessels shall be as follows:

- 150°F (65°C) for design temperatures less than or equal to 150°F (65°C);
- 250°F (120°C) or to within 35°F (19°C) of the glass transition temperature (whichever is lower) for design temperatures in excess of 150°F (65°C).

f) The maximum design, operating, and test temperatures of Class II vessels shall be limited to an inside wall temperature of 250°F (120°C) or to within 35°F (19°C) of the glass transition temperature of the resin (whichever is lower). The minimum design temperature of both Class I and Class II vessels shall be -65°F (-54°C).

iii. Fabrication:

Class I vessels shall be limited to four processes, namely, filament winding, bag molding, contact molding, and centrifugal casting. Class II vessels shall be limited to two processes, namely, filament winding and contact molding.

iv. Inspection:

The general philosophy of Section VIII, Division 1, regarding inspection during fabrication shall be followed for FRP equipmentôs also. Familiarity with the laminate production processes and the nature of vessel imperfections is required for the Inspector.

v. Liners:

Liners may be used in FRP vessels as a barrier between the laminate and the vessel contents. Such liners shall not be considered part of the structural component of the vessel.

3.9 **Usage of Existing Equipment**

3.9.1 **Shell & Tube And Air Cooled Heat Exchangers**

a) Adequacy checking of the existing exchangers w.r.t. the revised process/ design conditions, shall be carried out based on the following:

i) Dimensions available in the As-Built drawings, if As-Built drawings are available.

ii) Dimensions available in the thermal design data sheets, if As-Built drawings are not available.

If both As-Built drawings and thermal design data sheets are not available & mechanical design pressure and / or temperature, due to revised process condition, exceeds the original design parameters, then new exchangers shall be provided to replace the existing exchangers.

b) MRPL shall furnish As-Built drawings for existing exchangers (which are to be checked for adequacy) and As-Built isometrics of thermosyphon re-boilers.

c) Health check of the existing exchangers shall be carried out by MRPL. Mechanical adequacy checking shall be done on the basis of available thickness of components.

In absence of Health check report, adequacy checking shall be carried out based on thickness of components indicated in the As-Built drawings, considering no reduction in thickness of components over the years during operation.

d) MRPL shall indicate if any of the existing exchangers have already undergone any modification from the As-Built drawings. Otherwise, adequacy checking shall be carried out based on As-Built drawings, considering no modification over the years during operation.

e) MRPL shall check and inform plugging of tubes & damages to the existing exchangers, if any.

f) Mechanical adequacy checking of existing equipment shall be carried out as per latest ASME codes.

3.9.2 **Columns and Vessels**

a) Adequacy checking of the existing columns & vessels w.r.t. the revised process/ design conditions, shall be carried out based on the dimensions available in the As-Built drawings, if As-Built drawings are available.

If As-Built drawings are not available & mechanical design pressure and / or temperature, due to revised process condition, exceeds the original design parameters, then new columns & vessels shall be provided to replace the existing columns & vessels.

b) MRPL shall furnish As-Built drawings for existing columns & vessels (which are to be checked for adequacy).

c) Health check of the existing columns & vessels shall be carried out by MRPL. Mechanical adequacy checking shall be done on the basis of available thickness of components.

In absence of Health check report, adequacy checking shall be carried out based on thickness of components indicated in the As-Built drawings, considering no reduction in thickness of components over the years during operation.

d) MRPL shall indicate if any of the existing columns & vessels have already undergone any modification from the As-Built drawings. Otherwise, adequacy checking shall be carried out based on As-Built drawings, considering no modification over the years during operation.

e) Mechanical adequacy checking of existing equipment shall be carried out as per latest ASME codes.

3.10 **Transportation (Columns and Vessels)**

Columns and Vessels shall be transported in single piece. For large vessel/ column which cannot be transported in single piece from the shop, following methodology shall be adopted:

- The vessel /column shall be fully fabricated with additional length and fully hydro tested at shop.
- The vessel/ column shall be cut into number pieces as approved with exact dimensions (Max 2 site welds)
- Transported to site, fit up, fabrication welding carried out, 100% radiography of the weld joints taken apart from other QC activity. Limpet coil hydro testing carried out.
- Limpet coil shall be cut and removed later on.
- Additional cleats to be welded on the equipment for erecting temporary platforms

TABLE-I

DETAILS AND WEIGHT OF COLUMN ATTACHMENT

1.	Shape factor for shell (for wind force calculation)	:	0.7
2.	Weight of trays (with liquid) to be considered.	:	120 Kg./m^2.
3.	Weight of plain Ladder	:	15 Kg./m
4.	Weight of caged ladder	:	37 Kg./m
5.	Equivalent projection to be considered for wind load on caged ladder	:	300 mm
6.	Distance of platform below each manhole	:	Approx. 1000 mm
7.	Maximum distance between consecutive platforms	:	5000 mm
8.	Projection of Platform	:	900 mm upto 1 meter dia. column and 1200 mm for column dia. >1 meter, from column insulation surface.
9.	i) Equivalent height of platform (for wind load computation)	:	1000 mm
	ii) Shape Factor for platform	:	1.0
10.	Weight of platforms	:	170 Kg./m2.

11. Platform shall be considered all around for top & bottom platforms. All intermediate platforms shall be taken as half.

TABLE-II

(ALLOWABLE STRESSES FOR COMBINED LOADING)

VESSEL CONDITION/TEMP. TYPE OF STRESSES	C O N D I T I O N S		
	ERECTION	OPERATING	TEST
NEW OR CORRODED	NEW	CORRODED	CORRODED
TEMPERATURE	AMBIENT	DESIGN	AMBIENT
LONGITUDINAL	KxSxE	KxSxE	0.90xY.PxE
LONGITUDINAL COMPRESSIVE STRESS	KxB	KxB	B

Where

S = Basic allowable Tensile Stress as per Clause UG 23(a) of ASME Code Sec. VIII Div.1.
B = 'B' value calculated as per Clause UG-23(b).
E = Weld joint efficiency of circumferential weld, depending on extent of radiography.
K = Factor for increasing basic allowable value when wind or seismic load is present.

Note : Allowable stresses in skirt to shell joint shall be as per following :

a) 0.49S, if joint is shear type.
b) 0.70S, if joint is compression type.

ANNEXURE - I

MATERIAL SELECTION

The following table gives general guidelines for material selection for various Pressure Parts/Non Pressure Parts of the equipment based on design temperature wherever material of construction is not specified by the process licensor.

PRESSURE PARTS						NON PRESSURE PARTS			
DESIGN TEMP.8C	**PLATE**	**PIPE (SEE NOTE 8)**	**TUBES, SPACERS (SEE NOTE-11)**	**FORGING (SEE NOTE 12)**	**BOLTS/ STUDS/ NUTS EXTERNAL (SEE NOTE 13)**	**STRUCTURAL ATTACHMENT WELDED TO PRESSURE PARTS, BAFFELS, SUPPORTS, TIE RODS , SEALING, SLIDING STRIPS ETC.**	**INTERNAL PIPES**	**STUDS BOLTS NUTS INTERNAL**	**TIE RODS**
CRYOGENIC									
FROM-254 UPTO-196	SA 240 GR.304L,304, 316,316L 347 (IMPACT TESTED)	SA 312 TYPE 304 304L,316, 316L,347	SA 213 TYPE 304 304L,316, 316L,347	SA 182,GR F 304,304L,316 347,316L	SA 320 GR B8,8C,8T STRAIN HARDENED	SAME AS PRESSURE PARTS			SS GRADE SAME AS TUBES
ABOVE-196 UPTO -80	SA 240 GR.304L,304, 316,316L 321,347 SA 353/553 GR.A	SA 312 TYPE 304 304L,316, 316L,321, 347 SA 333 GR.8	SA 213 TYPE 304 304L,316, 316L,321, 347 SA 334 GR.8	SA 182,GR F 304,F304L, F316L,316 321,347, SA 522	SA 194 GR.S, 8C,8T				
LOW TEMPERATURE									
ABOVE -80 UPTO -60	SA 203 GR E IMPACT TESTED (SEE NOTE-1)	SA 333 GR.3	SA 334 GR.3	SA 350 GR.LF3	SA 320 L7 SA 194 GR.4 OR GR 7	SA 203 GR E	SA 333 GR.3	SA 193GR.B8 SA 194 GR.8	CS KILLED
ABOVE -60 UPTO -45	SA 537 CL.1 IMPACT TESTED(SEE NOTE-1)	SA 333 GR.3	SA 334 GR.3	SA 350 GR.LF3	SA 320 L7 SA 194 GR.4 OR GR 7	SA 537 CL.I	SA 333 GR.3	SA 193GR.B8 SA 194 GR.8	CS KILLED
ABOVE -45 UPTO -29	SA 516 (ALL GRADES) IMPACT TESTED (SEE NOTE-I)	SA 333 GR.6 OR GR I	SA 334 GR.6 OR GR I	SA 350 GR LF2	SA 320 GRL7 SA 194 GR.4 OR GR 7	SA-516 (IN ALL GRADES)	SA 333 GR.6	SA 193GR.B8 SA 194 GR.8	CS KILLED
ABOVE -29 UPTO 0	SA 516 (ALL GRADES) (SEE NOTE-3)	SA 106 GR.B (SEE NOTE 3)	SA 334 GR.6 OR 1 (SEE NOTE 3)	SA 105/ SA 266 (SEE NOTE 3)	SA-193 GR B7 SA-194 GR 2H	SA-516 (IN ALL GRADES)	SA 106 GR.B	SA-193GR.B8 SA-194 GR.8	CS KILLED
INTERMEDIATE TEMPERATURE									
ABOVE 0 UPTO 343	SA 516 (ALL GRADES) SA 240 TYPE 304L,316, 321 (SEE NOTE 4)	SA 106 GR.B SA-312 TP 304L 316L,321 SA-376 TP 321	SA 179 SA-213 TP 304L 316L,321	SA-105 SA-266 SA 182 F 304L,316L, 321	SA-193 B7 SA-194 GR 2H SA-193 B7 SA-194 GR 2H	IS-2062 (PLATES) SAME AS PRESSURE PARTS	SA 106 GR.B SA 106 GR.B	SA-193 GR.B8 SA-194 GR.4 SA-193GR.B8 SA-194 GR.8	IS- 2062 (WELDABLE QUALITY) SAME GRADE AS PRESSURE PARTS
ABOVE 343 UPTO 427	SA-204 GR.B SA 387 GR.11 CL.1/CL.2 SA 240 TYPE 304L,316L, 321(SEE NOTE 4)	SA 335 GR P1 SA 335 GR.P11 SA 312 TYPE 304L, 316L, 321 SA 376 TYPE 321	SA 209 GR T1 SA 213 GR.T11 SA 213 TYPE 304L, 316L, 321	SA 182 GR.F1 SA 182 GR.F11 SA 182 F 304L, 316L, 321	SA 193 GR.B7 SA 194 GR.4 SA 193 GR.B7 SA 194 GR.4 SA 193 GR.B7 SA 194 GR.4	SAME AS PRESSURE PARTS SAME AS PRESSURE PARTS SAME AS PRESSURE PARTS	SAME AS PRESSURE PARTS SAME AS PRESSURE PARTS SAME AS PRESSURE PARTS	SA-193 GR.B8 SA 194 GR.8 SA-193GR.B8 SA 194 GR.8 SA-193GR.B8 SA 194 GR.8	C-½ Mo (COMML. QLTY) 1¼ Cr.½ Mo (COMML. QLTY) SA 479 Gr.304L, 316L, 321
ELEVATED TEMPERATURE									
ABOVE 427 UPTO 538	SA 387 GR.11 CL.1/CL.2 SA 387 GR.12 CL.I/CL.2	SA 335 P11 SA 335 P12	SA 213 T11 SA 213 T12	SA 182 GR F11 SA 182 GR.F12	SA 193 GR.B16 SA 194 GR.4	SAME AS PRESSURE PARTS	SAME AS PRESSURE PARTS	SA-193 GR.B8 SA 194 GR.8	1¼Cr-½Mo (COMML. QTLY)
ABOVE 427 UPTO 500	SA 240 TYPE 304,316,321 (SEE NOTE 4)	SA 312/ SA 376 TYPE 304,316, 321	SA 213 TP 304,316, 321	SA 182F 304, 316, 321	SA 193 GR.B16 SA 194 GR.4	SAME AS PRESSURE PARTS	SAME AS PRESSURE PARTS	SA-193 GR.B8 SA 194 GR.8	SA 479 Gr. 304L,316L, 321
ABOVE 538	SA 387 GR.22	SA 335 P22	SA 213 T22	SA 182 GR	SA 193 GR B5	SAME AS PRESSURE PARTS	SAME AS PRESSURE	SAME AS PRESSURE	2¼ Cr.1 Mo (COMML.

UPTO 593	CL.1/CL.2 SA 387 GR.21 CL.1/CL.2			F22 SA 336 GR F22	SA 194 GR.3		PARTS	PARTS	QLTY)
ABOVE 500 UPTO 815	SA 240 GR.304H, 316H 321H,	SA 312/ SA 376 TYPE 304H, 316H, 321H	SA 213 TYPE 304H, 316H, 321H	SA 182 GRADES 304H, 316H,321H	SA 193 GRB8 SA 194 GR.8 (STRAIN HARDENED)	SAME AS PRESSURE PARTS	SAME AS PRESSURE PARTS	SAME AS PRESSURE PARTS	SA 479 Gr. 304H, 316 H, 321 H.

Notes:

1. Plates are purchased to the requirement of the standard ASME SA-20, which requires testing of individual plates for low temperature service. Carbon steel material is ordered to meet the impact requirements of supplement S5, of standard ASME SA-20, typical material specification is as follows. SA 516 Gr.60. Normalised, to meet impact requirements per supplement S5 of SA 20 at minus 508F.

2. All permanent attachments welded directly to 9% nickel steel should be of the same material or of an austentic stainless steel type, which cannot be hardened by heat treatment.

3. Check for impact testing requirement as per UCS-66, for coincident temperature and part thickness.

4. Selection of stainless steel material shall be based on process recommendation / process licensor.

5. This table is not applicable for atmospheric/low pressure storage tanks. Materials shall be selected as per API 650/API 620 as applicable.

6. Materials for caustic service, sour service or sour service + HIC shall be selected based on specific recommendation of process licensor.

7. Material for pressure vessels designed according to ASME Section VIII Division 2 shall be given special consideration as per code.

8. All pipes shall be of seamless construction.

9. Non-ferrous material and super alloys are not covered above and shall be selected based on specific recommendation.

10. Material for vessel / column skirt shall be the same material as of vessel / column shell for the upper part with a minimum of 1000mm.

11. All tubes shall be of seamless construction.

12. SA 336 shall be used for Heat Exchanger non standard SS/LAS forgings.

13. Internal bolting shall be selected on the basis of shell side material solid or clad as follows:

SHELL MATERIAL	STUD	NUTS
Carbon steel &up to 1% Cr.	ASTM A 193 Gr B-7M	ASTM A-194 Gr 2HM
5% Chrome	A 193 Gr B5	A 194 Gr 3
13% Chrome	A 193 Gr B6X	A 194 Gr 6
Stainless Steel	A 193 Gr*	A 194 Gr*

For low temperatures, min. quality of bolting material shall be as specified for external bolting and shall be improved if shell side materials are better.

* Compatible / same grade of SS.

SECTION-B

(TRAYS & TOWER INTERNALS)

CONTENTS:

1.0 **INTENT**

1.1 The intent of this specification is to define basis to be followed for Mechanical Design, engineering, fabrication, inspection/testing, supply and installation (inside the columns at site) of Trays, Packed Column Internals and Tower Packings separately and collectively known as "Internals". For licensed units, in case the requirements specified here are in conflict with licensorôs specifications, licensorôs requirements shall govern.

1.2 In case of any conflict between various documents, resolution shall be in accordance with the following:

- Data Sheets/P&IDôs
- Job Specifications
- Design Basis
- Standard Specifications/Engineering Standards.

2.0 **PROCESS PARAMETERS, DESIGN CONDITIONS & SELECTION OF INTERNALS**

As per ProcessDatasheets.

3.0 **USAGE OF EXISTING INTERNALS**

All As-Built drawings of Columns, Tray/Internals as well as Tower Attachments shall be provided by MRPL, which shall be the basis of revamp to be carried out by CONSULTANT. However in case drawings provided by MRPL are not As-Built, same shall be treated as base document for proceeding further with engineering. Wherever drawings of existing internals are not available, new internals will be considered including replacement of existing support ring/bolting bars to suit the new configurations.

All existing internals found adequate with/without any modifications will be retained presuming:

(a) All such internals are in good physical conditions and can be retained.
(b) All the existing internals are in good physical condition to permit partial modifications as necessary to make it suitable for revised conditions.
(c) No mechanical design checks of existing internals being retained will be carried out unless explicitly asked/required by MRPL based on operating feed back.

4.0 **DESIGN**

4.1 **Materials**

4.1.1 All materials shall conform to those specified in the respective process drawings or data sheets.

No substitution of material will be permitted without the written consent of Owner/CONSULTANT in required formats as per procedure. In case substitution of material is proposed, vendor shall clearly indicate the reasons for requiring such change

and give chemical and physical properties of the proposed alternate material with their standard specification number.

All the material supplied by vendor shall be new and of first quality supported with mill test certificates.

Unless specified in data sheets, Material shall be as per clause from 4.1.2 to 4.1.7.

4.1.2 **13 Cr Stainless Internals**

All sheet and plate material shall be in accordance with SA 240 Type 410S or 405 having No.1 finish only for thickness more than 4mm. For thickness up to and including 4 mm, No. 2B/2D finish is also acceptable.

All bolting material shall be 13 Cr - SA 193 Gr B6X or B6 for bolts and SA 194 Grade 6 for nuts and lock-nuts.

4.1.3 **18 Cr - 8 Ni Stainless Internals**

All sheet and plate material shall be in accordance with SA 240 Type 304 having No.1 finish only for thickness more than 4mm. For thickness up to and including 4 mm, No. 2B/2D finish is also acceptable.

All bolting material shall be SA 193 B8 for bolts and SA 194 Gr.8 for nuts and lock-nuts.

4.1.4 **Monel Internals**

All sheet and plate material shall be in accordance with SB127 in hot rolled, annealed and pickled condition.

All bolting material shall be Monel, made from rod or bar stock, SB164.

4.1.5 **Carbon Steel Internals**

Unless otherwise specified, sheets and plates shall be procured in hot rolled conditions and shall be free of mill scale. Material shall be suitable for bending. The bend test specimens shall stand being bent cold through 180 degree without cracking on outside of the bent portion, to an inside diameter equal to or less than twice the thickness of the specimen or as per relevant material specification, whichever is severe. All sheet, plate material shall conform to SA285, SA283 or better unless specified otherwise on the data sheets/drawings.

All fasteners including clamps, material shall be as per clause 4.1.2 above, unless specified otherwise.

4.1.6 **Gaskets**

Trays gasketing material shall be woven tape, fabricated from **Asbestos Free Material** such as Woven Fiber-glass Tape (Amatex-G36-P752 or equal), Woven Teflon Tape, Woven Expanded Graphite Tape or Ceramic Fiber Tape etc. and shall be suitable for process fluid and column design temperature, unless specified otherwise in the Data

Sheets/Purchase Specifications. The thickness of the woven tape shall be 1.5 mm minimum. The use of Woven Asbestos Tape or Wire shall be subject to CONSULTANT/Ownerôs prior approval only.

4.1.7 **Support Rings/Bolting Bars/Support Cleats**

Support rings, downcomer or up comer bars and other parts welded to vessel shall be of same metallurgy as of vessel. Minimum thickness excluding corrosion allowance of welded parts shall be 6 mm for vessel diameter up to 3000 mm and 10 mm for higher diameter. Corrosion allowance as specified in vessel data sheets shall be added on both sides of Support Ring, Bolting Bar and other welded parts.

4.2 **Thickness of Internals**

4.2.1 **Minimum thickness of Internals:**

Corrosion allowance, wherever specified in the data sheets for Internals in excess of corrosion allowance as indicated in clause 4.2.2 shall be added to the minimum thickness specified below:

		Alloy	CS
i)	Deck plates, seal pans, draw-off Pans, weirs/seal plates, other removable Components	2.0	3.5*
ii)	Welded deck plates, downcomer aprons and other welded components	3.0	3.5*
iii)	Downcomer/Internal pipes	2.0	3.5*
iv)	Bubble Caps	1.6	2.0
	Risers (fixed)	2.0	3.5*
	Risers (removable)	1.6	2.0
v)	Valves	1.6	(will not be used)
vi)	StructuredPackings	0.15	(will not be used)
vii)	Support Grid for Structured Packings	5.0	8.0
viii)	Locating Grid/Retaining Grid/Bed Limiter	5.0	8.0
ix)	Grid Packings		
	(a) Bottom-most layer	5.0	8.0
	(b) Next Five Layers	2.0	(As per vendorôs standard)
	(c) Balance Layers	1.6	(As per vendorôs standard)
x)	Random Packings	(As per vendorôs standard)	
xi)	Loose Beams	To suit load	To suit load

xii) Lattice Girders

(a) Primary Members	5.0	6.0
(b) Secondary Members	3.0	4.0
(c) Gusset Plates	10.0	10.0
(d) Downcomer bolting bars	5.0	10.0

(*10 USSG is also acceptable in lieu of 3.5 mm)

All bolting shall be minimum M10 for Internals and M16 for Lattice Girders. All bolt head/nuts shall be hexagonal.

Minimum corroded thickness of the internals for the loading condition as per Clause 4.3.3. (i) and (ii) below, shall be 3.0 mm.

4.2.2 **Corrosion Allowance**

The following corrosion allowance shall be added to calculate thickness of Internals unless otherwise specified on data sheets or bid specification.

i) No corrosion allowance is required for Monel or Stainless steel alloy assemblies.
ii) The corrosion allowance for all surfaces of floor of carbon steel assembly shall be 1.5 mm (total).

4.2.3 Unless specified on the data sheets or bid specifications, corrosion allowance shall be higher of 1.5 mm (total) or one quarter of the vessel corrosion allowance on each surface of trays and its components.

4.2.4 Beams, trusses and other support members shall have total corrosion allowance equal to vessel corrosion allowance for removable type construction and twice the vessel corrosion allowance for non-removable type construction through vessel man-hole.

4.3 **Design Loadings**

4.3.1 Design loads for tray assemblies shall be based on a liquid height of 50 mm liquid above weirs plus self weight of deck plates and beams or live load of 150 kg/m^2 whichever is severe. In case liquid density is less than water, 1000 kg/m^3 shall be considered for purpose of calculating liquid load.

4.3.2 Under-down-flow plates and seal pans shall be designed to withstand a weight of liquid equal to half the tray spacing or 300 kg/m^2, whichever is severe. In case liquid density is less than water, 1000 kg/m^3 shall be considered for purpose of calculating liquid load.

4.3.3 Five trays above/below 2-phase feed inlets and in bottom zone of column wherever process steam or two-phase feed is admitted, shall be provided with lock nuts. Trays shall be capable of sustaining a net thrust of

i) 1464 kg/m^2 and with shear clips for Vacuum Columns (Stripping + Wash + HVGO sections)
ii) 1000 kg/m^2 and with shear clips for Crude Column/Main Fractionator Columns.
iii) 450 kg/m^2 for all other services

4.3.4 One tray above and below the intermediate vapour/liquid feeds shall also be provided with locknuts.

4.3.5 The packing support plate shall be designed to support the maximum expected load of tower packings, liquid hold-up (min 10 percent). In case of liquid density is less than water, 1000 kg/m^3 shall be considered for purpose of calculating load due to liquid hold-up.

4.3.6 Bed limiters frame shall be strong enough to take care of surges/uniformly distributed load of 100 kg/m^2 and 135 Kgs concentrated load at any point.

4.3.7 Hold down plate shall exert sufficient static load on the bed to restrict movement of the packing. The hold down plate shall be designed for exerting a load of 100 kg/m^2 minimum on the packed bed.

4.3.8 Liquid distributors/Redistributor shall be designed for self weight plus maximum expected liquid load.

4.3.9 All Internals assemblies except cartridge tray assemblies, shall be able to withstand the self weight plus the following number of 135 Kgs concentrated loads (maintenance loads) at ambient temperature.

Vessel Diameter	Number of 135 kg loads
Up to 1200 mm	1 (at center of diameter)
Up to 3600 mm	2 (at center and ¼ point of diameter)
Over 3600 mm	3 (at center and ¼ points of diameter)

4.4 Allowable Stress and Deflection

4.4.1 Allowable stresses for all Internals shall be as per ASME Sec. II. Part D, latest edition.

4.4.2 The maximum deflection of tray/tower internal assembly shall not exceed 1 mm per meter of column diameter or 7.5 mm, whichever is lower for the design loadings given in clause 4.3.1 and 4.3.2 above. Deflection for distributor assembly shall be limited so that overall liquid maldistribution does not exceed the limit as per clause 4.5.18(v). Deflection for support plate and seal pans shall be limited to L/400, where L is the length of individual component.

4.4.3 Deflection as per clause 4.4.2 may be ignored for trays designed based on design loadings as per clause 4.3.3 and 4.3.9.

4.4.4 For large diameter vessels, initial camber may be made in the principal support members of the assemblies so as to limit the deflection as specified in clause 4.4.2 above.

4.5 Arrangement/Details of Internals

4.5.1 All assemblies except one piece cartridge type trays for column ID < 750mm shall be of removable type unless otherwise indicated. The general design, number, type and spacing shall be established on the individual vessel drawing/data sheets. Cartridge type trays shall be designed to rest on four support cleats.

4.5.2 Each removable section shall be so dimensioned/sized to permit passage through vessel manhole and shall be suitable for assembly/ dismantling from upper side in so far as structural contingencies permit. Maximum diagonal dimension of the components shall be restricted to vessel manhole ID - 12mm clearance.

4.5.3 Internals support trusses supporting more than one Internal, as are commonly used in large diameter columns and which can not be installed through manholes, shall be split into sections for access through manhole and minimising welding work inside the column.

4.5.4 Internals decks shall have a maximum length of 3000 mm. To achieve this maximum distance between main support beams or girders shall be limited to 3000 mm. However, the main support beams or girders having length more than 3000 mm shall be provided with one butt joint with splice plates of the same thickness as the main member upto 6000 mm length and two butt joints with splice plates of the same thickness as the main member for more than 6000 mm length and so on. The butt joint shall be provided inclined at 45 degrees.

4.5.5 **Manways**

i) One(1) manway in single cross flow decks, two(2) manway in double flow decks and so on shall be provided. These manway shall be freely removable from top and bottom. Manway shall be in the same vertical line for a set of trays. These shall be at such a location and of a shape and size to permit easy access to every area of the tray. Manway of different set of trays (about 20 trays) shall be staggered to each other. Minimum clear opening on tray shall be 380mmx450mm.

ii) Where manway cannot be provided, decks shall be split (turn-up - turndown) to provide suitable access for Inspection and assembly from top as well as bottom.

4.5.6 Unless specified otherwise, support rings, bolting bars, support bracket/cleats when required shall be designed for welding to the vessel. All other parts shall be designed for bolting or clamping in place. Clamping shall be used on Tray floor and all downcomer/up comer shall be through bolted. Spacing of bolting or clamping shall be close enough to ensure optimum liquid tight construction but shall not exceed 125 mm on deck portion in downcomer area/liquid holding area/downcomer apron bolting etc. and 150 mm in active area. All joints and seams of trays specified to be liquid tight without gasketted joints shall be seal welded at site. Maximum spacing for clamps/bolting for gasketted construction shall be restricted to 100 mm.

4.5.7 Drawings and instructions for installation and fabrication of support ring, bolting bar and support bracket/cleats welded to vessel shall be furnished by Internals supplier. They shall show clearly the type, size and extent of welding. All support rings and bolting bars shall be continuously welded on both sides. All support brackets shall be welded all around.

4.5.8 When locations of bed support, retainer and distributor are not indicated on data sheets, Tower Internal/Packing supplier shall determine and indicate dimensional requirement.

4.5.9 Gasketting need not be used in the design or installation of Internals except for bubble cap trays, all liquid holding portions (e.g. seal pans, draw-offs), collector trays, distributors and redistributors. Fabrication shall provide tight metal-to-metal joints. Metal seal plates shall be used to close construction joints where necessary.

4.5.10 All stiffeners and support members shall be located on the underside of the tray floor with the exception of open type trusses supporting two trays. Stiffeners and support members in bubbling areas shall not exceed 75 mm in width and shall be designed so as not to impede or channel the liquid flow on the tray. Depth of stiffeners and support members transverse and parallel to the liquid flow shall not exceed 20 and 30 percent respectively of tray spacing.

4.5.11 A minimum of 20 mm overlap shall be provided between tray floor section and support members.

4.5.12 Trays and seal pans not specified to be liquid tight, and of a design which would not easily drain shall be provided with one or more 12mm diameter/square drain holes/slots located in the outlet weir directly above the tray flow. Size and number of drain hole/slot may be reduced depending upon liquid rate. Draw off sumps shall be located flush with the invert inside of draw off nozzles to allow complete draining of sumps.

4.5.13 All the three (3) and four (4) pass trays shall have pressure equalising pipes (vent tubes) across the downcomers.

4.5.14 Bubble Cap Trays

Risers

Fixed risers shall be used unless otherwise specified in the data sheets. For deck plates less than 3 mm in thickness, riser shall be expanded into upward flanged opening in the deck plates and then stitch welded to upturned edges of the opening.
For deck plate 3 mm thickness and more, the riser shall be continuously welded to the deck plates with the holes in the deck plate being plane, not upturned. Caps shall be attached to the attachments welded to the top of risers.

Bubble Cap

Bubble caps are to be furnished in Full Annealed and scale free bright condition.

4.5.15 **Valve Trays**

Valve assemblies of proprietary trays shall be provided with following features.

i) A means of preventing the orifice covers from adhering to tray floor.
ii) A means of preventing the orifice covers with integral guide legs and lift stops from popping out of place during operation.

4.5.16 **Sieve Trays**

All perforations shall be punched and made from top side and burr side on tray decks must be downwards when installed, unless specified otherwise. In case of liquid-liquid

extractor column trays, punching direction shall depend on the direction of liquid flow of continuous phase.

4.5.17 Burrs shall be removed from all perforated areas and edge of Internal sections.

4.5.18 **Distributors/Redistributors**

Distributors of liquid feed to packed beds, unless otherwise specified in data sheets, shall be gravity flow type (e.g. orifice drip trays, tubed drip trays, trough type, orifice header laterals) in accordance with following requirements:

i) Orifice for liquid distributor shall preferably be minimum 8.4 mm diameter and shall be arranged on an approximate equal spacing throughout the distributor. Distributor supports shall be designed and arranged so as not to interfere with flow from orifices.

In case orifice diameter calculated is less than 8.4 mm, then antifouling covers shall be provided on each orifice. Orifice below 6mm diameter shall be preferably provided at an elevation in drip tube or in side of trough with guide tubes.

ii) Vapour risers shall have a total cross sectional area as per Vendor's design but not less than 15 percent of vessel cross sectional area. Number, size and arrangement of vapour risers shall be such so as not to affect the orifice spacing and liquid distribution to the packings.

iii) Distributor joints shall be gasketted to be liquid tight. Gasket material used shall be suitable for service and soft enough for leak tight joint.

iv) Distributor shall be capable of performing satisfactorily for the range of loadings specified to cover entire range of plant operation.

v) Flow variation from orifice to orifice shall not be more than 10 percent at turndown condition.

vi) Feed pipe shall form part of Distributor supply.

4.5.19 **Packing Support Plate**

Packed bed support plate shall be vapour-injection type, providing separate passage for liquid and vapour flow. The support plate shall have at least 90 percent free area based on cross sectional area of vessel. Slot size shall be so selected to avoid any sneak through of packings from slots.

4.5.20 **Bed Limiters/Bed Retainers**

Bed Limiters/Bed Retainers shall be located just above top of packings to avoid fluidising of bed and shall be fixed in position so as not to be moved by the packings and shall be designed so as not to affect distribution from the liquid distributor to the packings. Bed Limiters/Bed Retainers for use with spray nozzle distributor shall be designed with major structural support on the underside of the retainer so as not to affect the spray distribution on the packings.

4.5.21 **Hold Down Plates**

Hold down plates shall be provided on the top of ceramic or carbon tower packings. The hold-down plate shall directly rest on the bed without any support cleats. Hold-down plate shall exert sufficient static pressure on the bed to restrict movement of the bed. Care shall be taken not to use hold-down grid with metallic or plastic tower packings.

4.5.22 **Flash Feed Distributor**

Flash feed distributor for flashing or mixed phase, vapour and liquid feeds to packed bed shall be designed to separate the two phases and distribute the liquid phase on distributor/redistributor. If flashing feed gallery is used, riser area shall be 50% of vessel cross sectional area.

4.5.23 **Tower Packing**

If type of packings is not specified in the process data sheets, following shall be taken as guidelines:

i) For wash zone of vacuum column, Grid Packings shall be used.

ii) For all other applications preferably Pall Rings shall be used. If pall rings are not expected to perform to desired performance, proprietary random packings may be used. Alternatively, Vendor may also adopt/recommend use of Structured Packings.

4.5.24 The maximum allowable pressure drop for a packed bed shall include packed bed support, bed limiter and distributor.

5.0 **FABRICATION AND SUPPLY**

5.1 **Tolerances**

All sections shall be truly flat within 2 mm and shall be free from burrs and welds spatters.

Tolerances wherever unspecified shall be taken as ±1 mm and not to be accumulative, except on thickness and assembly diameter. Tolerances on thickness shall be as per applicable specification and tolerances on assembly diameter shall be as below:

Cartridge Trays : D^{+0}_{-3}

Other Assemblies : $D \le 1500, D^{+0}_{-6}$

$1500 < D \le 4500, D^{+0}_{-10}$

$D > 4500, D^{+0}_{-20}$

5.2 **Welding**

5.2.1 All welding shall be done by metal arc welding. For welding on thinner gauge sheets TIG welding is preferred.

5.2.2 Gas or Carbon arc welding shall not be used.

5.2.3 Welding electrodes of composition similar to Internals material shall be used except austenitic electrodes of higher chromium and nickel content such as AWS A5.4, ASME SFA 5.4 class E309 and E310 may be used for 12 Cr stainless steel. For dissimilar material welding, electrode composition shall be similar to nobler material being welded. Following electrodes shall be used unless specified otherwise:

E 7018	for all CS materials
E 308	for all SS 304 to SS 304
E 308L	for all SS 304L to SS 304L
E 309MoL	for SS 410S to SS 410S, SS to CS, SS 410S to SS 304, 304L, 316, 316L
E 316	for all SS 316
E 316L	for all SS 316L
E Ni Cu7	for Monel to Monel and Monel to CS/SS.

5.2.4 Welding wherever specified, is to be done by qualified and approved welders using the suitable fillers and fluxes recommended for the materials in the fabrication drawings. For welding the stud on tray decks and support beams, use of stud welding gun with suitable flux is acceptable. In manually welding the studs, care should be taken to minimise the weld spatter and the outside diameter of the weld so that it should not foul with tray deck or washer. For stud welding, proper welding procedure shall be established. Torque required for welding failure shall be higher than the torque required for failure of the stud.

5.2.5 A proposed Welding Procedure Specification (WPS) shall be submitted to AIA for his approval. On approval, a Procedure Qualification Test (PQT) shall be conducted which shall be witnessed by AIA. On acceptance of all tests as per ASME Section IX, a final WPS along with Procedure Qualification Record (PQR) shall be submitted. Production welding shall start only after approval of final WPS/PQR and qualification of welders as per ASME Section IX. AIA may accept previously qualified WPS/PQR at his sole discretion.

5.3 **Miscellaneous**

5.3.1 All parts fabricated shall be smooth, true, clean and free from burrs, grease and dents. Openings for passage of workman must have exposed edges rounded.

5.3.2 All support rings, bolting bars, beams support brackets and other components which are integral and therefore welded to the column shell inside, shall be supplied and installed by column fabricator.

5.3.3 Total draw-off trays shall be designed for zero leakage construction and may be seal welded (if required) at site to attain zero leakage.

5.3.4 Seal welds shall have a throat thickness at least equal to the specified corrosion allowance.

5.3.5 All stainless steel tray assemblies/internals and their components (e.g. Bubble caps, valves etc.) shall be pickled and passivated. Pickling and Passivation shall be as per ASTM 380. However, vendor shall prepare procedure for Pickling and Passivation and obtain approval from Owner/PMC.

5.3.6 All parts shall be fabricated in accordance with good shop practice and in uniformity so that all corresponding parts will be inter-changeable.

5.4 **Spares**

Following spares shall be included as part of the supply:

5.4.1 **Constructional Spares**

The supply shall include the following as constructional spares :

Bolts/Nuts	10% of total for each size (minimum 10 nos. of each size).
Clamp assemblies	10% of total for each type and size (minimum 10 nos. of each size).
Valves for trays	5% of each type
Bubble caps	5% of each type and size
Gasketing or tapes	100% of each type and size
Sealing foils for cartridge trays	200% of each size
U-clamps	10% of each type and size or 10 nos. whichever is minimum.
Tower Packings (Only Random Packings)	10% for Metallic and Plastic Packings 15% for Carbon and Ceramic Packings
Spray Nozzles	Up to 25 Nos. (of each type) - 100% More than 25 (or each type) - 25% (subject to minimum of 25 Nos.)

5.4.2 Vendor shall submit list of spares recommended for two years of satisfactory operation. However, following operational spares as a minimum shall be supplied as Mandatory Spares:

i)	Valves for Trays	-	10% of each type
ii)	Bolts/Nuts	-	10% of total for each type/size (minimum 10 nos. of each size).
iii)	Clamp Assemblies	-	- do -
iv)	Gaskets or Tapes	-	100% of each type and size
v)	Sealing foils for	-	200% of each size

	Cartridge Trays		
vi)	Spray Nozzles and size.	-	25% subject to minimum 5 Nos. of each type
vii)	Tower Packings (Only Random Packings)	-	5% of each type and size.

If desired by owner, item wise price for above spares shall be furnished after award of the job.

6.0 INSPECTION AND TESTING

6.1 General

6.1.1 The materials, fabrication, testing and trial assemblies are subject to inspection by Owner/CONSULTANT, at shop floor before shipment and during installation.

6.1.2 Any rejection made by Inspector shall be final. Approval/Inspection by CONSULTANT/Owner and/or their designated representative shall in no way relieve the Vendor of his responsibility to meet all the requirements of the Purchase Order.

6.1.3 Owner/CONSULTANT/Authorized Inspector shall have free entry to the Vendor's shop at all times where and while the work is being performed. The Vendor shall offer the inspectors all reasonable facilities to satisfy them that the materials are being furnished in accordance in accordance with the specifications.

6.1.4 Vendor shall notify the Owner/CONSULTANT sufficiently in advance of any fabricating operations to permit the Inspector to arrive at the Vendor's shop.

6.2 **Stage Inspection During Fabrication**

6.2.1 **Dimensions**

The inspector will check that the thickness and the dimensions of all parts for the Decks, Weirs, Seal and Draw off pans, Down comers, Draw off pipes, Supports, Beams, Valves, Bubble caps, Clamps, Studs, Bolts, Nuts, Risers, Washers and Gaskets etc. are as per the approved drawings.

6.2.2 **Fabrication**

The inspector shall check each individual part of the equipment fabricated as per approved drawings and specifications. For instance, for the Bubble cap dimensions, height, width and number of slots, heights, O.D. and I.D. or riser and cap, shroud ring height, exit and inlet weirs height etc. shall be measured. The inspector will check that all identical parts shall be interchangeable.

Inspector shall check that the sharp edges on the Internal components, manway covers, weirs, downcomers etc. are properly removed. Also that all burrs from punched holes and loose weld slags and materials are removed from all components. Stage-wise inspection during fabrication will be thoroughly carried out. Before starting welding, welders' qualification test will be carried out, if required, as per ASME Sec. IX. Where numbers of similar items are to be made, inspector shall give the clearance for the fabrication of the lot only after checking and approving the first sample piece.

6.3 **Trial Assembly**

One tray of each type and size with its accessories shall be assembled on a test fixture resembling the tower, inside the fabricators' shop. The components for such an assembly will be taken at random from each lot of identical items.

The assembled tray will be carefully checked for its dimensions, tolerances, number and arrangement of perforation, the working of the valves in case of valve trays, V-notch or Blocked Weir, adjustability of weir, vent tube details, downcomer clearance, weir heights, downcomer length and width, number of clamps, gaps and potential leakage points etc.

The assembly shall also be checked for each type and size of packed tower internals.

Inspector will also check the flatness and deflection of the trays, internals, beams, tray edges and beam ends clearance.

Trays/ Internals shall be assembled at site on ground prior to fixing inside the column.

6.4 **Leak Testing**

Bubble cap, Collector trays, Liquid holding portion of other trays such as Seal pans, Recessed seal pans, Draw off pans, Distributors/Redistributors shall be subjected to leakage test at shop floor as well as in the field by filling water up to weir level or up to normal liquid level as the case may be. Appropriate ring fixture or a portion of column

shell with supports for seal pan/recessed seal pans/draw off box etc. shall be made by Internals Vendor to facilitate leak testing in the shop.

Leak testing shall be carried out with service gaskets and drain holes temporarily plugged.

All distributors/redistributors shall be leak tested with all holes temporarily plugged. It shall be ensured that leakage is uniform and not from few concentrated places/corners. All plugs shall be removed after leak testing is over. Leakage rate shall not exceed 0.5 percent of design liquid flow rate unless otherwise specified.

6.5 **Distributor Testing**

6.5.1 All Vendorôs ProprietaryLiquid distributors/redistributors shall be water tested in the vendorôs shop only by the following procedure at 50%, 100% and 110% of the design liquid volumetric flow rate. The vendor shall certify to the purchaser at the time of bidding that they believe their equipment can meet the testing requirements listed below:

(i) If the distributor contains a pre-distributor, it shall be tested first to ensure that it has a CV of 5 or less at the design flow rate. Each orifice in the pre-distributor shall be tested. The CV is defined as the ratio of the standard deviation to the sample mean, expressed as a percent.

(ii) The distributor/re-distributor itself shall be tested and the CV determined. To determine the CV, at least 30 pour points or at least 10% of the pour points (whichever is higher) shall be randomly selected and tested. If the CV specified below cannot be met, the vendor will correct the problem at its expense.

(a) For orifice pans, tubed drip pans and other similar devices, a CV of 10 or less must be achieved at the design liquid volumetric flow rate.

(b) Four orifice parts, tubed drip pans or trough distributors that employ a modular (sectional) design, (wherein many pieces are geometrically identical) all pieces of the same geometry shall be treated as one group or strata. One piece from each strata shall then be tested by the procedure outlined above.

(c) The average flow rate per pour point for any grouping of 10 of the tested pour points from a single area should differ by no more than 5% from the average for the group or strata being tested.

(d) The test results shall be furnished to PMC/Owner in a written report. This report shall also contain a drawing of the distributor in plan view. This drawing shall be broken down into 3 radial zones of equal area and the location of pour points sampled in each zone.

In case vendor can demonstrate procedure establishing above quality requirements, performance testing of distributors can be waived off.

6.5.2 **Spray Nozzle Distributors**

Spray header with Spray nozzles duly installed, shall be mock assembled & tested at site on ground on a fixture resembling the height above the bed, before installation. Nozzle height etc shall be modified, if required, to get proper wetting, after such a mock test. Test shall be carried out as close to design rates as possible.

Spray Nozzles

Apart from the usual material quality tests (chemical analysis and mechanical properties) and manufacturing quality control tests, vendor shall include for & carry out the testing of the spray nozzles with respect to the flow rates for specific ΔP, spray angle, spray coverage and distribution for the tip distance given in the data sheet. The testing medium shall be water. These results shall be submitted to Owner/CONSULTANT for review. Tests and acceptance criteria is as below:

Flow rates	-	±5% for specific ΔP
Spray angle	-	±5°
Flow variation	-	As per vendorגs Standard. (Data to be reported for Information)
No. of nozzle to be tested	-	10% of each size and type. (Min. 2 nos. of each type & size)

7.0 SITE INSTALLATION AND SUPERVISION

7.1 For revamp jobs, cutting & removal of existing attachments, welding of new attachments inside the existing columns and installation of new internals shall preferably be done by column internals supplier to have single point responsibility for complete supply.

Alternatively, all these activities can also be included in the scope of Mechanical Contractor (covered in separate mechanical tender) to minimize the agencies involved at the site. In such a case, all such modifications, installation shall be carried out under the supervision of Internals supplier so as to ensure guarantee of performance of column internals by supplier.

7.2 For new columns, installation of internals shall be done by column internals supplier only.

SECTION-C

(MECHANICAL EQUIPMENT)

CONTENTS:

1.0 SCOPE

This design basis defines the minimum design criteria to be followed for the design of various mechanical equipment.

2.0 CODES & STANDARDS

2.1 The following codes & standards (latest editions) including their latest addenda shall be followed unless specified otherwise.

ASTM	:	American Society for Testing and materials
API	:	American Petroleum Institute
ASME	:	American Society of Mechanical Engineers
BSI	:	British Standards Institute
BIS	:	Bureau of Indian Standards
AGMA	:	American Gear Manufacturerôs Association
NFPA	:	National Fire Protection Association
OCIMF	:	Oil Companies International Marine Forum
TEMA	:	Tubular Exchangers Manufacturerôs Association
IS	:	Indian Standards

2.2 Statutory Provisions

National laws and statutory provisions such as Indian Boiler Regulation and Department of Explosives, Nagpur, India together with any local by-laws for the state shall be complied with. Static and Mobile Pressure Vessel (SMPV) rules, Petroleum rules, Factory Acts and Rules, Environmental Protection Act & Rules etc. as applicable shall also be complied with.

3.0 REFERENCED PUBLICATIONS

ABMA	:	American Boiler Manufacturerôs Association
HEI	:	Heat Exchangers Institute

4.0 GENERAL DESIGN REQUIREMENTS

While specific guidelines pertaining to individual equipment and systems are listed in subsequent sections, the following shall be considered for all items while formulating their specifications and also in downstream procurement engineering activities:

- Reliability in service (assessed from vendorôs relevant track record and improved by incorporating certain minimum design features or requirements in the specification)

- Compliance with applicable national or overseas codes and standards as well as any statutory regulations in existence for a specific item.

- Ease of operation and maintenance including any necessary measures for ensuring safety of personnel and equipment as well as conducive working environment.

- Standardization of components wherever feasible.

- Adherence to any limitation of space available for the equipment and its operation/maintenance.

- Facility for any known future expansion of plant capacity with a minimum of modification or shutdown.

5.0 DESIGN REQUIREMENTS FOR SPECIFIC APPLICATIONS

i) Corrosion allowance for carbon steel vessels shall be minimum 3 mm.

ii) All components/equipments shall meet the requirements of respective area classification.

iii) Insulation shall be provided for personal protection for all surface temperature higher than $60^{o}C$.

iv) All couplings, gears and exposed rotating parts shall be provided with adequate protection guards.

6.0 BASKET FILTER

1) Basket filters shall normally be used when particles of around 40 microns or larger size are to be filtered from a fluid stream.

2) Filter shall be designed not to exceed the allowable pressure drop in dirty conditions.

3) In order to avoid the possibility of frequent basket cleaning the gross and free areas shall be at least 20 and 8 times respectively of the filter inlet nozzle area.. Basket shall be of straight cylindrical shape. Both concentric and pleated type baskets shall not be accepted.

4) Filter shall be vertical type, unless mentioned otherwise, with facility for removal of the basket from the top after opening the housing cover.

5) Fluid flow shall be from inside to outside of the basket, unless specified otherwise.

6) Filter housing design shall be as per ASME Section VIII, Division 1. For steam jacketed housings, applicable IBR requirements shall also be complied with.

7) For filter top cover weighing more than 15 kg, lifting davit shall be provided.

7.0 CARTRIDGE FILTER

1) Cartridge Filter shall normally be used when particles of less than 40 microns size are to be filtered from a fluid stream.

2) Cartridge material and type of selection shall be consistent with the service conditions.

3) Cartridge elements of throwaway type (meant for depth filtration) shall be used.

4) Cartridge element quantity shall be based on element manufacturer=s data for flow and pressure drop. The pressure drop across the housing (including nozzles and cartridge mounting plate) shall be separately calculated to arrive at the permissible drop through the cartridge.

5) Filter housing design shall be as per ASME Section VIII, Div.1. For steam-jacketed housings, applicable IBR requirements shall be complied with.

6) Filter shall be vertical type unless mentioned otherwise. Top covers shall normally be of quick opening type for easy replacement of cartridge elements.

7) Filter shall be vertical type unless mentioned otherwise. For filter top cover weighing more than 15 kg, lifting davit shall be provided.

8) Superficial velocity for charcoal filter in Amine Service shall not exceed 10 M^3 / hr/m^2 and the minimum height of charcoal bed shall be as indicated in the filter process data sheet.

9) 100 % spares throwable cartridges, shall be supplied alongwith equipment as commissioning spares.

8.0 FILTER SEPARATOR/COALESCER

1) Material and type of coalescing and separating elements shall be consistent with the service conditions as specified in the datasheets. Coalescer pack and or cartridge suppliersô recommendations shall be followed for meeting performance requirements, liquid velocity and flux rate established.

2) Coalescing cartridge shall be designed for bursting pressure of 2.0 $Kg./cm^2$ min.

3) Quick opening closure equal to full vessel diameter shall be provided, to meet the process and maintenance requirements, unless otherwise specified.

4) Coalescer vessel shall be designed as per ASME Section VIII Division 1.

5) Coalescer Packs / elements of throw away type shall be used.

6) 100 % spares cartridges, shall be supplied alongwith equipment as commissioning spares.

9.0 FEED FILTERS WITH AUTOMATIC BACKWASH FACILITIES

1) Filtration system shall ensure continuous uninterrupted filtration of feed. The system shall be capable of removing solid particles of size 20 microns of largest and shall have an automatic back flushing system for instant clearing of filter elements.

2) Back washing media shall be filtered feed or gas assisted or as specified in the process data sheet and shall be designed for a minimum amount of backwash media. Backwash cycle shall be initiated when the set point pressure drop reaches and the cycle shall be complete only, when all filters are cleaned as per the defined sequence of operation.

3) Filter housing design requirements shall be as stated for basket filters above.

10.0 FLARE STACK COMPONENTS

The flare stack components shall include the flare tip with pilot burners, gas seal, flame front generator, and related hardware.

Elevated Flares

1) Pressure drop across the flare tip and molecular seal shall not exceed the allowable pressure drop under maximum flow conditions, as indicated in the data sheet.
2) Noise level at the base shall not exceed 85 dBA.
3) Location of flame front generator panel shall be such that the pilot flame is visible from it. The panel should preferably be 90 metres away from the stack base. Radiation level shall be lower than that allowable for 8 hours continuous exposure.
4) Gas seal shall be provided to ensure safe flare operation by preventing ingress of air into the stack. Flare tips upto and including 600 mm diameter (or if specified in process in datasheet) shall have integral gas seal with the tip. Flare tips more than 600 mm diameter shall have Molecular Seal fitted upstream of the tip. The gas seal shall be designed to minimise purge gas requirement.
5) The tip shall ensure smokeless combustion upto about 10% of design flow, unless specified otherwise, with the aid of a smoke suppression medium such as steam. Where such a medium is not available, the tip shall be inherently designed to flare with minimum smoke generation.
6) Tip shall be provided with wind shield for prevention of flame lick-off.
7) Continuous pilot burners with flame sensors and alarm shall be provided. Pilot burners shall be low gas consumption (low energy) type.
8) Heat resistant alloy steel shall be used for the flare tip and the integral gas seal, as specified in data sheet, tip material shall be INCOLOY 800 H grade or superior or HK40 with refractory lining on the inside..

9) Suitable provision of retractable davit for trouble free tip replacement shall be provided. A ground winch (with or without guyed ropes depending on the type and height of stack supporting structure) shall be used for replacement of the tip. Platform for the operation of retractable davit shall be provided as near as possible to the tip for its trouble free removal. .

10) The flame front generator panel shall be suitable for outdoor location. Suitable weather hood shall be provided. The flame front generator shall be gas-electric type suitable for manual ignition unless otherwise specified. All electricals/ instruments shall be flame proof and weather proof.

11.0 VENT SILENCER

1) The design shall be such as to limit the noise level to 85 dBA at 1-meter (perpendicular) distance from silencer discharge.

2) Mineral wool or glass fibre of suitable density shall be used for acoustic insulation

3) Silencer shall be located outside the building, unless specified otherwise.

4) Silencers venting to atmosphere shall be provided with detachable rain hood and bird screen.

5) ASME Sec. VIII Div.1 shall be governing code for mechanical design of silencers.

6) Material of construction will be either boiler quality plates or seamless pipes in carbon steel or stainless steel depending upon the job requirements.

7) Diffusers shall be of seamless construction or with full radiography of butt-welds silencers body as a minimum shall be spot radiographed.

ADDENDUM TO ENGINEERING DESIGN BASIS

ADDENDUM TO ENGINEERING DESIGN BASIS

		AMENDMENTS BY OWNER TO.
SECTION	CLAUSE	DESIGN PHILOSOPHY / CRITERIA

MATERIALS OF CONSTRUCTION (NOTE-38)

MAJOR PARTS		MATERIAL
SHELL/DISHED ENDS		SA-516 GR.70N + 3MM SS316 CLAD
NOZZLE & MANHOLE FLANGES		SA-105N + 3MM SS316 WELD OVERLAY
NOZZLE NECK (PIPE)		SA-106 GR.B + 3MM SS316 WELD OVERLAY
NOZZLE NECK & MANHOLE NECK		SA-105N + 3MM SS316 WELD OVERLAY
PIPE FITTINGS		SA-234 WPBN + 3MM SS316 WELD OVERLAY
SKIRT	TOP PORTION	SA-516 GR.70N
	BOTTOM PORTION	SA-36
BOLTS AND NUTS	EXTERNAL	SA-193 GR.B7M/SA-194 GR.2HM
	INTERNAL	SS-193 GR.B8M / SA-194- GR.8M
GASKETS	EXTERNAL	SPWD SS-316L + GRAFIL
	INTERNAL	-
INTERNALS / WELDED INTERNALS		SS 316L
LIFTING TRUNNIONS / LIFTING PAD		SA-36 / SA-516 GR.70N
NAME PLATE / BRACKET		SS-304 / SA-516 GR.70N
EARTHING LUG		SS-304
EXTERNAL ATTACHMENTS / PAD		SA-36 / SA-516 GR.70N
BASE RING		SA-36
ANCHOR BOLTS		SA-36 (GALV.) - BY OTHERS

APPLICABLE CONSTRUCTION STANDARDS

VESSEL TOLERANCES	02-CS-001
SKIRT BASE DETAIL	02-CS-003
SKIRT OPENING DETAIL	02-CS-004
MANHOLE WITH DAVIT	02-CS-006
LADDER RUNGS FOR MANHOLE / DEMISTER	02-CS-007
NOZZLE REINF AND PROJECTION	02-CS-008
STANDARD BOLT HOLE ORIENTATION	02-CS-009
INTERNAL FLANGES	02-CS-010
VORTEX BREAKER	02-CS-011
PIPE DAVIT	02-CS-014
FIRE PROOFING AND INSULATION SUPPORTS FOR VERTICAL VESSEL	02-CS-016
MANUFACTURES NAME PLATE - VESSEL	02-CS-018
EARTHING LUG	02-CS-019
S.R NOZZLE NECK	02-CS-020
DET. OF FORGED NOZZLES	02-CS-021
DET. OF M.HOLE DAVIT FOR S.R NOZZLE	02-CS-022
TYP.WELD DETAILS	02-CS-023
STIFFNER FOR NOZZLES 2 INCH NB. AND BELOW	02-CS-025
ALLOY LINER DETAILS	02-CS-027
LIFTING TRUNNIONS	02-CS-032
DETAIL OF STEEL LADDER	05-CS-212
DETAIL OF PLATEFORM	XX-XX-XXX
SPECIFICATION FOR TEMPLATE	9680-02-OT-001

APPLICABLE DOCUMENTS

MECHANICAL DESIGN BASIS	9680-02-DB-001
PROJECT SPARE PARTS PHILOSOPHY	EDB 0013
DESIGN BASIS FOR SURFACE PREPARATION AND PROTECTIVE COATING / PAINTING	9680-03-TS-003
SPECIFICATION FOR PIPING SUPPORT DESIGN	9680-03-TS-007
PROCESS DATA SHEET	9680-01-DS-DA-33211
PMI	9680-03-TS-004
NOZZLE ORIENTATION DWG.	XXXX-XX-XX-XX-XXXXX
PIPING CLEATS DETAILS	XXXX-XX-XX-XX-XXXXX
PLATFORM/LADDER CLEATS DETAILS	XXXX-XX-XX-XX-XXXXX

APPROXIMATE WEIGHT (*)

EMPTY WT. (TON)	~ 265
OPERATING WT. (TON)	~ 370
HYDROTEST WT. (TON)	~ 540

DESIGN DATA

DESIGN CODE		ASME SEC. VIII DIV. 1, ED 2019
OPERATING PRESSURE	$Kg/cm^2(g)$	27.0 (TOP) / 29.0 (BOTTOM)
OPERATING TEMPERATURE	°C	44.0 (TOP) / 44.0 (BOTTOM)
DESIGN PRESSURE	$Kg/cm^2(g)$	36.4 / F.V. (REFER NOTE 35 & 37)
DESIGN TEMPERATURE	°C	65 (REFER NOTE 35 & 37)
MDMT	°C	16
HYDROTEST PRESSURE	$Kg/cm^2(g)$	AS PER CODE
GEOMETRIC CAPACITY	m^3	-
JOINT EFFECIENCY		SHELL=1.0, HEAD=1.0
RADIOGRAPHY		SHELL=FULL, HEAD=FULL
POST WELD HEAT TREATMENT		YES (FOR COMPLETE VESSEL)
INSULATION (THK / TYPE)	mm	NO
CORROSION ALLOWANCE	mm	3.0 (SS316 CLAD)
FLUID HANDLED		LPG/AMINE
IMPACT TEST REQUIREMENT		AS PER CODE
DENSITY	Kg/m^3	LPG = 527.9 & AMINE = 1026.2
WIND DESIGN CODE		IS 875 LATEST
DESIGN WIND SPEED	m/sec	39
SEISMIC DESIGN CODE		IS 1893-LATEST RSM
PAINTING (EXTERNAL)		AS PER SPEC.
QUANTITY		1 NO.
EQUIPMENT TAG NO.		DA-33211
NACE APPLICABILITY/SPECIFICATION		YES/NACE MR-0103 (REFER NOTE 30 & 31)
SOUR SERVICE APPLICABILITY		YES

NOZZLE DATA

NOZZ. MARK NO.	SERVICE	QTY.	NOZZLE		FLANGE			PROJ.	REIN. PAD	
			SIZE	SCH/THK	RATING	TYPE	FACE		OD.	THK
M1-M4	MANHOLE +BF+ DAVIT	4	24"	10 THK	300#	SRWN	RF	470	-	-
N1	LPG INLET (WITH INLET PIPE & DISTRIBUTOR)	1	16"	10 THK	300#	SRWN	RF	395	-	-
N2	LPG OUTLET	1	16"	10 THK	300#	SRWN	RF	SEE DWG	-	-
N3	LEAN AMINE INLET (WITH INLET PIPE & DISTRIBUTOR)	1	3"	SCH.160	600#	SRWN	RF	230	-	-
N4	RICH AMINE OUTLET (WITH VORTEX BREAKER)	1	4"	SCH.120	300#	SRWN	RF	SEE DWG	-	-
D	DRAIN	1	4"	SCH.120	300#	WN	RF	SEE DWG	AS PER STD.	
V	VENT	1	4"	SCH.120	300#	SRWN	RF	SEE DWG	-	-
S	STEAM OUT	1	3"	SCH.160	600#	SRWN	RF	230	-	-
P1-P4	DIFFERENTIAL PRESSURE TRANSMITTER	4	3"	SCH.160	300#	SRWN	RF	280	-	-
L1A-F	LEVEL TRANSMITTER (INTERFACE)	6	3"	SCH.160	300#	SRWN	RF	280	-	-
L2A/B	LEVEL TRANSMITTER (INTERFACE)	2	3"	SCH.160	300#	SRWN	RF	280	-	-
L3A/B	LEVEL GAUGE	2	3"	SCH.160	300#	SRWN	RF	280	-	-
AO1-2	ACCESS OPENING WITH COVER	2	20"	14 THK.	AS PER STANDARD					
SV1-4	SKIRT VENTS	4	4"	SCH.40	AS PER STANDARD					

WIND/EARTH QUAKE SHEAR & BENDING (DBE) (*)

EMPTY				OPERATING	
WIND SHEAR kgf	WIND BENDING kgf-m	EARTHQUAKE SHEAR kgf	EARTHQUAKE BENDING kgf-m	EARTHQUAKE SHEAR kgf	EARTHQUAKE BENDING kgf-m
12046	161302	56548	765643	105323	1421567

WIND/EARTH QUAKE SHEAR & BENDING (MCE) (*)

12046	161302	81435	1446011	154620	2698965

* APPROX. DATA, SUBJECTED TO CHANGE BASED ON THE INTERNAL VENDORS DETAILS, TO BE VERIFIED BY VENDOR.

NOTES:-

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. ALL NOZZLE FLANGES SHALL BE AS PER ASME B16.5 & BOLT HOLES SHALL STRADDLE PRINCIPAL CENTRE LINES UNLESS OTHERWISE STATED.
3. NOZZLE PROJECTION IS MEASURED FROM VESSEL OUTER DIA OR HEAD TANGENT LINE OR AS SHOWN IN DRG. TO FLANGE GASKET FACE.
4. NOZZLE FLANGE GASKET FACE SHALL HAVE SURFACE FINISH OF 125-250 AARH.
5. NOZZLES LESS THAN OR EQUAL TO 2" NB SHALL BE STIFFENED WITH 2 NOS STIFFENERS 6THK x 40W AT 90° APART.(AS APPLICABLE)
6. WHERE BLIND FLANGES OR COMPANION FLANGES ARE SPECIFIED, VENDOR SHALL ALSO SUPPLY BOLTS, NUTS, WASHERS AND GASKETS, INCLUDING SPARE BOLTS, NUTS, WASHERS AND GASKETS.
7. INTERNAL RUNGS AND HAND GRIP SHALL BE PROVIDED.
8. ALL INTERNAL ATTACHMENTS SHALL BE ATTACHED TO THE SHELL OR HEAD BY FULL PENETRATION WELDS.
9. ALL REINFORCING PADS TO BE PRESSURE TESTED WITH SOAP SOLUTION USING AIR AT 1.05 Kg/CM TELLTALE HOLES SHALL BE PLUGGED BY HARD GREASE AFTER TEST.
10. ANCHOR BOLTS SHALL BE SA-36 (GALV.) OR EQUIVALENT (BY OTHERS).
11. DISHED ENDS SHALL BE STRESS RELIEVED AFTER FORMING.
12. NO WELDING ON PRESSURE CONTAINMENT PARTS SHALL BE ALLOWED AFTER PWHT.
13. ELLIPSOIDAL DISHED ENDS SHALL BE FORMED IN SEAMLESS / SINGLE PIECE CONSTRUCTION.
14. ALL REMOVABLE INTERNALS SHALL BE FABRICATED SUITABLY SO AS TO PASS THROUGH VESSEL MANHOLE.
15. VENDOR SHALL DESIGN LIFTING LUGS CONSIDERING IMPACT FACTOR OF MINIMUM 2.0.
16. ITEM NO., P.O. NO., MANUFACTURER'S NAME, ERECTION WT., DESTINATION SHALL BE PAINTED / STENCILED IN 200 mm HIGH LETTERS ON FINISHED EQUIPMENT BEFORE DISPATCH.
17. VENDOR'S SCOPE SHALL INCLUDE ALL COMPONENTS SHOWN IN THIS DATA SHEET INCLUDING ALL INTERNALS AS PER PROCESS DATA, APPLICABLE STANDARD / SPECIFICATION REQUIREMENTS.THE SUPPLY INCLUDES THE LIQUID DISTRIBUTOR AND THE PACKING SUPPORT.
18. ALL SHARP CORNERS, EDGES, INSIDE/OUTSIDE THE VESSEL SHALL BE ROUNDED OFF. ALL BUTT WELDS SHALL BE ROUNDED FLUSH SMOOTH FROM INSIDE.
19. NOZZLE WELDING SHALL BE SET-IN TYPE WITH FULL PENETRATION WELDS. REINFORCEMENT PAD TO NOZZLE WELDING SHALL BE FULL PENETRATION COMPLETE WITH FILLET WELD.
20. WATER USED FOR HYDROTEST SHALL BE POTABLE QUALITY & SHOULD CONTAIN RUST INHIBITOR (0.2% OF SODIUM NITRATE), TEST WATER SHOULD NOT CONTAIN CHLORIDE CONTENTS MORE THAN 30 PPM.
21. EQUIPMENT SHALL BE DRIED THOROUGHLY BY BLOWING DRY AIR AFTER HYDROTEST.
22. EARTHING LUGS ARE NOT TO BE PAINTED.
23. PIPING & PF/LADDER CLEATS SHALL BE PROVIDED BY VENDOR AS PER DETAILED ENGINEERING REQUIREMENTS AND SHALL BE OF SAME MOC AS THAT OF THE VESSEL.
24. ALL FILLET WELDS OF PRESSURE RETAINING PARTS SHALL BE EXAMINED BY DYE PENETRANT OR MAGNETIC PARTICLE INSPECTION AFTER WELDING.
25. PICKLING & PASSIVATION OF SS MATERIAL SHALL BE CARRIED OUT AS PER ASTM A380.
26. ALL INTERNALS WELDING SHALL BE FULL PENETRATION WELDS.
27. INTERNALS SUPPLY INCLUDED THE LIQUID DISTRIBUTOR AND THE PACKING SUPPORT.
28. THE PACKING AND DISTRIBUTOR WILL HAVE TO WORK SATISFACTORILY FOR FLOW RATES OF 60 - 110 % OF SPECIFIED FLOW RATES.
29. THICKNESS OF WELD OVERLAY SHALL BE SUCH THAT UNDILUTED CHEMISTRY OF SS-316 IS ACHIEVED AT A DEPTH OF 3MM.
30. COLUMN IS IN SOUR SERVICE. MAX H2S CONTENT IN LPG FEED = 0.02 WT%, MAX H2S CONTENT IN LEAN AMINE FEED = 0.172 WT%.
31. ALL PRESSURE PARTS, ATTACHMENTS WELDED TO PRESSURE PARTS & WETTED SURFACE BY PROCESS FLUID SHALL MEET THE REQUIREMENT OF NACE MR103.
32. ALL NOZZLES OPENING SHALL BE INTEGRALLY REINFORCED. REINFORCEMENT PAD ARE NO ALLOWED.
33. THE INTRNAL VENDOR SHALL GUARANTEE THE PRESSURE DROP AND FLEXIBILITY OF THE PACKING ZONE, INCLUDING THE PACKING ITSELF, THE PACKING SUPPORT AND THE DISTRIBUTOR.
34. THE INTERNAL VENDOR SHALL INDICATE IF A FILTRATION SET IS REQUIRED AND WILL SPECIFY FILTER MESH IF ANY.
35. COLUMN IS SUBJECTED TO STEAM OUT. STEAM OUT CONDITIONS ARE 0.5 KG/CM^2G @ 200 DEGREE C.
36. COLUMN IS IN AMINE SERVICE.
37. TOTAL ALLOWABLE PRESSURE DROP ACROSS THE THREE BEDS OF PACKING IS 0.35 KG/CM^2
38. ALL PRESSURE PARTS, ATTACHMENTS WELDED TO PRESSURE PARTS & WETTED SURFACE BY PROCESS FLUID SHALL DEOXIDIZED STEEL AND NORMALIZED & PRODUCED IN FINE GRAIN.

HOLD:-

1. NOZZLE ELEVATION & ORIENTATION.
2. CLEATS FOR PLATFORM, LADDER & PIPING.
3. FIRE PROOFING CLEATS.

REV.NO.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
0	23-06-2021	ISSUED FOR QUOTATION	VSN	APH	HAS

OWNER: MANGALORE REFINERY AND PETROCHEMICALS LIMITED.

LICENSER: TechnipFMC

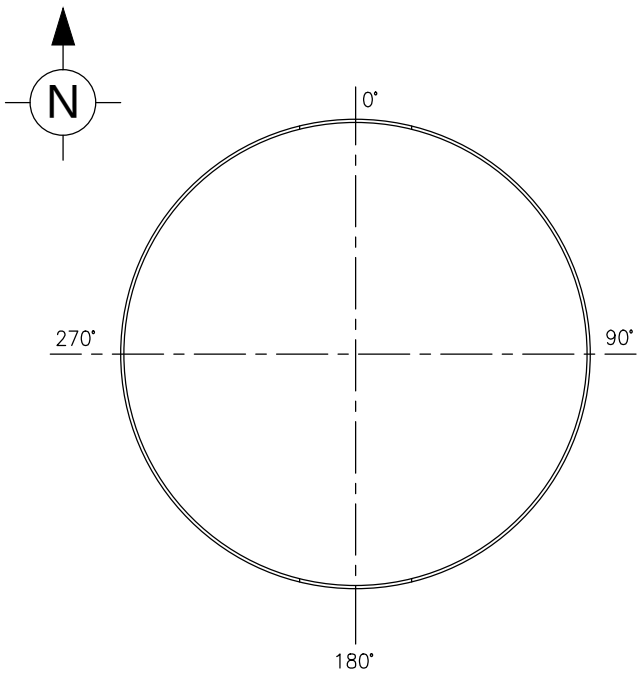
CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

ENGINEERING CONSULTANT: TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI

PROJECT : EPCM SERVICES FOR INSTALLATION OF LPG AMINE ABSORBER SYSTEM IN PFCC UNIT AT MRPL, MANGALURU

TITLE : MECHANICAL DATASHEET FOR LPG AMINE CONTACTOR ITEM NO. (DA-33211)

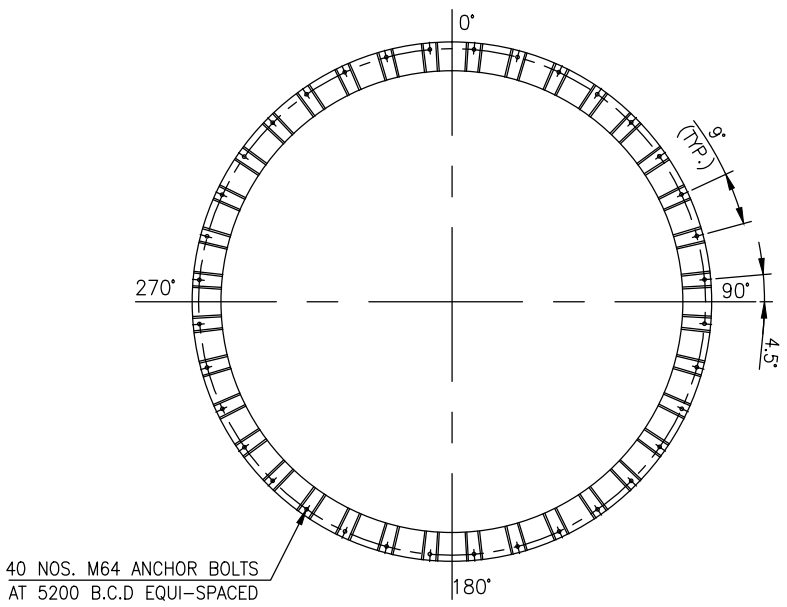
SCALE	JOB NO.	DOCUMENT NO.	REV.
~	9680	9680-02-DS-C-01	0



NOZZLE ORIENTATION PLAN

REFER PIPING DWG. NO.XXXX

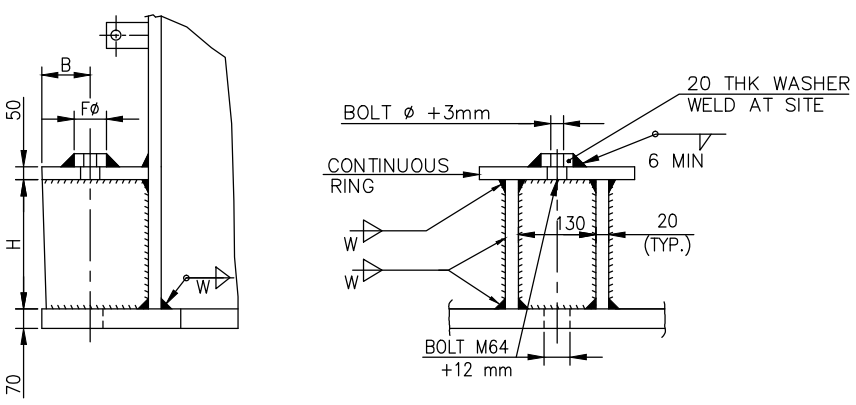
(HOLD)



SKIRT BASE DETAIL

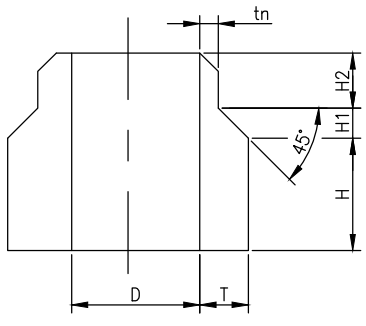
PLAN

(HOLD)

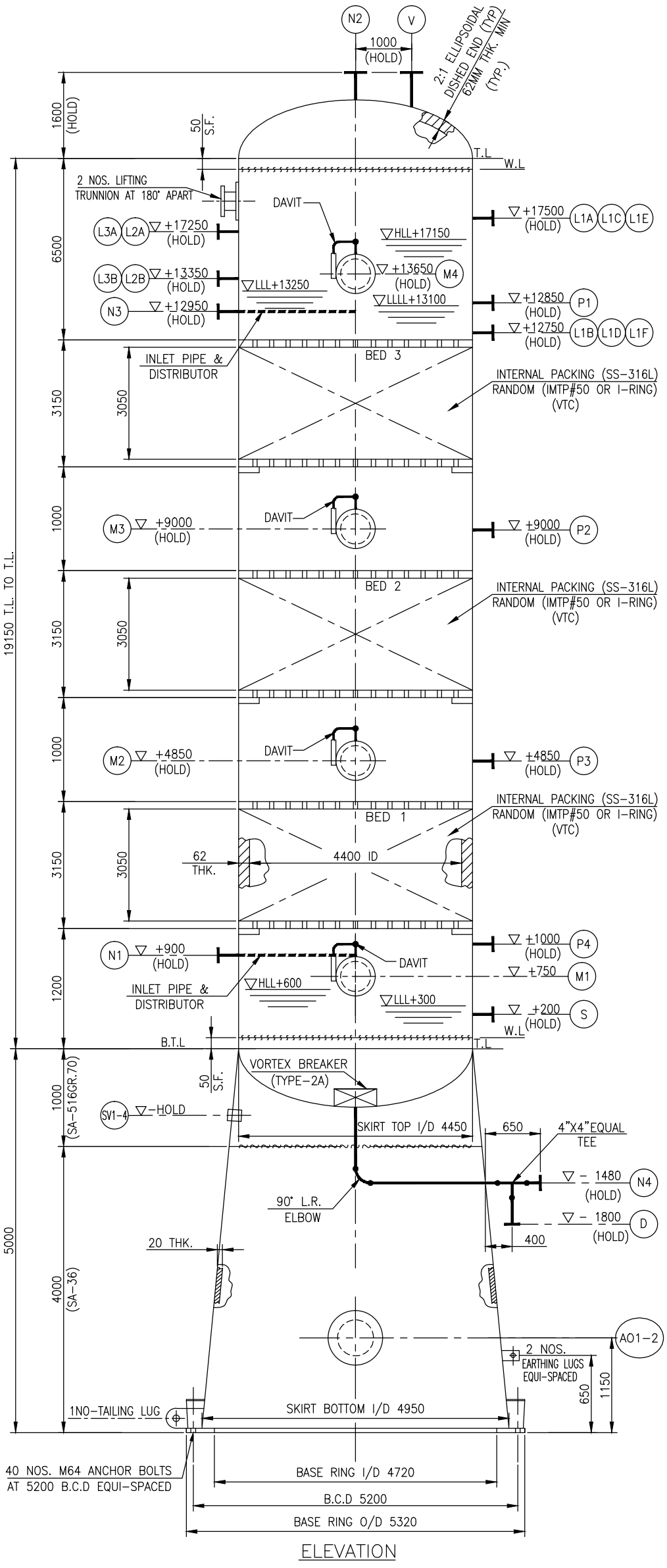


SKIRT BASE DETAIL

(ALL OTHER DIMENSIONS AS PER STD.)



DETAIL OF SR NOZZLES



ELEVATION

DETAIL OF SR NOZZLES							
NOZZ. MARK NO.	SIZE	D	tn	T	H	H1	H2 (**)
M1-M4	24"	–	10	140	110	130	60
N1,N2	16"	–	10	110	90	100	60
N3	3"	–	SCH.160	40	50	30	60
N4	4"	–	SCH.120	50	50	40	60

(**) MINIMUM, TO MEET THE PROJECTION REQUIREMENT VENDOR MAY INCREASE THE H2 VALUE.

REV.NO.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
0	23-06-2021	ISSUED FOR QUOTATION	VSN	APH	HAS

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NEW DELHI

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TITLE : MECHANICAL DATASHEET FOR LPG AMINE CONTACTOR ITEM NO. (DA-33211)

SCALE	JOB NO.	DOCUMENT NO.	REV.
~	9680	9680-02-DS-C-01	0

SHT. 2 OF 2

MANGALORE REFINERY AND PETROCHEMICALS LIMITED

EPCM SERVICES FOR INSTALLATION OF
LPG AMINE ABSORBER SYSTEM IN PFCC UNIT
AT MRPL, MANGALURU

PROCESS DATA SHEET - LPG AMINE CONTACTOR

Rev.	Date	Description	Prpd.	Chkd.	Appd.
1	1/7/2021	REISSUED FOR FEED	GMN	RBN	VPB
0	10/6/2021	ISSUED FOR FEED	RBN	SNI	VPB

Triune Energy Services Pvt. Ltd. New Delhi	PROCESS DATA SHEET - LPG AMINE CONTACTOR	Document Number	Rev.
		9680-01-DS-DA-33211	1
		Sheet 1 of 5	

Excel

PROCESS DATASHEET

FOR

LPG AMINE CONTACTOR (DA-33211)

REV	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED
0	19.07.2019	FINAL ISSUE	S SUNDARI	S C BHARATH	PAUL MARCHANT	DAVID VAN WYK
A	13.06.2019	ISSUED FOR REVIEW	S SUNDARI	S C BHARATH	PAUL MARCHANT	DAVID VAN WYK

PROCESS DATA SHEET

Project N° - Unit		Doc. type	Equipment N°	Serial N°	Rev. index
7	C-332	PDS	1	1	

Revision

CLIENT MRPL

LOCATION Mangalore, India

UNIT 332

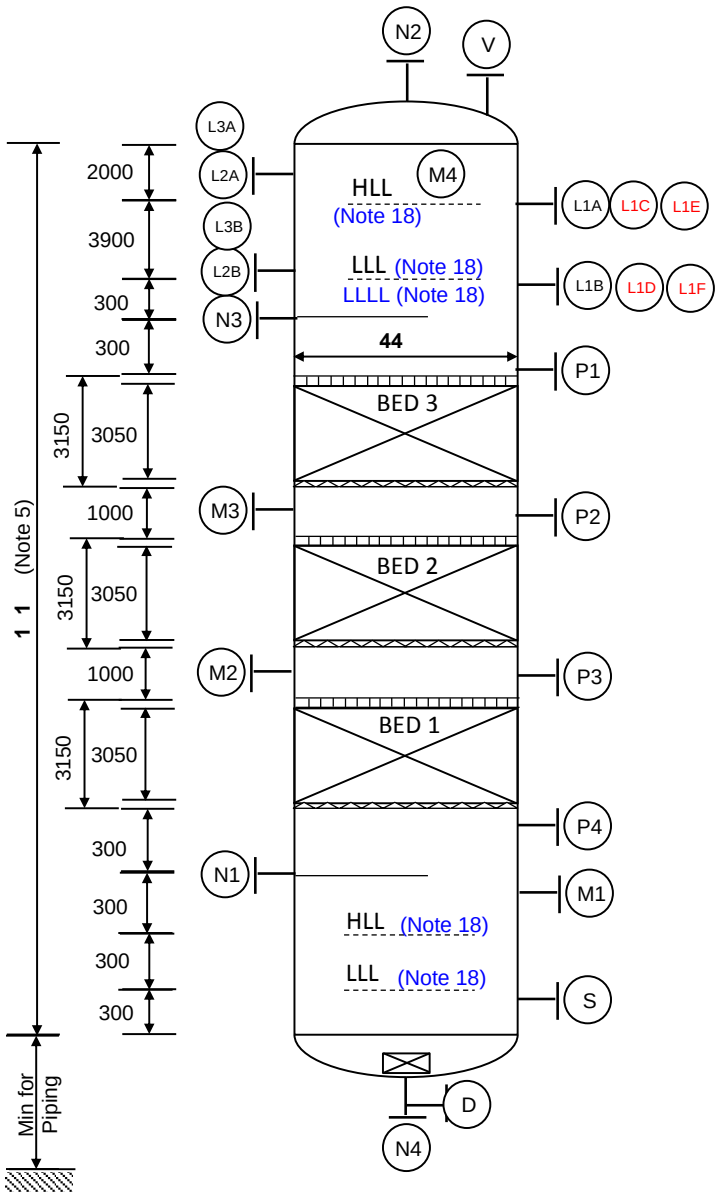
LPG AMINE CONTACTOR

Rev.	Date	Made by	Checked by	Page
A	13.06.2019	SS	SCB	
0	19.07.2019	SS	SCB	3 of 5

	ITEM	DA-33211		
	SERVICE	LPG AMINE CONTACTOR		
		OPERATING	PROCESS DESIGN	
	Pressure	kg/cm^{2}g	kg/cm^{2}g	
0	Top	27.0	36.4 / FV (Note 4)	
0	Bottom	29.0	36.4 / FV (Note 4)	
	Temp.	°C	°C	
	Top	44	65	
	Bottom	44	65	
		SHELL / ENDS	WELDED INTERNAL PIECES	
	Materials	KCS	SS316L	
	Corrosion allow.	3mm SS316 Clad		
	Fluid :	LPG / Amine		
0	Density at T :	LPG =527.9 & Amine = 1026.2	kg/m³	
	Insulation	None		
	Lining	-		
	Elev. betw. lower TL & reboil. lower part =	NA	min.	
	Lower TL elevation above ground =	Min for piping	min.	

NOZZLE DATA

	REF.	Nb	Ø	SERVICE
	M	4	24	Manhole + B.F. + Devit
	N1	1	16	LPG Inlet (With Inlet Pipe and Distributor) (Note 17)
	N2	1	16	LPG Outlet
	N3	1	3	Lean Amine Inlet (With Inlet Distributor) (Note 17)
0	N4	1	4	Rich Amine Outlet (With Vortex Breaker)
0				
	D	1	4	Drain
	V	1	4	Vent
	S	1	3	Steam out
	P1 - P4	4	3	Differential Pressure Transmitter
0				
0				
	L1A -F	6	3	Level transmitter (Interface)
	L2A/B	2	3	Level transmitter (Interface)
	L3A/B	2	3	Level Gauge



All dimensions are in mm.

When applicable, process conditions for H2 and H2S services or depressuring conditions (T,P) shall be specified.

PROCESS DATA SHEET

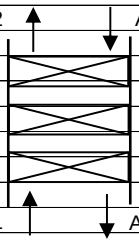
Project N° - Unit		Doc. type	Equipment N°	Serial N°	Rev. index
7	C-332	PDS	1	1	

CLIENT	MRPL	LPG AMINE CONTACTOR (INTERNALS)	Rev.	Date	Made by	Checked by	Page	Revision
LOCATION	Mangalore, India		A	13.06.2019	SS	SCB	4 of 5	
UNIT	332		0	19.07.2019	SS	SCB		

SERVICE

COLUMN ITEM	DA-33211
COLUMN SERVICE	LPG AMINE CONTACTOR
PACKING SERVICE	LPG AMINE CONTACT (Bed 1 to 3) (Note 11)
PACKING TYPE	RANDOM (IMTP #50 or I-RING) (Note 14)
INSIDE COLUMN DIAMETER (A)	4400 mm

OPERATING CONDITIONS



EXCHANGED HEAT : 0 Gcal/h

CASE 2

		L1	L2	A1	A2	
PRODUCT		SOUR LPG	TREATED LPG	LEAN AMINE	RICH AMINE	
TEMPERATURE (T)	°C	44	43.8	45	43.6	0
PRESSURE	kg/cm^2g	29	27	27	29	
DENSITY AT T	kg/m^3	527.9	528.1	1026.2	1026.4	0
VISCOSITY (B)	cP	0.107	0.107	2.34	2.387	0
SURFACE TENSION	dynes/cm	4.686	4.685	59.496	59.53	0
FLOW RATE AT CONDITIONS (Note 12)	kg/h	170520	170591	15479.3	15407.8	0
	m^3/h	323.0	323.0	15.1	15.0	0

CHECK CASE 1

		L1	L2	A1	A2	
PRODUCT		SOUR LPG	TREATED LPG	LEAN AMINE	RICH AMINE	
TEMPERATURE (T)	°C	44	43.6	45	43.6	0
PRESSURE	kg/cm^2g	29	27	27	29	
DENSITY AT T	kg/m^3	527.9	528.4	1026.2	1025.9	0
VISCOSITY (B)	cP	0.107	0.108	2.34	2.421	0
SURFACE TENSION	dynes/cm	4.686	4.703	59.496	59.396	0
FLOW RATE AT CONDITIONS (Note 12)	kg/h	170520	170658.3	2783.4	2645	0
	m^3/h	323.0	323.0	2.7	2.6	0

ALLOWABLE PRESSURE DROP kg/cm^2 (Note 13)

MATERIALS SS316L (Note 11)

REQUIREMENTS

THE MANUFACTURER WILL SPECIFY THE PACKING HEIGHT REQUIRED : 3050 (Note 11) mm

THE SUPPLY INCLUDES THE LIQUID DISTRIBUTOR AND THE PACKING SUPPORT.

THE PACKING AND DISTRIBUTOR WILL HAVE TO WORK SATISFACTORILY FOR FLOW RATES OF 60 - 110 %
OF SPECIFIED FLOW RATES.

THE MANUFACTURER WILL GUARANTEE THE PRESSURE DROP AND FLEXIBILITY OF THE PACKING ZONE, INCLUDING
THE PACKING ITSELF, THE PACKING SUPPORT AND THE DISTRIBUTOR.

THE MANUFACTURER WILL INDICATE IF A FILTRATION SET IS REQUIRED AND WILL SPECIFY FILTER MESH IF ANY.

GENERAL NOTES

(A) UNLESS OTHERWISE SPECIFIED.
(B) LIQUID PHASE ONLY.

PROCESS DATA SHEET

Project N° - Unit		Doc. type	Equipment N°	Serial N°	Rev. index
7	C-332	PDS	1	1	

			Rev.	Date	Made by	Checked by	Page	Revision
CLIENT	MRPL	**LPG AMINE CONTACTOR**	A	13.06.2019	SS	SCB	5 of 5	
LOCATIOI	Mangalore, India		0	19.07.2019	SS	SCB		
UNIT	332							

NOTES:

1. Column is designed for following cases:
   - Maximum Loads — Case 2 with 10% overdesign
   - Minimum Loads — Check Case 1 with 60% turndown
2. Column is subjected to steam out. Steam out conditions are 0.5 kg/cm^{2}g @ 200 ˚C
3. Minimum Design Metal Temperature (MDMT): 16˚C . MA/MB
4. Design pressure to be confirmed based on LPG pump (GA-33222~~A/B~~) shut off pressure during detailed engineering.
5. Column height to be confirmed based on vendor data.
6. Column is in Amine service.
7. Column is in sour service. NACE applicable. Max H2S content in LPG feed = 0.02 wt%
   Max H2S content in Lean Amine feed = 0.172 wt%
8. Bed Numbering is from Bottom to Top.
9. All internals shall be removable through manways.
10. Approved internals/packing vendors are Koch-Glitsch & Sulzer Chemtech
11. Diameter, packing height, number of beds, distributor, and material dimensions to be checked and confirmed by packing manufacturer ~~and Detailed Engineering Contractor.~~
12. Loads indicated are Normal flowrate.
13. Total allowable pressure drop 0.35 kg/cm^2 to be considered across the three beds of packing.
14. Vendor to confirm type of packing.
15. Nozzle sizes are preliminary. All nozzles flange rating shall be minimum 300# — 0
16. ~~Plant designed considering 4 years continuous cycle time~~. — 1 ~~0~~
17. As per "Requirement" mentioned on sheet 4 of 5 (to be decided by column internal manufacturer)
18. Column Bottom section level setting (from BTL): HLL : 600 mm
    LLL : 300 mm
    Column Top section level setting (from BTL): HLL : 17150 mm
    LLL : 13250 mm
    LLLL : 13100 mm

MANGALORE REFINERY AND PETROCHEMICAL LIMITED

EPCM SERVICES FOR INSTALLATION OF LPG AMINE ABSORBER SYSTEM IN PFCC UNIT AT MRPL, MANGALURU

SPECIFICATION FO POSITIVE MATERIAL IDENTIFICATION

0	31.05.2021	ISSUED FOR INFORMATION	AML	GBJ	CRR
Rev.	**Date**	**Description**	**Prpd.**	**Chkd.**	**Appd.**

Triune Energy Services Pvt. Ltd. New Delhi	SPECIFICATION FO POSITIVE MATERIAL IDENTIFICATION	Document Number	Rev
		9680-03-TS-004	0
		Sheet 1 of 4	

INDEX

1.0 EXECUTIVE SUMMARY

This document specifies the minimum requirements for Positive Material Identification for MRPL LPG Amine Absorber System.

2.0 PROJECT DESCRIPTION

MRPL has installed Petrochemical Fluidized Catalytic Cracking (PFCC) unit with a capacity of 2.2 MMTPA. The unit was commissioned in 2014. The process technology was licensed by M/s. Technip Stone and Webster. While processing feed with higher Sulphur content in PFCCU, higher H2S is expected in LPG stream. A New LPG Amine Treatment unit shall be installed to remove the hydrogen sulfide present in the LPG and to minimize the spent caustic generation in existing caustic treatment system.

BDEP was prepared by Technip Stone and Webster and MRPL has selected Triune Engineering Services to provide EPCM services.

3.0 BASIS FOR POSITIVE MATERIAL IDENTIFICATION

This project is a Brown field project coming in the PFCC unit of the MRPL refinery. Triune Standard specification (03-TS-039) for Positive Material Identification has been used as Project specification.

4.0 ATTACHMENT-A SPECIFICATION FOR POSITIVE MATERIAL IDENTIFICATION

ATTACHMENT-A

STANDARD SPECIFICATION FOR POSITIVE MATERIAL IDENTIFICATION (PMI)

3	24.08.18	Periodic Review/Updating and Issued for Implementation	VKR	SSH	BN
Rev.	**Date**	**Description**	**Prpd.**	**Chkd.**	**Appd.**

REVISION HISTORY SHEET

Rev.	Date	Description	Prpd.	Chkd.	Appd.
0	30.04.1996	Issued as standard	SM	DRC	BBN
1	30.11.2006	General revision due to change in organization name and issued for implementation	SOB	NCS	BN
2	29.07.2011	Revision due to change of organization name and issued for implementation	DKS	BRB	BN
3	24.08.2018	Periodic Review/Updating and Issued for Implementation	VKR	SSH	BN

REVIEW COMMITTEE MEMBERS

Sr. No.	Name	Position	Dept.	Signature	Date
1	Brahmanand	H.O.D.	Piping		24.08.18
2	Sameer Mehta	H.O.D.	Electrical		24.08.18
3	Rosamma Samuel	H.O.D.	Structure		24.08.18

CONTENTS

1.0 SCOPE

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

1.1 Any post order deviation from this specification must be approved by Owner/TES in the Deviation/ Waiver permit form.

1.2 This specification covers the procedures and methodology to be adopted to assure that the chemical composition of the alloy material is consistent with the material specifications as specified in purchase documents using 'Alloy Analyser' 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 Alloy Materials listed 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.)
- Alloy steel Longitudinal Pipe & Fittings Welds.
- Gaskets (for Ring Type Joints)

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 TES site RCM (Resident Construction Manager).

2.0 REFERENCE DOCUMENTS

2.1 API Recommended Practice 578, Material Verification Program for new and Existing Alloy Piping Systems.

3.0 DEFINITIONS

3.1 **Suppliers**: 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.

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/TES prior to commencing manufacture/inspection of product.

4.2 PMI examination of alloy 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/TES.

5.0 ACCEPTABLE METHODS FOR PMI

5.1 The method used for PMI examination shall provide a quantitative determination of the alloying elements like Cr, Mo, Ni, V 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. The data of the last service shall be stated on 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.

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 to 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/TES.

5.12 The persons performing PMI shall demonstrate their capabilities to the satisfaction of Owner/TES 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 TES.

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 alloy items.

A. Flanges, Fittings - 100%
Valves, RTJ Gaskets

B. Pipes - 100% (for pipes procured from traders).

C. Fasteners -

Lot Size	Sample Size
Upto 100	2% (Min 2)
101 to 500	1% (Min 3)
501 and above	0.5% (Min 5)

Note:

a. For Welded Pipes and Fittings, PMI shall be performed on Base Metal as well as weldments.

b. Whenever any sample drawn to PMI test on the basis of percentage selection in B and C above, fails to meet specification requirements,100% of lot shall be tested for PMI.

7.0 RECORDING AND DOCUMENTATION

The results of PMI examination shall be recorded in a Report Format as enclosed with this specification "Positive Material Identification Report Bulk Materials"

8.0 MARKING

8.1 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

9.0 ABBREVIATIONS

API	:	American Petroleum Institute
LSTK	:	Lump Sum Turnkey Basis
PMI	:	Positive Material Identification
TPI or TPIA	:	Third Party Inspection Agency
TES	:	Triune Energy Services Pvt. Ltd.

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	Alloy content, Weight Percent				Remarks Accept/Reject
Element	Cr	Mo	Ni	V	
Specified Range					
Actual observation 1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
Instrument Type / ID Last Service Date	Inspection Agency				Witnessed By

MANGALORE REFINERY AND PETROCHEMICAL LIMITED

EPCM SERVICES FOR INSTALLATION OF LPG AMINE ABSORBER SYSTEM IN PFCC UNIT AT MRPL, MANGALURU

SPECIFICATION FOR PIPING SUPPORT DESIGN

0	01.06.2021	Issued for information	AIK	TTS	CRR
Rev.	**Date**	**Description**	**Prpd.**	**Chkd.**	**Appd.**

Triune Energy Services Pvt. Ltd. New Delhi	**SPECIFICATION FOR PIPING SUPPORT DESIGN**	**Document Number**	**Rev.**
		9680-03-TS-007	**0**
		Sheet 1 of 104	

REVISION HISTORY SHEET

Rev.	Purpose	List of modifications
0	Issued for information	

CONTENTS

1.0 EXECUTIVE SUMMARY

The purpose of this specification is to define the philosophy of pipe supporting and pipe support engineer's responsibilities and activities to be performed, in order to ensure the scope of work for the Pipe Support design for LPG Amine Treating Unit is fully covered, taking into account all the relevant codes, practices, standards, guidelines and regulations.

2.0 PROJECT DESCRIPTION

MRPL has installed Petrochemical Fluidized Catalytic Cracking (PFCC) unit with a capacity of 2.2 MMTPA. The unit was commissioned in 2014. The process technology was licensed by M/s. Technip Stone and Webster. While processing feed with higher Sulphur content in PFCCU, higher H2S is expected in LPG stream. A New LPG Amine Treatment unit shall be installed to remove the hydrogen sulfide present in the LPG and to minimize the spent caustic generation in existing caustic treatment system.

BDEP was prepared by Technip Stone and Webster and MRPL has selected Triune Engineering Services to provide EPCM services.

3.0 INTERFACES

Piping:

Pipe Support location and number shall be shown on the Piping Isometric.

Structural:

Cumulative pipe support loads on particular beam > 10 KN, including special pipe supports and / or Pipe Supports attached to structural steel in areas with special restrictions for welded attachments, shall be reported to the Structural Department for approval. Piping Engineer shall provide load inputs on pedestals, sleepers and foundations for structural design.

Mechanical:

Details of cleats for supporting the connected piping from equipment's, exchangers and vessels shall be informed to mechanical department along with loads to include in equipment design and manufacture.

4.0 GENERAL

a. Linear dimensions are in mm and angles are specified in degrees, unless specified otherwise.

b. Sharp edges and corners shall be grinded to 6 mm radius specified prior to painting unless noted otherwise.

c. All drilled holes shall be chamfered to remove the sharp edges.

d. Selection of correct pipe supports type shall be made with respect to restrain required like resting, guide, line stop, or anchor etc. and modeled such that complete support tag information is retrieved from model to appear on piping plan or isometric drawings.

e. Piping shall be properly supported, anchored or guided to prevent undue stresses or deflection and to protect both piping and connected equipment from excessive loadings. Pipe deflection or sag between support points is to be limited to 15 mm.

f. Where, spacing between adjacent pipes is inadequate to accommodate the guide supports, guide supports shall be staggered at alternate location.

g. Pipe support tag shall appear in all isometrics and in Piping GA drawings. Pipe support tag shall also be able to identify the complete material requirement from Bill of material reports.

5.0 MATERIAL

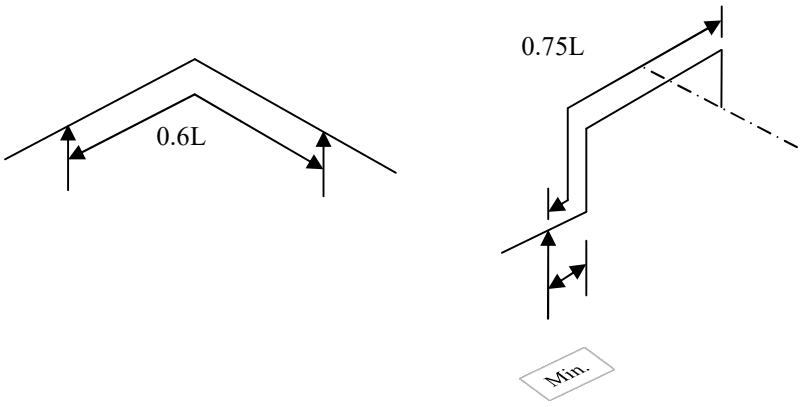
All plates and section materials shall be as per IS 2062 or equivalent with minimum yield strength 250 MPa.

6.0 ALLOWABLE PIPE SPANS AND GUIDE SPACING

Pipe support spans shall be followed as per Annexure I. Guides supports shall be provided according to Annexure II. For critical lines the support and guides shall be provided as per recommendations of stress analysis.

Note that these charts are guidelines and applicable for straight pipe runs with no external loads.

Load effects caused by wind, acceleration etc. must be added and may result in shorter allowable pipe span.



Recommending spans for offset shapes.

7.0 PIPE SUPPORT DOCUMENTS

7.1 Pipe Support Detail Drawing

Pipe supports shall be selected from the standard pipe supports listed in Annexure III. Special pipe support drawings shall be prepared for support not available in Annexure III.

7.2 Pipe Support Numbering

Standard support numbering for this project is as per.

PROJECT CODE	UNIT	PIPE SUPPORT	SEQUENCE NUMBER
9680	332	PS	0000

For Example:-

9680	332	PS	0001

7.3 Special Pipe Support

Special Pipe Support is required where standard project specific supports are not available. All Special Pipe Support drawings shall be furnished for fabrication with Index.

Numbering philosophy for SPS shall be:

PROJECT CODE	UNIT	SPECIAL PIPE SUPPORT	SEQUENCE NUMBER
9680	332	SPS	0000

FOR EXAMPLE:-

9680	332	SPS	0001

8.0 DESIGN NOTES

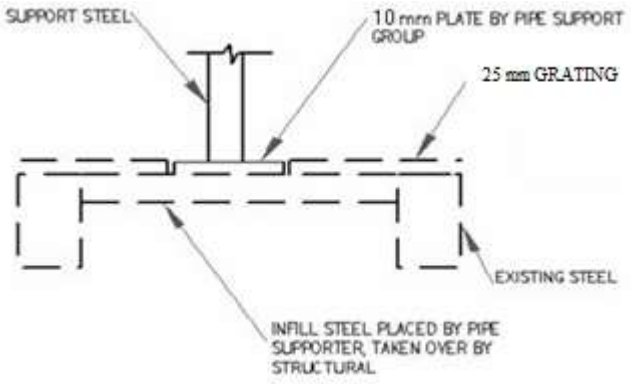
8.1 Pipe Support minimum requirements

All lines shall be supported as per this standard.

Pipes shall be grouped together so as to minimize the number of supporting structures required for pipe supports or shall be run closer to existing structures which can be utilized for supports. Pipe supports shall be designed to include allowances for the weight of pipe such as water filled, attached unsupported components (valves and actuators), environmental loads, insulation, thermal expansion/contraction, and PSV reactions forces etc.

In Grated areas, No pipe shall be supported from Grating. Pipes shall be supported from structure but avoid pipe support on column or beam splice location. Additional trimmers if required are to be called up and put into a zone called "INFILL STEEL" as input for structural. Minimum 40mm gap is required for fixing the grating.

Information concerning cut outs in grating must be given to structural department.



8.2 Restrictions

Pipe supports shall not be attached to cast pad eyes or lifting lugs or other "NO GO" Areas.

Supporting from one line to another is not allowed without special written permission from the Stress Engineer. Hanger rods shall only be used where no other means of support is possible. Rods shall be secured with a nut and lock nut. Pipe Supports shall not encroach on headroom clearances and shall not block or interfere with escape routes or cause a tripping hazard etc.

8.3 Bracing of branch connections

Piping branch connections of size up to 1-1/2" in services that give potential for piping vibration shall be designed with bracing. Unsupported branch connections with a mass concentration (e.g. vent/drain valves), attached shall be braced against the parent pipe for the following services:

a. Process rotary m/c piping

b. Reciprocating pumps and compressors piping

c. Piping subject to slugging or flow induced vibrations

d. Gas piping

Branches, having only minor weights, such as flange and blind flange assemblies of size ¾" 1-1/2" , pressure testing vent and drain arrangements, etc., do not require bracing, provided the branch is short enough (100 mm vertical spool).

Branches, having significant weights such as modular double block bleed valve, direct mounted instruments or valves or piping system of 600# and above or piping system in a cyclic fatigue environment shall be braced/properly supported. Normally branches shall be provided with bracings in two directions. Bracings

shall preferably be made from L-profiles and are 90 degrees circumferentially apart.

8.4 Low Friction Supports

Low friction supports will only be used if specified by the stress engineer.

Pipe Supports requiring a low coefficient of friction shall have a slide unit installed on the surface between the support and the pipe saddle/attachment. The units shall be commercially available component. Any bonding of low friction material to steel backing plates shall be done in Vendors fabrication shop.

The normal coefficient of friction shall be considered as 0.3.

8.5 Spring Supports

In general, the use of spring supports shall be kept to a minimum by careful consideration of support location and alternative pipe routing.

Spring supports shall only be used when specified by the stress engineer on the stress isometrics. Spring support Base plate has to be bolted to structure. No welding is allowed.

All spring support shall be fitted with SS 321L name plates.

8.6 Welded Attachments & Trunnion

Stresses introduced in pipe due to loads from welded attachments (i.e. wherever Trunnion supports height exceeds 0.5M), shall be examined by a stress engineer.

Welded attachments to piping systems shall be minimized. If no other form of attachment is possible to secure a reliable support function, welded attachments are acceptable. Weld attachments shall be welded to piping system prior to post weld heat treatment if applicable.

When supports are subject to extensive repeated line movements, local pipe wall stresses needs to be limited. When high support load applies to thin walled pipes, Trunnion shall be welded directly to standard wear plate on the pipe. Trunnion details with orientation shall also be included in piping isometric drawings.

Wear plates on Trunnion shall only be used when no other alternative can be found and shall be verified by stress engineer. For acoustic fatigue affected pipes, special encircled wear plates shall be used as per the direction of vendor & stress engineer.

9.0 ANNEXURE

9.1 ANNEXURE – I : TABLE OF BASIC SPAN

Maximum support span is as specified in PART-I, PART – II and PART – III below.

PART- I

Nom. Pipe Size (Inches)	SCH/ THK (Inches)	PIPE-VAPOUR INSULATION			PIPE-LIQUID INSULATION			BARE PIPE EMPTY		BARE PIPE WATER-FILLED		Nom.Pipe Size (Inches)
		BASIC SPAN (L) M			BASIC SPAN (L) M			Upto 175^{0}C		Upto 175^{0}C		
		Up to 175^{0}C	176^{0}C to 315^{0}C	316 to 400^{0}C	Up to 175^{0}C	176^{0}C to 315^{0}C	316 to 400^{0}C	SPAN (L) M	Weight (kg /m^3)	SPAN (L) M	Weight (kg /m^3)	
0.75”	SCH 40	3.5	3.5	2.5	3.5	3.0	2.0	4.5	1.68	4.0	2.04	0.75
1”	SCH 40	4.5	4.0	3.0	4.5	3.5	3.0	5.0	2.52	4.5	3.07	1”
1-1.5”	SCH 40	5.0	5.0	4.5	5.0	4.5	3.5	6.0	4.08	5.0	5.4	1-1.5”
2”	SCH 40	5.5	5.0	4.5	5.0	4.5	3.5	6.5	5.47	5.5	7.65	2”
2-2.5	SCH 40	6.5	6.0	5.0	6.0	5.5	4.5	7.5	8.7	6.5	11.79	2-2.5”
3”	SCH 40	7.5	6.5	5.5	6.5	6.0	5.0	8.0	11.35	6.5	16.15	3”
4”	SCH 40	8.0	7.5	6.5	7.5	7.0	6.0	9.0	16.2	7.5	24.45	4”
6’	SCH 40	10.0	9.5	8.5	9.0	8.0	7.5	10.5	28.3	9.0	46.7	6’
8”	SCH 40	12.0	11.0	10.0	10.0	10.0	9.0	12.0	42.84	10.0	75.22	8”
10”	SCH 40	13.5	13.0	12.0	11.5	10.5	10.5	14.0	60.74	11.5	111.9	10”
12”	3/8” w	14.5	13.5	13.0	12.0	11.5	11.0	15.0	74.40	12.0	147.5	12”
14”	3/8” w	15.0	14.5	13.5	12.0	12.0	11.5	16.0	82.5	12.5	172.05	14”
16”	3/8” w	16.0	15.5	14.5	13.0	12.5	12.0	17.0	94.5	13.0	213.15	16”
18”	3/8” w	17.0	16.5	15.0	13.5	13.0	12.0	18.0	106.5	13.5	258.3	18”
20”	3/8” w	18.0	17.5	16.0	14.0	13.5	12.5	19.0	118.5	14.0	307.5	20”
24”	3/8” w	20.0	19.0	17.5	14.5	14.5	13.0	21.0	142.5	15.0	418.2	24”

PART- II

Nom. Pipe Size (Inches)	SCH/ THK (Inches)	PIPE-VAPOUR INSULATION			PIPE-LIQUID INSULATION			BARE PIPE EMPTY		BARE PIPE WATER-FILLED		Nom. Pipe Size (Inches)
		BASIC SPAN (L) M			BASIC SPAN (L) M			Upto 175^{0}C		Upto 175^{0}C		
		Up to 175^{0}C	176^{0}C to 315^{0}C	316 to 400^{0}C	Up to 175^{0}C	176^{0}C to 315^{0}C	316 to 400^{0}C	SPAN (L) M	Weight (kg /m^3)	SPAN (L) M	Weight (kg /m^3)	
0.75”	SCH 80	3.5	3.5	2.5	3.5	3.0	2.0	4.5	2.20	4.0	2.49	0.75 ”
1”	SCH 80	4.5	4.0	3.0	4.5	3.5	3.0	5.0	3.25	4.5	3.72	1”
1-1.5”	SCH 80	5.0	5.0	4.5	5.0	4.5	4.0	6.0	5.45	5.0	6.60	1-1.5”
2”	SCH 80	6.0	5.0	4.5	5.5	5.0	4.0	6.5	7.53	6.0	9.45	2”
2-2.5	SCH 80	6.5	6.0	5.5	6.0	6.0	5.0	7.5	11.49	6.5	14.25	2-2.5
3”	SCH 80	7.5	6.5	6.0	6.5	6.5	6.0	8.0	15.37	7.0	19.66	3”
4”	SCH 80	8.0	8.0	7.0	7.5	7.5	6.5	9.0	22.47	8.0	29.94	4”
6”	SCH 80	10.5	10.0	9.0	9.5	9.0	8.5	10.5	42.90	9.5	59.85	6”
8”	½” w	12.0	11.5	10.5	10.5	10.0	10.0	12.0	65.10	11.0	94.8	8”
10”	½” w	13.5	13.0	12.0	11.5	11.5	10.5	14.0	82.20	12.0	130.69	10”
12”	½” w	14.5	13.5	13.0	12.5	12.0	11.5	15.0	98.13	13.0	168.64	12”
14”	½” w	15.0	14.5	13.5	13.0	12.5	12.0	16.0	108.15	13.5	194.4	14”
16”	½” w	16.0	15.5	15.0	13.5	13.0	13.0	17.0	124.2	14.0	240.0	16”
18”	½” w	17.5	17.0	16.0	14.5	14.0	13.5	18.0	140.25	14.5	286.64	18”
20”	½” w	18.0	17.5	17.0	15.0	14.5	14.0	19.0	157.5	15.0	341.8	20”
24”	½” w	20.0	19.0	18.5	16.0	15.0	15.0	21.0	188.25	16.0	458.44	24”

PART- III

Nom. Pipe Size (Inches)	SCH/ THK (Inches)	PIPE-VAPOUR INSULATION			PIPE-LIQUID INSULATION			BARE PIPE EMPTY		BARE PIPE WATER-FILLED		Nom Pipe Size (Inches)
		BASIC SPAN (L) M			BASIC SPAN (L) M			Upto 175^{0}C		Upto 175^{0}C		
		Up to 175^{0}C	176^{0}C to 315^{0}C	316 to 400^{0}C	Up to 175^{0}C	176^{0}C to 315^{0}C	316 to 400^{0}C	SPAN (L) M	Weight (kg /m^3)	SPAN (L) M	Weight (kg /m^3)	
1”	10 S	4.0	3.5	3.0	4.0	3.0	2.5	4.5	2.08	4.0	2.7	1”
1-1.5”	10 S	5.0	4.5	3.5	4.5	4.0	3.0	5.5	3.12	5.0	4.57	1-1.5”
2”	10 S	5.0	4.5	3.5	4.5	4.0	3.0	6.0	3.94	5.5	6.33	2”
2-2.5”	10 S	6.5	5.5	4.5	5.5	5.0	4.5	7.0	5.26	6.0	8.85	2-2.5”
3”	10 S	7.0	6.0	5.0	6.0	5.5	5.0	7.5	6.45	6.0	11.91	3”
4”	10 S	7.5	7.0	6.0	6.5	6.0	6.0	8.0	8.34	7.0	17.67	4”
6”	10 S	9.5	9.0	8.0	8.0	7.5	7.5	10.0	13.82	8.5	34.54	6”
8”	10 S	11.0	10.5	10.0	9.5	9.5	8.5	11.5	19.94	10.0	55.5	8”
10”	10 S	12.5	12.0	11.0	10.5	10.0	9.5	13.0	27.83	11.0	83.4	10”
12”	10 S	14.0	13.0	12.0	11.0	11.0	10.0	14.5	36.00	11.5	114.6	12”
14”	10 S	14.5	14.0	13.0	11.5	11.0	11.0	15.5	41.18	11.5	132.6	14”
16”	10 S	16.5	14.5	14.0	12.0	11.5	11.5	16.5	47.33	12.5	172.2	16”
18”	10 S	16.5	15.5	14.5	12.5	12.5	11.5	17.5	53.18	13.0	212.1	18”
20”	10 S	17.5	16.5	15.5	13.0	13.0	12.0	18.5	68.50	13.0	264.5	20”
24”	10 S	19.0	18.0	17.0	14.0	13.5	12.5	20.5	94.37	14.0	376.8	24”

9.2 ANNEXURE – II: VERTICAL AND HORIZONTAL GUIDES SPACING

Nom. Pipe size (Inches)	Guide spacing (in meters)	
	Horizontal Note –2,3	Vertical
1	6	6
1½	6	6
2	6	6
2 ½	6	6
3	6	8
4	8	8
6	12	8
8	12	8
10	18	12
12	18	12
14	18	12
16	18	12
18	18	12
20	18	16
24	18	16

Notes:

a. The guide spacing given in the above table are indicative only.

b. The above spacing is valid for all lines unless otherwise specified by stress group

c. These spacing may be varied to suit column spacing of rack. The above spacing is for straight runs of pipes and does not include guides, which are used for control of thermal movements as would occur as expansion loops etc.

9.3 ANNEXURE – III : PIPE SUPPORT STANDARD

SR.NO.	ITEM LIST OF PIPE SUPPORTS	TYPE	PAGE NO.	REV NO.
1	PIPE SHOE FOR INSULATED C.S. PIPE 2" THRU 8" TYPE S1	S1	16	4
2	PIPE SHOE FOR HOT INSULATED C.S. PIPE SIZE 10" THRU 30" TYPE S2 (FROM TEMP. UP TO 343 C)	S2	17	4
3	PIPE SHOE FOR HOT INSULATED ALLOY STEEL/SS PIPE SIZE 2" THRU 8" TYPE-S3 UP TO 343 C	S3	18	4
4	PIPE SHOE FOR HOT INSULATED ALLOY STEEL/SS PIPE SIZE 10" THRU 24" TYPE-S4A/S4B/S4C	S4A/S4B/S4C	19	4
5	PIPE SHOE FOR HOT INSULATED ALLOY STEEL/SS PIPE SIZE 2" THRU 8" TYPE-S5A/S5B (ABOVE 343 C)	S5A/S5B	21	4
6	PIPE SHOE FOR HOT INSULATED C.S PIPE ON SLEEPER/RCC BEAM SIZE 2" THRU 8" TYPE S16	S16	23	4
7	PIPE SHOE FOR HOT INSULATED C.S PIPE ON SLEEPER/RCC BEAM SIZE 10" THRU 30" TYPE S17	S17	24	4
8	PIPE SHOE FOR SLOPE LINE PIPE/INSULATION EXCEEDING 175MM SIZE 2" THRU 8" TYPE-S9A/S9B/S9C	S9A/S9B/S9C	25	4
9	SHOE SUPPORT (PIPE SIZE 3/4" TO 1 1/2")	S12	27	0
10	SPECIAL PIPE SHOE FOR INSULATED PIPE SIZE 2" THRU 24" TYPE B41	B41	28	4
11	GUIDE SUPPORT FOR BARE CS PIPE SIZE 1/2" THRU 20" TYPE G1 & G1A	G1,G1A	29	3
12	GUIDE SUPPORT FOR BARE PIPE SIZE 1/2" THRU 24" TYPE G2 & G2A (FOR TEMP. UP TO 343C)	G2, G2A	30	4
13	GUIDE SUPPORT FOR BARE (AS/SS) PIPE SIZE 1/2" THRU 24" TYPE G3 & G3A	G3, G3A	31	4
14	CROSS GUIDE FOR BARE PIPE SIZE 2" THRU 24" TYPE G4 (FOR OFFSITE)	G4	32	4
15	ADJUSTABLE LOW SUPPORT WITH GUIDE AND CROSS-GUIDE FOR BARE AND INSULATED PIPE SIZE 2" THRU 24" TYPE-L19 AND L19A	L19, L19A	33	4
16	LOW SUPPORT SLIDING FOR BARE AND INSULATED PIPE SIZE 2" THRU 36" TYPE-L1 AND L1A	L1, L1A	34	4
17	LOW SUPPORT SLIDING FOR BARE AND INSULATED PIPE SIZE 2" THRU 24" TYPE-L3 AND L3A	L3, L3A	35	4
18	LOW SUPPORT SLIDING FOR BARE PIPE SIZE 3/4" THRU 36" TYPE-L5 AND L5A	L5, L5A	36	4
19	LOW SUPPORT SLIDING FOR BARE AND INSULATED PIPE SIZE 2" THRU 36" TYPE-L6	L6	37	4
20	LOW SUPPORT FIXED FOR BARE AND INSULATED PIPE SIZE 2" THRU 36" TYPE-L7	L7	38	4
21	LOW SUPPORT RESTRAINED FOR BARE AND INSULATED PIPE SIZE 2" THRU 36" TYPE-L7A	L7A	39	4
22	LOW SUPPORT GUIDE AND CROSS GUIDE FOR BARE AND INSULATED PIPE SIZE 2" THRU 36" TYPE-L8 AND L8A	L8, L8A	40	4
23	ADJUSTABLE LOW SUPPORT SLIDING FOR PIPE SIZE 2" THRU 24" TYPE L10 &L10A	L10, L10A	41	4
24	LOW SUPPORT SLIDING AND FIXED FOR PIPE SIZE 2" THRU 6" TYPE-L11	L11	42	4
25	LOW SUPPORT ON MITERED ELBOW FOR PIPE SIZE 14" THRU 36" TYPE-L13	L13	43	4
26	LOW SUPPORT ON MITERED ELBOW FOR PIPE SIZE 14" THRU 36" TYPE-L13A	L13A	44	4
27	LOW SUPPORT SLIDING AND FIXED FOR PIPE SIZE 3/4" THRU 1.5" TYPE-L15	L15	45	4

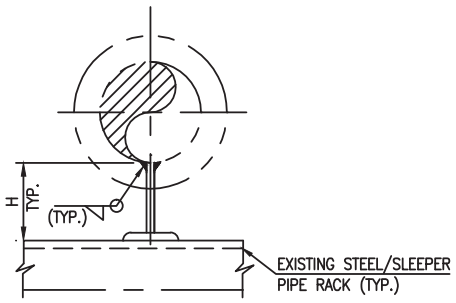


FIG-1
SLIDING

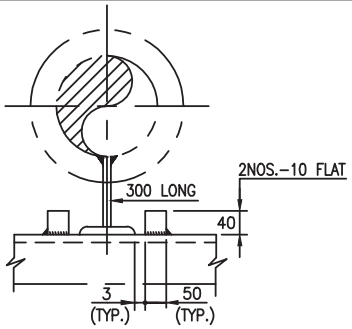


FIG-2
GUIDE

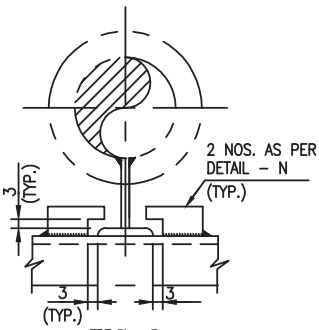


FIG-3
GUIDE

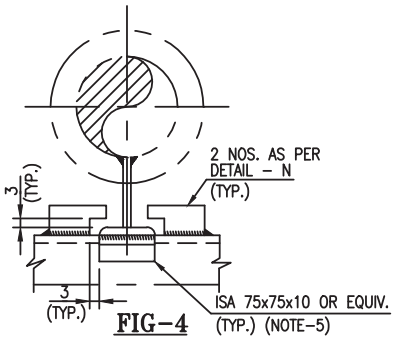
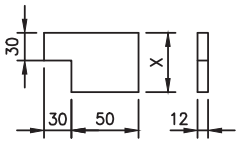
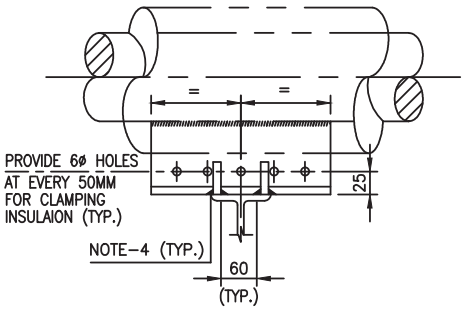


FIG-4
PARTIAL RESTRAINT



DETAIL-N
12THK. C.S. GUIDE PLATE



SIDE VIEW SHOWING GUIDE ARRANGEMENT
(TYPICAL FOR FIG. 2,3&4)

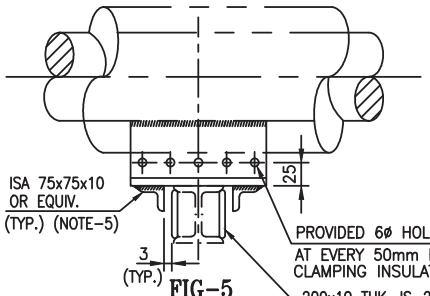


FIG-5
CROSS GUIDE

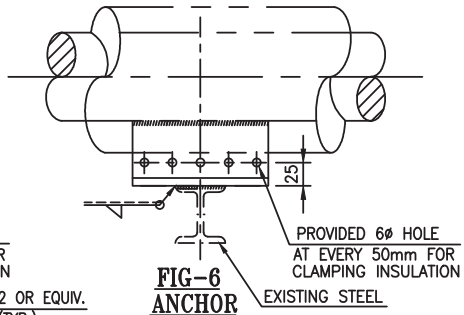
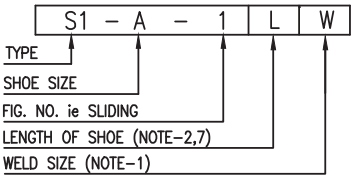


FIG-6
ANCHOR
(SHOE AS PER FIG.1 TO BE
WELDED TO EXISTING STEEL)



MATERIAL-

SHOE-SIZE				
INSULATION THICKNESS	H	CUT FROM ISMB	SHOE SIZE	X
25 TO 75	100	200	A	44
76 TO 125	150	300	B	46
126 TO 175	200	400	C	49
BELOW 25	50	200	D	44
GUIDE-PLATE - IS-2062 OR EQUIV.				

MAXIMUM ALLOWABLE LOAD ON FILLET-WELD OF RESTRAINT (KG/CM)				
WELD SIZE (MM) W	TEMPERATURE (IN DEG.C)			
	200	250	300	350
6	340	250	220	200
8	450	340	300	270
10	560	420	370	330

FOR TEMP. UP TO 343°C ONLY

NOTE:-

1. LOADS ON FILLET WELD OF GUIDE/CROSS-GUIDE/ANCHOR SHALL BE LIMITED TO THE VALUES TABULATED ABOVE AGAINST VARIOUS TEMPERATURES, FOR THE RESPECTIVE WELD-SIZE. FOR RUNNING LENGTH OF WELD. LOADS MAY BE INTERPOLATED FOR INTERMEDIATE TEMPERATURES.
2. SHOE-LENGTH SHALL BE TAKEN AS 300MM FOR FIG, 1,2,3 AND 6, AND AS 400MM FOR FIG, 4 AND 5, UNLESS SPECIFIED OTHERWISE. FOR FIG, 1,2 OR 3. FOR AXIAL MOVEMENT EXCEEDING 100MM (& MAX. UPTO150MM). SHOE LENGTH SHALL BE INCREASED CORRESPONDINGLY MAX. UPTO 400MM.
3. FOR FIG, 3 AND 4, IF THE REQUIRED GUIDE-GAP IS MORE THAM 3MM, DIMENSIONS OF THE GUIDE-PLATE SHALL BE SUITABLY MODIFIED.
4. GUIDE-PLATES SHALL BE WELDED ON BOTH SIDES.
5. FOR CROSS-GUIDE IN FIG. 4 AND 5. LENGTH OF ANGLE SHALL BE SAME AS SHOE-WIDTH.
6. IN CASE OF BEAM TYPE SUPPORTING STEEL, PLATES SHALL BE PROVIDED DN BOTH SIDES AS SHOWN IN FIG. HEIGHT OF PLATE SHALL BE BASED ON THE SIZE OF THE SUPPORTING STEEL MEMBER.
7. FOR TEMPERATURES EXCEEDING 343°C REFER STD.-03-PS-006

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	NRK	DEP	SHR/BN
0	15-02-92	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PIPE SHOE FOR INSULATED
C.S. PIPE 2" THRU 8"
TYPE-S1

Standard Number	Rev.
03-PS-001	4
Sheet 1of 1	

AUTOCAD

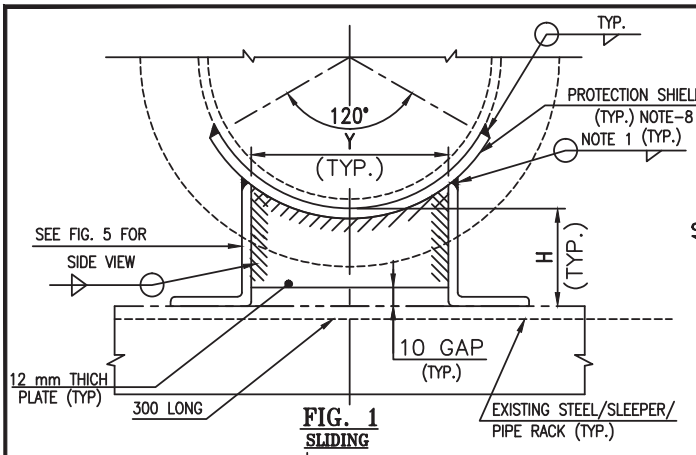


FIG. 1
SLIDING

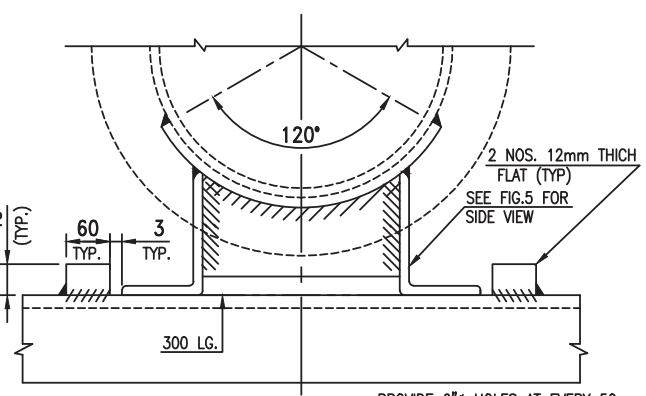
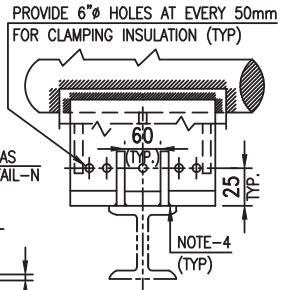


FIG. 2
GUIDE



END VIEW
FOR GUIDE

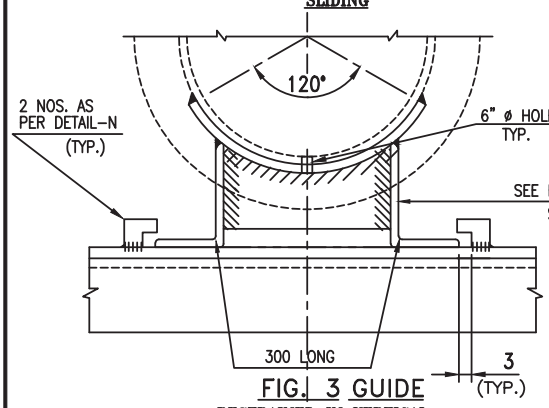


FIG. 3 GUIDE
RESTRAINED IN VERTICAL

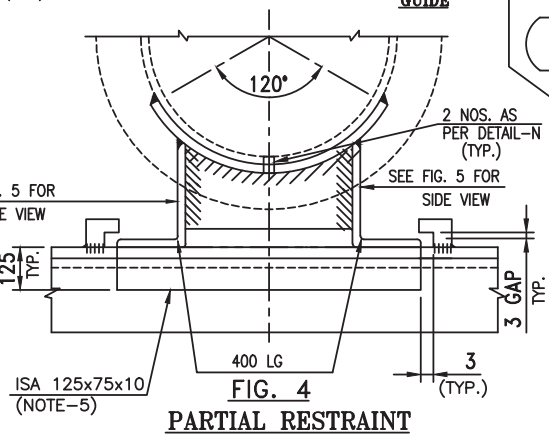


FIG. 4
PARTIAL RESTRAINT
(THREE DIRECTIONAL STOP

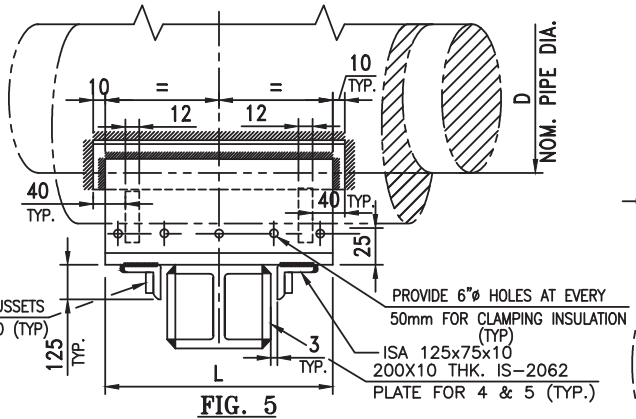
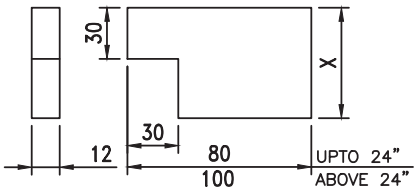


FIG. 5
CROSS GUIDE



DETAIL-N
12 THK. C.S GUIDE PLATE (IS-2062)

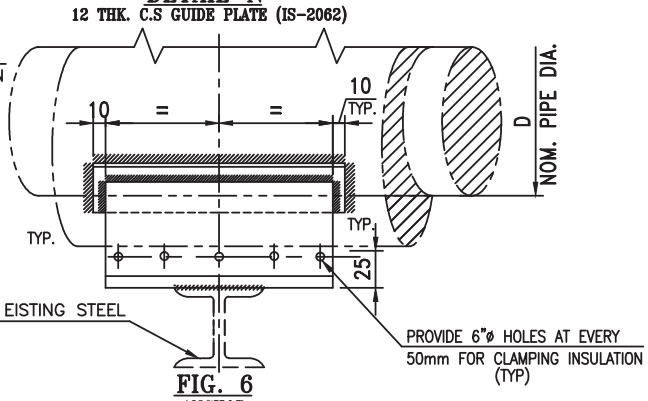
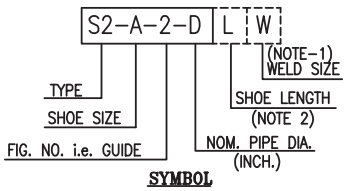


FIG. 6
ANCHOR
(SHOE AS FOR FIG. 1 TO BE WELDED TO EXISTING STEEL)

D	10"	12"	14"	16"	18"	20"	22"	24"	26"	28"	30"
Y	160	190	210	240	270	300	320	360	390	420	450

INSULATION THICKNESS	H	SHOE SIZE	PIPE DIA	SECTION SIZE	X
UP TO 75	100	A	10" TO 22"	ISA 150x75x10	43
			24" TO 30"	ISA 200x75x10	43
76 TO 125	150	B	10" TO 22"	ISA 200x75x10	43
			24" TO 30"	FAB. FROM MC 250	47
126 TO 175	200	C	10" TO 22"	FAB. FROM MC 250	47
			24" TO 30"	FAB. FROM MC 300	47



SYMBOL

NOTE:-

1. FOR NOTES NOS. 1 THRU 6 REFER 03-PS-001.
7. FOR FIG. 4 & 5, IF VERTICAL MOVEMENT IS MORE THAN 15mm, PROVIDE 3NOS. GUSSETS (IS-2062) EQUALLY SPACED.
8. PROTECTION SHIELD SHALL BE CUT FROM LINE PIPE OR ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION SHIELD SHALL BE SAME AS THAT OF LINE PIPE OR 12mm, WHEREVER IS LESS.
9. LONGITUDINAL PIPE MOVEMENT NOT EXCEED 150mM AND SHOE LENGTH NOT EXCEED 400mm.
10. FOR TEMPERATURES EXCEEDING 343°C REFER STD. ---- S15A

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	20-04-18	GENERAL REVISION & ISSUED FOR IMLEMENTATION	AJW	DEP	SHR / BN
0	08-01-07	ISSUED AS STANDARD	SOB	NCS	BN

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PIPE SHOE FOR HOT INSULATED C.S. PIPE SIZE 10" THRU 30" TYPE-S2 (FOR TEPM. UPTO 343° C)

Standard Number	Rev.
03-PS-093	4
Sheet 1 of 1	

AUTOCAD

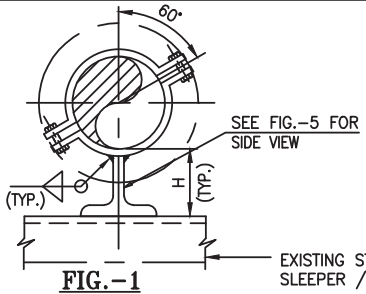


FIG.-1
SLIDING

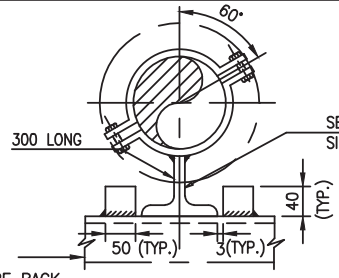


FIG-2
GUIDE

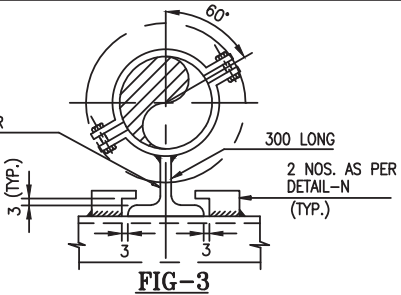


FIG-3
GUIDE
(RESTRAINED IN VERTICAL)

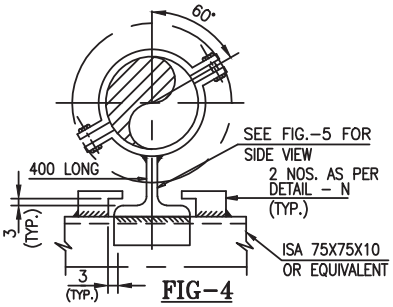
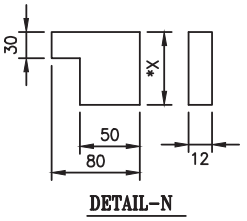
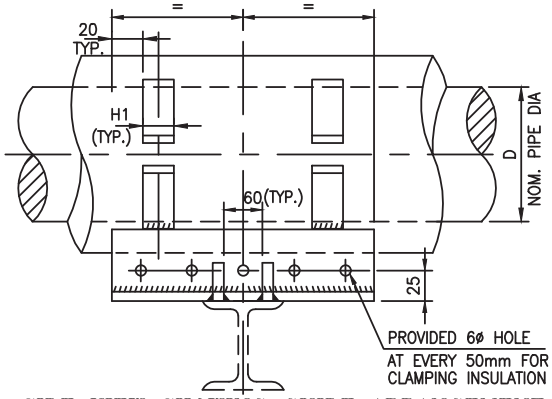


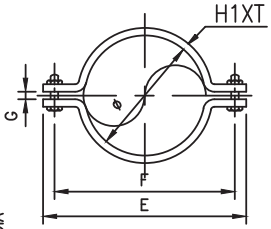
FIG-4
PARTIAL RESTRAINT
(THREE DIRECTIONAL STOP)



DETAIL-N



SIDE VIEW SHOWING GUIDE ARRANGEMENT
(TYPICAL FOR FIG. 2,3&4)



CLAMP

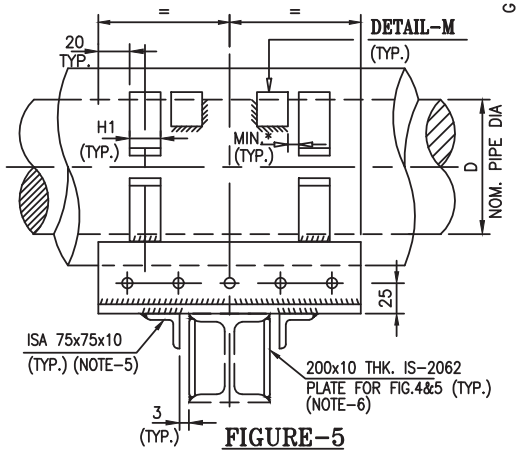
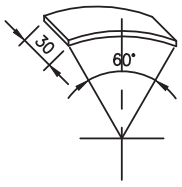


FIGURE-5
CROSS GUIDE



DETAIL-M
CUT FROM LINE PIPE
2 NOS. 30 mm LONG
FOR FIG. 4, 5 & 6 ONLY)

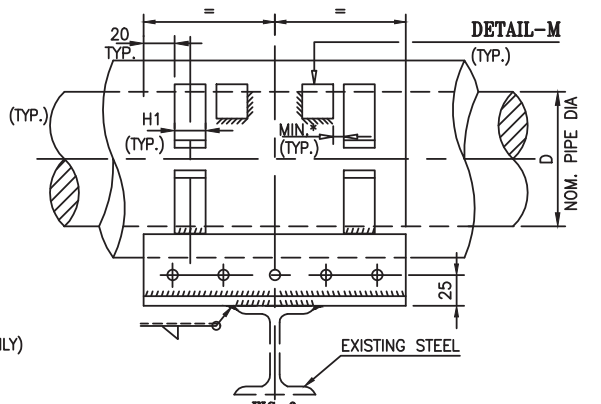


FIG-6
ANCHOR (SHOE AS PER FIG.1 TO BE WELDED TO EXISTING STEEL)

MATERIAL-

SHOE-SIZE				
INSULATION THICKNESS	H	CUT FROM ISMB SIZE	SHOE TYPE	X
UPTO 75	100	ISMB-200	A	44
76 TO 125	150	ISMB-300	B	46
126 TO 175	200	ISMB-400	C	49
BOLT AND NUT : ASTM A 193 Gr. B 7 & A 194 Gr.2H.				
CLAMP : AISI-304/316/321/347 PLATE				
GUIDE & SHOE : ANGLE & FLATE- IS 2062 OR EQUIVALENT.				

CLAMP-DETAILS-

D	ø	E	F	G	H1	T	BOLT SIZE
2"	60	140	110	5	30	6	M10 x 35
3"	89	190	150	5	40	6	M12 x 35
4"	114	215	176	5	50	6	M16 x 40
6"	168	290	246	5	65	8	M20 x 45
8"	219	325	280	5	65	8	M20 x 45

NOTE:- FOR NOTE NOS. 1 THRU 6 REFER STD. 03-PS-001

7. FOR TEMPERATURES EXCEEDING 343°C REFER STD.-03-PS-004.

8. "MIN*" REPRESENT AS NEAR TO ZERO.

S3	-	A	-	1	D	L	W

TYPE
SHOE TYPE
FIG. NO. ie SLIDING
NOM. PIPE DIA (INCH)
LENGTH OF SHOE (NOTE-2,7)
WELD SIZE (NOTE-1)

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RCB	DEP	SHR/BN
0	06-02-92	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	PIPE SHOE FOR HOT INSULATED ALLOY STEEL/SS PIPE SIZE 2" THRU 8" TYPE-S3 UP TO 343° C	Standard Number	Rev.
		03-PS-002	4
		Sheet 1of 1	

AUTOCAD

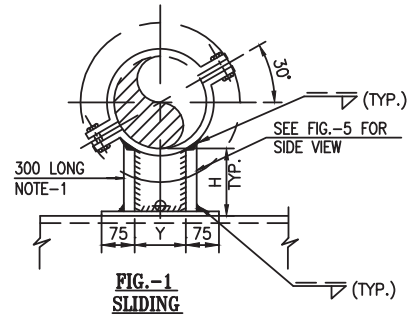


FIG.-1
SLIDING

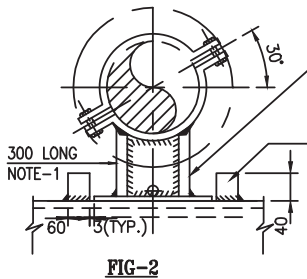


FIG-2
GUIDE

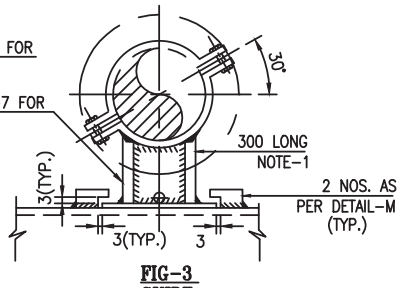


FIG-3
GUIDE
(RESTRAINED IN VERTICAL)

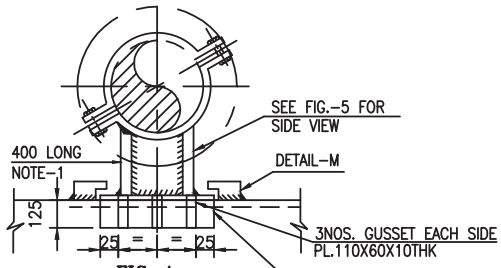
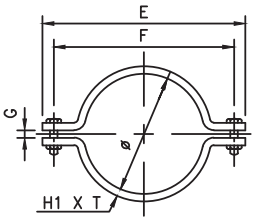


FIG-4
PARTIAL RESTRAINT
(THREE DIRECTIONAL STOP)



CLAMP

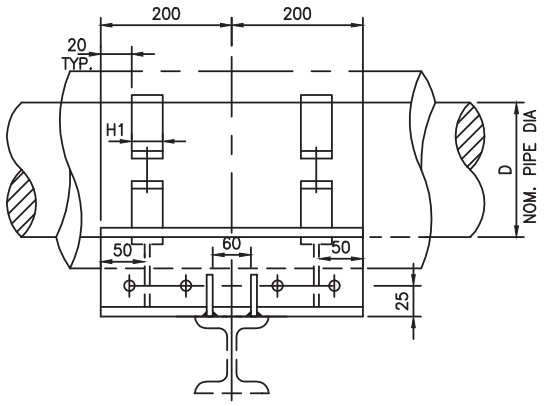


FIGURE -7
SIDE VIEW SHOWING GUIDE ARRANGEMENT
(TYPICAL FOR FIG. 2, 3 & 4)

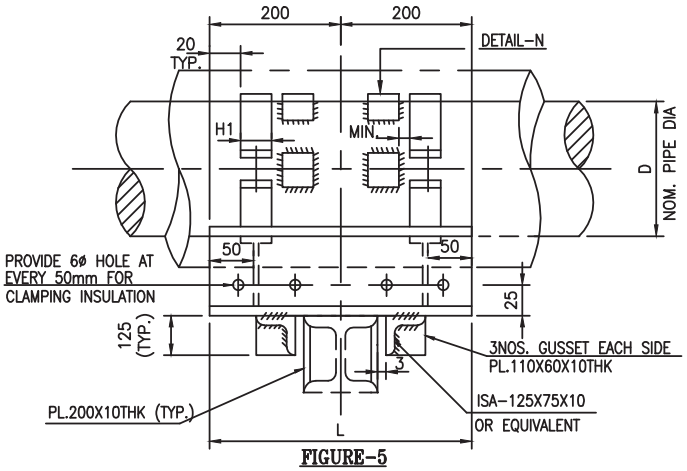
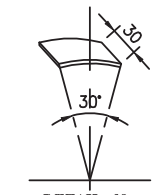
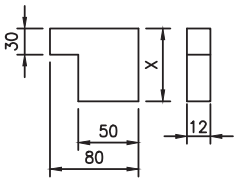


FIGURE-5
CROSS GUIDE



DETAIL-N
CUT FROM LINE PIPE
6 NOS. 30 mm LONG
FOR FIG. 4, 5 & 6 ONLY)



DETAIL-M
12 Thk. C.S. GUIDE PLATE

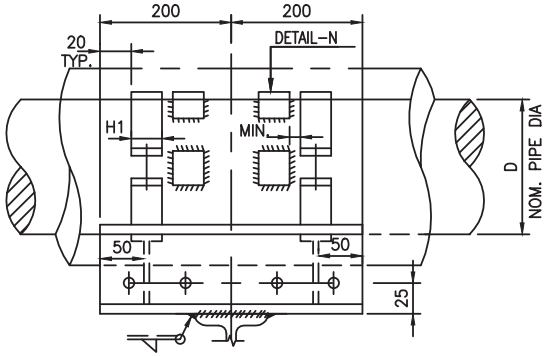


FIG.6 ANCHOR
(SHOE AS PER FIG. 1 TO BE
WELDED TO EXISTING STEEL)

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	PK	DEP	SHR/BN
3	29-07-11	REVISION DUE TO CHANGE OF ORGANIZATION NAME AND ISSUED FOR IMPLEMENTATION.	RAJG	BRB	BN
0	06-02-92	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PIPE SHOE FOR HOT INSULATED
ALLOY STEEL / SS
PIPE SIZE 10" THRU 24"TYPE-S4A/S4B/S4C

Standard Number	Rev.
03-PS-003	4
Sheet 1of 2	

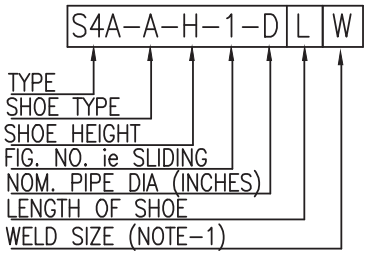
AUTOCAD

CLAMP DIMENSIONS:-

D	ø	E	F	G	H1	T	BOLT SIZE
10"	268	400	340	10	65	10	M20 x 60
12"	320	450	390	10	75	10	M25 x 75
14"	356	485	426	10	75	10	M25 X 65
16"	407	540	480	10	75	10	M25 X 65
18"	458	590	530	10	100	10	M28 X 65
20"	508	640	580	10	100	10	M28 X 65
24"	610	750	690	10	100	10	M28 X 65

SHOE DIM.:-

D	Y
10"	160
12"	190
14"	210
16"	240
18"	270
20"	300
24"	360



SYMBOL

INSULATION THICKNESS	H
UPTO 75	100
76 TO 125	150
126 TO 175	200

MATERIAL:-

TEMPERATURE	SHOE MATERIAL			X	SHOE TYPE
	VERT. PL.& RIBS	BASE PLATE	PLATE THK.		
UPTO 343°C	IS-2062	IS-2062	12	45	S4A
344°C TO 427°C	ASTM A516/A515 (GR.60/65/70)/ IS-2002 GR.2	IS-2062	12	45	S4B
ABOVE 427°C	AISI-304/316/321/347 PLATE		10	43	S4C
BOLT & NUT : ASTM A193 Gr.B16 AND A194 GR.4					
CLAMP : AISI-304/316/321/347 PLATE					
GUIDE PLATE : IS-2062					

NOTE:- FOR NOTE NOS.1 THRU 7 REFER STD. 03-PS-001.

8. FOR INSULATION THICKNESS EXCEEDING 175MM. REFER STD. 03-PS-007.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	PK	DEP	SHR/BN
3	29-07-11	REVISION DUE TO CHANGE OF ORGANIZATION NAME AND ISSUED FOR IMPLEMENTATION.	RAJG	BRB	BN
0	06-02-92	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PIPE SHOE FOR HOT INSULATED
ALLOY STEEL / SS
PIPE SIZE 10" THRU 24"TYPE-S4A/S4B/S4C

Standard Number	Rev.
03-PS-003	4
Sheet 2 of 2	

AUTOCAD

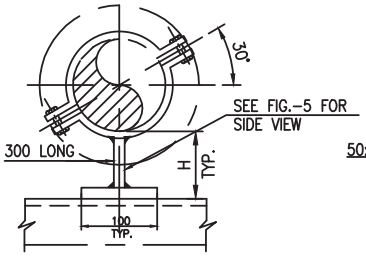


FIG.-1
SLIDING

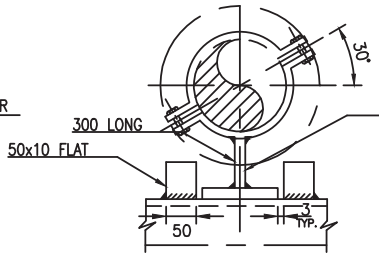


FIG-2
GUIDE

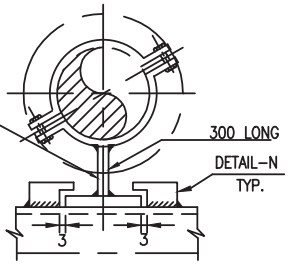


FIG-3
GUIDE
(RESTRAINED IN VERTICAL)

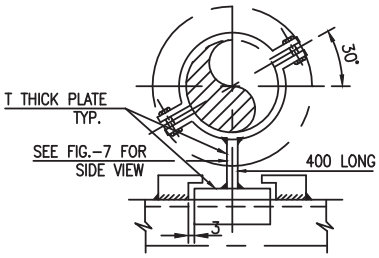
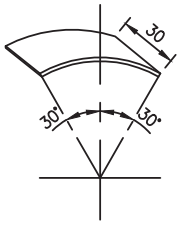


FIG-4
PARTIAL RESTRAINT
(THREE DIRECTIONAL STOP)



DETAIL-M
CUT FROM LINE PIPE
2 NOS. 30 mm LONG
FOR FIG. 4, 5 & 6 ONLY)

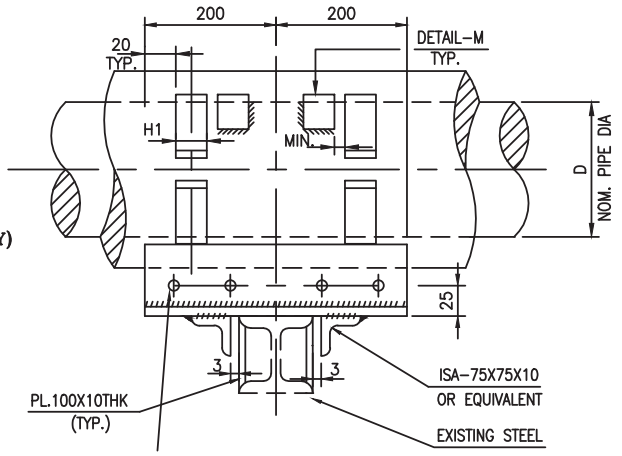


FIGURE-5
(CROSS GUIDE)

PROVIDE 6ø HOLE AT
EVERY 50mm FOR
CLAMPING INSULATION

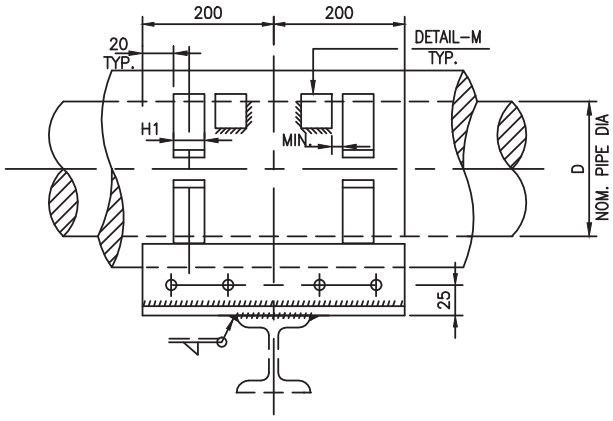
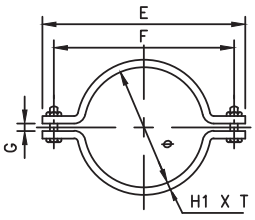
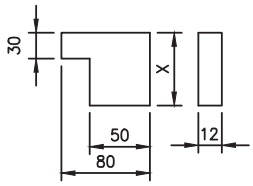


FIG.6 ANCHOR
(SHOE AS PER FIG. 1 TO BE
WELDED TO EXISTING STEEL)



CLAMP



DETAIL-N

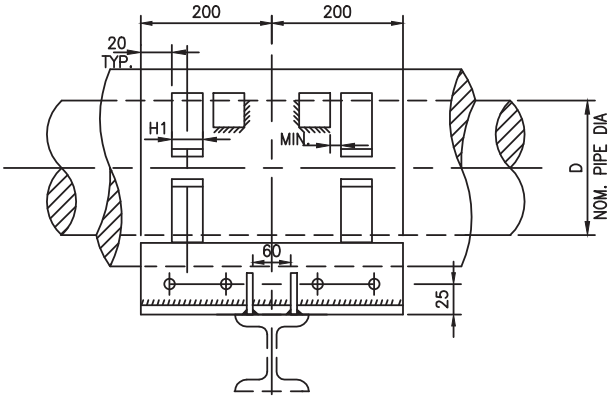


FIGURE-7
SIDE VIEW SHOWING GUIDE ARRANGEMENT

4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	PK	DEP	SHR/BN
0	06-02-92	ISSUED AS STANDARD	SDM	AKR	KPS
Rev.	Date	Description	Prpd.	Chkd.	Appd.

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	PIPE SHOE FOR HOT INSULATED ALLOY STEEL / SS PIPE SIZE 2" THRU 8" TYPE-S5A/S5B (ABOVE 343° C)	Standard Number: 03-PS-004 Rev. 4 Sheet 1of 2

AUTOCAD

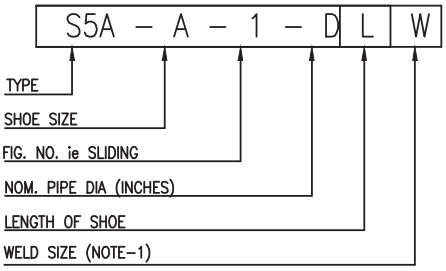
SHOE AND GUIDE MATERIAL:-

TEMPERATURE	SHOE			X	SHOE SIZE
	VERT. PL.& RIBS	BASE PLATE	PLATE THK.'T'		
344°C TO 427°C	ASTM A516/A515 (GR.60/65/70)/ IS-2002 GR.2	IS-2062 OR EQUIVALENT	12	45	S5A
ABOVE 427°C	AISI-304/316/321/347 PLATE		10	43	S5B

BOLT & NUT : ASTM A193 Gr.B16 AND A194 GR.4
CLAMP : AISI-304/316/321/347 PLATE

CLAMP DETAILS:-

D	ø	E	F	G	H1	T	BOLT SIZE
2"	60	140	110	5	30	6	M10 x 35
3"	89	190	150	5	40	6	M12 x 35
4"	114	215	176	5	50	6	M16 x 40
6"	168	290	248	5	65	8	M20 x 45
8"	219	325	280	5	65	8	M20 x 45



SYMBOL

SHOE SIZE

INSULATION THICKNESS	H	SHOE SIZE
UPTO 75	100	A
76 TO 125	150	B
126 TO 175	200	C

NOTE:- FOR NOTE NOS.1 THRU 6 REFER STD. 03-PS-001

7. FOR INSULATION THICKNESS EXCEEDING 175MM. REFER STD. 03-PS-006

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	PIPE SHOE FOR HOT INSULATED ALLOY STEEL / SS PIPE SIZE 2" THRU 8" TYPE-S5A/S5B (ABOVE 343° C)	Standard Number	Rev.
		03-PS-004	4
		Sheet 2 of 2	

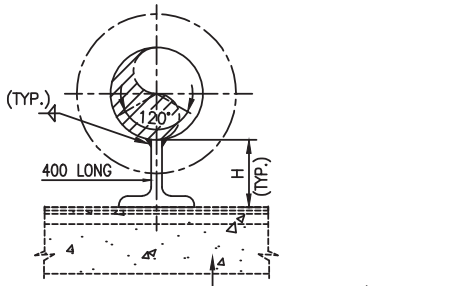


FIG.-1
SLIDING

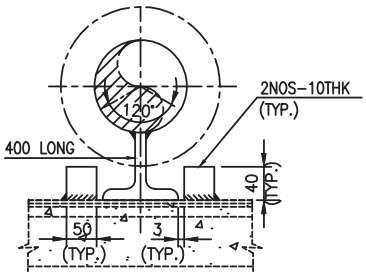


FIG-2
GUIDE

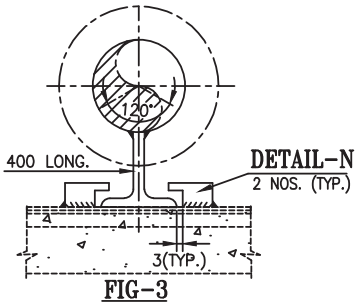
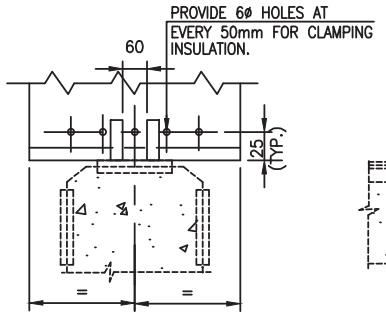


FIG-3
GUIDE
(RESTRICTED IN VERTICAL)



SIDE VIEW SHOWING
GUIDE ARRANGEMENT
(FOR FIG. 2, 3 & 4)

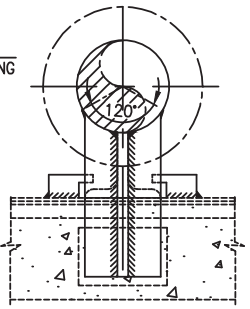


FIG-4
PARTIAL RESTRAINT
(THREE DIRECTIONAL STOP)

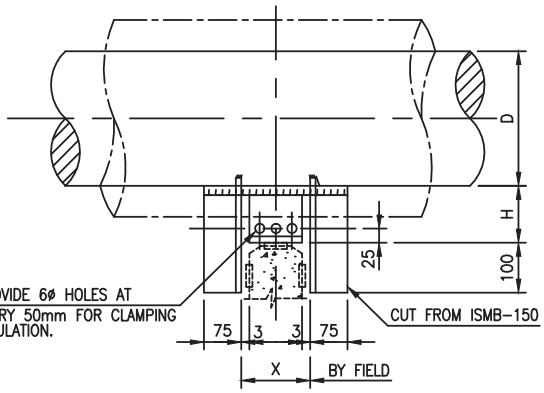


FIGURE-5
CROSS GUIDE

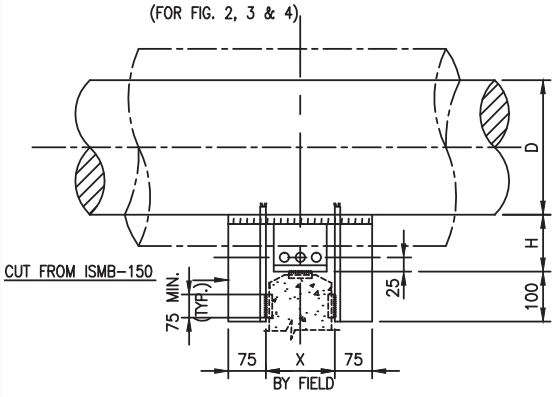
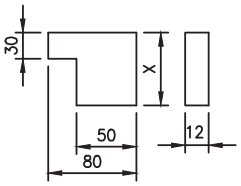


FIGURE-6
ANCHOR

(THE SHOE DETAIL WILL BE SAME AS FIG.5
AND TO BE WEILDED TO EXISTING STRUCTURE
INSERT-PLATES ON BOTH SIDE OF THE SLEETER)



DETAIL-N
10 THK. C.S. GUIDE PLATE
FOR SHOE TYPE A & B

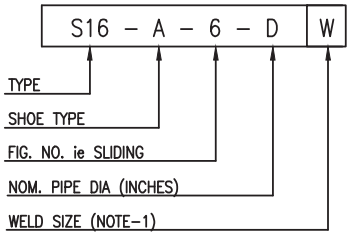
INSULATION THICKNESS	H	CUT FROM ISMB SIZE	SHOE TYPE	X
UPTO 75	100	ISMB-200	A	44
76 TO 125	150	ISMB-300	B	46
126 TO 175	200	ISMB-400	C	49

MAXIMUM ALLOWABLE LOAD ON FILLET WELD OF RESTRAINT (KG/CM)				
WELD SIZE	TEMPERATURE (IN DEG.C)			
W (MM)	200	250	300	350
6	340	250	220	200
8	450	340	300	270
10	560	420	370	330

USE PROTECTION SHIELD FOR WELDING ALL C.S.
ATTACHMENT TO S.S./ALLOY STEEL PIPES

NOTES:-

1. LOADS ON FILLET WELDS OF GUIDE/CROSS-GUIDE/ANCHOR SHALL BE LIMITED TO THE VALUES TABULATED AGAINST VARIOUS TEMPERTURES,FOR THE RESPECTIVE WELD-SIZE, FOR RUNNING LENGTH OF WELD. LOADS MAY BE INTERPOLATED FOR INTERMEDIATE TEMPERTURES.
2. FOR FIG.3 AND 4 ,IF THE REQUIRED GUIDE GAP IS MORE THAN 3MM, DIMENSIONS OF GUIDE PLATE SHALL BE SUITABLE MODIFIED.
3. GUIDE PLATE SHALL BE WELDED ON BOTH SIDE.
4. LONGITUDINAL PIPE MOVEMENT NOT TO EXCEED 150 MM.
5. FOR TEMPERTURE EXCEEDING 343°C OR INSULATION THICKNESS EXCEEDING 175 MM OR A.S/S.S LINE PIPE. REFER STD.03-PS-004.



SYMBOL
FOR TEMP UP TO 343° C ONLY

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	NRK	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	PIPE SHOE FOR HOT INSULATED C.S PIPE ON SLEEPER/RCC BEAM SIZE 2"THRU 8" TYPE S16	Standard Number	Rev.
		03-PS-008	4
		Sheet 1of 1	

AUTOCAD

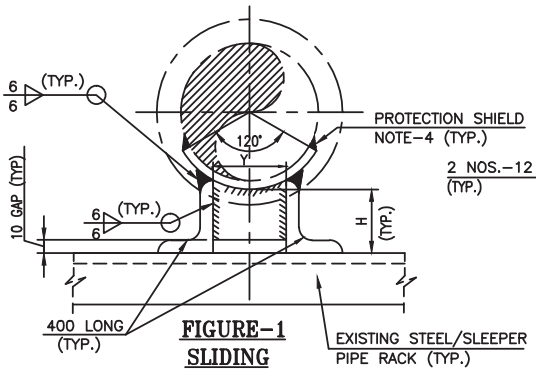


FIGURE-1
SLIDING

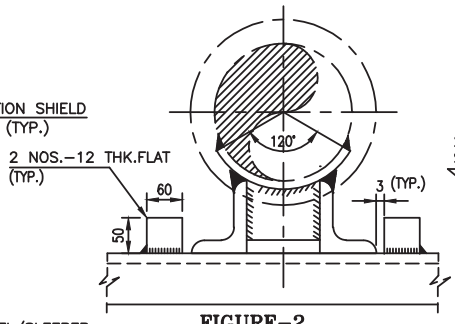


FIGURE-2
GUIDE

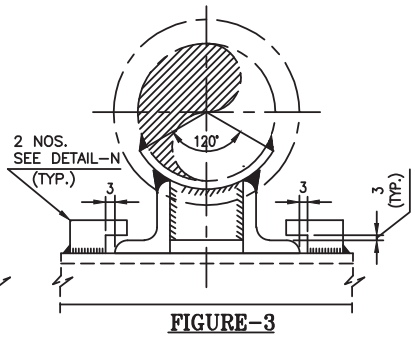


FIGURE-3
GUIDE

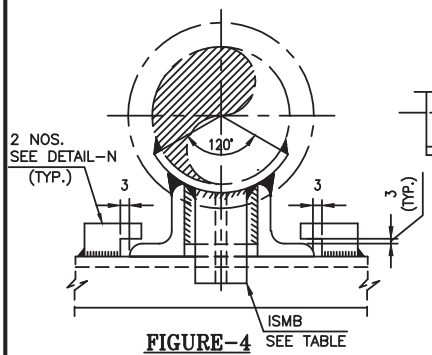
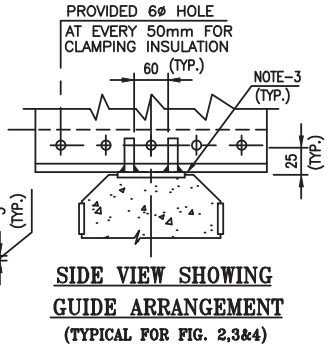


FIGURE-4
PARTIAL RESTRAINT
(THREE DIRECTIONAL STOP)



SIDE VIEW SHOWING
GUIDE ARRANGEMENT
(TYPICAL FOR FIG. 2,3&4)

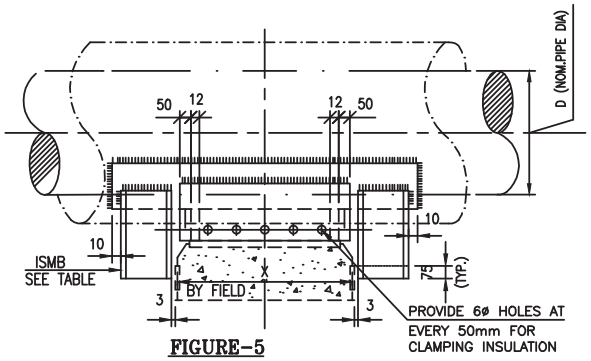
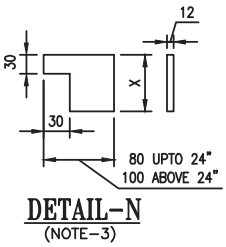


FIGURE-5
CROSS GUIDE



DETAIL-N
(NOTE-3)

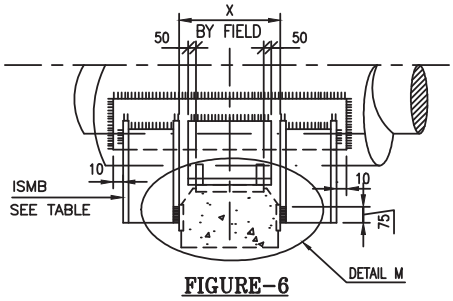
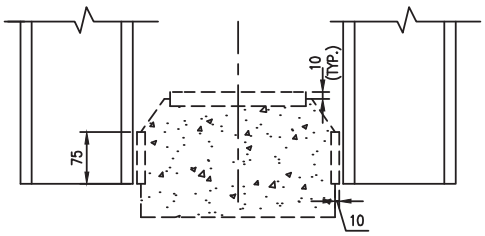
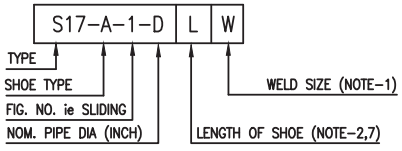


FIGURE-6
ANCHOR



DETAIL M

(THE SHOE DETAIL FOR FIG.6 WILL BE THE SAME AS FOR FIG.5 AND THE CROSS-GUIDE MEMBERS SHALL BE WELDED TO THE EXISTING INSERT PLATES ON THE BOTH SIDE OF THE SLEEPERS)



SYMBOL

MATERIAL–

SHOE–					
INSULATION THICKNESS	H	PIPE DIA	SECTION	X	SHOE SIZE
UPTO 75	100	10" TO 22"	ISA 150x75x10	43	A
		24" TO 30"	ISA 200x75x10	43	
76 TO 125	150	10" TO 22"	ISA 200x75x10	43	B
		24" TO 30"	FAB. FROM MC 250	47	
126 TO 175	200	10" TO 22"	FAB. FROM MC 250	47	C
		24" TO 30"	FAB. FROM MC 300	47	
GUIDE-PLATE : IS-2062					

NOTE:–

1. FOR MAXIMUM ALLOWABLE LOADS ON FILLET WELDS OF GUIDE/CROSS-GUIDE/ANCHOR REFER TO STANDARD 03-PS-001.
2. FOR FIG, 3 AND 4, IF THE REQUIRED GUIDE-GAP IS MORE THAM 3MM, DIMENSIONS OF THE GUIDE-PLATE SHALL BE SUITABLY MODIFIED.
3. GUIDE-PLATES SHALL BE WELDED ON BOTH SIDES.
4. PROTECTION-SHIELD SHALL BE CUT FROM LINE-PRE OR ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION-SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS.
5. LONGITUDINAL PIPE MOVEMENT NOT TO EXCEED 150 MM
6. FOR TEMPERATURES EXCEEDING 343°C OR INSULATION THICKNESS EXCEEDING 175 MM. OR A.S/S.S. LINE PIPE, REFER STD. 03-PS-095

(FOR TEMP. UPTO 343°C)

D	10"	12"	14"	16"	18"	20"	22"	24"	26"	28"	30"
Y	160	190	210	240	270	300	320	360	390	420	450
ISMB*	150		200			250					

* FOR FIGS. 4,5, & 6 ONLY

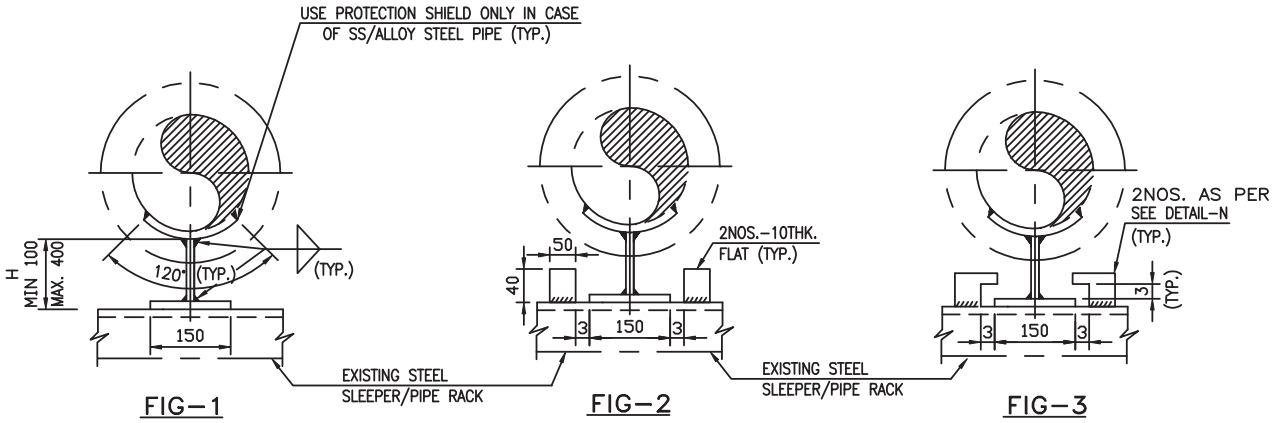
Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	PK	DEP	SHR/BN
0	22-06-92	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PIPE SHOE FOR HOT INSULATED
C.S. PIPE ON SLEEPER/RCC-BEAM
SIZE 10" THRU 30" TYPE S-17

Standard Number	Rev.
03-PS-009	4
Sheet 1of 1	

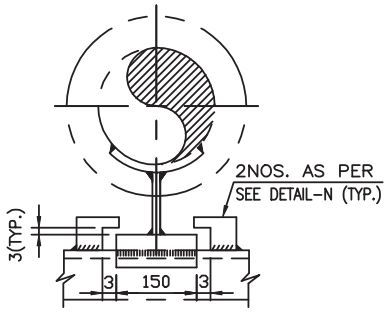
AUTOCAD



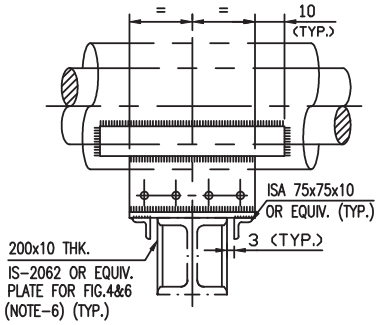
FIG–1
SLIDING

FIG–2
GUIDE

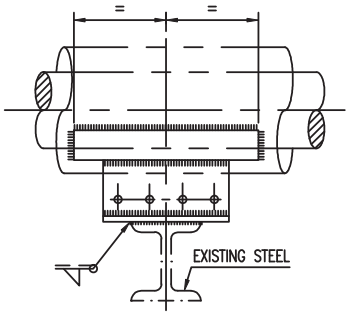
FIG–3
GUIDE
(RESTRAINED IN VERTICAL)



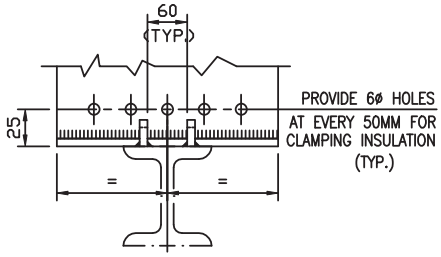
FIG–4
PARTIAL RESTRAINT
(THREE DERECTIONAL STOP)



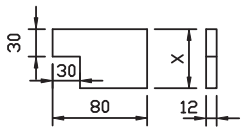
FIG–5
CROSS–GUIDE



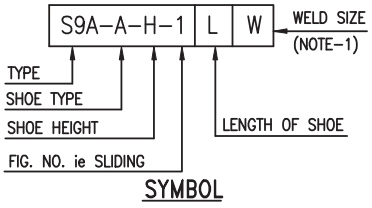
FIG–6
ANCHOR



SIDE VIEW FOR GUIDE
(TYP. FOR FIG. 2, 3 & 4)



DETAIL–N
(NOTE–3)



SYMBOL

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30–04–18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	NRK	DEP	SHR/BN
3	29–07–11	REVISION DUE TO CHANGE OF ORGANIZATION NAME AND ISSUED FOR IMPLEMENTATION.	RAJG	BRB	BN
0	21–5–93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PIPE SHOE
FOR SLOPE LINE PIPE/
INSULATION EXCEEDING 175MM
SIZE 2" THRU 8" TYPE–S9A/S9B/S9C

Standard Number	Rev.
03–PS–006	4
Sheet 1of 2	

AUTOCAD

SHOE AND GUIDE MATERIAL						
PIPE MATL.	TEMPERATURE	VERT.PLATE	BASE PLATE	PLATE THK.	X	SHOE TYPE
CS/AS/SS	UPTO 343°C	IS-2062 OR EQUIV.	IS-2062 OR EQUIV.	12	45	A
	344° TO 427°C	ASTM A516/A515 (GR.60/65/70) / IS-2002 GR.2 OR EQUIV.	IS-2062 OR EQUIV.	12	45	B
AS/SS	ABOVE 427°C	AISI-304/316/321/347 PLATE OR EQUIV.		10	43	C
GUIDE-PLATE : IS-2062 OR EQUIV.						

SHOE-HEIGHT	
INSULATION THICKNESS	H
25 TO 75	100
76 TO 125	150
126 TO 175	200
BELOW 25	50

MAXIMUM ALLOWABLE LOAD ON FILLET-WELD OF RESTRAINT (KG/CM)				
WELD SIZE (MM)	TEMPERATURE (IN DEG.C)			
	200	250	300	350
6	340	250	220	200
8	450	340	300	270
10	560	420	370	330

NOTE:-

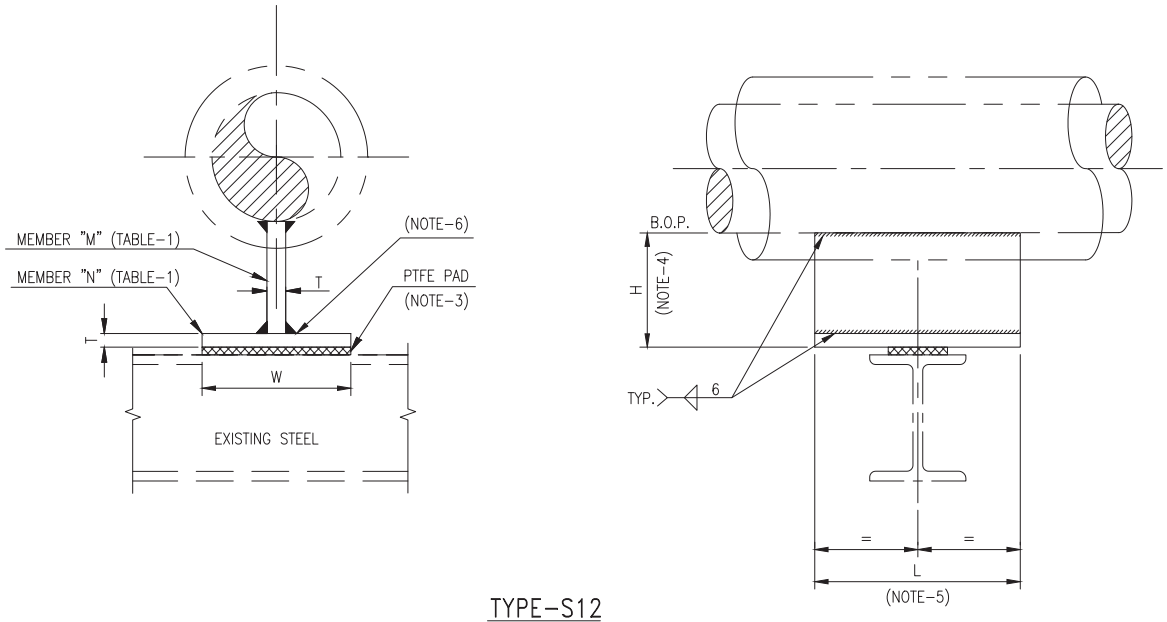
1. LOADS ON FILLET WELD OF GUIDE/CRDSS-GUIDE/ANCHOR SHALL BE LIMITED TO THE VALUES TABULATED ABOVE AGAINST VARIOUS TEMPERATURES, FOR THE RESPECTIVE WELD-SIZE. FOR RUNNING LENGTH OF WELD. LOADS MAY BE INTERPOLATED FOR INTERMEDIATE TEMPERATURES.
2. SHOE-LENGTH SHALL BE TAKEN AS 300MM FOR FIG, 1,2,3 AND 6, AND AS 400MM FOR FIG, 4 AND 5, UNLESS SPECIFIED OTHERWISE. FOR FIG, 1,2 OR 3. FOR AXIAL MOVEMENT EXCEEDING 100MM (& MAX. UPTO150MM). SHOE LENGTH SHALL BE INCREASED CORRESPONDINGLY MAX. UPTO 400MM.
3. FOR FIG, 2 AND 3, IF THE REQUIRED GUIDE-GAP IS MORE THAN 3MM, DIMENSIONS OF THE GUIDE-PLATE SHALL BE SUITABLY MODIFIED.
4. GUIDE-PLATES SHALL BE WELDED ON BOTH SIDES.
5. FOR CROSS-GUIDE IN FIG. 4 AND 6. LENGTH OF ANGLE SHALL BE SAME AS SHOE-WIDTH.
6. IN CASE OF BEAM TYPE SUPPORTING STEEL, PLATES SHALL BE PROVIDED DN BOTH SIDES AS SHOWN IN FIG. HEIGHT OF PLATE SHALL BE BASED ON THE SIZE OF THE SUPPORTING STEEL MEMBER.
7. PROTECTION-SHIELD SHALL BE CUT FROM LINE-PIPE OR ROLLED PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION-SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	NRK	DEP	SHR/BN
3	29-07-11	REVISION DUE TO CHANGE OF ORGANIZATION NAME AND ISSUED FOR IMPLEMENTATION.	RAJG	BRB	BN
0	21-5-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PIPE SHOE
FOR SLOPE LINE PIPE/
INSULATION EXCEEDING 175MM
SIZE 2" THRU 8" TYPE-S9A/S9B/S9C

Standard Number	Rev.
03-PS-006	4
Sheet 2of 2	



TYPE-S12
SHOE FOR SMALL LINES

TABLE-1 SHOE DIMENSIONS

PIPE SIZE (NPS)	LENGTH(*) "L"(MIN) (NOTE-5)	WIDTH "W"	HEIGHT "H"	PLATE THK "T"	LOAD (MAX) KG
3/4"-1 1/2"	300	75	100-200	8	250

* WHEN USED AS LINE STOP, L=STRL MEMBER+ (2 X GAP)+ (2 X AXIAL STOP MEMBER) + 50MM.

TABLE-2

PIPE MATERIAL (NOTE-2)	MATL CODE
CARBON STEEL	CS
STAINLESS STEEL	SS
DUPLEX SS (22% CR)	DS
SUPER DUPLEX SS (25% CR)	SD

NOTES:-

1. ALL DIMENSIONS ARE IN MM AND ANGLES IN DEGREES.
2. THIS SUPPORT STANDARD SHALL BE READ IN CONJUNCTION WITH DOCUMENT (03-CS-002) FOR TECHNICAL REQUIREMENTS AS APPLICABLE.
3. SHOE HEIGHT H=100MM FOR PIPES WITH INSULATION THICKNESS UPTO 75MM.
4. IF REQUIRED, SHOE LENGTH CAN BE REDUCED TO 200MM IN CONSULTATION WITH STRESS.
5. FOR MATERIAL OTHER THAN C.S , DISSIMILAR WELDING IS REQUIRED.

SUPPORT TAG NO.

S12 - XX - H - L

SUPPORT TYPE
SIZE
HEIGHT
LENGTH

Rev.	Date	Description	Prpd.	Chkd.	Appd.
0	15-12-20	ISSUED AS STANDARD	RAJ	ABS	SSH

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

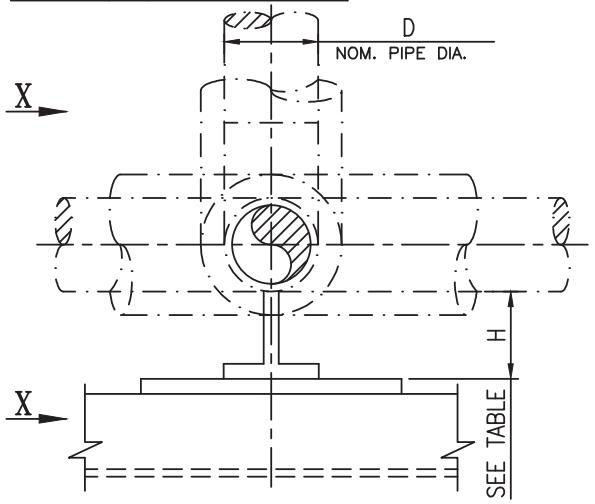
SHOE SUPPORT
(PIPE SIZE 3/4" TO 1 1/2")
(TYPE-S12)

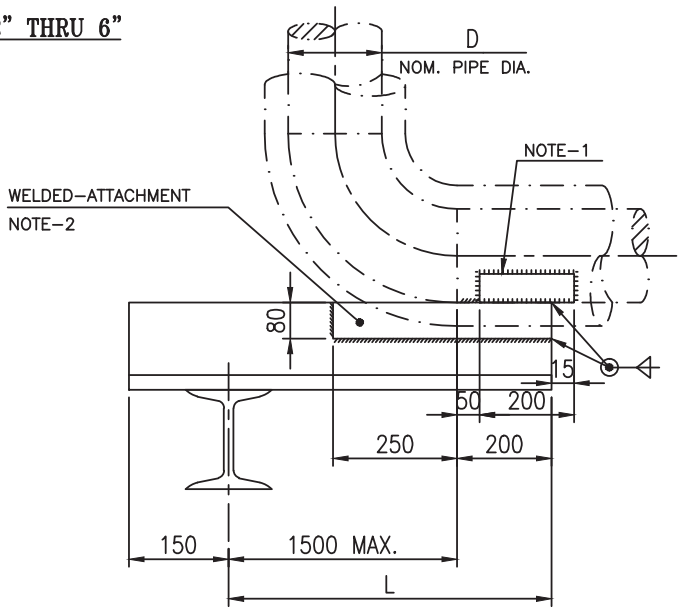
Standard Number	Rev.
03-PS-172	0
Sheet 1of 1	

AUTOCAD

INSULATION THICKNESS	H	CUT FROM BEAM SIZE	SHOE TYPE
UPTO 75	100	ISMB 200	A
76 TO 125	150	ISMB 300	B
126 TO 175	200	ISMB 400	C

FOR PIPE SIZE 2" THRU 6"

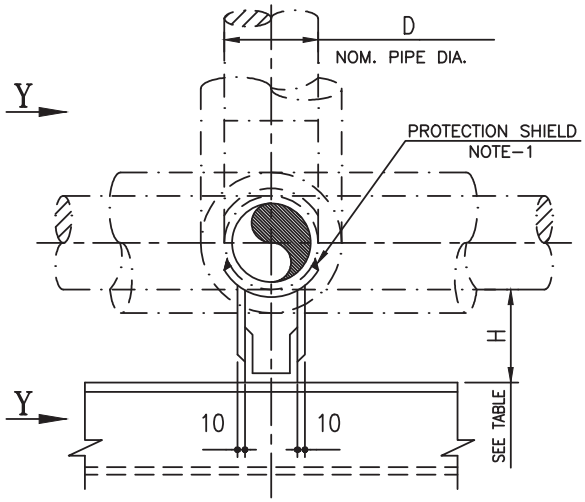




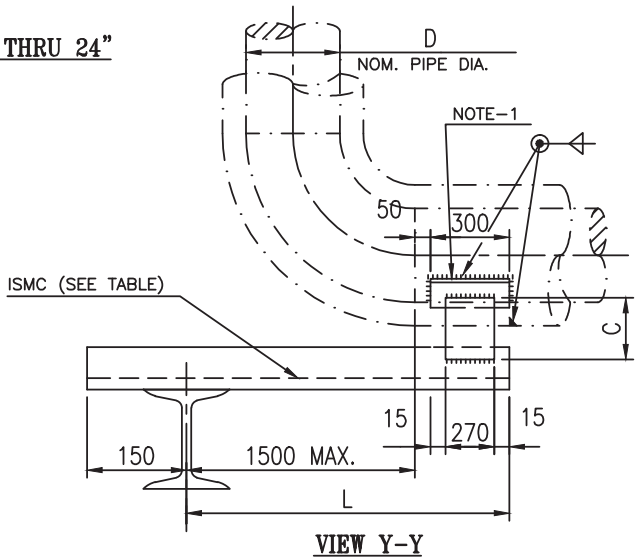
VIEW X-X

SIZE OF ISMC FOR SIZES 8" THRU 24"									
D	8"	10"	12"	14"	16"	18"	20"	22"	24"
ISMC	125 x 65		200 x 75				300 x 90		

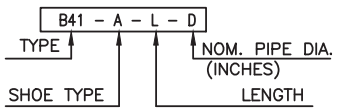
FOR PIPE SIZE 8" THRU 24"



FOR PIPE SIZE 8" THRU 24"



VIEW Y-Y



SYMBOL

WELDED ATTACHMENT FOR SIZE 8" THRU 24"										
INSULATION THICKNESS	H	SHOE TYPE	C							
			8"	10"	12"	14"	16"	18"	20"	22"	24"
UPTO 75	100	A	100						120		
76 TO 125	150	B	150						170		
126 TO 175	175	C	200						220		

NOTES:-

1. PROTECTION SHIELD SHALL BE CUT FROM LINE PIPE OR ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION-SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS. IN CASE OF ALLOY/ STAINLESS STEEL LINE-PIPE, PROTECTION SHIELD SHALL BE PROVIDED FOR PIPE SIZE 2" THRU 6" ALSO. PROTECTION SHIELD SHALL BE POSITIONED SYMMETRICALLY. INCLUDED ANGLE OF PROTECTION SHIELD SHALL BE 120° FOR 8"& ABOVE AND 90° UPTO 6".
2. WELDED-ATTACHMENT PLATE MATERIAL-
   FOR TEMPERATURES UPTO 343°C
   - FOR 2" THRU 6" PIPE - ISMB TO BE USED DIRECTLY
   - FOR 8" THRU 24" PIPE - IS-2062 PLATE (12 THK.)
   FOR TEMPERATURES OF 344°C TO 427°C
   -ASTM A516/A515/(GR. 60/65/70)/IS-2002 GR.2 PLATE (12 THK.)

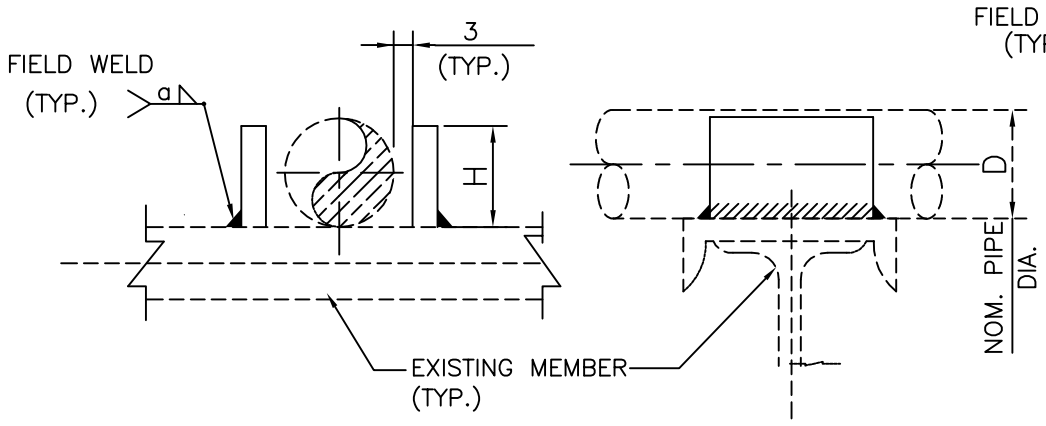
Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	SUD	DEP	SHR/BN
0	08-10-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

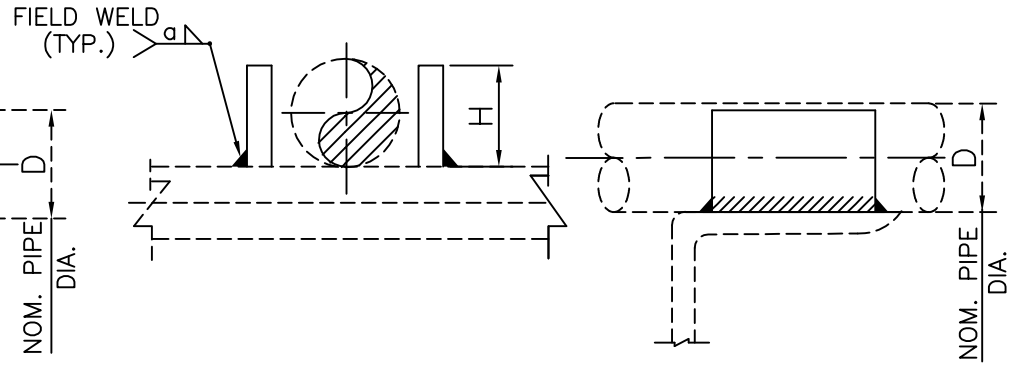
SPECIAL PIPE SHOE
FOR INSULATED PIPE
SIZE 2" THRU 24" TYPE-B41

Standard Number	Rev.
03-PS-108	4
Sheet 1of 1	

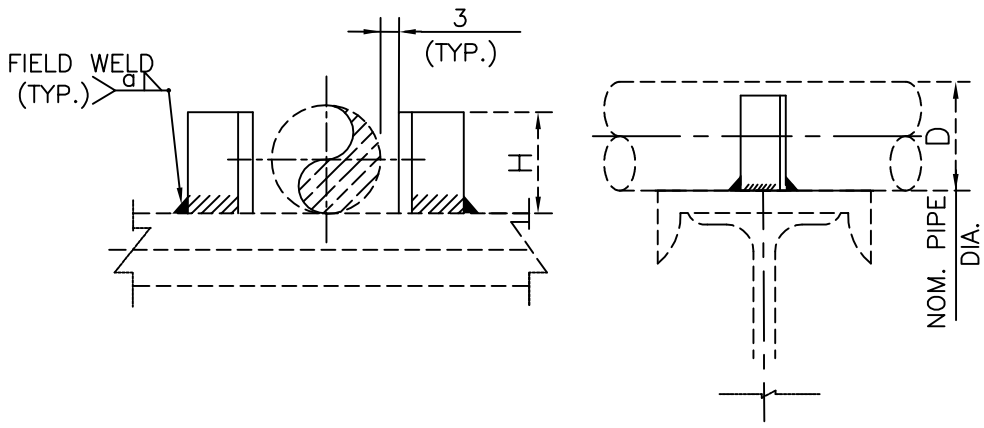
AUTOCAD



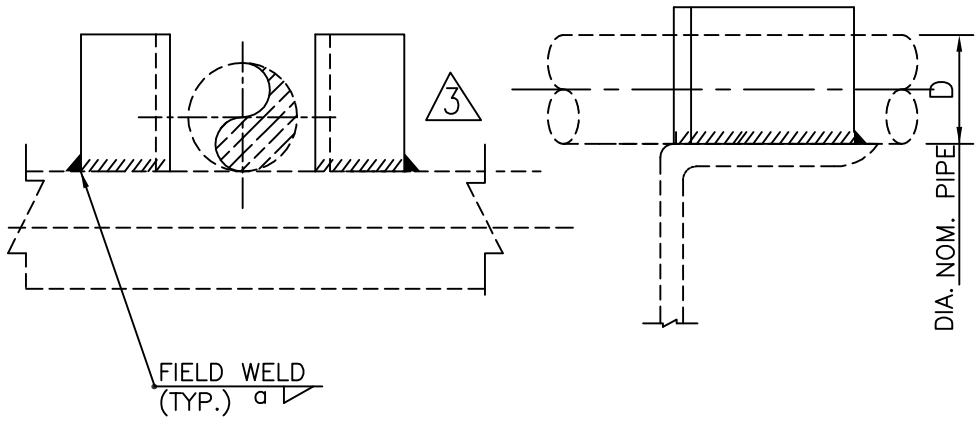
FOR SIZES UPTO 4"



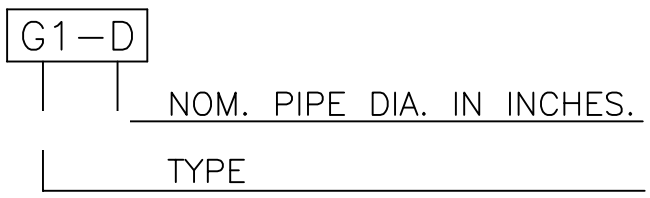
FOR SIZES UPTO 4"



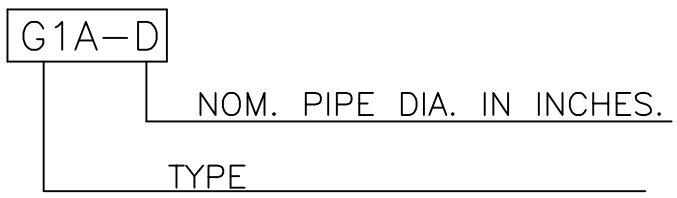
FOR SIZES 6" THRU 20"



FOR SIZES 6" THRU 20"



SYMBOL



SYMBOL

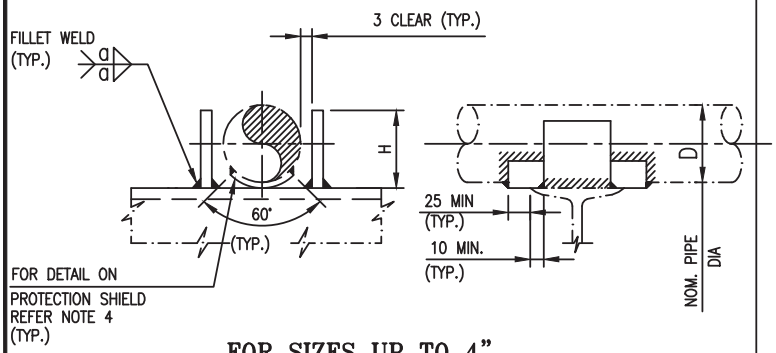
D	H	a	MATERIAL
2"& SMALLER	40	6	2 Nos. PLATE 75x10
3" TO 4"	70	6	2 Nos. PLATE 80x10
6" TO 8"	130	6	2 Nos. ISA–50x50x6
10" TO 18"	230	8	2 Nos. ISA 75x75x10
20"	350	8	2 Nos. ISA 90x90x10

TEMPERATURE UPTO 150 °C	
WELD SIZE (MM)	MAXIMUM ALLOWABLE LOAD ON FILLET–WELD (KG/mm)
6	34
8	45

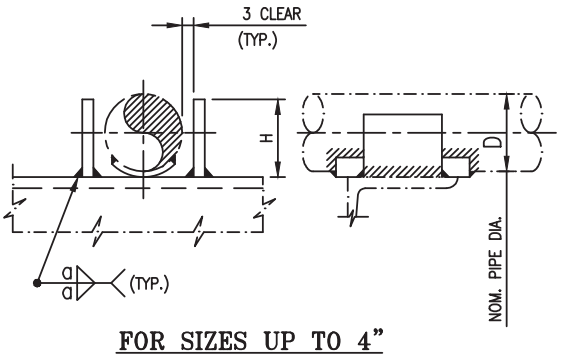
NOTES:– 1. GUIDE ANGLES SHOULD BE SUITABLY TRIMMED WHEREVER IT OBSTRUCTS WITH ADJOINING ANGLES.
2. LOAD BEARING CAPACITY FOR THE SUPPORT SHALL BE CALCULATED FROM ABOVE TABLE
3. ALL PLATE MATERIALS SHALL BE AS PER IS2062 OR EQUIVALENT.

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	GUIDE SUPPORT FOR BARE CS PIPE SIZE 1/2" THRU 20" TYPE G1 & G1A	Standard Number	Rev.
		03–PS–173	3
		SHEET 1 OF 1	

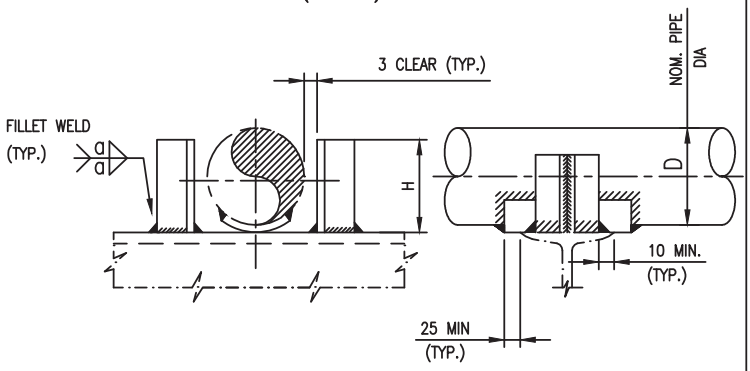
AUTOCAD



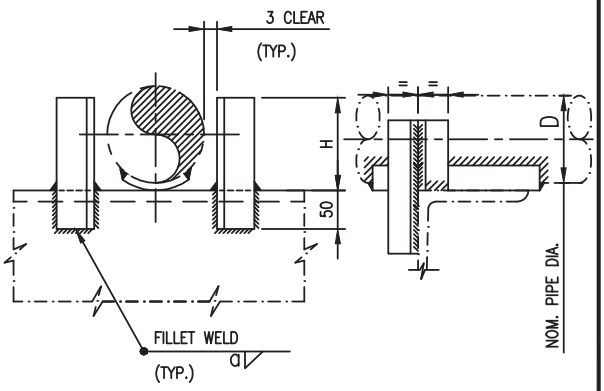
FOR SIZES UP TO 4"
(NOTE-4)



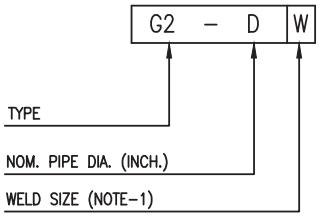
FOR SIZES UP TO 4"
(NOTE-4)



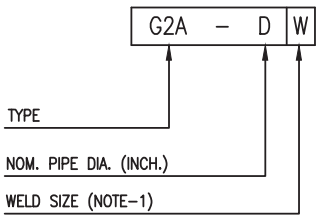
FOR SIZES 6" THRU 24"
(NOTE-4)



FOR SIZES 6" THRU 24"
(NOTE-4)



SYMBOL



SYMBOL

MAXIMUM ALLOWABLE LOAD ON FILLET-WELD OF RESTRAINT (KG/CM)					
WELD SIZE (MM)	TEMPERATURE (IN DEG.C)				
	200	250	300	350	400
6	340	250	220	200	170
8	450	340	300	270	220
10	560	420	370	330	280

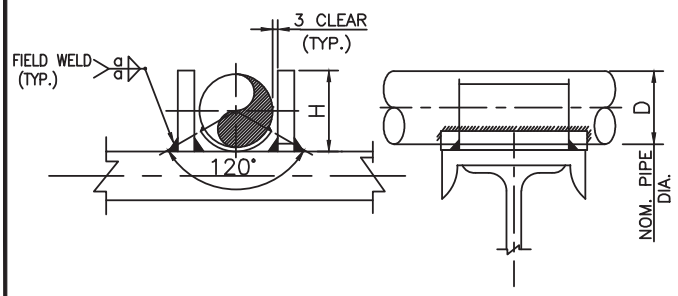
D	H	a	MATERIAL
2" & SMALLER	40	6	FLAT 60 x 10 (IS-2062 OR EQUIVALENT)
3" TO 4"	70	6	FLAT 75 x 10
6" TO 8"	130	6	2 NOS. ISA-50 x 50 x 6 OR EQUIVALENT
10" TO 18"	230	10	2 NOS. ISA-50 x 50 x 10 OR EQUIVALENT
20" TO 24"	350	10	2 NOS. ISA-90 x 90 x 10 OR EQUIVALENT

NOTES:

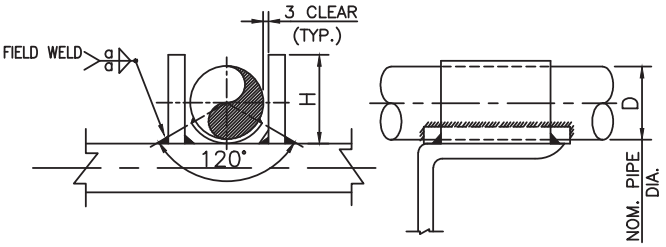
1. LOADS ON FILLET WELDS OF GUIDE SHALL BE LIMITED TO THE VALVE TABULATED ABOVE AGAINST VARIOUS TEMPERATURES, FOR THE RESPECTIVE WELD-SIZE, FOR RUNNING LENGTH OF WELD. LOAD MAY BE INTERPOLATED FOR INTERMEDIATE TEMP.
2. GUIDE PLATES/ANGLES SHALL BE WELDED ON BOTH SIDES.
3. GUIDE ANGLES SHALL BE SUITABLY TRIMMED WHEREVER THESE OBSTRUCT ADJACENT GUIDE ANGLES.
4. PROTECTION-SHIELD SHALL BE PROVIDED ON A.S AND S.S LINES 2"NB AND ABOVE, AND ON ALL OTHER LINES 14"NB AND ABOVE. IT SHALL BE CUT FROM LINE-PIPE OR ROLLED PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION-SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	NRK	DEP	SHR/BN
0	21-02-93	ISSUED AS STANDARD	SDM	AKR	KPS

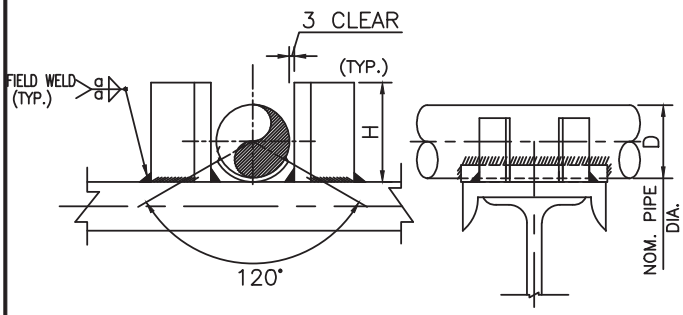
TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	GUIDE SUPPORT FOR BARE PIPE SIZE 1/2" THRU 24" TYPE G2 & G2A (FOR TEMP.UPTO 343°C)	Standard Number	Rev.
		03-PS-015	4
		Sheet 1of 1	



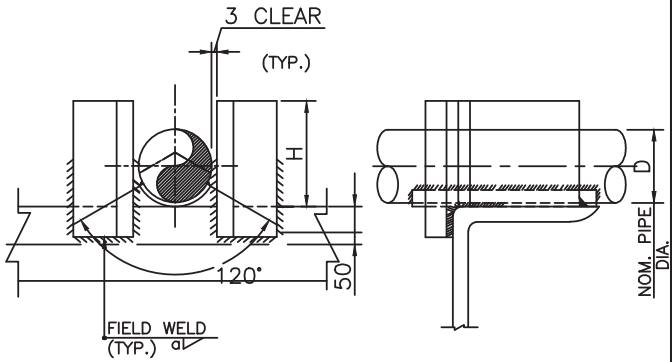
FOR SIZES UP 4"



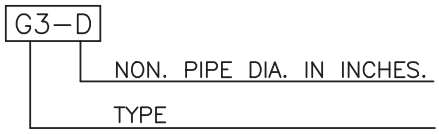
FOR SIZES UP 4"



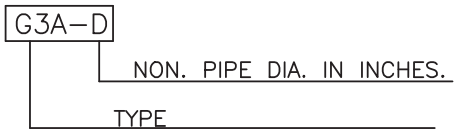
FOR SIZES 6" THRU 24"



FOR SIZES 6" THRU 24"



SYMBOL



SYMBOL

D	H	a	MATERIAL
2"& SMALLER	40	6	FLAT 80x10
3" TO 4"	70	6	FLATE 75x10
6" TO 8"	130	6	2 Nos ISA–50x50x6
10" TO 18"	230	10	2 Nos. ISA 75x75x10
20" TO 24"	350	10	2 Nos. ISA 90x90x10

NOTES:–

1. GUIDE ANGLES SHOULD BE SUITABLY TRIMMED WHEREVER IT OBSTRUCTS WITH ADJOING ANGLES.
2. PROTECTION SHIELD SHALL BE CUT FROM LINE PIPE OR ROLLED PLATE OF MATERIAL EQUIVALENT TO THAT OF LINE–PIPE OR ROLLED PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION SHIELD SHALL BE SAME AS THAT OF LINE–PIPE OR 12mm, WHICHEVE IS LESS.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30–04–18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	AJW	DEP	SHR/BN
0	23–09–02	ISSUED AS STANDARD	SDM	AKR	KPS

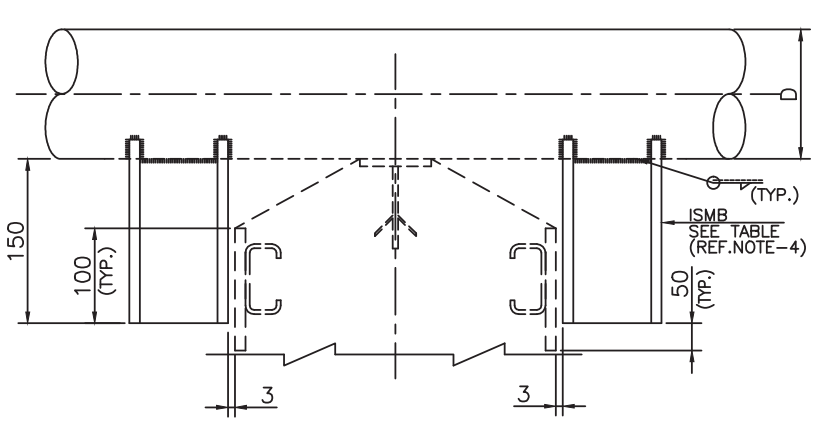
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

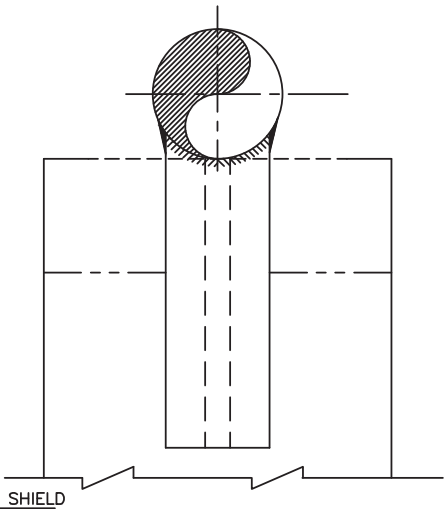
GUIDE SUPPORT FOR BARE (AS/SS) PIPE
SIZE 1/2" THRU 24" TYPE G3 & G3A

Standard Number	Rev.
03–PS–010	4
Sheet 1of 1	

AUTOCAD

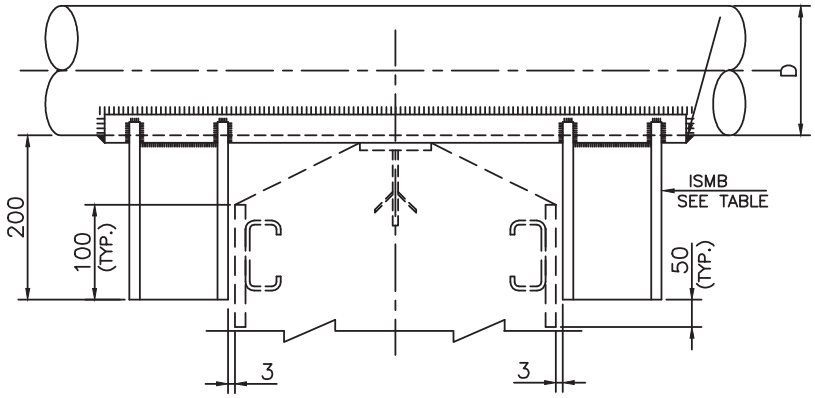
D(INCH.)	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
I BEAM	ISA-50 x10t	ISA-50 x10t	ISMB-100		ISMB-150				ISMB-200		ISMB-250	

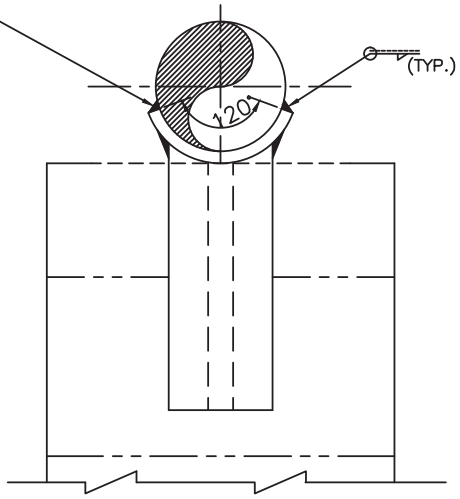




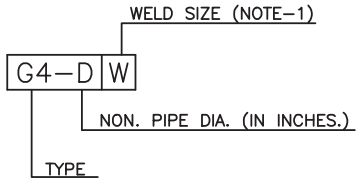
FOR PIPE SIZE 8" THRU 12"
(FOR PIPE-SIZE 2" TO 6" REFER NOTE-4)
(NOTE-2,3)

PROTECTION SHIELD
(NOTE-3)





FOR PIPE-SIZE 14" THRU 24"



SYMBOL

MAXIMUM ALLOWABLE LOAD ON FILLET-WELD OF RESTRAINT (KG/CM)					
WELD SIZE (MM)	TEMPERATURE (IN DEG.C)				
	200	250	300	350	400
6	340	250	220	200	170
8	450	340	300	270	220
10	560	420	370	330	280

NOTE:-

1. LOADS ON FILLET OF CROSS-GUIDE SHALL BE LIMITED TO THE VALUE TABULATED ABOVE AGAINST VARIOUS TEMPERATURES, FOR THE RESPECTIVE WELD-SIZE, FOR RUNNING LENGTH OF WELD. LOADS MAY BE INTERPOLATED FOR INTERMEDIATE TEMPERATURES.
2. FOR A.S. AND S.S. LINES, FOR SIZES 2" THRU 12", PROTECTION-SHIELD AS PER NOTE-3 IS TO BE PROVIDED.
3. PROTECTION-SHIELD SHALL BE CUT FROM LINE-PIPE OR ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION-SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS.
4. FOR SUPPORTING DETAILS FOR PIPE-SIZE 2" THRU 6".

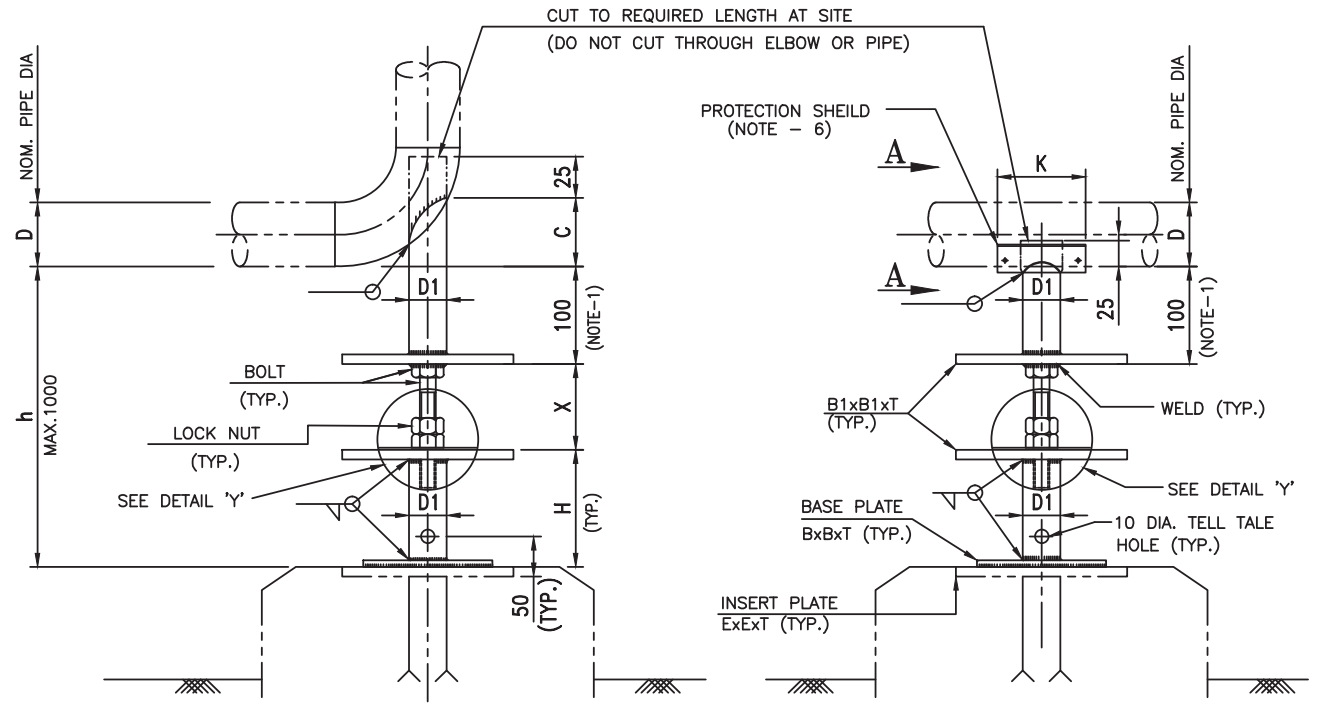
Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	SUD	DEP	SHR/BN
0	08-10-93	ISSUED AS STANDARD	SDM	AKR	KPS

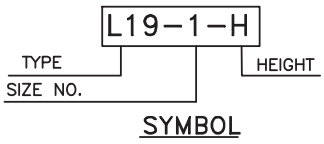
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

CROSS GUIDE FOR BARE PIPE
SIZE 2" THRU 24"
TYPE -G4 (FOR OFFSITE)

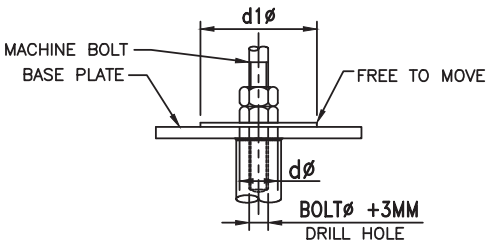
Standard Number	Rev.
03-PS-112	4
Sheet 1of 1	

AUTOCAD

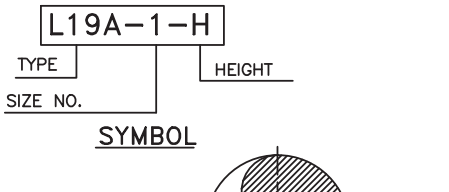




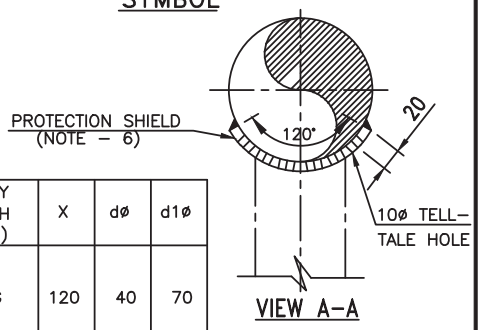
SYMBOL



DETAIL-Y



SYMBOL



VIEW A-A

SIZE NO.	D	D1 (NOTE-3)	B1	B	E	T	K	C	HEX.HEADED FULLY THREADED BOLT WITH TWO NUTS(NOTE-3)	X	dø	d1ø
1.	2"	2" SCH. 40	80	150	170	10	160	70	1.25" x 6.0" LONG	120	40	70
	3"							115				
2.	4"	3" SCH. 40	110	200	220	10	190	137				
	6"							174				
3.	8"	4" SCH. 40	135	200	220	12	215	205	1.5" x 6.0" LONG	140	46	90
	10"							262				
	12"							287				
4.	14"	6" SCH. 40	190	250	270	12	270	388	1.625" x 6.0" LONG	150	50	100
	16"							418				
5.	18"	8" SCH. 40	240	300	320	12	320	454				
6.	20"	10" SCH. 40	295	350	370	12	375	554	1.875" x 8.0" LONG	160	56	110
	24"							615				

INSTALLATION PROCEDURE:-

PLACE SUPPORT UNDER PIPE BEFORE CONNECTING PIPE TO EQUIPMENT.
TURN ADJUSTING NUT UNTIL PIPE FLANGE IS ALIGNED WITH EQUIPMENT OR VALVE FLANGE.

NOTE:-

1. ALL PLATES SHALL BE CARBON STEEL. THE STUB PIPE MATERIAL SHALL BE EQUIVALENT TO THAT OF LINE PIPE AND THE LOWER SUPPORT PIPE SHALL BE CARBON STEEL.
2. IN CASE SIZE AND/OR SCHEDULE OF SUPPORT PIPE (D1) LISTED IN THE TABLE BELOW IS NOT AVAILABLE. USE THE NEXT HIGHER SIZE AND/OR NEAREST HIGHER THICKNESS AVAILABLE.
3. MATERIALS FOR BOLTS AND NUTS SHALL BE TO A193 GR.B7 AND A194 GR.2H, OR TO A193 GR.B16 AND A194 GR.4, RESPECTIVELY.
4. DIMENSION 'C' IS TO BE MODIFIED IF OTHER THAN 1.5D RADIUS ELBOW'S ARE USED.
5. IN CASE CALCULATED h EXCEEDS THE MAX. VALUE, PEDESTAL SHALL BE RAISED ACCORDINGLY.
6. PROTECTION SHIELD (LENGTH=Kmm) CUT FROM LINE-PIPE OR EQUIVALENT PLATE SHALL BE PROVIDED ON HORIZONTAL LINE AS FOLLOWS-

A. FOR 150# AND 300# CLASS PIPING
CS AND AS LINES-10" AND ABOVE
SS LINES -2" AND ABOVE

B. FOR 600# AND HIGHER CLASS PIPING
CS, AS AND SS LINES-10" AND ABOVE

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	SUD	DEP	SHR/BN
0	08-01-07	ISSUED AS STANDARD	SOB	NCS	BN

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

ADJUSTABLE LOW SUPPORT WITH GUIDE AND CROSS-GUIDE FOR BARE AND INSULATED PIPE SIZE 2" THRU 24" TYPE-L19 AND L19A

Standard Number	Rev.
03-PS-098	4
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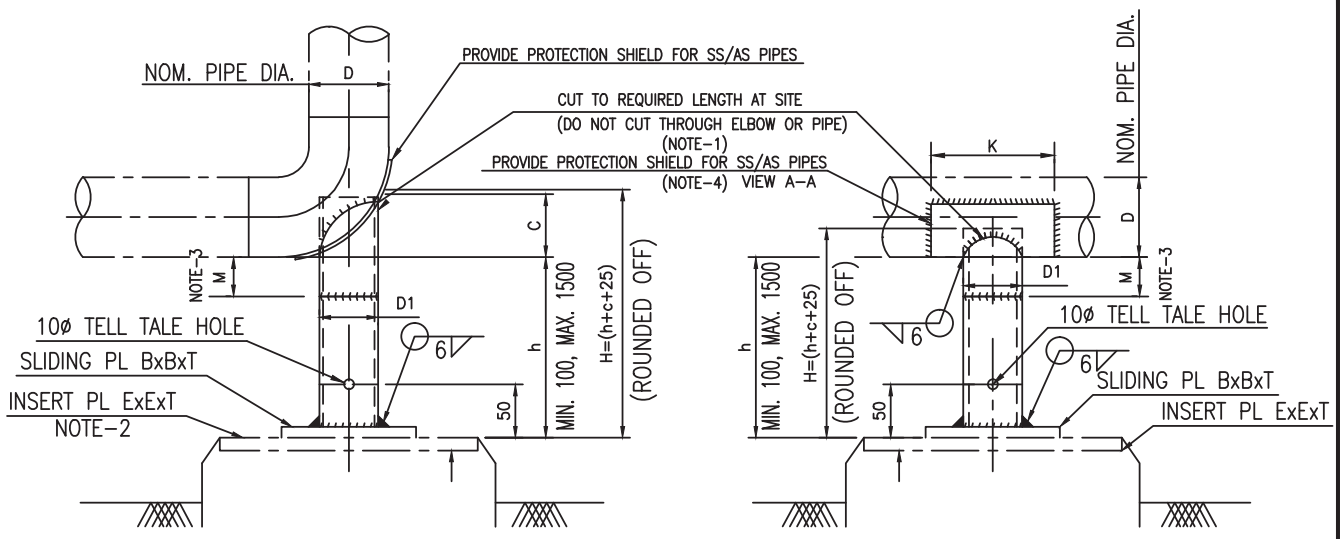
AUTOCAD



L1 – 1 – H/M

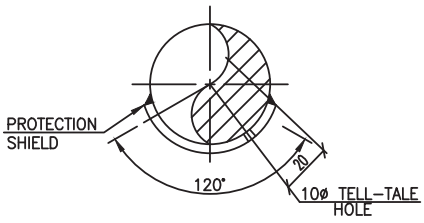
TYPE
SIZE NO.
LOCATION OF MATERIAL TRANSITION (NOTE-3)
HEIGHT

SYMBOL

L1A – 2 – H/M

TYPE
SIZE NO.
LOCATION OF MATERIAL TRANSITION (NOTE-3)
HEIGHT

SYMBOL



VIEW A-A

SIZE	D	D1(NOTE – 1)	B	T	C	E	K
1	2"	2" SCH 40/10S	150	10	70	250	150
	3"				115		
2	4"	3" SCH 40/10S	200	10	137	300	190
	6"				174		
3	8"	4" SCH 40/10S	200	12	205	300	215
	10"				262		
	12"				287		
4	14"	6" SCH 40/10S	250	12	388	350	270
	16"				418		
5	18"	8" SCH 40/10S	300	12	454	400	320
6	20"	10" SCH 40/10S	350	12	554	450	375
	24"				615		
7	26"	12" SCH 20/10S	400	16	675	500	425
	30"				800		
	36"				950		

NOTES:-

1. IN CASE SIZE AND / OR SCH. OF SUPPRT PIPE (D1) LISTED IN THE TABLE IS NOT AVAILABLE USE NEXT HIGHER SIZE AND / OR NEAREST EQUIVALENT THICKNESS AVAILABLE.
2. ALL PLATES CARBON STEEL.
3. DIMENSIONS "M" LOCATES THE POINT OF MATERIAL TRANSITION ON THE SUPPORT. THE STUB MATERIAL SHALL BE EQUIVALENT TO THAT LINE PIPE & LOWER SUPPORT PIPE SHALL BE CS.
   MIN. VALUE OF "M" SHALL BE
   "INSULATION THK.+25MM" OR WHEN h=500mm
   IN THAT CASE M=h.
4. PROTECTION SHIELD (LENGTH=KMM) CUT FROM LINE PIPE PIPE OR EQUIVALENT PLATE SHALL BE PROVIDED ON HORIZONTAL LINE AS FOLLOWS.
   A. FOR 150# AND 300# CLASS PIPING.
      CS AND AS LINES – 10" AND ABOVE.
      SS LINES – 2" AND ABOVE.
   B. FOR 600# AND HIGHER CLASS PIPING.
      CS, AS AND SS LINES – 10" AND ABOVE.
5. DIMENSION 'C' IS TO BE MODIFIED IF OTHER THAN 1.5D RADIUS ELBOWS ARE USED.
6. IN CASE CALCULATED h EXCEEDS THE MAX VALUE, PEDESTAL SHALL BE RAISED ACCORDINGLY.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUE FOR IMPLEMENTATION.	RCB	DEP	SHR/BN
0	30-08-91	ISSUED AS STANDARD	SDM	AKR	KPS

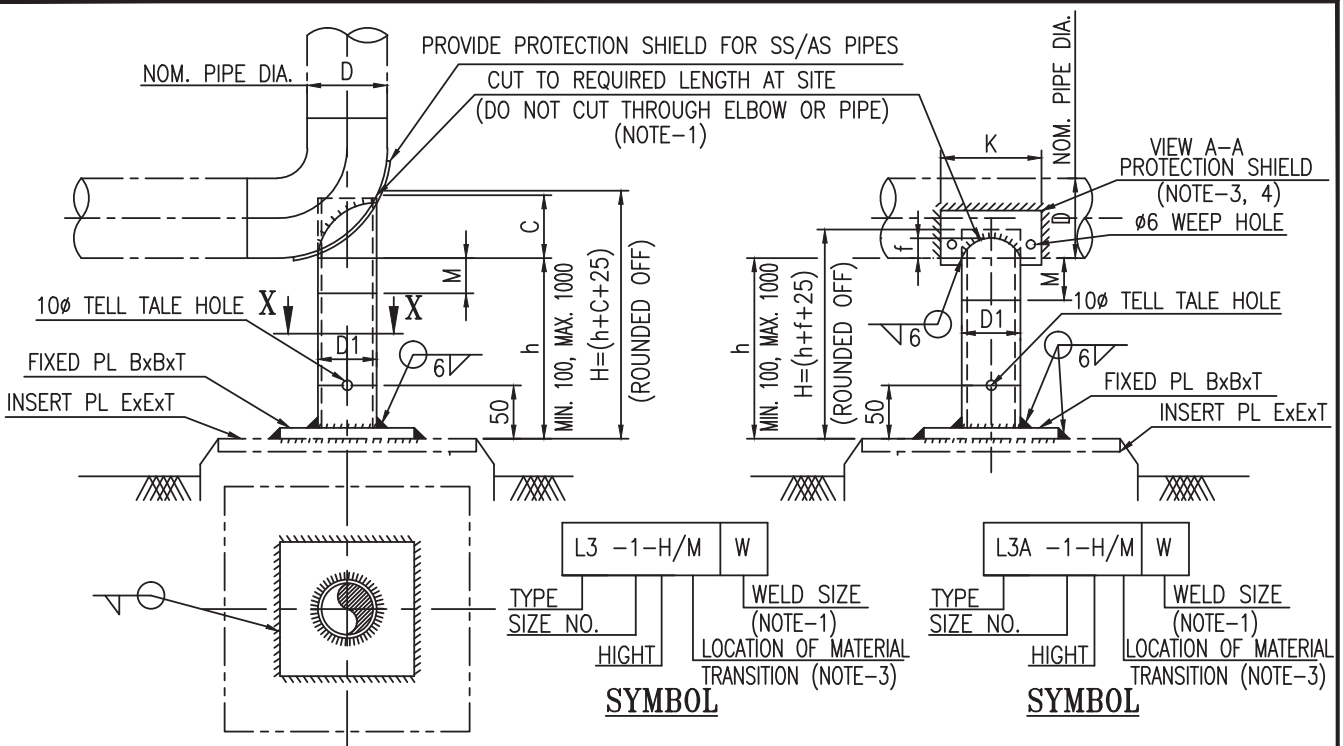
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

LOW SUPPORT SLIDING FOR BARE AND INSULATED PIPE SIZE 2" THRU 36" TYPE-L1 AND L1A

Standard Number: 03-PS-016 | Rev.: 4

Sheet 1of 1

AUTOCAD



VIEW X-X

L3 -1-H/M | W

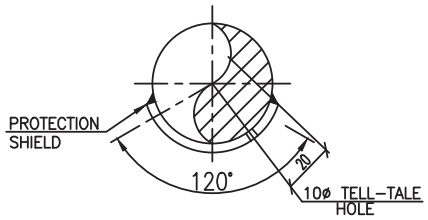
TYPE
SIZE NO.
HIGHT
WELD SIZE (NOTE-1)
LOCATION OF MATERIAL TRANSITION (NOTE-3)

SYMBOL

L3A -1-H/M | W

TYPE
SIZE NO.
HIGHT
WELD SIZE (NOTE-1)
LOCATION OF MATERIAL TRANSITION (NOTE-3)

SYMBOL



VIEW A-A

SIZE	D	D1(NOTE - 1)	B	T	C	E	K
1	2"	2" SCH 40/10S	150	10	70	250	150
	3"				115		
2	4"	3" SCH 40/10S	200	10	137	300	190
	6"				174		
3	8"	4" SCH 40/10S	200	12	205	300	215
	10"				262		
	12"				287		
4	14"	6" SCH 40/10S	250	12	388	350	270
	16"				418		
5	18"	8" SCH 40/10S	300	12	454	400	320
6	20"	10" SCH 40/10S	350	12	554	450	375
	24"				615		
7	26"	12" SCH 20/10S	400	16	675	500	425
	30"				800		
36"	36"				950		

MAXIMUM ALLOWABLE LOAD ON FILLET -WELD (KG/CM)				
WELD SIZE (MM) W	LINE DESIGN TEMP. (IN DEG.C)			
	200	250	300	350
6	340	250	220	200
8	450	340	300	370
10	560	420	370	330

NOTES:-

1. IN CASE SIZE AND / OR SCH. OF SUPPRT PIPE (D1) LISTED IN THE TABLE IS NOT AVAILABLE USE NEXT HIGHER SIZE AND / OR NEAREST EQUIVALENT THICKNESS AVAILABLE.
2. ALL PLATES CARBON STEEL.
3. DIMENSIONS "M" LOCATES THE POINT OF MATERIAL TRANSITION ON THE SUPPORT. THE STUB MATERIAL SHALL BE EQUIVALENT TO THAT LINE PIPE & LOWER SUPPORT PIPE SHALL BE CS.
   MIN. VALUE OF "M" SHALL BE
   "INSULATION THK.+25MM" OR WHEN h=500mm
   IN THAT CASE M=h.
4. PROTECTION SHIELD (LENGTH=KMM) CUT FROM LINE PIPE PIPE OR EQUIVALENT PLATE SHALL BE PROVIDED ON HORIZONTAL LINE AS FOLLOWS.
   A. FOR 150# AND 300# CLASS PIPING.
      CS AND AS LINES - 10" AND ABOVE.
      SS LINES - 2" AND ABOVE.
   B. FOR 600# AND HIGHER CLASS PIPING.
      CS, AS AND SS LINES - 10" AND ABOVE.
5. DIMENSION 'C' IS TO BE MODIFIED IF OTHER THAN 1.5D RADIUS ELBOWS ARE USED.
6. IN CASE CALCULATED h EXCEEDS THE MAX VALUE, PEDESTAL SHALL BE RAISED ACCORDINGLY.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	20-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	PK	DEP	SHR/BN
0	30-8-91	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

LOW SUPPORT FIXED FOR BARE AND INSULATED PIPE SIZE 2" THRU 24" TYPE-L3 AND L3A

Standard Number	Rev.
03-PS-017	4
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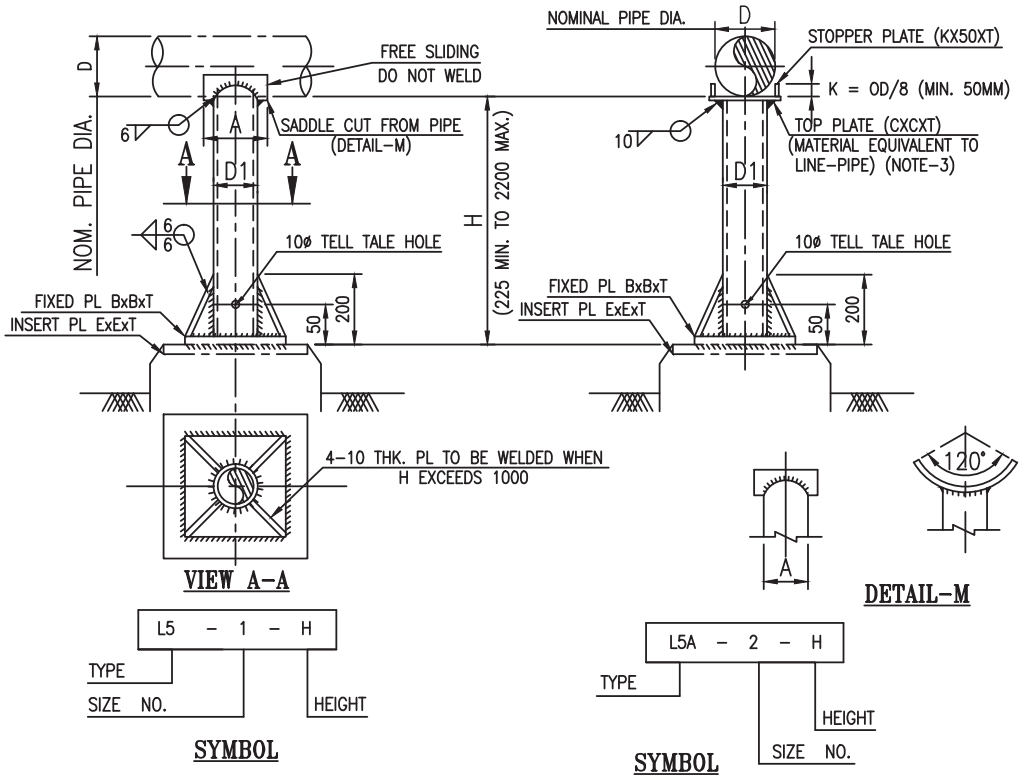
AUTOCAD



L5 – 1 – H
TYPE
SIZE NO.
HEIGHT

SYMBOL

L5A – 2 – H
TYPE
HEIGHT
SIZE NO.

SYMBOL

NOTES:-

1. IN CASE SIZE AND / OR SCH. OF SUPPRT PIPE (D1) LISTED IN THE TABLE IS NOT AVAILABLE USE NEXT HIGHER SIZE AND / OR NEAREST EQUIVALENT THICKNESS AVAILABLE.
2. SUPPORT PIPE AND PLATE MATERIAL SHALL BE CARBON STEEL, UNLESS SPECIFIED OTHERWISE.
3. FOR L5A TYPE, PROTECTION-SHIELD CUT FROM LINE-PIPE, FOR PIPE-SIZES 14"NB AND ABOVE., SHALL BE PROVIDED. IN SUCH CASES TOP-PLATE SHALL BE OF CARBON-STEEL.
4. IN CASE CALCULATED H EXCEEDS THE MAXIMUM VALUE, PEDESTAL SHALL BE RAISED ACCORDINGLY.

SIZE	D	A	D1(NOTE – 1)	C	B	E	T
1	3/4"	2" NB X 100 LG.	2" HEAVY IS : 1239 (OR EQUIVALENT)	150	150	200	12
	1"						
	1½"	3" NB X 100 LG.		200			
	2'						
2	3"	6" NB X 150 LG.	2" HEAVY IS : 1239 (OR EQUIVALENT)	200	150	200	12
	4"						
3	6"	10" NB X 250 LG.	3" HEAVY IS : 1239 (OR EQUIVALENT)	300	200	250	16
	8"						
4	10"	14" NB X 350 LG.	4" HEAVY IS : 1239 (OR EQUIVALENT)	350	200	250	16
	12'						
5	14"	18" NB X 350 LG.	6" HEAVY IS : 1239 (OR EQUIVALENT)	400	250	300	20
	16'						
6	18"	20" NB X 350 LG.	8" SCH.40	400	300	350	20
7	20"	24" NB X 350 LG.	10" SCH.40	450	350	400	20
	24"						
8	26"	30" NB X 350 LG.	12" SCH.40	550	400	500	20
	30"						
	36"	36" NB X 400 LG.					

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	20-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	PK	DEP	SHR/BN
0	30-08-91	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

LOW SUPPORT SLIDING FOR BARE PIPE SIZE 3/4" THRU 36" TYPE-L5 AND L5A

Standard Number	Rev.
03-PS-018	4
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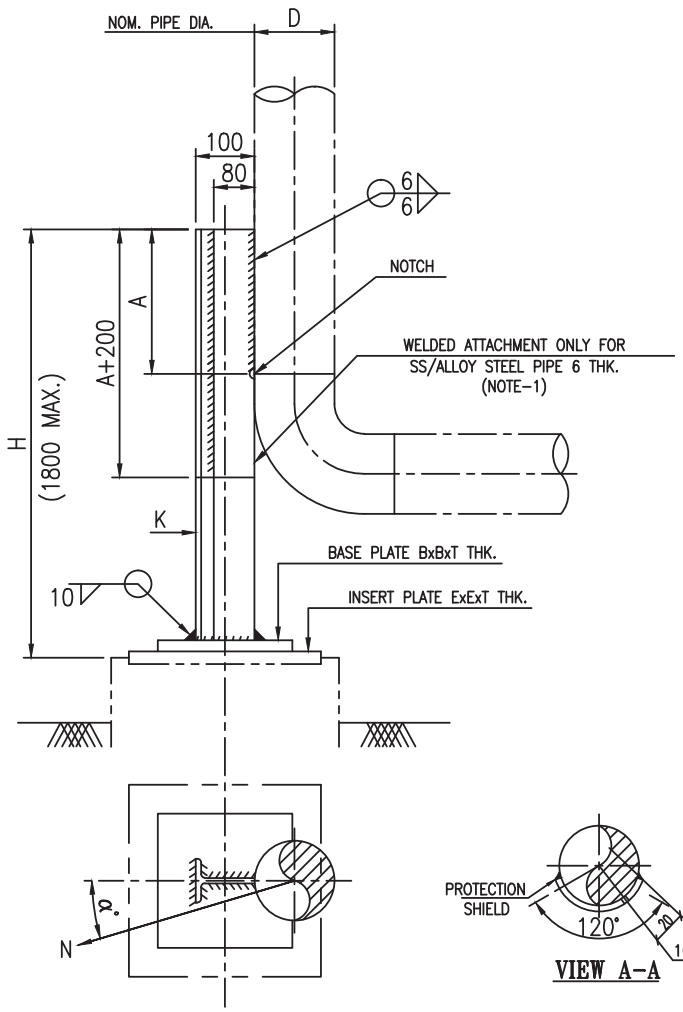
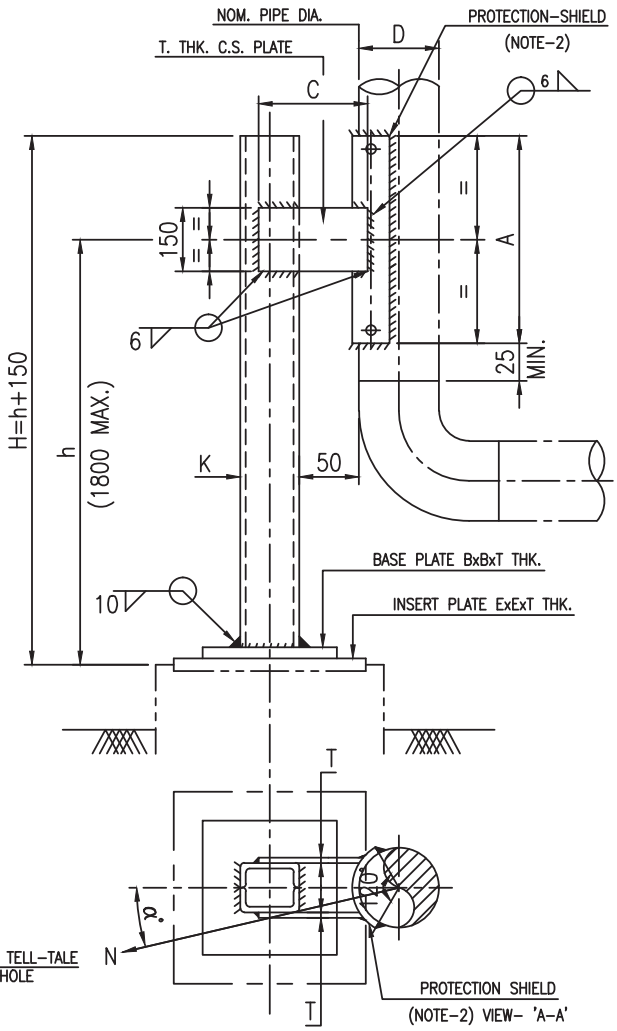
AUTOCAD



FOR PIPE SIZES 2" THRU 4"

VIEW A-A



FOR PIPE SIZES 6" THRU 24"

SIZE NO.	D	K (OR EQUIVALENT)	A	T	C	E	B
1	2" TO 4"	CUT FROM ISMB 200	200	10	–	250	150
2	6" TO 10"	ISMC_125 2 NOS.	200	12	150	300	200
3	12" TO 24"	ISMC_225 2 NOS.	300	12	230	400	300
	26" TO 36"			16			

FOR TEMP. UP TO 400 °C ONLY

$\alpha^\circ =$ L6 – 2 – H

TYPE

SIZE NO.

HEIGHT

SYMBOL

NOTES:–

1. WELDED ATTACHMENT (6MM THICK) REQUIRED ONLY IN CASE OF STAINLESS –STEEL/ALLOY–STEEL LINE–PIPE. MATERIAL OF WELDED ATTACHMENT SHALL BE EQUIVALENT TO PIPE MATERIAL.
2. PROTECTION SHIELD SHALL BE CUT FROM LINE–PIPE OR EQUIVALENT PLATE.
3. FOR LINE–TEMPERATURES UPTO 343°C CONNECTING PLATE SHALL BE CARBON STEEL(C.S). FOR HIGHER TEMPERATURES IT SHALL BE EQUIVALENT TO THAT OF LINE–PIPE.
4. IN CASE CALCULATED H/h EXCEEDS THE MAXIMUM VALUE, PEDESTAL SHALL BE RAISED ACCORDINGLY.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	20–04–18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	AJW	DEP	SHR/BN
0	21–05–93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

LOW SUPPORT SLIDING
FOR BARE AND INSULATED PIPE
SIZE 2" THRU 36" TYPE–L6

Standard Number: 03–PS–019 | Rev.: 4

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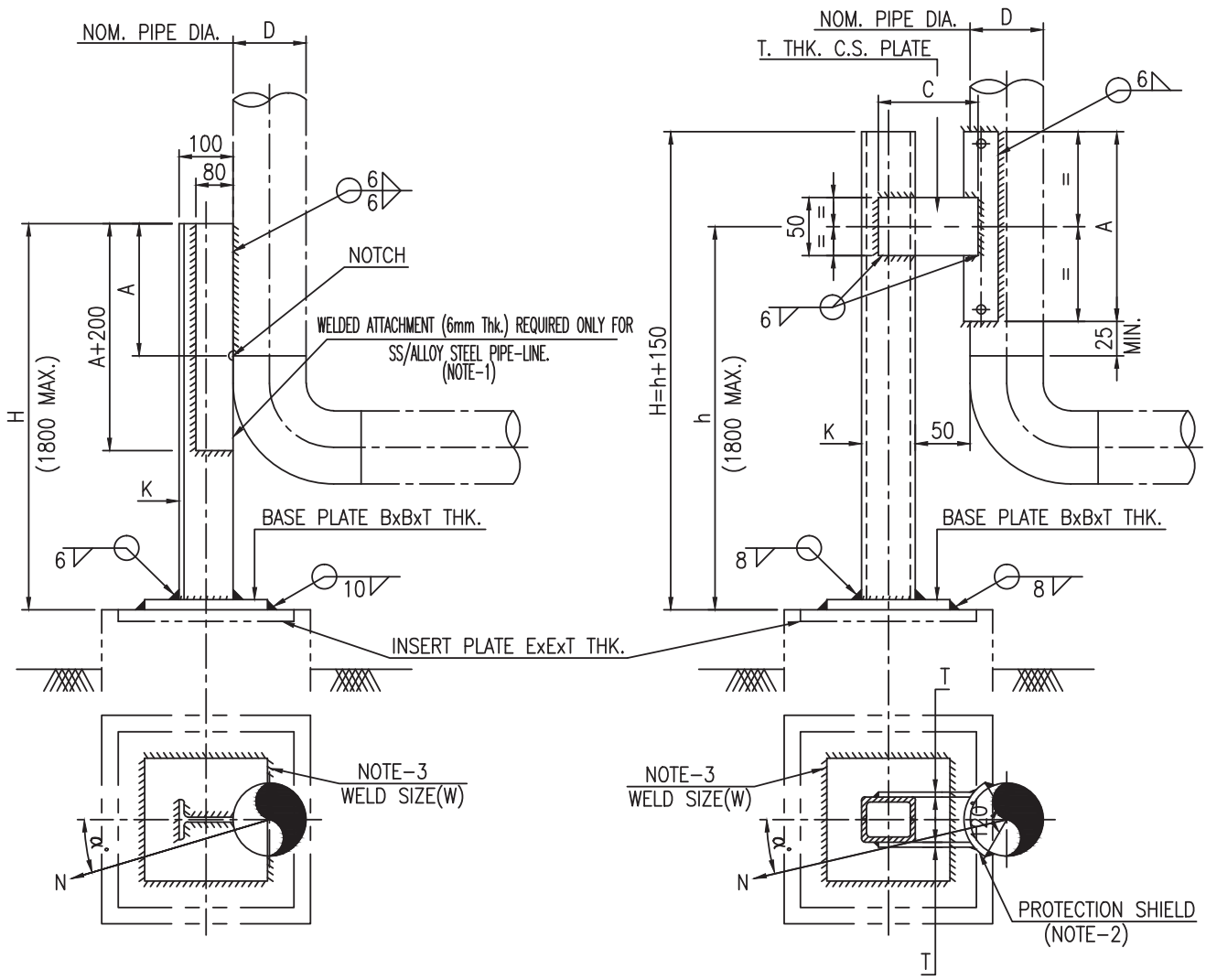
AUTOCAD



FOR PIPE SIZES 2" THRU 4"

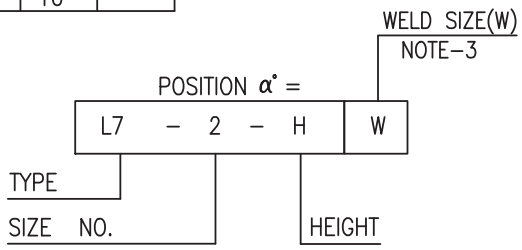
FOR PIPE SIZES 6" THRU 36"

SIZE NO.	D	K	A	E	C	T	B
1	2" TO 4"	CUT FROM ISMB 200 *	200	200	–	10	150
2	6" TO 10"	ISMC 125 2 NOS. *	200	250	150	12	200
3	12" TO 24" / 26" TO 36"	ISMC 250 2 NOS. *	300	350	230	12 / 16	300

NOTES:-

1. MATERIAL FOR WELDED ATTACHMENT IS EQUIVALENT TO PIPE MATERIAL IN CASE OF SS/AS PIPE.
2. PROTECTION SHIELD SHALL BE CUT FROM LINE PIPE OR EQUIVALENT.
3. LOAD ON FILLET WELDS ON BASE/INSERT PLATE SHALL BE LIMITED TO THE VALVE TABULATED UNDER 03-PS-017.
4. (*) OR EQUIVALENT.

SYMBOL



Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RP	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

LOW SUPPORT FIXED FOR BARE AND INSULATED PIPE SIZE 2" THRU 36" TYPE-L7

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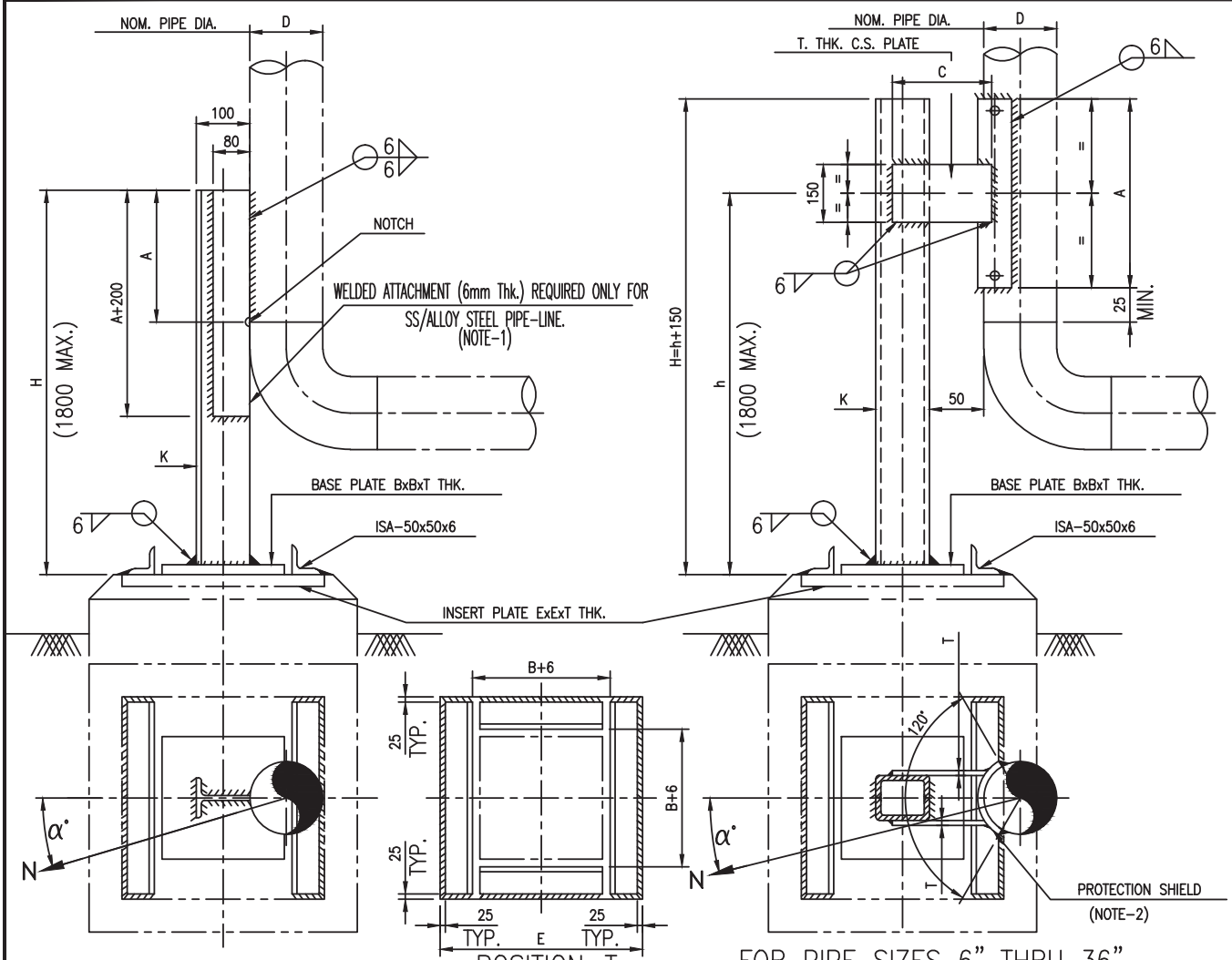
AUTOCAD



FOR PIPE SIZES 2" THRU 4"

POSITION–T (THREE DIRECTIONAL STOP)

FOR PIPE SIZES 6" THRU 36"

WELD SIZE(W) NOTE-3

POSITION α° =

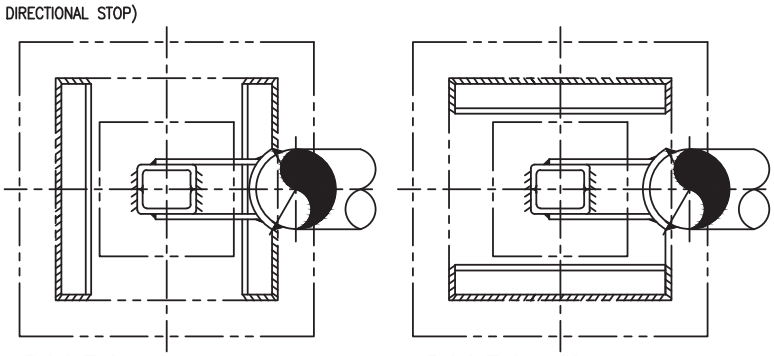
L7A	–	2	–	H	W

TYPE

SIZE NO.

HEIGHT

SYMBOL



POSITION–N (CROSS GUIDE)

POSITION–S (GUIDE)

NOTES:–

1. MATERIAL FOR WELDED ATTACHMENT TO BE EQUIVALENT TO PIPE MATERIAL IN CASE OF SS/AS PIPE.
2. PROTECTION SHIELD SHALL BE CUT FROM LINE PIPE OR EQUIVALENT (*).
3. LOAD ON FILLET WELDS ON BASE/INSERT PLATE SHALL BE LIMITED TO THE VALVE TABULATED UNDER 03–PS–017.
4. (*) OR EQUIVALENT.

SIZE NO.	D	K	A	E	C	T	B
1	2" TO 4"	CUT FROM ISMB 200 *	200	306	–	10	150
2	6" TO 10"	ISMC 125 2 NOS. *	200	406	150	12	200
3	12" TO 24" / 26" TO 36"	ISMC 250 2 NOS. *	300	506	230	12 / 16	300

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10–04–18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RP	DEP	SHR/BN
0	21–05–93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

LOW SUPPORT RESTRAINED FOR BARE AND INSULATED PIPE SIZE 2" THRU 36" TYPE–L7A

Standard Number	Rev.
03–PS–021	4
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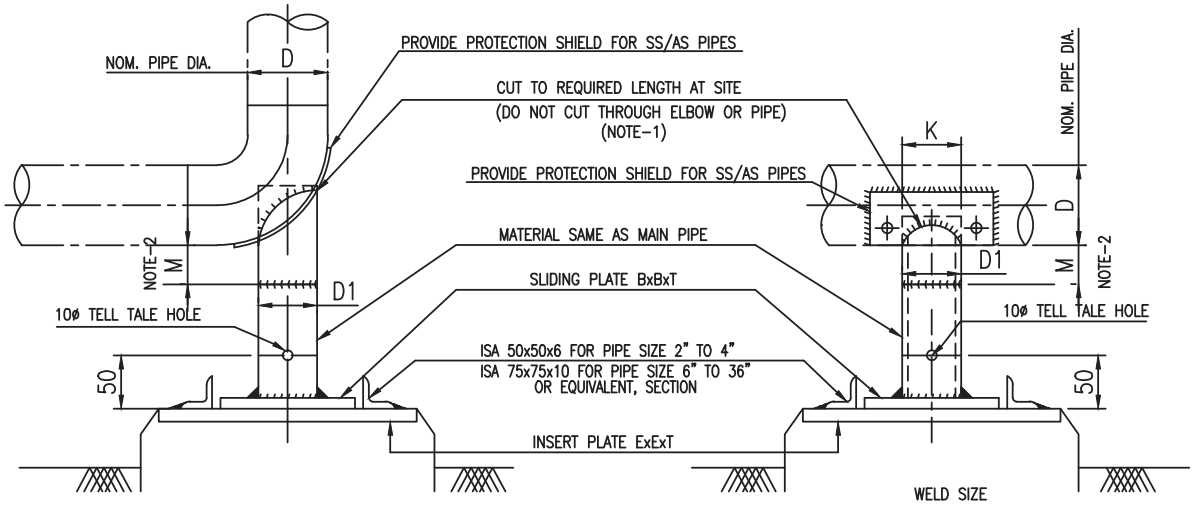
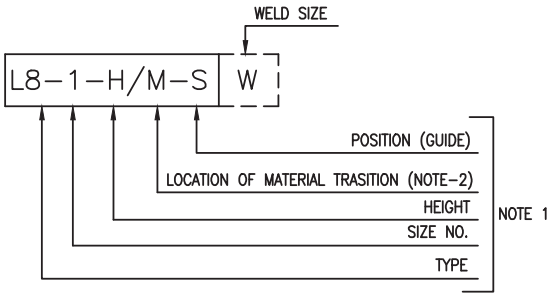
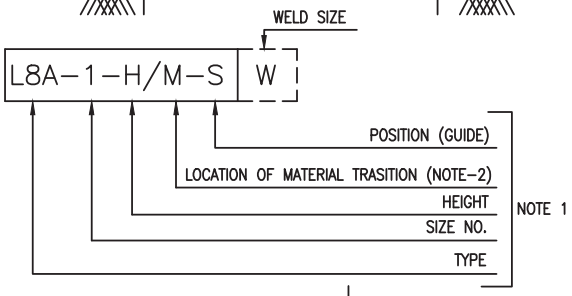
AUTOCAD





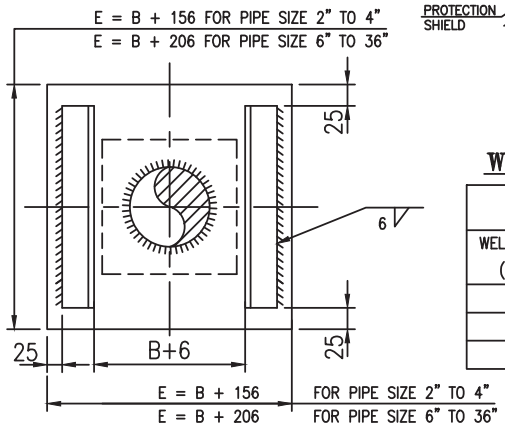
SYMBOL

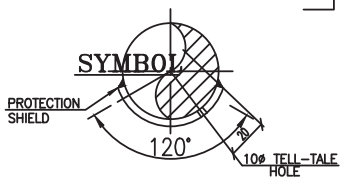


SYMBOL

NOTES:-

1. FOR SIZE NOS., DIMENSION TABLE AND NOTES REFER 03-PS-016.
2. DIMENSIONS "M" LOCATES THE POINT OF MATERIAL TRANSITION ON THE SUPPORT. THE STUB MATERIAL SHALL BE EQUIVALENT TO THAT OF LINE PIPE & LOWER SUPPORT PIPE SHALL BE CS.
   MIN. VALUE OF "M" SHALL BE "INSULATION THK.+25MM" OR WHEN h=500mm IN THAT CASE M=h.

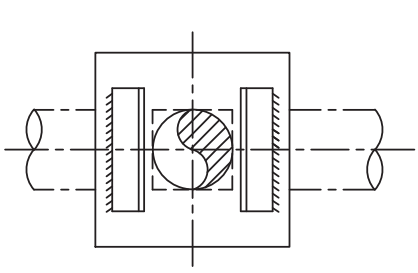




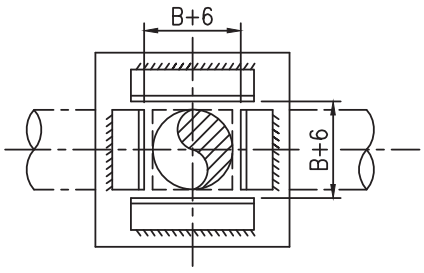
VIEW A-A

WELD SIZE

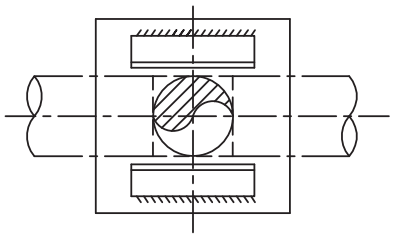
MAXIMUM ALLOWABLE LOAD ON FILLET-WELD OF RESTRAINT (KG/CM)				
WELD SIZE (MM)	TEMPERATURE (IN DEG.C)			
	200	250	300	350
6	340	250	220	200
8	450	340	300	270
10	560	420	370	330



POSITION-N
(CROSS GUIDE)



POSITION-T
(THREE DIRECTIONAL STOP)

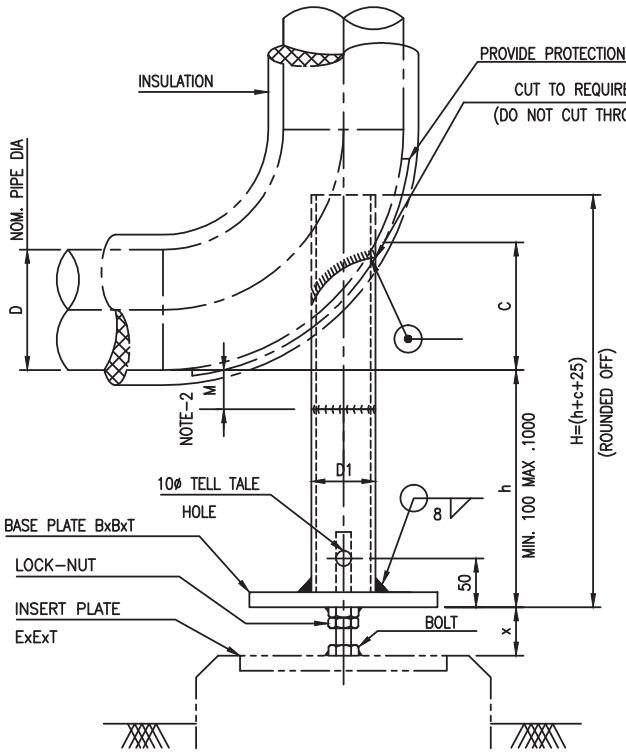


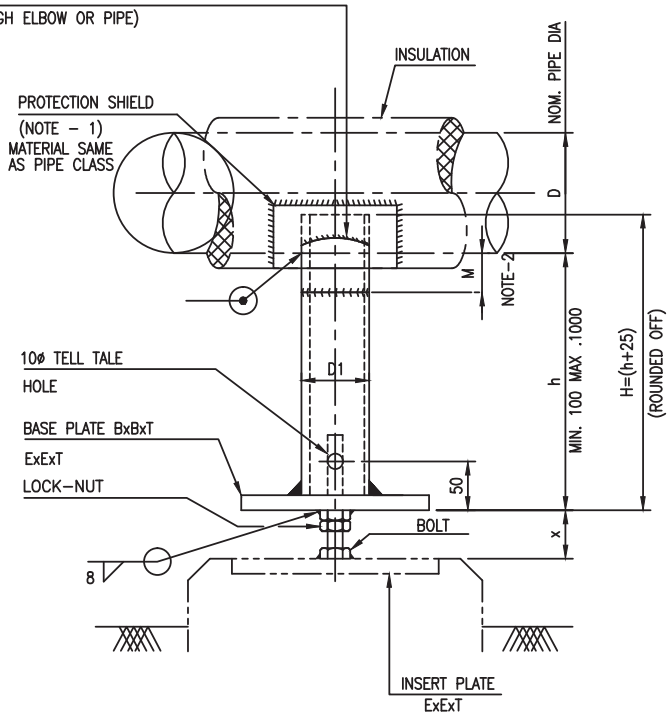
POSITION -S
(GUIDE)

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RCB	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	LOW SUPPORT GUIDE & CROSS GUIDE FOR BARE & INSULATED PIPE SIZE 2" THRU 36" TYPE-L8 AND L8A	Standard Number	Rev.
		03-PS-022	4
		Sheet 1of 1	

AUTOCAD





L10 - 1 - H

TYPE | SIZE NO. | HEIGHT

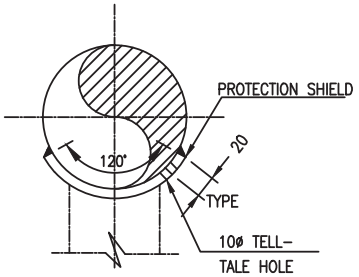
SYMBOL

L10A - 1 - H

TYPE | SIZE NO. | HEIGHT

SYMBOL

SIZE NO.	D	D1(NOTE - 1)	B	E	T	C	HEX. BOLT FULLY THREADED WITH TWO NUT	X
1	2"	2" SCH 40	150	150	10	70	M - 30 x 150 LONG	120
	3"					115		
2	4"	3" SCH 40	200	200	10	137	M - 30 x 150 LONG	
	6"					174		
3	8"	4" SCH 40	200	200	12	205	M - 39 x 175 LONG	140
	10"					262		
	12"					287		
4	14"	6" SCH 40	250	250	12	388	M - 42 x 175 LONG	150
	16"					418		
5	18"	8" SCH 40	300	300	12	454		
6	20"	10" SCH 40	350	350	12	554	M - 48 x 200 LONG	170
	24"					615		



PROTECTION SHIELD

NOTES:-

1. IN CASE SIZE AND / OR SCH, OF SUPPRT PIPE (D1) LISTED IN THE TABLE IS NOT AVAILABLE USE NEXT HIGHER SIZE AND / OR NEAREST EQUIVALENT THICKNESS AVAILABLE.
2. DIMENSIONS "M" LOCATES THE POINT OF MATERIAL TRANSITION ON THE SUPPORT. THE STUB MATERIAL SHALL BE SHALL BE EQUIVALENT TO THAT OF LINE PIPE & LOWER SUPPORT PIPE SHALL BE CS. MIN. VALUE OF "M" SHALL BE "INSULATION THK.+25MM OR WHEN h=500mm IN THAT CASE M=h.
3. BOLTS & NUTS MATERIAL SHALL BE TO A193 GR. B7 & A194 GR. 2H OR TO BE A193 GR. B16 & A194 GR.4 & RESPECTIVELY.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RCB	DEP	SHR/BN
0	15-02-92	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

ADJUSTABLE LOW SUPPORT SLIDING FOR PIPE SIZE 2" THRU 24" TYPE L10 & L10A

Standard Number	Rev.
03-PS-023	4
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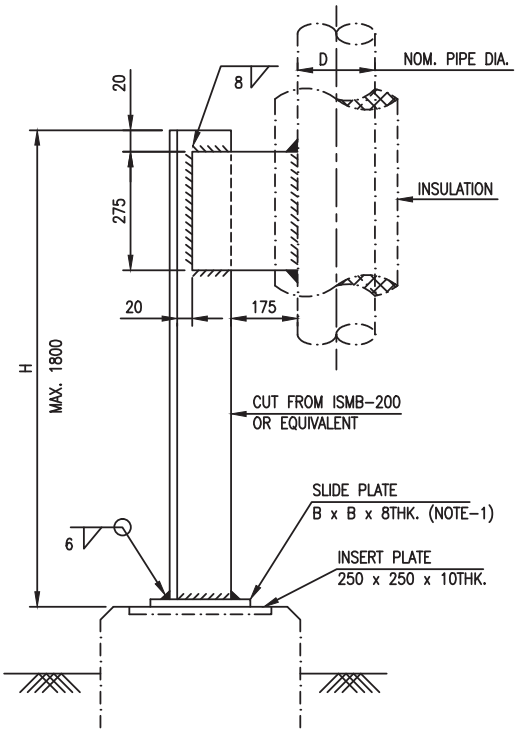
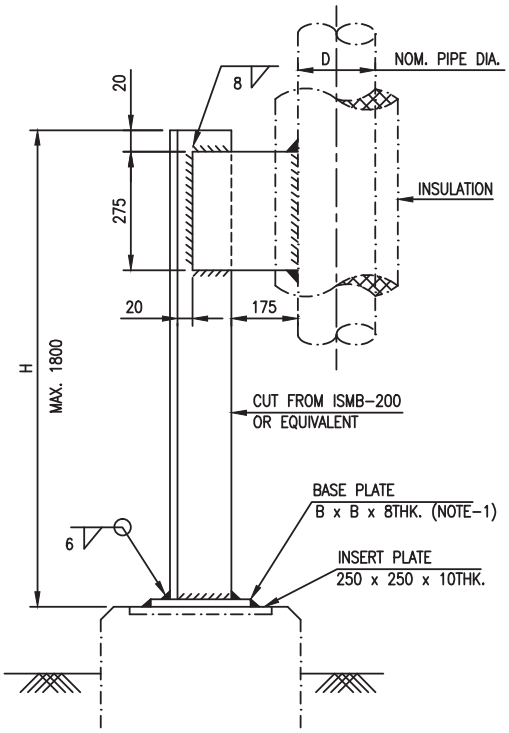
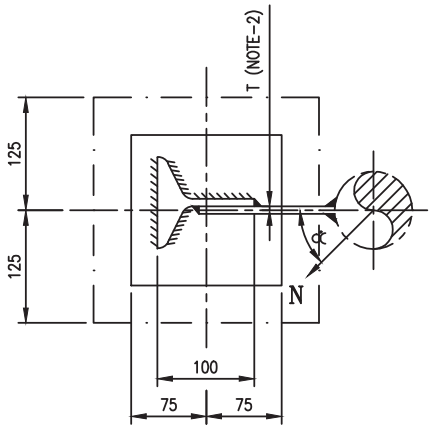
AUTOCAD

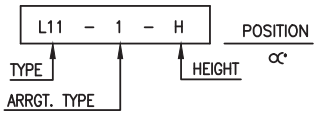


ARRANGEMENT
TYPE-1(SLIDING)



ARRANGEMENT
TYPE-2(FIXED)
(NOTE-3)





SYMBOL

MAXIMUM ALLOWABLE LOAD ON FILLET-WELD OF RESTRAINT (KG/CM)				
WELD SIZE (MM) W	TEMPERATURE (IN DEG.C)			
	200	250	300	350
6	340	250	220	200
8	450	340	300	270
10	560	420	370	330

NOTES:-

1. DIMENSION 'B' SHALL BE 150MM FOR LINE-PIPE SIZE UPTO 4"NB & 200MM FOR 6"NB
2. FOR LINE TEMPERATURES UPTO 343°C MATERIAL FOR WELD ATTACHMENT SHALL BE C.S. FOR HIGHER TEMP. IT SHALL BE EQUIVALENT TO PIPE MATERIAL. THICKNESS, "T" SHALL BE 10MM FOR CS LINE PIPE SIZE UPTO 4"NB & 12MM FOR 6"NB. FOR SS & AS LINE PIPE "T" SHALL BE 6MM.
3. LOADS ON FILLET WELD ON BASE/INSERT PLATES SHALL BE LIMITED TO THE VALUES TABULATED ABOVE AGAINST VARIOUS TEMPERATURES FOR THE RESPECTIVE WELD-SIZE, FOR RUNNING LENGTH OF WELD. LOADS MAY BE INTERPOLATED FOR INTERMEDIATE TEMPERATURE. WELD SIZE SHALL BE DEEMED 6MM, UNLESS SPECIFIED OTHERWISE.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	NRK	DEP	SHR/BN
0	30-08-91	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

LOW SUPPORT SLIDING &
FIXED FOR PIPE SIZE
2" THRU 6" TYPE- L11

Standard Number	Rev.
03-PS-024	4
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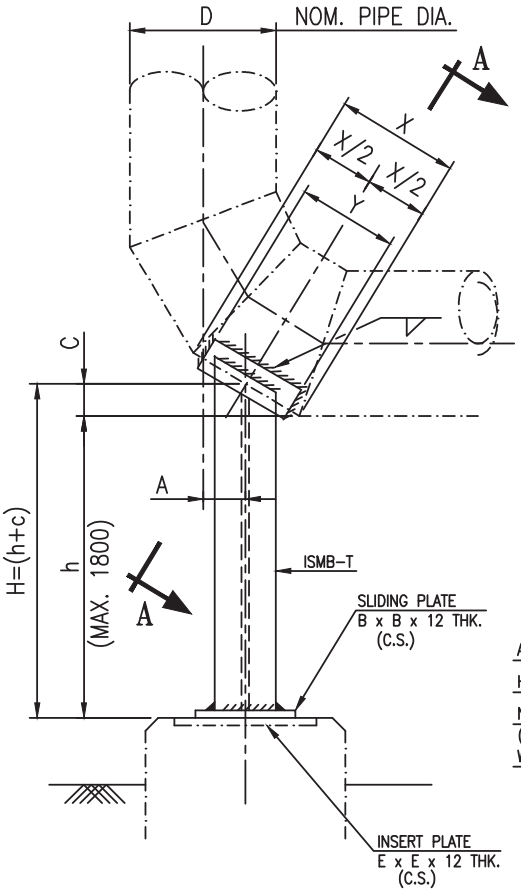
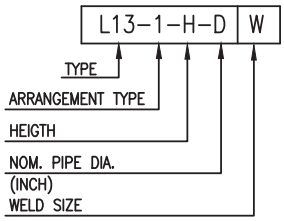
AUTOCAD

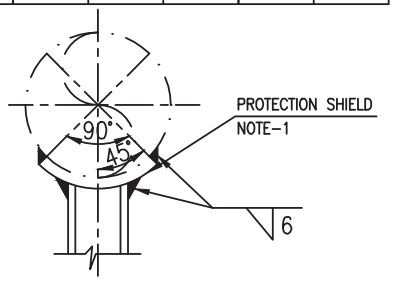
D	A	C	X	Y	T	B	E
14"	177	95	382	300	200	250	300
16"	204	109	435				
18"	229	122	490				
20"	253	136	546	350	250	300	350
22"	278	150	600				
24"	304	164	654				
26"	330	177	708	300	250	300	350
30"	380	205	818				
32"	407	218	870	400	300	350	400
36"	456	246	982				



ARRANGEMENT TYPE-1
(SLIDING)



SYMBOL



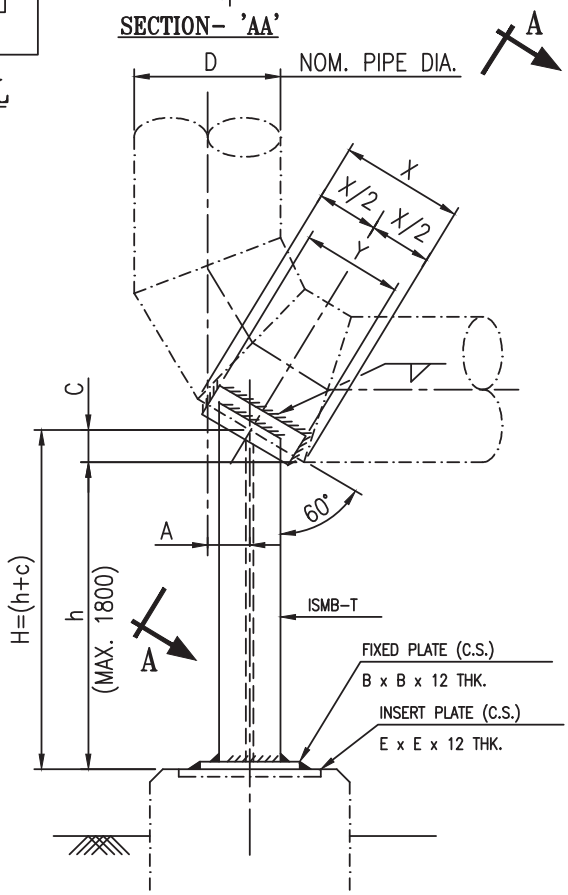
SECTION- 'AA'

MAXIMUM ALLOWABLE LOAD ON FILLET -WELD (KG/CM)				
WELD SIZE (MM) W	LINE DESIGN TEMP. (IN DEG.C)			
	200	250	300	350
6	340	250	220	200
8	450	340	300	370
10	560	420	370	330

NOTES:-

1. PROTECTION SHIELD SHALL BE CUT FROM LINE PIPE OR EQUIVALENT PLATE.
2. IN CASE CALCULATED h EXCEEDS THE MAXIMUM VALUE, PEDESTAL SHALL BE RAISED ACCORDINGLY.
3. LOADS ON FILLET WELDS ON BASE/INSERT PLATE SHALL BE LIMITED TO THE VALUES TABULATED ABOVE AGAINST VARIOUS TEMPERATURES, FOR THE RESPECTIVE WELD-SIZE, FOR RUNNING LENGTH OF WELD. LOADS MAY BE INTERPOLATED FOR INTERMEDIATE TEMPERATURES. WELD SIZE SHALL BE DEEMED 6MM, UNLESS SPECIFIED OTHERWISE.

MAX. LOAD: 2000 Kg.
MAX. MOMENT : 600 Kg. M. (FOR ARRGT. TYPE-2 ONLY)



ARRANGEMENT TYPE-2
(FIXED)

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	20-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	AJW	DEP	SHR/BN
0	22-06-92	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

LOW SUPPORT ON MITERED ELBOW FOR PIPE SIZE 14" THRU 36" TYPE- L13

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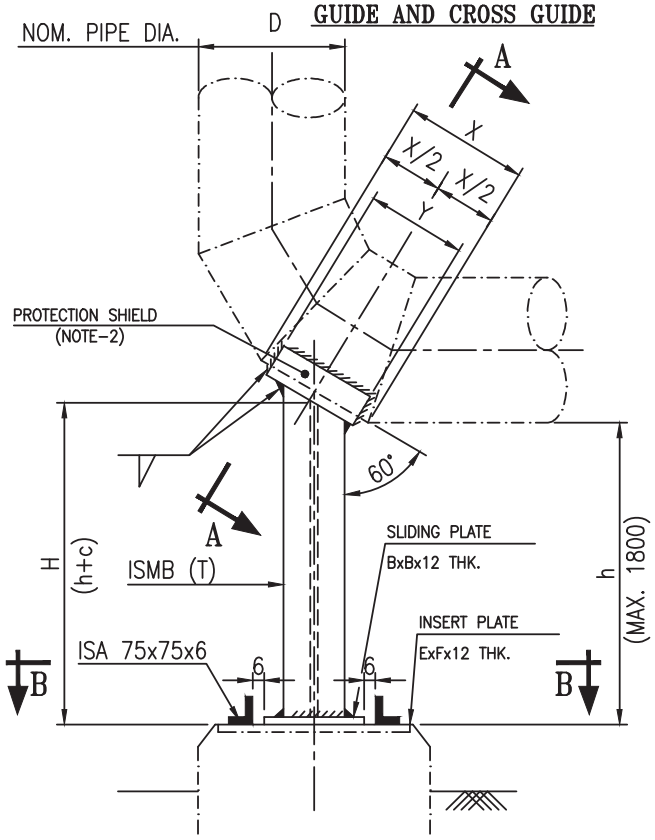
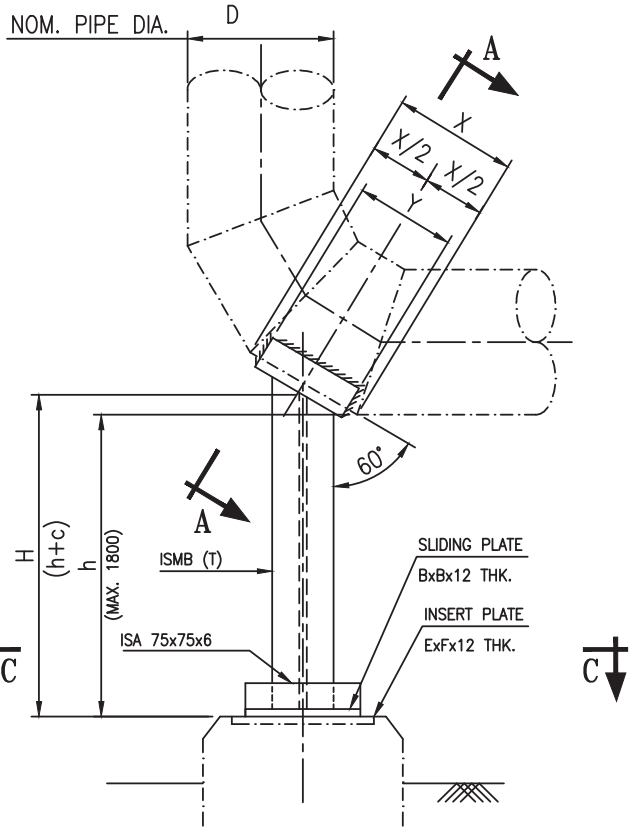
AUTOCAD

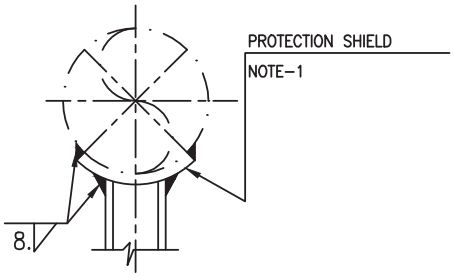
GUIDE AND CROSS GUIDE



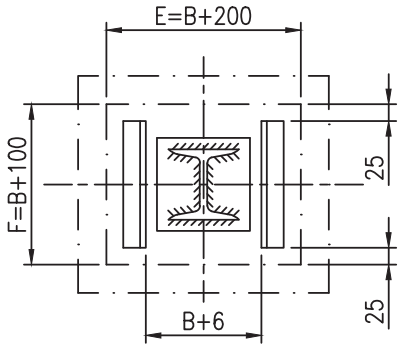
ARRANGEMENT TYPE-1
(CROSS GUIDE)



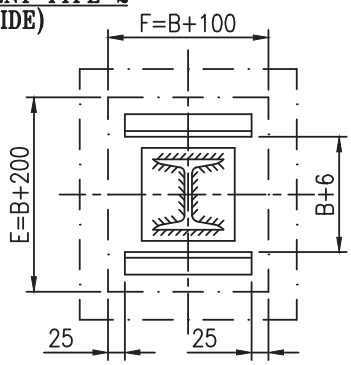
ARRANGEMENT TYPE-2
(GUIDE)



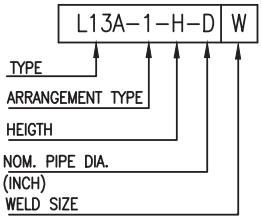
SECTION- 'AA'



SECTION- 'BB'



SECTION- 'CC'



SYMBOL

MAXIMUM ALLOWABLE LOAD ON FILLET -WELD (KG/CM)				
WELD SIZE (MM) W	LINE DESIGN TEMP. (IN DEG.C)			
	200	250	300	350
6	340	250	220	200
8	450	340	300	370
10	560	420	370	330

D	A	C	X	Y	T	B	E	F
14"	177	95	382	300	200	250	450	350
16"	204	109	435					
18"	229	122	490					
20"	253	136	546	350	250	300	500	400
22"	278	150	600					
24"	304	164	654					
26"	330	177	708	300	250	300	500	400
30"	380	205	818					
32"	407	218	870	400	300	350	550	450
36"	456	246	982					

NOTES:-

1. PROTECTION SHIELD SHALL BE CUT FROM LINE PIPE OR EQUIVALENT PLATE.
2. IN CASE CALCULATED h EXCEEDS THE MAXIMUM VALUE, PEDESTAL SHALL BE RAISED ACCORDINGLY.
3. LOADS ON FILLET WELDS ON BASE/INSERT PLATE SHALL BE LIMITED TO THE VALUES TABULATED ABOVE AGAINST VARIOUS TEMPERATURES, FOR THE RESPECTIVE WELD-SIZE, FOR RUNNING LENGTH OF WELD. LOADS MAY BE INTERPOLATED FOR INTERMEDIATE TEMPERATURES. WELD SIZE SHALL BE DEEMED 6MM, UNLESS SPECIFIED OTHERWISE.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	20-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	NRK	DEP	SHR/BN
0	22-06-92	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

LOW SUPPORT ON MITERED ELBOW FOR PIPE SIZE 14" THRU 36" TYPE- L13A

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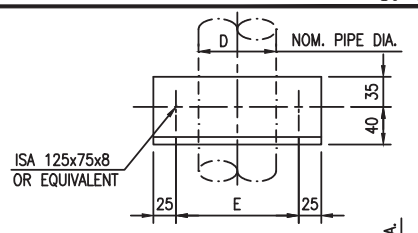
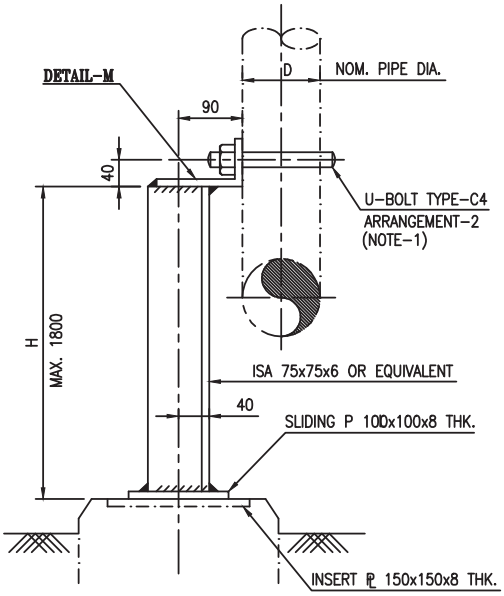
AUTOCAD

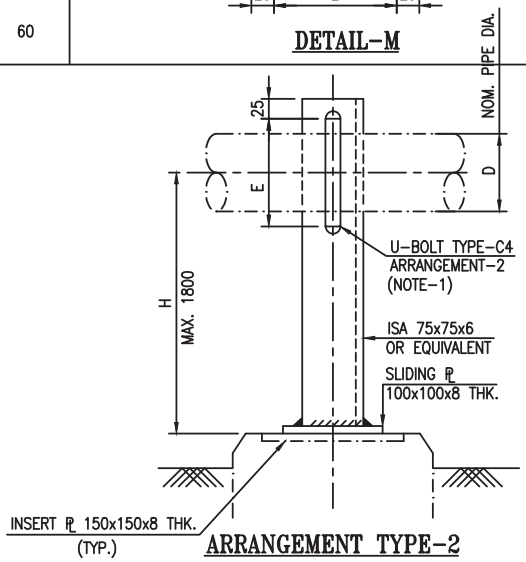
D	E
3/4"	36
1"	45
1½"	60



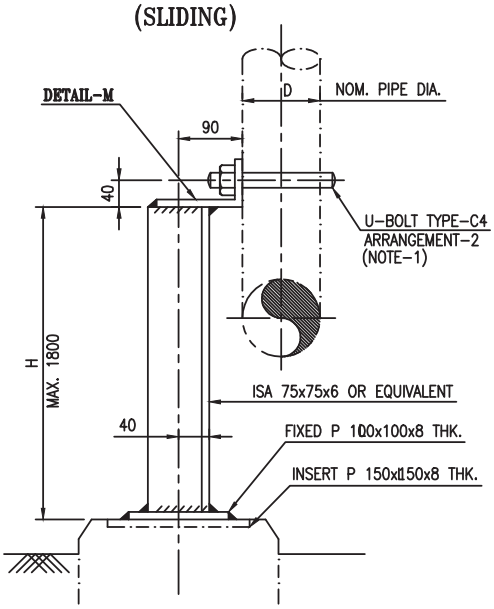
DETAIL-M



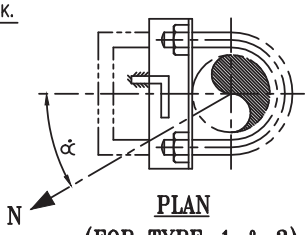
ARRANGEMENT TYPE-1
(SLIDING)



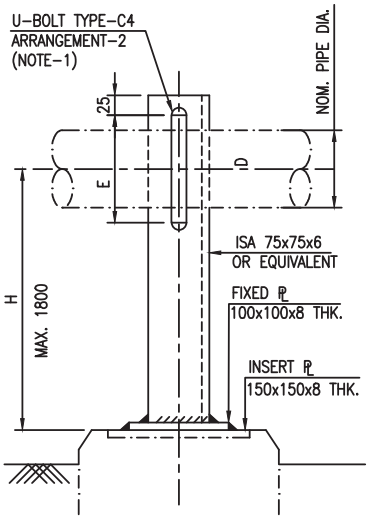
ARRANGEMENT TYPE-2
(SLIDING)



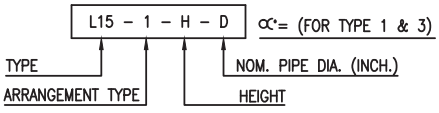
ARRANGEMENT TYPE-3
(FIXED)



PLAN
(FOR TYPE-1 & 3)



ARRANGEMENT TYPE-4
(FIXED)



SYMBOL

VERTICAL MAX. LOAD= 750 KG.

NOTES:-

1. FOR DETAILS OF U- BOLT TYPE-C4 REF. STD. NO. 03-PS-033 & U-BOLT MATERIAL SHALL BE EQUIVALENT TO THAT OF LINE-PIPE.
2. FOR DETAIL-M, FOR CARBON STEEL(CS) PIPE USE CS ANGLE BUT CASE OF ALLOY-STEEL/STAINLESS-STEEL USE 8mm THICK PLATE MATERIAL EQUIVALENT TO THAT OF LINE-PIPE FOR FABRICATION.
3. IN CASE CALCULATED H EXCEED THE MAX. VALUE, CONCRETE PEDSTAL SHALL BE RAISED ACCORDINGLY.

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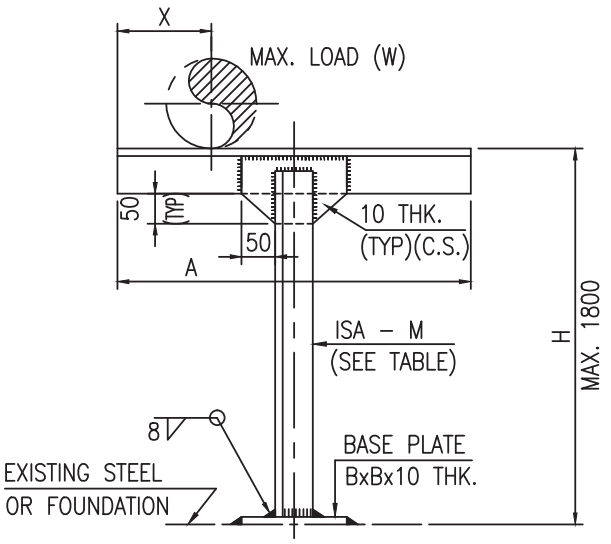
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

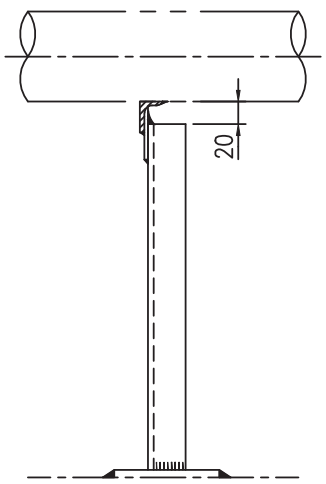
LOW SUPPORT SLIDING AND FIXED FOR PIPE SIZE 3/4" THRU 1½" TYPE- L15

Standard Number	Rev.
03-PS-027	4
Sheet 1of 1	

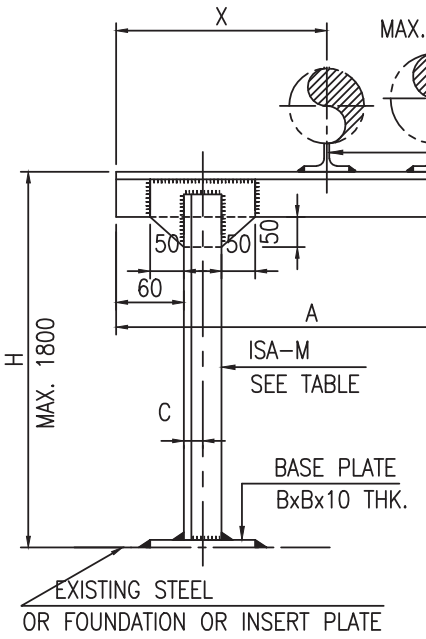
AUTOCAD



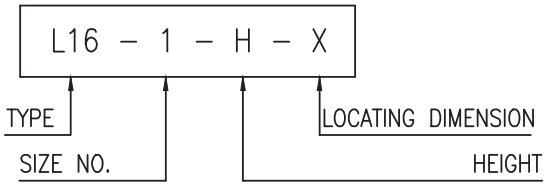
TYPE–L16



SIDE VIEW

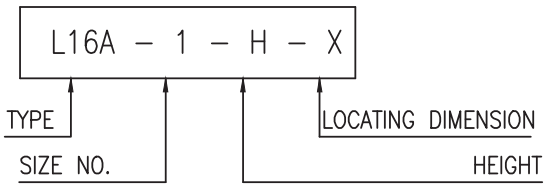


TYPE–L16A



SYMBOL

SIZE NO.	MAX. LOAD (W) Kg	M	A	B	C
1	500	ISA– 90x90x8 OR EQUIVALENT	600	150	45
2	800	ISA– 100x100x10 OR EQUIVALENT	700	150	60
3	1500	ISA– 130x130x12 OR EQUIVALENT	800	150	80



NOTE:–

1. DO NOT USE THIS SUPPORT FOR ANCHORING THE PIPE.
2. REFER STANDARD FOR SHOE SUPPORT.
3. IN CASE SUPPORT IS TO BE PROVIDED ON A FOUNDATION, INSERT PLATE OF 250x250x10THK. SIZE SHALL BE USED.
4. IN CASE CALCULATED H EXCEEDS THE MAX. VALUE, PEDESTAL SHALL BE RAISED ACCORDINGLY.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
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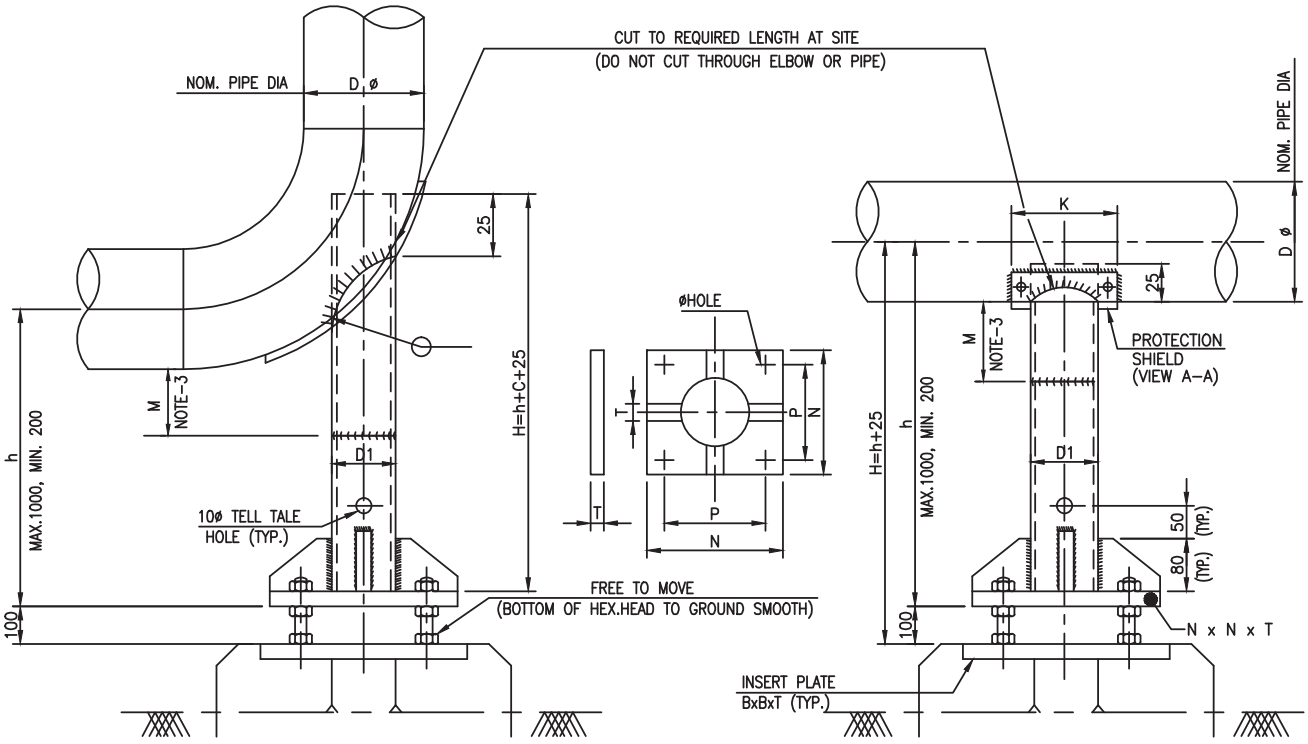
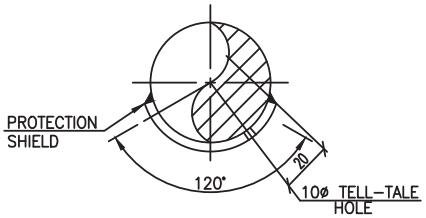
0	15–02–92	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	LOW SUPPORT STANCHION TYPE– L 16 & L 16 A	Standard Number	Rev.
		03–PS–028	4
		Sheet 1of 1	

AUTOCAD





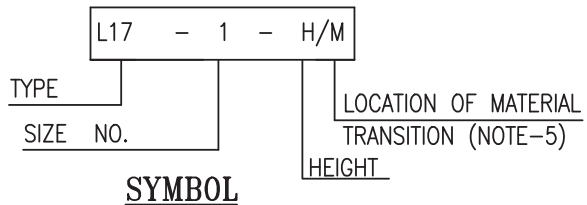
VIEW A-A

INSTALLATION PROCEDURE

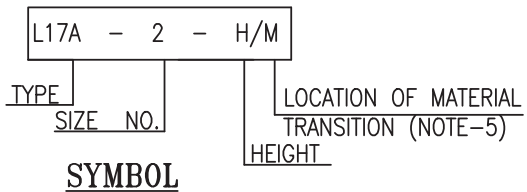
PLACE SUPPORT UNDER PIPE BEFORE CONNECTING PIPE TO EQUIPMENT. TURN ADJUSTABLE NUT TURN ADJUSTING NUT UNTI PIPE FLANGE IS ALIGNED WITH EQUIPMENT OR VALVE FLANGE.

NOTES:-

1. ALL PLATES SHALL BE CARBON STEEL.
2. IN CASE SIZE AND OR Sch. OF SUPPORT PIPE (DI) LISTED IN TABLE BELOW IS NOT AVAILABLE, USE THE NEXT HEIGHER SIZE AND OR NEAREST HIGHER THICKNESS AVAILABLE.
3. BOTTOM OF HEX. HEAD OF SLIDING-BOLTS TO BE GROUND SMOOTH.
4. MATERIALS OF BOLTS AND NUTS SHALL BE TO A193 GR.B7 AND A194 GR.2H, OR TO A193 GR.B16 AND A194 GR.4, RESPECTIVELY.
5. ALSO REFER NOTE NOS. 2,4 & 6 OF 03-PS-016.



SYMBOL



SYMBOL

SIZE NO.	D	DI (NOTE-2)	B	T	C	HEX. BOLT PULLEY THREADED WITH TWO NUTS (NOTE-4)	N	P	ø	K
1	8"	4"Sch40/10S	350	12	205	M-0.75"x150 LONG.	250	140	22	215
	10"				262	M-0.875"x175 LONG.	300	180	25	
	12"				287		300	180	25	
2	14"	6"Sch40/10S	400	12	383	M-1"x175 LONG.	350	230	27	270
	16"				418		350	230	27	
3	18"	8"Sch40/10S	400	12	454		350	230	27	320
4	20"	10"Sch20/10S	450	12	554	M-1.25"x200 LONG.	400	280	33	375
	24"				615		400	280	33	

Rev.	Date	Description	Prpd.	Chkd.	Appd.
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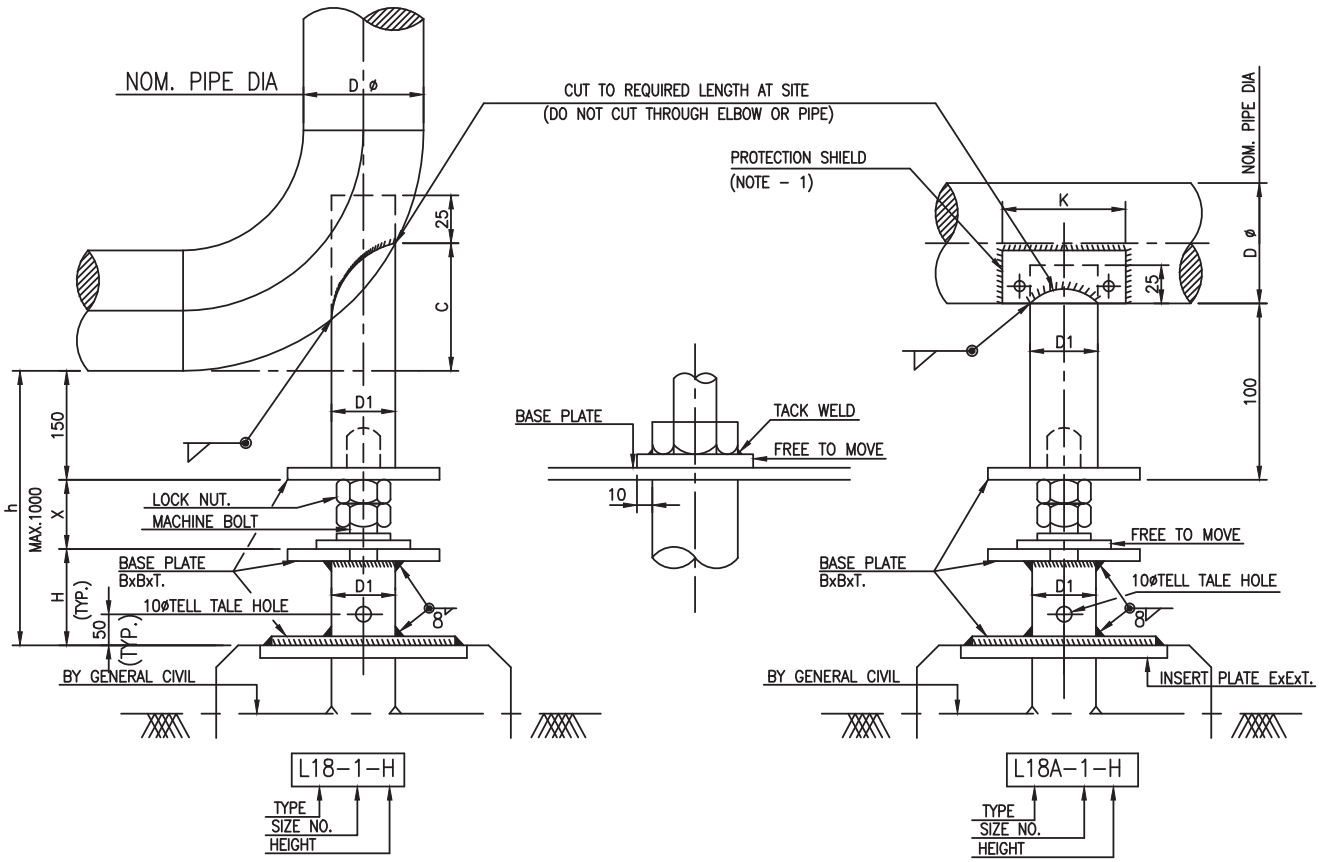
0	15-02-92	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

ADJUSTABLE LOW SUPPORT
WITH 4 BOLTS FOR PIPE SIZE
SIZE 8" THRU 24"
TYPE L17&L17A

Standard Number	Rev.
03-PS-029	4
Sheet 1of 1	

AUTOCAD



SIZE	D	D1(NOTE – 2)	B1	B	E	T	K	C	HEX. BOLT FULLY THREADED WITH ONE NUT	X	dø
1	2"	2" SCH 40	80	150	170	10	160	70	M – 30 x 150 LONG	120	40
	3"							115			
2	4"	3" SCH 40	110	200	220	10	190	137			
	6"							174			
3	8"	4" SCH 40	135	200	220	12	215	205	M – 39 x 175 LONG	140	46
	10"							262			
	12"							287			
4	14"	6" SCH 40	190	250	270	12	270	388	M – 42 x 175 LONG	150	50
	16"							418			
5	18"	8" SCH 40	240	300	320	12	320	454			
6	20"	10" SCH 40	295	350	370	12	375	554	M – 48 x 200 LONG	170	56
	24"							615			

INSTALLATION PROCEDURE:–

A. PLACE SUPPORT UNDER PIPE BEFORE CONNECTING PIPE TO EQUIPMENT.
B. TURN ADJUSTABLE NUT UP UNTIL PIPE FLANGE IS ALIGNED WITH EQUIPMENT OR VALVE FLANGE.

NOTES:–

1. MATERIAL OF SUPPORT PIPE SAME AS MAIN PIPE SPEC. ALL PLATES CARBON STEEL.
2. IN CASE SIZE AND OR Sch. OF SUPPORT PIPE (DI) LISTED IN THE TABLE IS NOT AVAILABLE, USE NEXT HIGHER SIZE AND OR NEAREST EQUIVALENT THICKNESS AVAILABLE.
3. USE THIS SUPPORT IN PREFERANCE TO TYPE L10 & L10A (03–PS–023)'
4. USE THIS DETAIL AS SOLID SUPPORT FOR LINES WHEN VERTICAL THERMAL IS NOT PRESENT. THE MOST COMMON USE WOULD BE TO END SUCTION PUMP, TURN ADJUSTING NUT UNTIL ELBOW FLANGE IS ALIGNED.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30–04–18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	AJW	DEP	SHR/BN
0	15–02–92	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

ADJUSTABLE LOW SUPPORT
FOR BARE & INSULATED PIPE
SIZE 2" THRU 24"
TYPE L18&L18A

Standard Number	Rev.
03–PS–030	4
Sheet 1of 1	

AUTOCAD

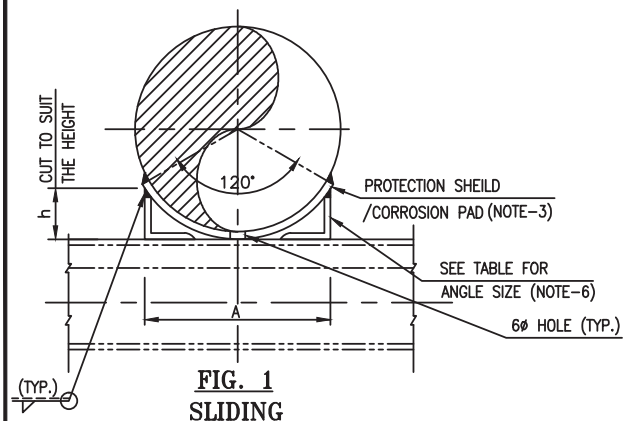
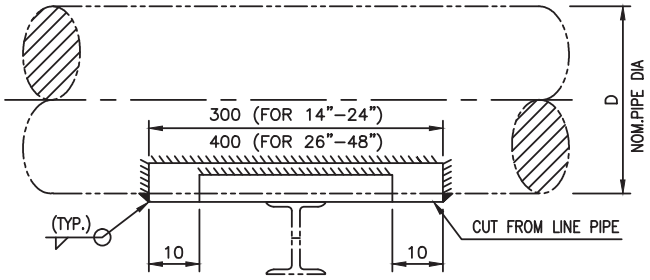
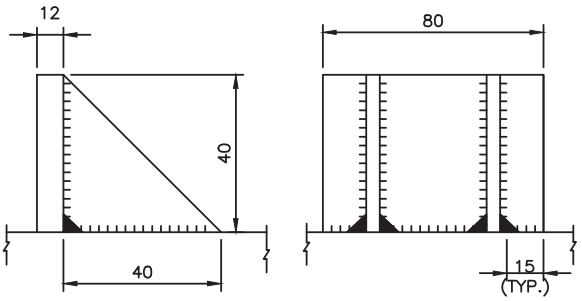


FIG. 1
SLIDING





DETAIL-M

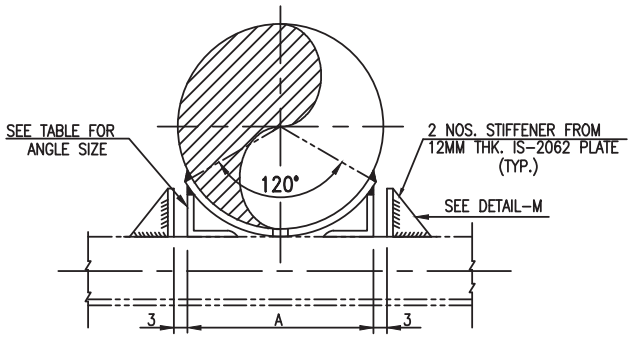


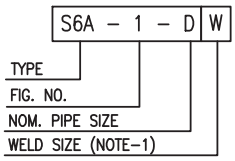
FIG. 2
GUIDE

MAXIMUM ALLOWABLE LOAD ON FILLET -WELD (KG/CM)				
WELD SIZE (MM)	LINE DESIGN TEMP. (IN DEG.C)			
	200	250	300	343
6	340	250	220	200
8	450	340	300	270
10	560	420	370	330

D IN INCH.	PIPE SCH.	R	A	h	ANGLE SIZE
2 TO 12	REFER NOTE-6				
14	STD	178	258	52	75 x 75 x 8
16	STD	203	266	47	
18	STD	229	272	43	
20	STD	254	279	40	
22	STD	279	335	54	100 x 75 x 8
24	STD	305	341	50	
26	STD	330	347	48	
28	STD	356	352	45	
30	STD	381	357	43	
32	STD	406	362	42	
34	STD	432	487	73	150 X 75 X 10
36	STD	457	492	70	
38	XS	483	498	67	
40	XS	508	503	65	
42	XS	533	508	63	
48	XS	610	522	57	

NOTES:-

1. LOADS ON FILLET WELDS OF GUIDE SHALL BE LIMITED TO THE VALUES TABULATED BELOW AGAINST VARIOUS TEMPERATURES, FOR THE RESPECTIVE WELD-SIZE, FOR RUNNING LENGTH OF WELD.LOADS MAY BE INTERPOLATED FOR INTERMEDIATE TEMPERATURES.
2. IN CASE THE PIPE -SCHEDULE IS NOT THE SAME AS TABULATED ABOVE, THE DIMENSIONS "A" AND "h" SHALL BE MODIFIED ACCORDINGLY.
3. PROTECTION-SHIELD SHALL BE CUT FROM LINE-PIPE OR ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS.
4. GUIDE PLATE SHALL BE TO IS-2062.
5. IN CASE OF SIZE REDUCTION(S) IN A STRAIGHT RUN WITH SAME BOP, PROTECTION SHIELD THICKNESS FOR ALL SIZES SHALL BE EQUAL TO THAT FOR THE LARGEST DIAMETER PIPE.
6. FOR SIZES 2" TO 12" , PROTECTION SHIELD /CORROSION PAD SHALL BE USED AS PER JOB REQUIREMENT. ANGLES SHALL BE WELDED TO PROTECTION SHIELD /CORROSION PAD.



SYMBOL

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	20-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	PK	DEP	SHR/BN
0	08-01-07	ISSUED AS STANDARD	SOB	NCS	BN

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PIPE SADDLE FOR BARE
PIPE TYPE S6A

Standard Number	Rev.
03-PS-094	4
Sheet 1 of 1	

AUTOCAD

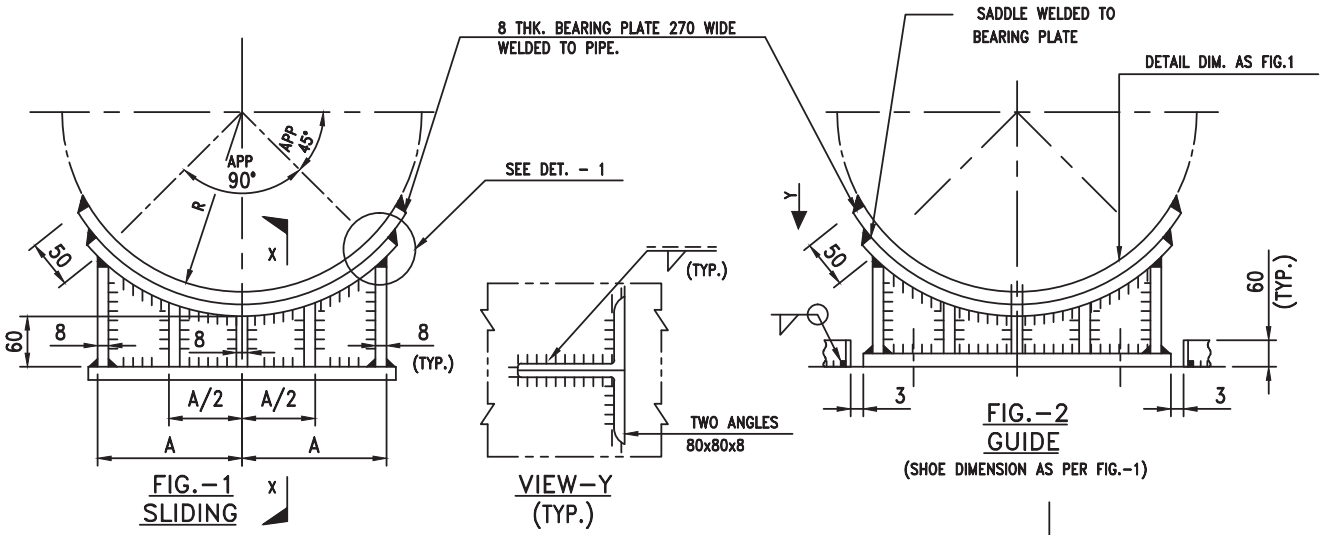
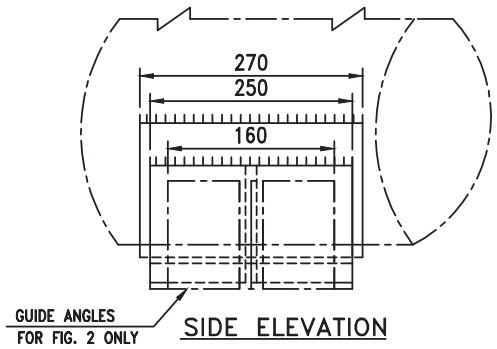


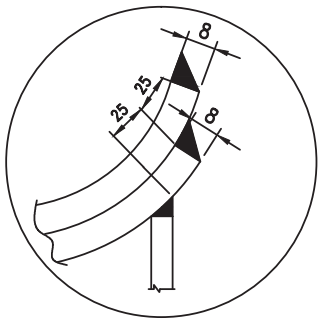
FIG.–1 SLIDING

VIEW–Y (TYP.)

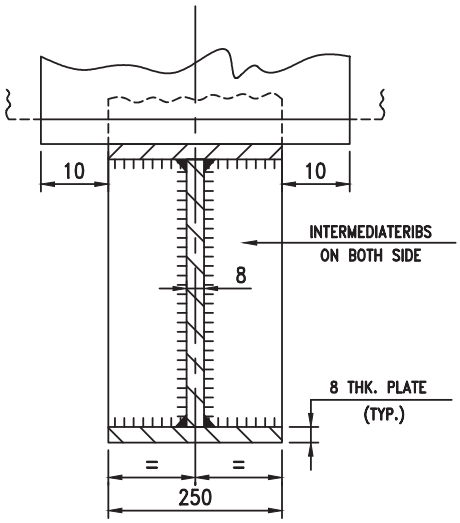
FIG.–2 GUIDE
(SHOE DIMENSION AS PER FIG.–1)



SIDE ELEVATION



DETAIL – 1



SECTION X–X
(TYP.)

NOMINAL DIA.		A	R	DEVELOPED LENGTH OF BEARING PLATE
INCHES	mm			
52	1321	478	660	1184
54	1372	496	686	1225
60	1524	550	762	1344
66	1676	604	838	1463
72	1829	658	914	1583
78	1981	712	991	1704
84	2135	766	1067	1823
90	2286	820	1143	1943
96	2438	873	1219	2062
102	2591	927	1295	2181
108	2743	981	1372	2302

S7–1–52"

TYPE — FIG. NO. i.e SLIDING

NOM. PIPE DIA. (INCH.)

SYMBOL

MAXIMUM ALLOWABLE LOAD ON FILLET–WELD OF RESTRAINT (KG/CM)				
WELD SIZE (MM) W	TEMPERATURE (IN DEG.C)			
	200	250	300	350
6	340	250	220	200
8	450	340	300	270
10	560	420	370	330

NOTES:–

1. LOADS ON FILLET WELDS OF GUIDE SHALL BE LIMITED TO THE VALUES TABULATED VALUES AGAINST VARIOUS TEMPERATURES, FOR RESPECTIVE WELD–SIZE, FOR RUNNING LENGTH OF WELD. LOADS MAY BE INTERPOLATED FOR INTERMEDIATE TEMPERATUES.
2. LONGITUDINAL PIPE MOVEMENT NOT TO EXCEED 100MM.
3. GUIDE ANGLES SHOULD BE SUITABLY TRIMMED WHEREVER THESE OBSTRUCT ADJOINING GUIDE ANGLE.
4 PLATE MATERIAL TO IS–2062 OR EQUIVALENT SHALL BE USED.

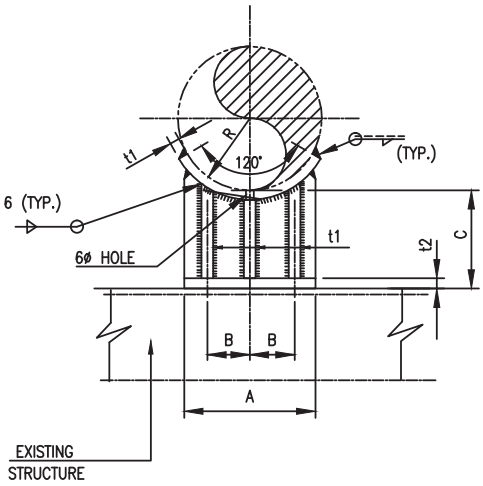
Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10–04–18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RCB	DEP	SHR/BN
0	08–01–07	ISSUED AS STANDARD	SOB	NCS	BN

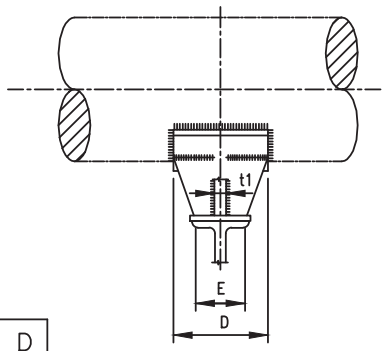
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

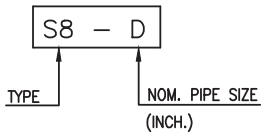
PIPE SADDLE FOR BARE
C.S. PIPE SIZE 52" THRU 108"
TYPE – S7
(FOR TEMP. UP TO 343°C)

Standard Number	Rev.
03–PS–099	4
Sheet 1 of 1	

AUTOCAD







NOM. PIPE SIZE	A	B	C	D	E	R	t1	t2
10"	237	75	100	125	100	137	6	12
12"	281	90	100	125	100	162	6	12
14"	308	100	100	125	100	178	6	12
16"	352	115	100	125	100	203	6	12
18"	396	130	100	125	100	229	8	12
20"	440	145	100	125	100	254	8	12
22"	484	160	100	125	100	279	8	12
24"	528	175	100	125	100	305	8	12
26"	572	190	100	175	125	330	8	12
28"	616	200	100	175	125	356	8	12
30"	660	220	100	175	125	381	10	12
32"	704	230	100	175	125	405	10	12
34"	748	250	100	175	125	432	10	12
36"	792	265	100	175	125	457	10	12
40'	880	290	100	200	150	508	10	12
44"	968	340	100	200	150	559	10	12
48"	1056	350	100	200	150	610	10	12
54"	1188	400	100	200	150	686	12	16
60"	1320	445	100	200	150	762	12	16
72"	1584	530	100	200	150	914	12	16
80"	1760	590	100	200	150	1016	12	16

NOTES :

1. MAXIMUM TEMPERATURE 343°C
2. USE 03–PS–099 IN PREFERENCE TO THIS TYPE FOR SIZE 54" & ABOVE.
3. PLATE–MATERIAL FOR SHOE SHALL BE IS–2062. OR EQUIV.
4. PROTECTION–SHEILD SHALL BE CUT FROM LINE–PIPE OR ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION–SHIELD SHALL BE SAME AS THAT OF LINE–PIPE OR 12MM, WHICHEVER IS LESS.
5. LONGITUDINAL PIPE MOVEMENT NOT TO EXCEED 40% OF "E".
6. PROTECTION SHIELD FOR REDUCING SIZES IN A STRAIGHT RUN– PROTECTION SHIELD THICKNESS FOR ALL SIZES SHALL BE EQUAL TO THICKNESS OF PROTECTION SHIELD FOR LARGER DIAMETER PIPE.

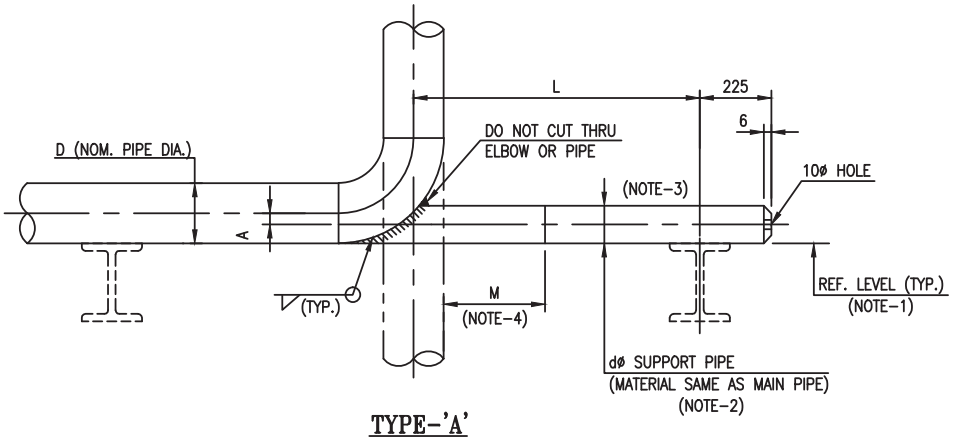
Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10–04–18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	NRK	DEP	SHR/BN
0	27–5–92	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PIPE SADDLE FOR BARE PIPE SIZE 10" THRU 80" TYPE–S8

Standard Number	Rev.
03–PS–005	4
Sheet 1of 1	

AUTOCAD



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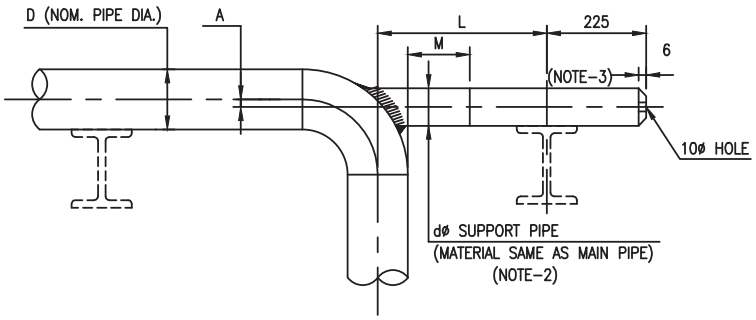

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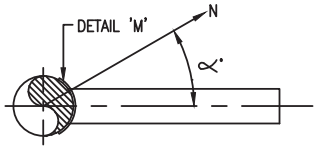
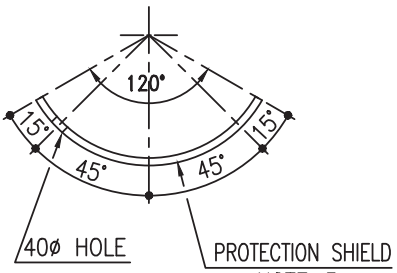


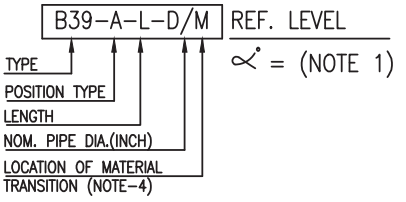
PLAN FOR SUPPORT ON VERTICAL PIPE
(NOTE-1 & 3)



DETAIL-M

FOR L=1500 OR LESS		
D	d (NOTE 2)	A
2"	2" SCH. 40	–
3"	2" SCH. 40	15
4"	3" SCH. 40	13
6"	3" SCH. 40	40
8"	4" SCH. 40	52
10"	6" SCH. 40	52
12"	6" SCH. 40	78
14"	8" SCH. 40	68
16"	8" SCH. 40	94
18"	8" SCH. 40	119
20"	10" SCH. 40	118
24"	10" SCH. 40	168

FOR L=OVER 1500		
D	d (NOTE 2)	A
2"	2" SCH. 40	–
3"	2" SCH. 40	15
4"	3" SCH. 40	13
6"	4" SCH. 40	27
8"	6" SCH. 40	25
10"	8" SCH. 40	27
12"	8" SCH. 40	52
14"	10" SCH. 40	41
16"	10" SCH. 40	67
18"	10" SCH. 40	92
20"	12" SCH. 40	92
24"	12" SCH. 40	143



SYMBOL

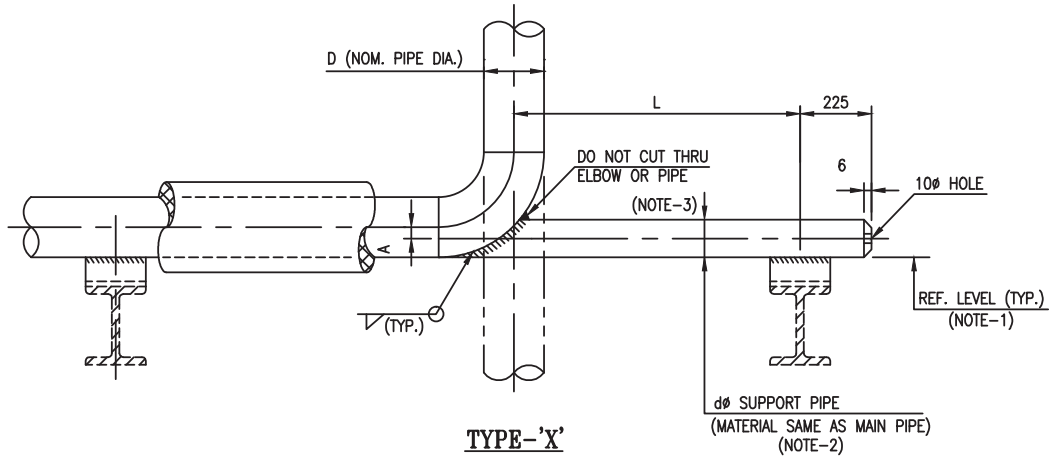
NOTES:-

1. REF. LEVEL & ∝° TO BE GIVEN IN CASE, SUPPORT IS WELDED TO VERTICAL PIPE.
2. IN CASE SIZE AND/OR SCH. OF SUPPORT PIPE (d) LISTED IN TABLE IS NOT AVAILABLE USE NEXT HIGHER SIZE AND/ OR NEAREST EQUIVALENT THICKNESS AVAILABLE.
3. PROVIDE PROTECTION SHIELD FOR DUMMY SUPPORT ON VERTICAL LINES.
4. DIMENSION 'M' LOCATES THE POINT OF MATERIAL TRANSITION ON THE SUPPORT, THE STUB MATERIAL SHALL BE EQUIVALENT TO THAT OF LINE PIPE AND THE REST OF THE SUPPORT PIPE SHALL BE C.S. MINIMUM VALUE OF M SHALL BE "INSULATION THK. + 25MM.
   A. FOR C.S. LINE PIPE, THE ENTIRE SUPPORT PIPE SHALL BE C.S., THAT IS M=0.
   B. FOR A.S. OR S.S. LINE PIPE SUPPORT PIPE SHALL BE CONSIST OF THE FOLLOWING–
      – FOR (L–0.5(O.D.)) LESS THAN OR EQUAL TO 500MM, ENTIRE SUPPORT PIPE MATERIAL SHALL BE EQUIVALENT TO THAT OF LINE PIPE, THAT IS M=(L–0.5D).
      – FOR (L–0.5(O.D.)) GREATER THAN 500MM, SUPPORT PIPE SHALL BE COMPOSITE WITH M=INSULATION THK. +25MM OR 100MM, WHICHEVER IS GREATER.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30–04–18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RCB	DEP	SHR/BN
0	30–08–91	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	DUMMY PIPE SUPPORT FOR BARE PIPE SIZE 2" THRU 24" TYPE– B 39	Standard Number	Rev.
		03–PS–079	4
		Sheet 1of 1	

AUTOCAD



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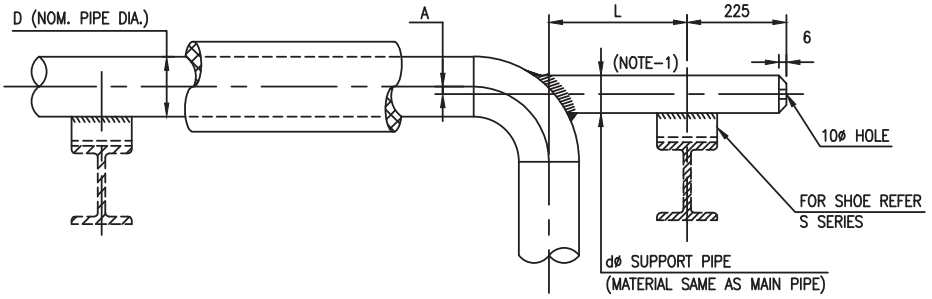

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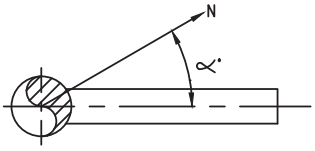
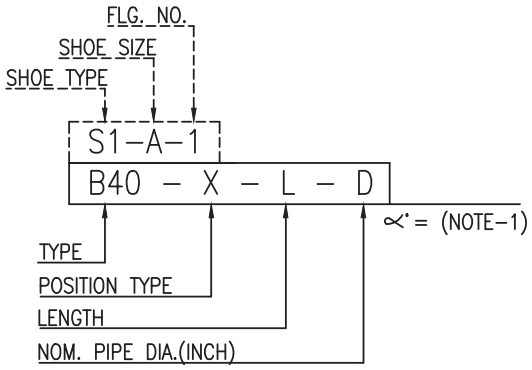


PLAN FOR SUPPORT ON VERTICAL PIPE
(NOTE-1 & 3)

FOR L=1500 OR LESS		
D	d (NOTE 2)	A
2"	2" SCH. 40	–
3"	2" SCH. 40	15
4"	3" SCH. 40	13
6"	3" SCH. 40	40
8"	4" SCH. 40	52
10"	6" SCH. 40	52
12"	6" SCH. 40	78
14"	8" SCH. 40	68
16"	8" SCH. 40	94
18"	8" SCH. 40	119
20"	10" SCH. 40	118
24"	10" SCH. 40	168

FOR L=OVER 1500 (MAX. 3000)		
D	d (NOTE 2)	A
2"	2" SCH. 40	–
3"	2" SCH. 40	15
4"	3" SCH. 40	13
6"	4" SCH. 40	27
8"	6" SCH. 40	25
10"	8" SCH. 40	27
12"	8" SCH. 40	52
14"	10" SCH. 40	41
16"	10" SCH. 40	67
18"	10" SCH. 40	92
20"	12" SCH. 40	92
24"	12" SCH. 40	143



SYMBOL

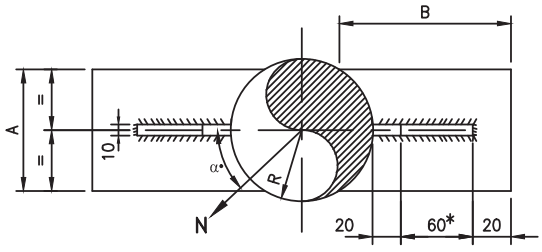
NOTES:-

1. REF. LEVEL & ∝' TO BE GIVEN IN CASE, SUPPORT IS WELDED TO VERTICAL PIPE.
2. IN CASE SIZE AND/OR SCH. OF SUPPORT PIPE (d) LISTED IN TABLE IS NOT AVAILABLE USE NEXT HIGHER SIZE AND/ OR NEAREST EQUIVALENT THICKNESS AVAILABLE.
3. PROVIDE PROTECTION SHIELD FOR DUMMY SUPPORT ON VERTICAL LINES.

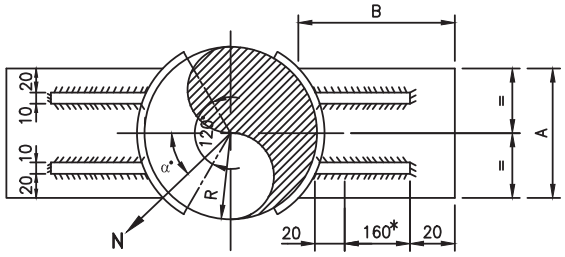
Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RCB	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	DUMMY PIPE SUPPORT FOR INSULATED PIPE SIZE 2" THRU 24" TYPE- B 40	Standard Number	Rev.
		03-PS-080	4
		Sheet 1of 1	

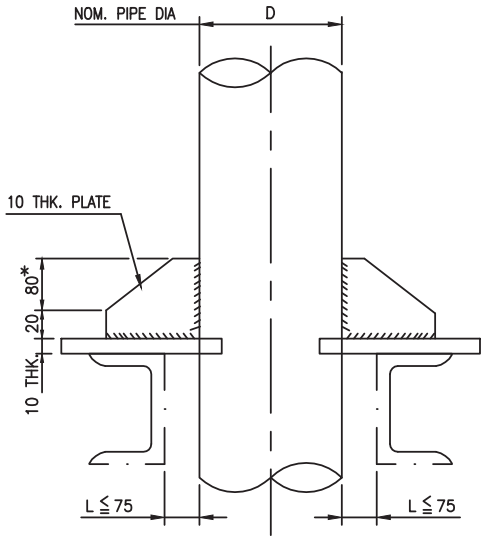
AUTOCAD

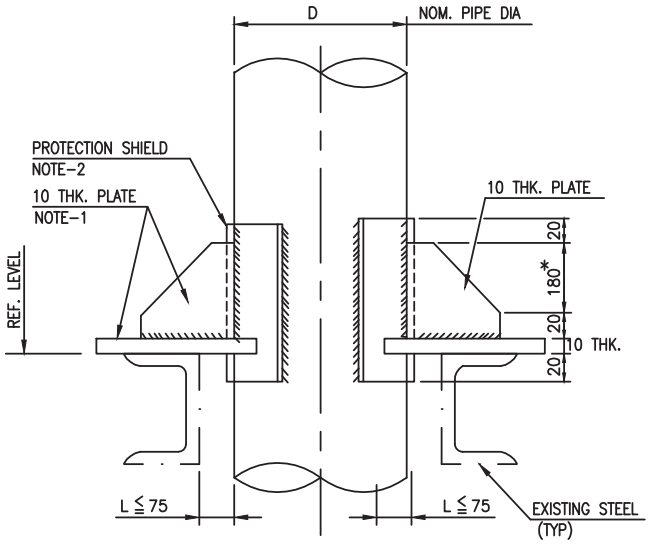


FOR SIZE 1" THRU 6"



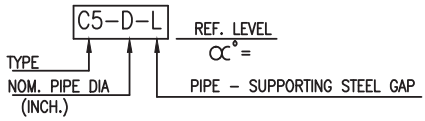
FOR SIZE 8" THRU 24"





D	1"	1½"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"
R	17	25	30	45	58	85	110	137	162	178	204	229	254	280	305
A	30	40	50	70	80	110	150	200	200	200	200	200	300	300	300
B	109	110	113	117	116	120	226	239	232	228	225	222	246	241	238

FOR BARE PIPE



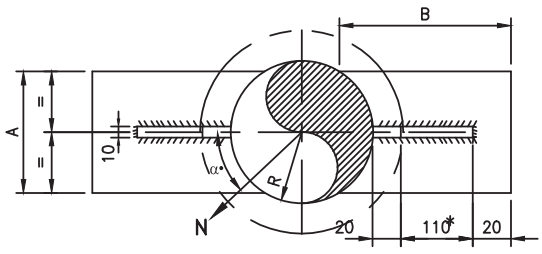
SYMBOL

NOTES:-

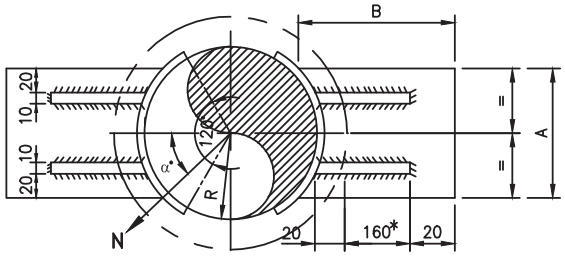
1. FOR PIPE SIZE UP TO 6" ALL PLATE MATERIAL SHALL BE EQUIVALENT TO PIPE MATERIAL. FOR PIPE SIZE 8" AND ABOVE PLATE MATERIAL SHALL BE AS PER THE ADJACENT TABLE.
2. PROTECTION-SHIELD SHALL BE CUT FROM LINE-PIPE OR ROLLED FROM PLATE MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION-SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS. 10ø TELL-TALE HOLE TO BE PROVIDED.
3. DIMENSION 'B' AND THOSE MARKED WITH '*' SHALL BE SUITABLY REVISED IN THE FOLLOWING CASES AND WHERE L > 75MM –
   - 3.1 HIGHER INSUL. THK. (APPLICABLE TO PAGE 1/2 BUT NOT TO PAGE 2/2).
   - 3.2 HIGHER LATERAL MOVEMENT.
   - 3.3 MORE GAP BETWEEN STRUCTURAL MEMBERS.
4. IN CASE OF 3.3, IF POSSIBLE, WELD ADDITIONAL STEEL TO REDUCE GAP.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	AJW	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

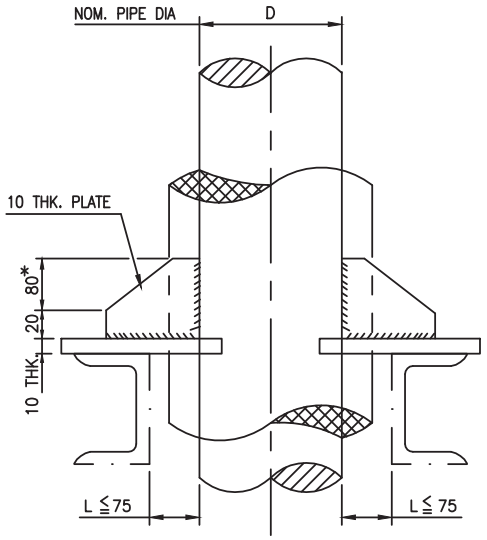
TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	SUPPORT LUGS-SLIDING FOR BARE/INSULATED PIPE SIZE 1" THRU 24" TYPE-C5 & C5A	Standard Number	Rev.
		03-PS-034	4
		Sheet 1 of 2	

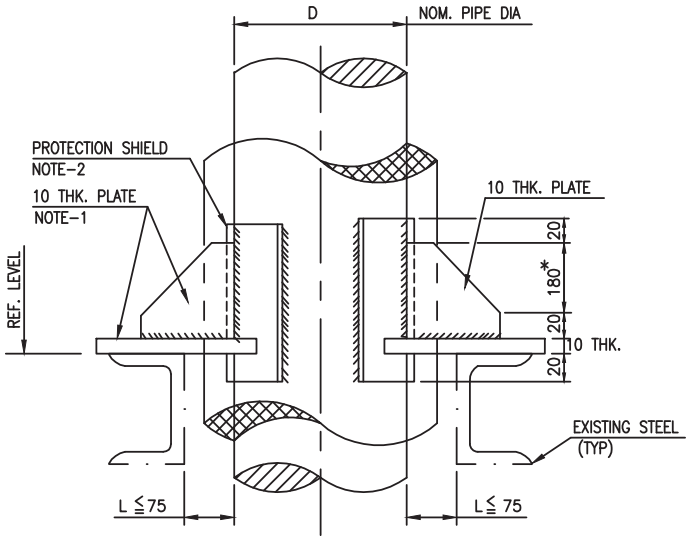


FOR SIZE 1" THRU 6"



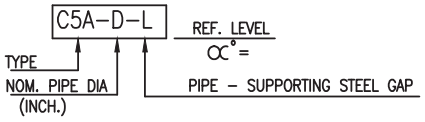
FOR SIZE 8" THRU 24"





D	1"	1½"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"
R	17	25	30	45	58	85	110	137	162	178	204	229	254	280	305
A	30	40	50	70	80	110	150	200	200	200	200	200	300	300	300
B	159	160	163	167	166	170	286	299	292	288	285	282	306	301	298

FOR INSULATED PIPE



SYMBOL

FOR PIPE 8" AND ABOVE

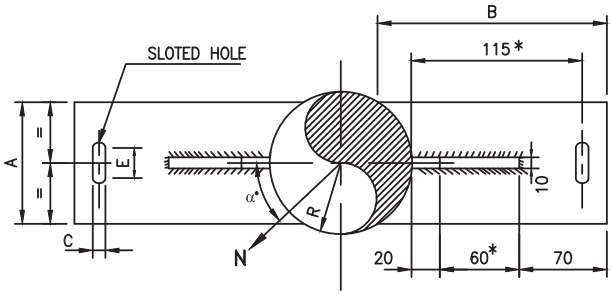
TEMPRETURE	PLATE MATERIAL
UP TO 343°C	IS-2062
344°C TO 427°C	ASTM A516/A515 (GR. 60/65/70)/ IS-2002 GR.2
ABOVE 427°C	PIPE MATL. OR EQUIVALENT / SS-316 PLATE

NOTES:-

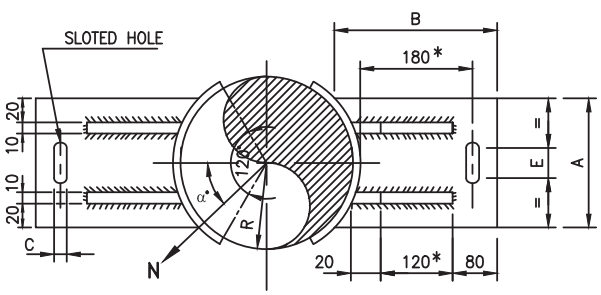
FOR NOTES REFER SHEET 1 OF 2.

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	SUPPORT LUGS-SLIDING FOR BARE/INSULATED PIPE SIZE 1" THRU 24" TYPE-C5 & C5A	Standard Number	Rev.
		03-PS-034	4
		Sheet 2 of 2	

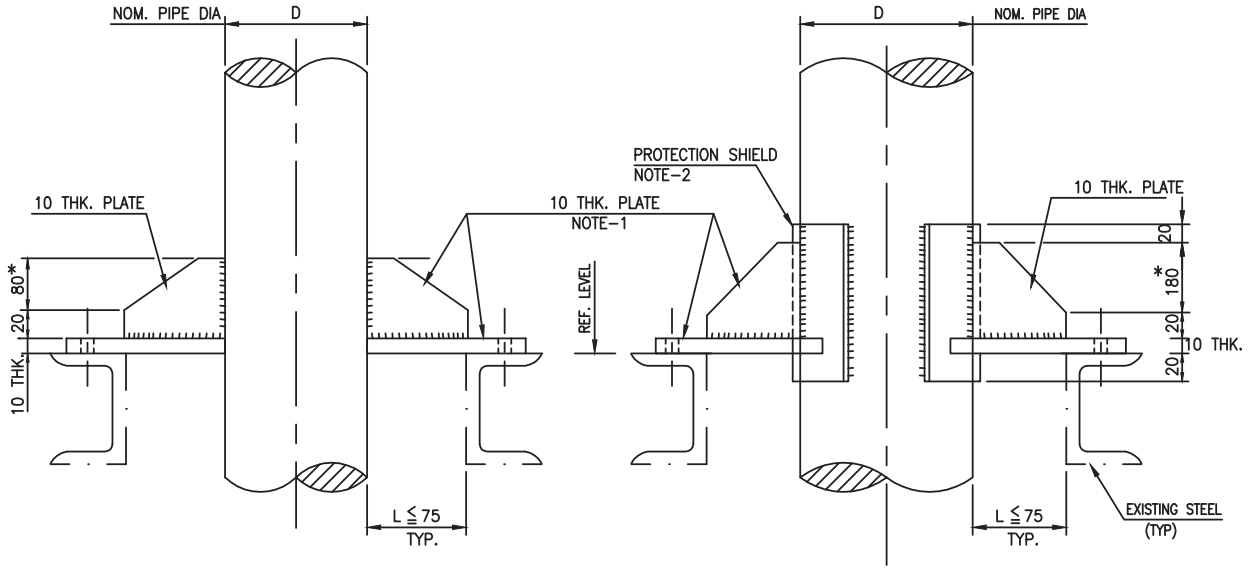
AUTOCAD



FOR SIZE 1" THRU 6"

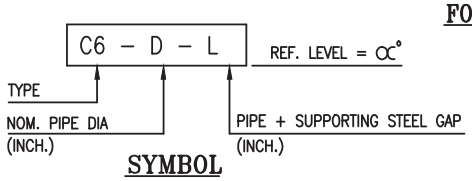


FOR SIZE 8" THRU 24"



D	1"	1½"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"
R	17	25	30	45	58	85	110	137	162	178	204	229	254	280	305
A	30	40	50	70	80	110	150	200	200	200	200	200	300	300	300
B	159	160	163	167	166	170	246	259	252	248	245	242	266	261	258
C	14	14	14	14	18	18	18	18	22	22	22	22	22	22	22
E	14	14	14	14	25	25	25	25	30	30	30	30	30	30	30
BOLT SIZE	M12 x 40				M16 x 50				M20 x 60						

FOR BARE PIPE



SYMBOL

NOTES:–

1. FOR PIPE SIZE UP TO 6" ALL PLATE MATERIAL SHALL BE EQUIPMENT TO PIPE MATERIAL FOR PIPE SIZE 8" AND ABOVE PLATE MATERIAL SHALL BE AS PER THE ADJACENT TABLE.
2. PROTECTION–SHIELD SHALL BE CUT FROM LINE–PRE OR ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION–SHIELD SHALL BE SAME AS THAT OF LINE–PIPE OR 12MM, WHICHEVER IS LESS. 10ø TELL–TALE HOLE TO BE PROVIDED.
3. DIMESNSION 'B' AND THOSE MARKED WITH '*' SHALL BE SUITABLY REVISED IN THE FOLLOWING CASES AND WHERE L > 75MM –
   3.1 HIGHER INSUL. THK. (APPLICABLE TO PAGE 1/2 BUT NOT TO PAGE 2/2).
   3.2 MORE GAP BETWEEN STRUCTURAL MEMBERS.
4. IN CASE OF 3.2, IF POSSIBLE, WELD ADDITIONAL STEEL TO REDUCE GAP.

FOR PIPE 8" AND ABOVE

TEMPERATURE	PLATE MATERIAL
UPTO 343°C	IS–2062
344°C TO 427°	ASTM A516/A515 (GR.60/65/70) / IS–2002 GR.2
ABOVE 427°C	PIPE MATL. OR EQUIVALENT / SS–316 PLATE

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30–04–18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	NRK	DEP	SHR/BN
0	21–05–93	ISSUED AS STANDARD	SDM	AKR	KPS

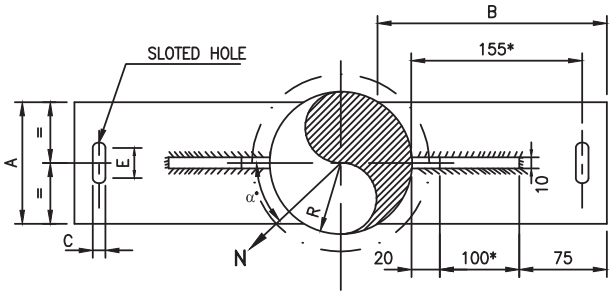
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

SUPPORT LUGS FIXED FOR BARE/INSULATED PIPE SIZE 1" THRO 24" TYPE C6 & C6A

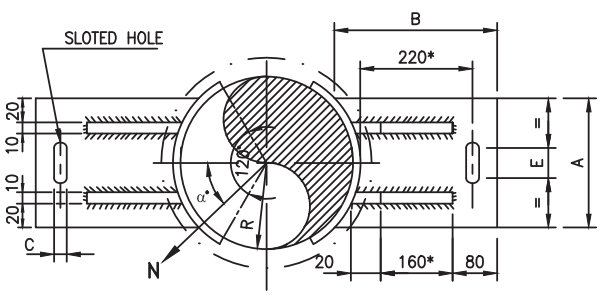
Standard Number: 03–PS–035 | Rev.: 4

Sheet 1 of 2

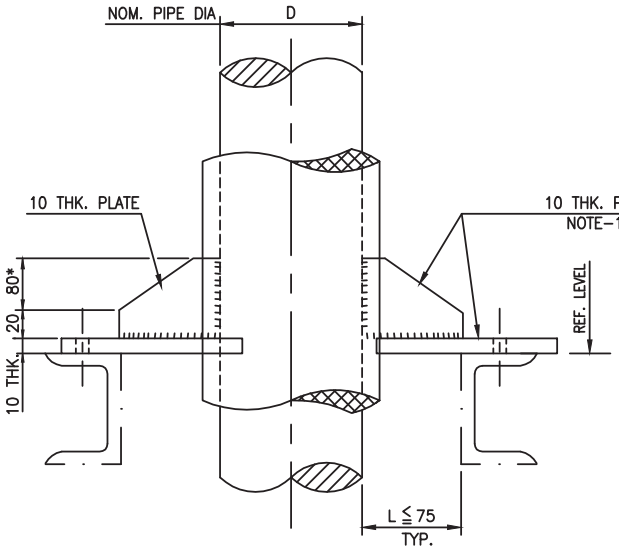
AUTOCAD

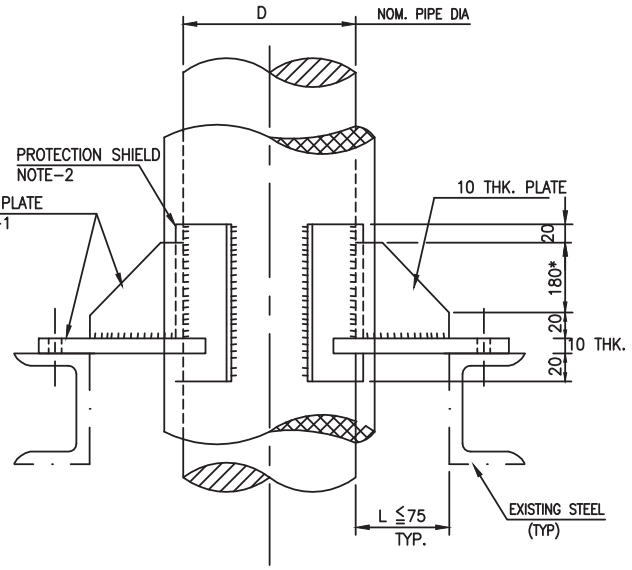


FOR SIZE 1" THRU 6"



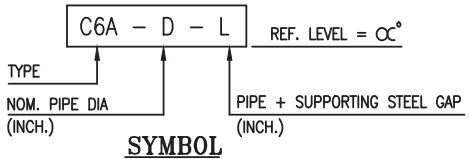
FOR SIZE 8" THRU 24"





D	1"	1½"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"
R	17	25	30	45	58	85	110	137	162	178	204	229	254	280	305
A	30	40	50	70	80	110	150	200	200	200	200	200	300	300	300
B	199	200	203	207	206	210	286	299	292	288	285	282	306	301	298
C	14	14	14	14	18	18	18	18	22	22	22	22	22	22	22
E	14	14	14	14	25	25	25	25	30	30	30	30	30	30	30
BOLT SIZE	M12 x 40				M16 x 50				M20 x 60						

INSULATED PIPE



SYMBOL

TEMPERATURE	PLATE MATERIAL
UPTO 343°C	IS-2062
344°C TO 427°	ASTM A516/A515 (GR.60/65/70) / IS-2002 GR.2
ABOVE 427°C	PIPE MATL. OR EQUIVALENT / SS-316 PLATE

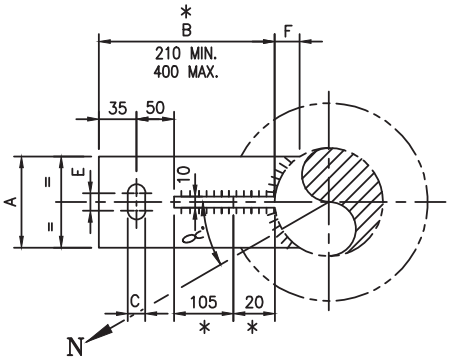
NOTES:-

FOR NOTES REFER SHEET 1 OF 2.

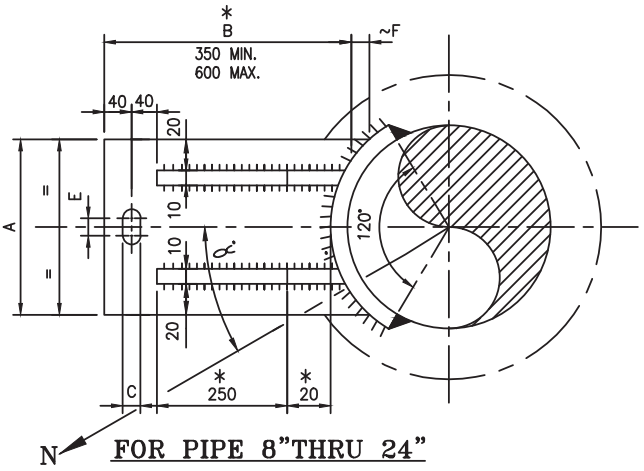
TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	SUPPORT LUGS FIXED FOR BARE/INSULATED PIPE SIZE 1" THRO 24" TYPE C6 & C6A	Standard Number: 03-PS-035 / Rev.: 4 / Sheet 2 of 2

AUTOCAD

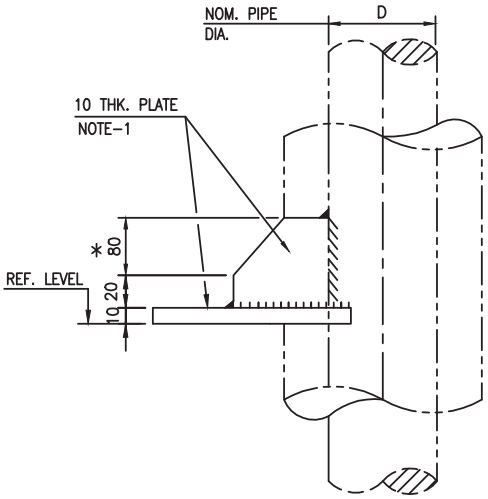
D	1"	1½"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
R	17	24	30	45	57	84	110	137	162	178	203	229	254	305
A	30	40	50	60	80	100	150	200	200	200	200	200	300	300
C	14	14	14	14	18	18	18	18	22	22	22	22	22	22
E	14	14	14	14	25	25	25	25	30	30	30	30	30	30
F	10	10	10	10	10	10	25	35	25	25	20	15	40	35
BOLT SIZE	M12 x 40				M16 x 50				M20 x 60					
BOLT MAT.	ASTM A193 GR. B7 / ASTM A194 GR.2H													

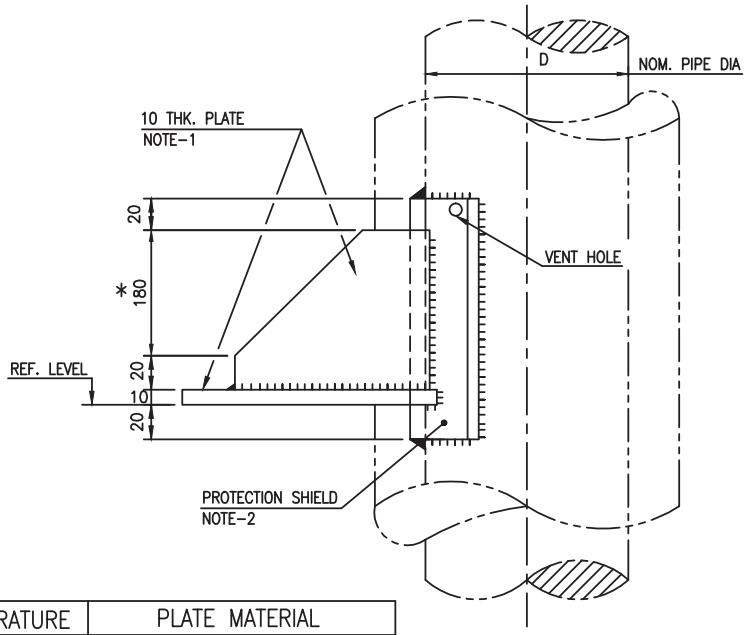


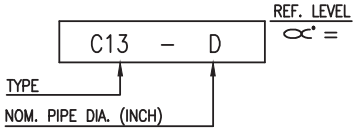
FOR PIPE 1"THRU 6"



FOR PIPE 8"THRU 24"







SYMBOL

TEMPERATURE	PLATE MATERIAL
UPTO 343° C	IS-2062 OR EQUIV.
343° C TO 427° C	ASTM A516/A515 (GR.60/65/70)/ IS-2002 GR.2 OR EQUIV.
ABOVE 427° C	PIPE MATERIAL OR EQUIVALENT/ SS-316 PLATE OR EQUIV.

NOTES :-

1. ALL PLATE MATERIAL SHALL BE AS PER THE ADJACENT TABLE.
2. PROTECTION-SHIELD SHALL BE CUT FROM LINE-PIPE OR ROLLED PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION-SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS. 10ø TELL-TALE HOLE TO BE PROVIDED.
3. DIMENSION MARKED WITH '*' SHALL BE SUITABLY REVISED IN CASE WHERE DISTANCE BETWEEN OUTER EDGE OF SUPPORTING STEEL AND O.D. OF PIPE EXCEEDS 75MM.
4. ALL PLATE MATERIAL SHALL BE AS PER THE ADJACENT TABLE.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	NRK	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

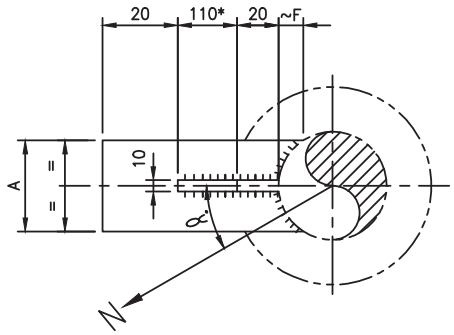
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

SUPPORT LUG (SINGLE) FIXED
FOR BARE AND INSULATED
PIPE SIZE 1" THRU 24" TYPE-C13

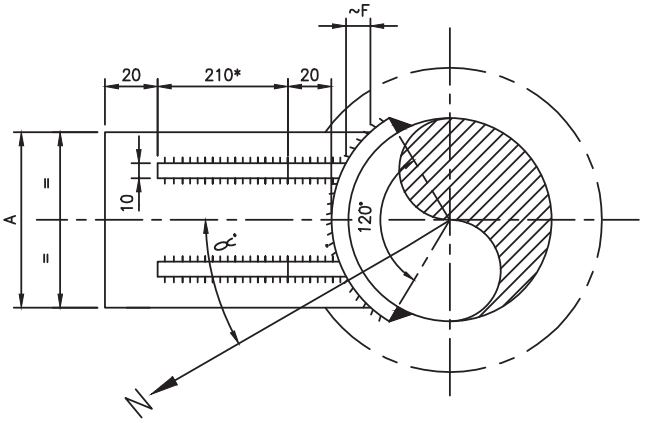
Standard Number	Rev.
03-PS-037	4
Sheet 1of 1	

AUTOCAD

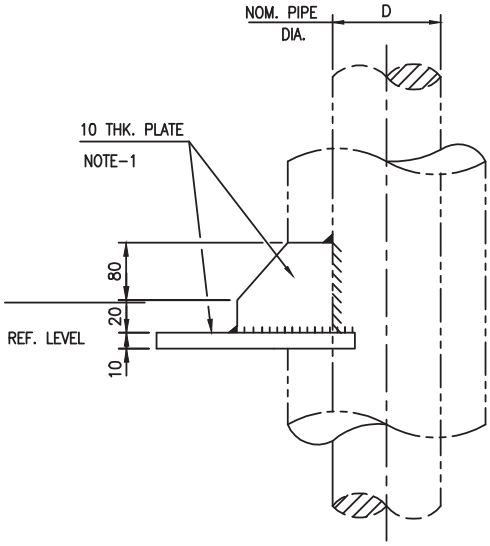
D	1"	1½"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	22"	24"
R	17	24	30	45	57	84	110	137	162	178	203	229	254	280	305
A	30	40	50	60	80	100	150	200	200	200	200	200	300	300	300
~F	10	10	10	10	10	10	25	35	25	25	20	15	45	35	35

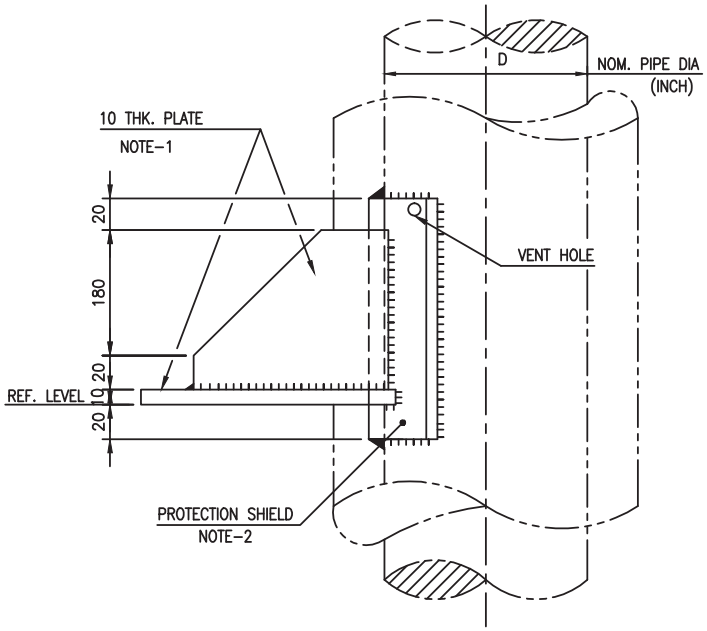


FOR PIPE 1"THRU 6"



FOR PIPE 8"THRU 24"

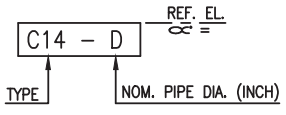




TEMPERATURE	PLATE MATERIAL
UPTO 343°C	IS-2062 OR EQUIVALENT
344°C TO 427°C	ASTM 516/A515 (GR.60/65/70)/IS-2002 GR.2
ABOVE 427°C	PIPE MATL. OR EQUIVALENT / SS-316

NOTES :-

1. ALL PLATE MATERAIL SHALL BE AS PER ABOVE TABLE.
2. PROTECTION SHIELD SHALL BE CUT FROM LINE PIPE OR ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE.THICKNESS OF PROTECTION -SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS. 10 ø TELL-TALE HOLE TO BE PROVIDED.
3. DIMENSIONS MARKED WITH * SHALL BE SUITABLY REVISED IN CASES WHERE DISTANCE BETWEEN OUTER EDGE OF SUPPORTING STEEL AND OD OF PIPE EXCEEDS 75MM.



SYMBOL

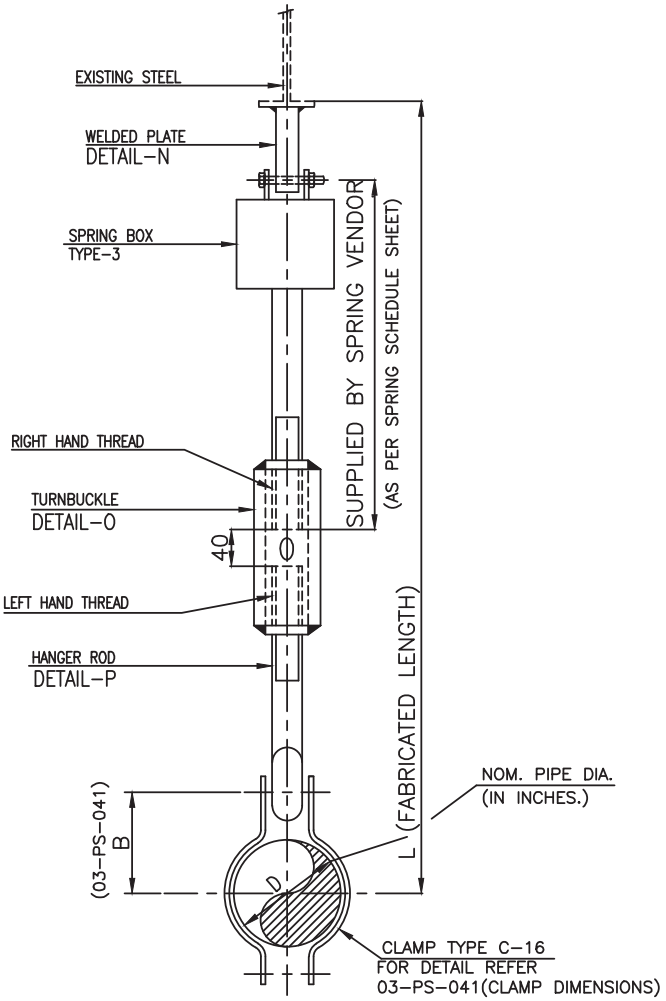
Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	RCB	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

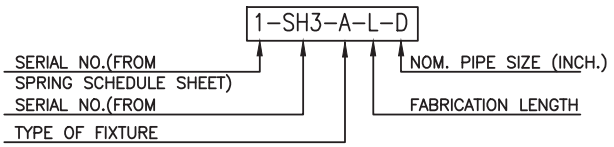
SUPPORT LUG (SINGLE) SLIDING FOR BARE AND INSULATED PIPE SIZE 1" THRU 24" TYPE-C14

Standard Number	Rev.
03-PS-039	4
Sheet 1of 1	

AUTOCAD



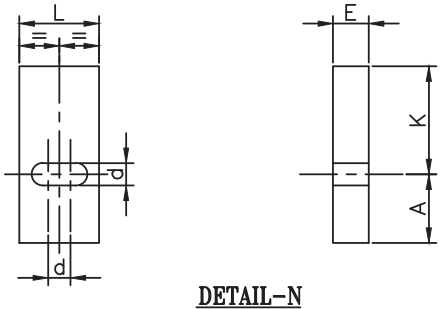
FIXTURE TYPE -A



SYMBOL

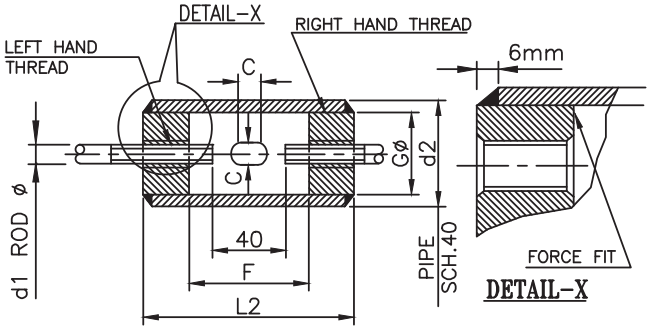
NOTES :

1. ALL MATERIALS ARE C.S UNLESS OTHER-WISE NOTED. EXCEPT MATERIAL FOR CLAMP AS PER STD 03-PS-041.
   D- NOM. PIPE DIA. IN INCHES
2. ALL THREADS ARE AS PER IS: 4218
3. 25mm ø ROD IS TO HAVE 24mm THREADING.
4. 28mm ø ROD IS TO HAVE 27mm THREADING.
5. PROTECTION SHIELD SHALL BE PROVIDED ON 8" AND HIGHER NPS FOR C.S. PIPE FOR A.S. AND S.S. PIPE IT SHALL BE PROVIDED ON ALL SIZES. IT SHALL BE CUT FROM LINE-PIPE ON ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE AND SHALL HAVE AN INCLUDED ANGLE OF 90°. IT SHALL BE POSITIONED SYMMERTICALLY THICKNESS OF PROTECTION-SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12mm, WHICHEVER IS LESS.



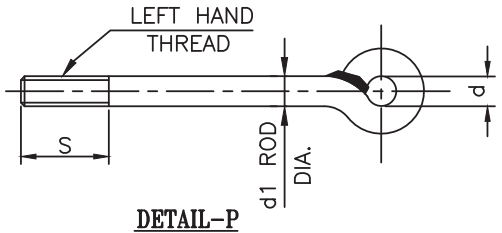
DETAIL-N

D	A	d	E	L	K
1",1 1/2",2"	25	14	12	100	75
3", 4"	30	18	16	130	80
6", 8"	40	27	25	130	80
10",12",14",16"	45	30	28	150	100
18", 20"	50	33	30	180	100
24"	55	39	36	220	120



DETAIL-O

D	C	d1	d2	L2	F	G
2"	15	12	2"	130	100	53
3",4"	15	16	2"	150	110	53
6",8"	15	25	2"	200	140	53
10",12",14",16"	20	28	3"	210	150	78
18",20"	20	30	3"	240	170	78
24"	20	36	3"	280	200	78



DETAIL-P

D	S	d1	d
1",1 1/2",2"	75	12	14
3",4"	85	16	18
6",8"	115	25	27
10",12",14",16"	130	28	30
18",20"	150	30	33
24"	170	36	39

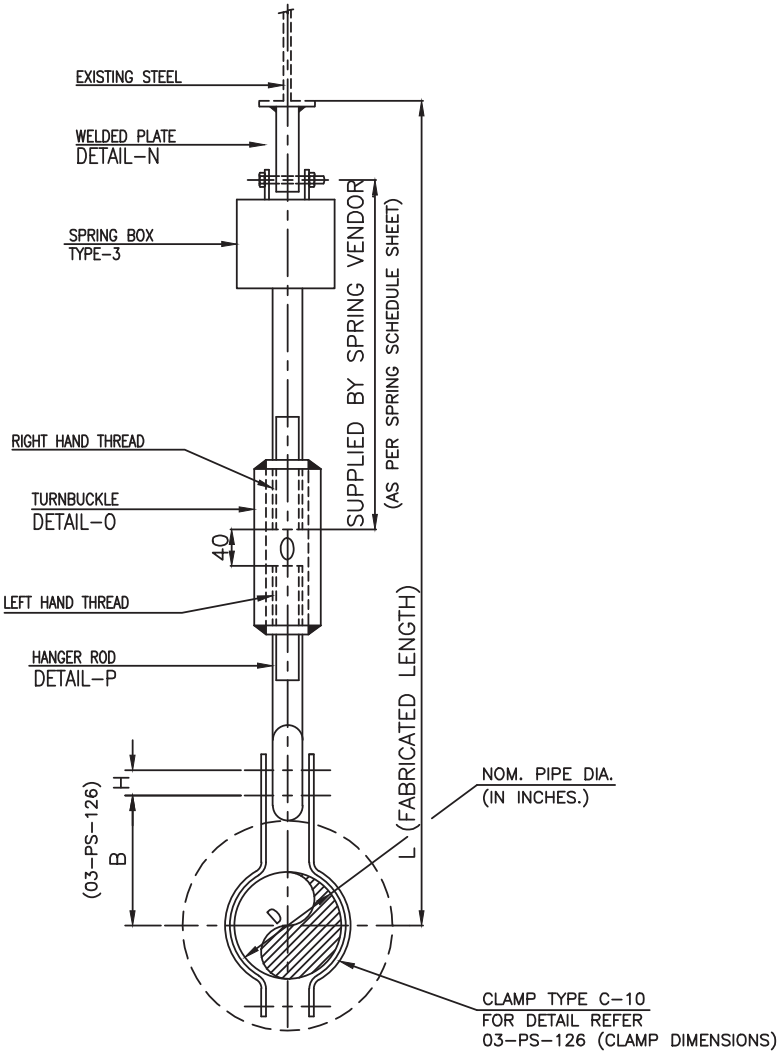
Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	AJW	DEP	SHR/BN
0	16-12-95	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

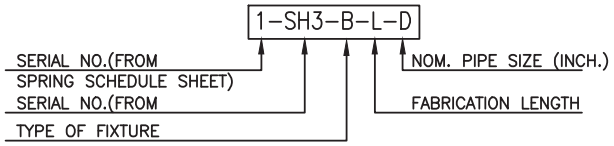
SPRING SUPPORT ARRANGEMENT
FOR BARE & INSULATED PIPE
SIZE 1" THRU 24" TYPE-SH3

Standard Number: 03-PS-090 | Rev.: 4

AUTOCAD



FIXTURE TYPE -B



SYMBOL

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	SPRING SUPPORT ARRANGEMENT FOR BARE & INSULATED PIPE SIZE 1" THRU 24" TYPE-SH3	Standard Number	Rev.
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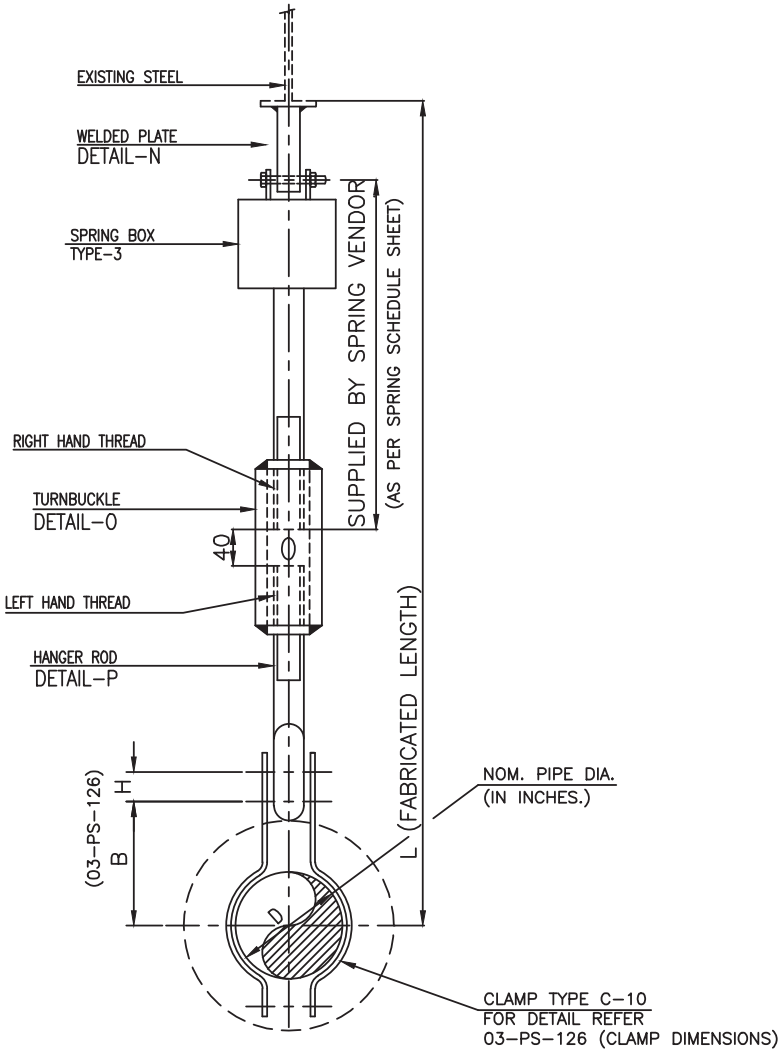
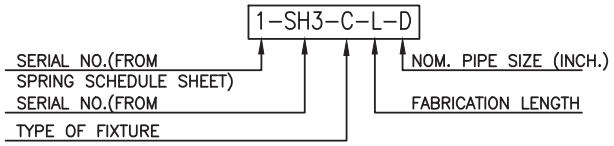
AUTOCAD



FIXTURE TYPE -C
ALLOY/S.S. PIPE



SYMBOL

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	SPRING SUPPORT ARRANGEMENT FOR BARE & INSULATED PIPE SIZE 1" THRU 24" TYPE-SH3	Standard Number	Rev.
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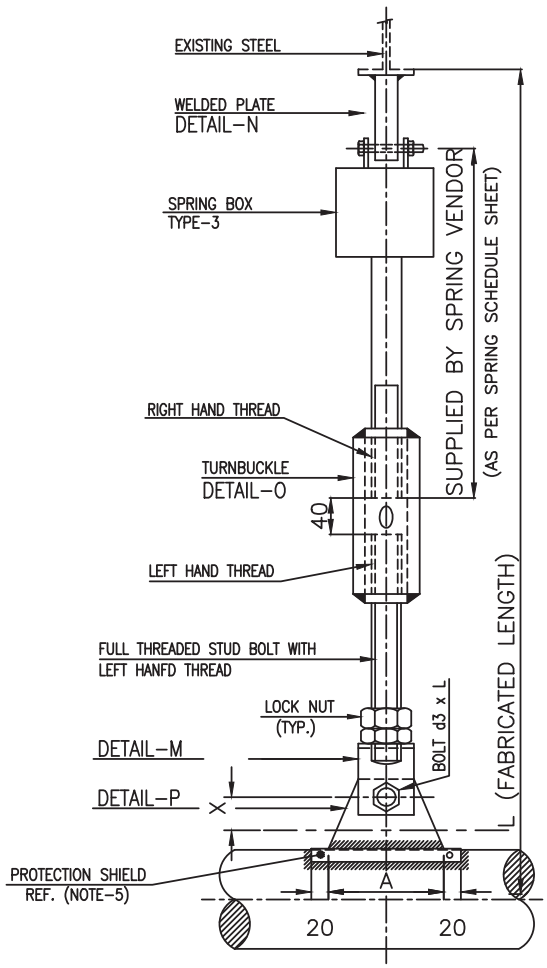
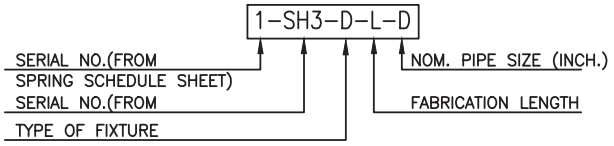
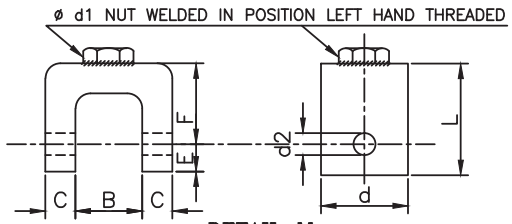


FIXTURE TYPE -D



SYMBOL

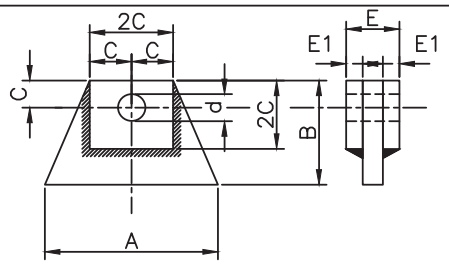


DETAIL-M

NOTES :

1. ALL THREADS ARE AS PER IS 4218

D	d1	B	C	d2	E	F	G	L	BOLT d3 x L
2"	12	30	8	14	30	75	80	105	12 x 90
3",4"	18	40	10	18	30	75	80	105	16 x 110
6",8"	25	40	12	27	40	75	100	115	24 x 120
10",12" 14",16"	28	45	16	30	45	75	100	120	27 x 140
18",20"	30	50	16	33	50	100	100	150	30 x 150
24"	36	60	20	39	60	100	130	160	36 x 180



DETAIL-P

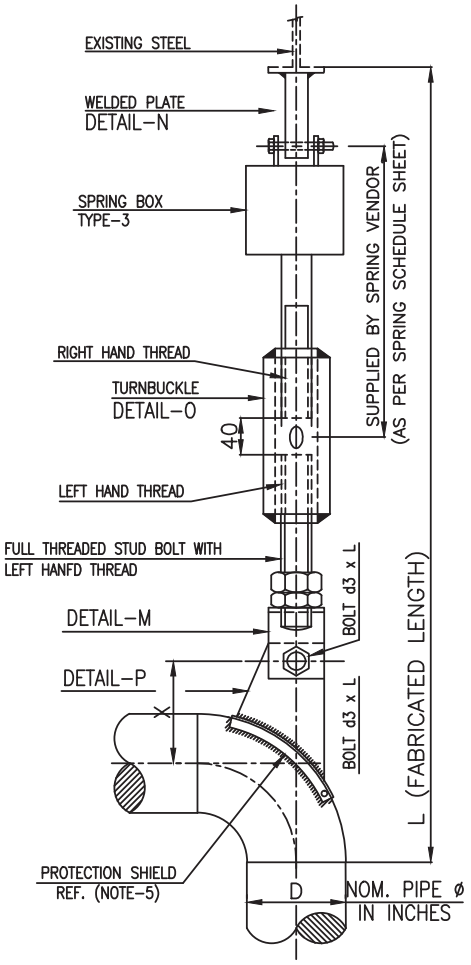
NOTES :

1. MATERIALS EQUIVALENT TO PIPE MATERIAL

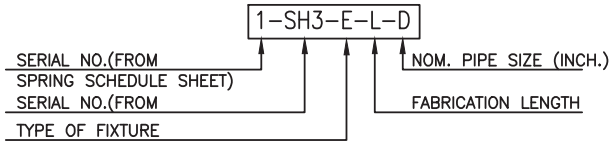
D	A	B	C	d	E	E1
2"	80	80	25	14	10	4
3",4"	100			18		
6",8"	120	100	30	27	14	4
10",12"	160	110	40	30	18	6
14",16"	200	140				
18",20"	260	150	50	33		
24"	280			39	22	15

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	SPRING SUPPORT ARRANGEMENT FOR BARE & INSULATED PIPE SIZE 1" THRU 24" TYPE-SH3	Standard Number: 03-PS-090 — Rev.: 4 Sheet 4 of 5

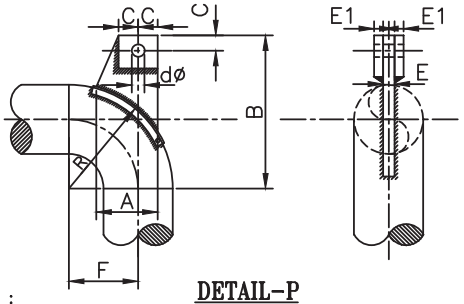
AUTOCAD



FIXTURE TYPE-E



SYMBOL



DETAIL-P

NOTES :

1. MATERIALS EQUIVALENT TO PIPE MATERIAL

D	A	B	C	d	E	E1	F	R
2"	80	150	25	14	10	4	76	106
3"		155		18			114	159
4"	100	170					152	209
6"	120	220	30	27	14		229	313
8"		280					305	415
10"	160	300		30			381	518
12"		360	40			6	457	619
14"	200	400			18		533	711
16"		460					610	813
18"	260	520	50	33			686	915
20"		560					762	1016
24"	280	620		39	22	10	914	1219

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	SPRING SUPPORT ARRANGEMENT FOR BARE & INSULATED PIPE SIZE 1" THRU 24" TYPE-SH3	Standard Number 03-PS-090	Rev. 4
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AUTOCAD

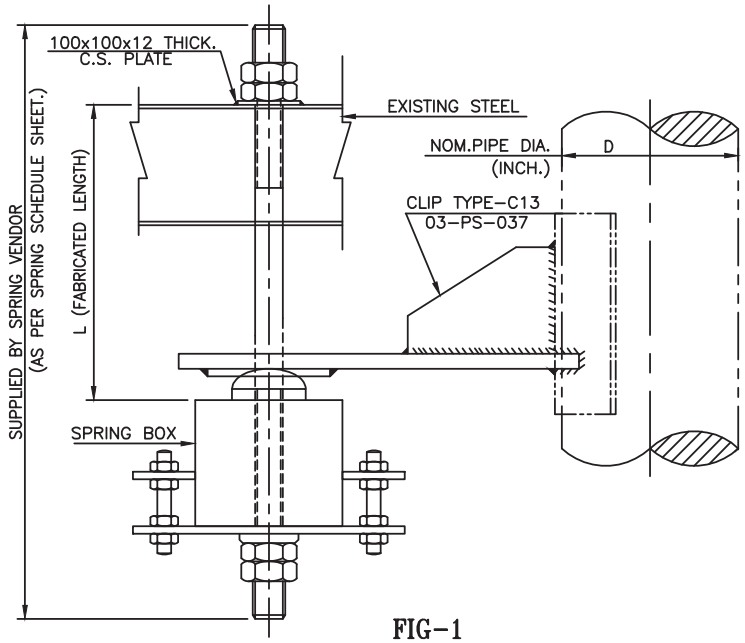


FIG-1

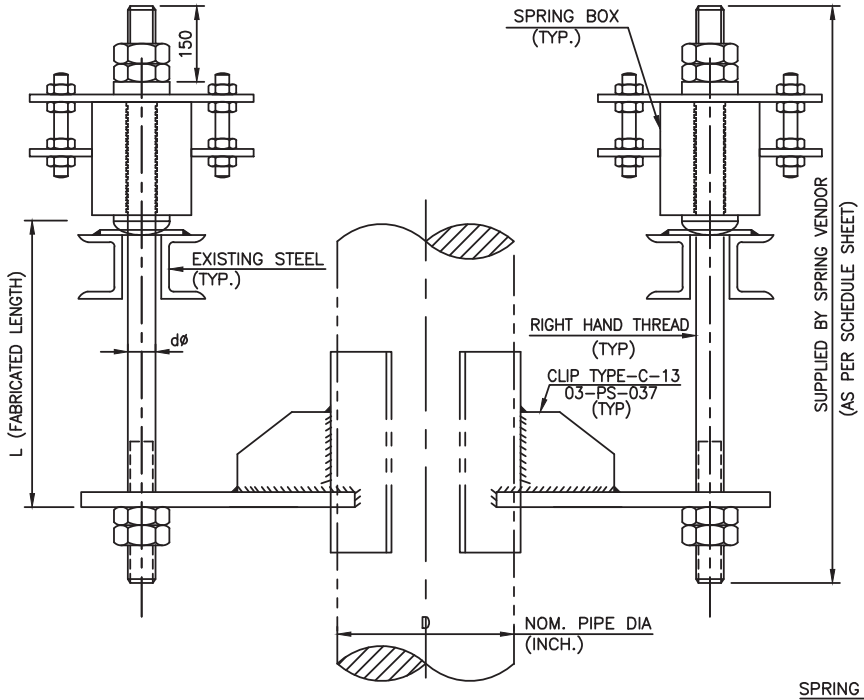
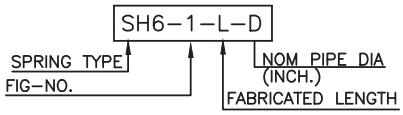


FIG-2

D	MAX.ALLOWABLE LOAD ON HANGER (KG)
1" TO 2"	450
3", 4"	800
6", 8"	1950
10" TO 16"	2600
18", 20"	3000
24"	4500



SYMBOL

NOTES:-

1. ALL MATERIALS ARE C.S. UNLESS OHERWISE NOTED.
2. WHEREVER THE SUPPORT IS SUBJECTED TO VIBRATION AN ADDITIONAL LOCK-NUT SHALL BE USED. BOLT LENGTH SHALL BE SUITABLY INCREASED TO ACCOMODATE THE LOCK NUT.
3. BOLTING MATERIAL-BOLTS TO IS-1367 CLASS 10.9 AND NUTS TO IS-1367 CLASS 12.

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0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

SPRING SUPPORT ARRANGMENT FOR BARE & INSULATED PIPE SIZE 2" THRU 24" TYPE-SH6

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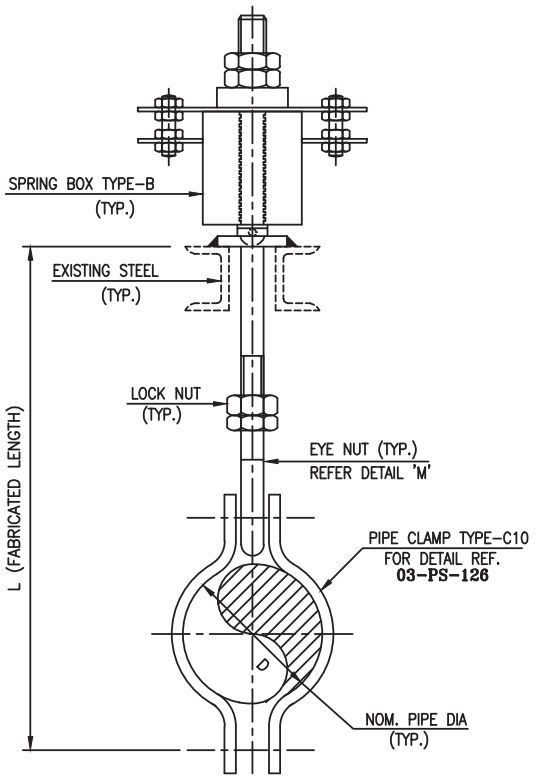
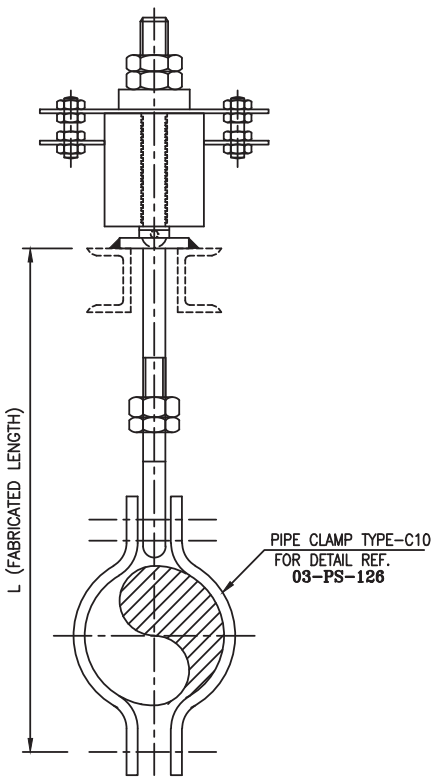
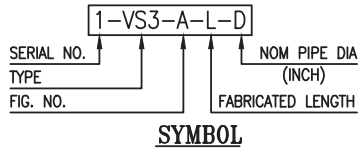
AUTOCAD



FIXTURE TYPE-A



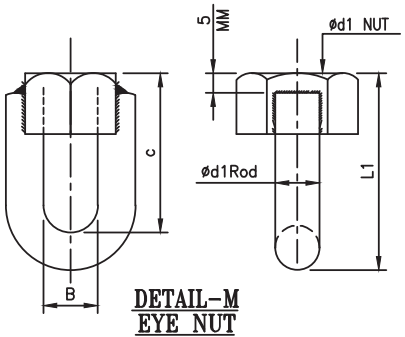
FIXTURE TYPE-B



SYMBOL

NOTES:-

1. WHRERever THE SUPPORT IS SUBJECTED TO VIBREATION AN ADDITIONAL LOCK-NUT SHALL BE UESD. BOLT LENGTH SHALL BE SUITABLY INCREASED TO ACCOMODIATE THE LOCK NUT.
2. PROTECTION SHIELD SHALL BE PROVIDED ON 8" AND HIGHER NPS FOR C.S. PIPE FOR A.S. AND S.S. PIPE IT SHALL BE PROVIDED ON ALL SIZES. IT SHALL BE CUT FROM LINE-PIPE ON ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE AND SHALL HAVE AN INCLUDED ANGLE OF 90°. IT SHALL BE POSITIONED SYMMERTICALLY THICKNESS OF PROTECTION-SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12mm, WHICHEVER IS LESS.
3. BOLTING MATERIAL - BOLTS TO IS-1367 CLASS 10.9 AND NUTS TO IS-1367 CLASS 12.
4. ENSURE THAT HORIZONTAL THERMAL PIPE MOVEMENT DOES NOT DEVELOP AN EXCESSIVE ANGLE +5° TO THE VERTICAL AXIS.
5. FIG.C SHOULD BE PREFFERED TO FIG.D.
6. FIG.D IS APPLICABLE FOR SIZE 2" AND ABOVE.
7. ALL THREADS SHALL BE AS PER IS*4218.



DETAIL-M
EYE NUT

D	d1	L1	C	B	MAXIMUM ALLOWABLE LOAD (KG)
1", 1½", 2"	12	75	63	14	450
3", 4"	16	100	84	18	800
6", 8"	25	125	100	27	1950
10",12",14",16'	28	145	117	30	2600
18', 20"	30	160	130	35	3000
24'	36	190	154	40	4500

D	MAX. ALLOWABLE LOAD(Kgs)
1"	450
1½"	
2"	
3"	800
4"	
6"	1950
8"	
10"	2600
12"	
14"	
16"	
18"	3000
20"	
24"	4500

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4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	MYS	DEP	SHR/BN
0	11-12-95	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

VARIABLE HANGER SPRING SUPPORT ARRANGEMENT FOR BARE & INSULATED PIPE SIZE 2" THRU 24" TYPE-VS3

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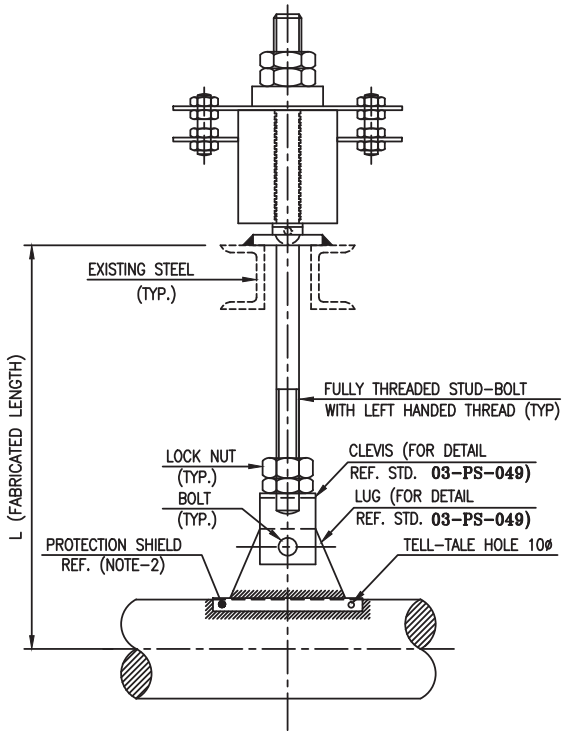
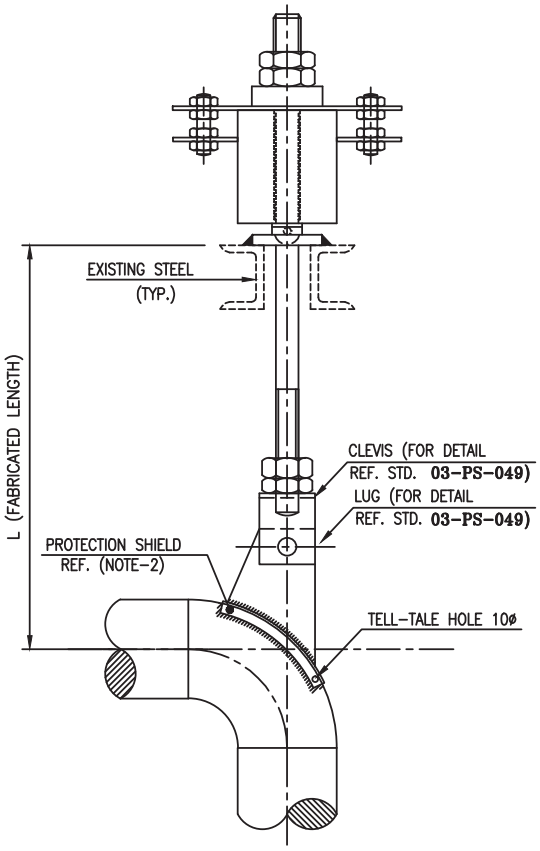
AUTOCAD



FIXTURE TYPE-C



FIXTURE TYPE-D
NOTE- 5, 6

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	VARIABLE HANGER SPRING SUPPORT ARRANGEMENT FOR BARE & INSULATED PIPE SIZE 2" THRU 24" TYPE-VS3	Standard Number 03-PS-130	Rev. 4
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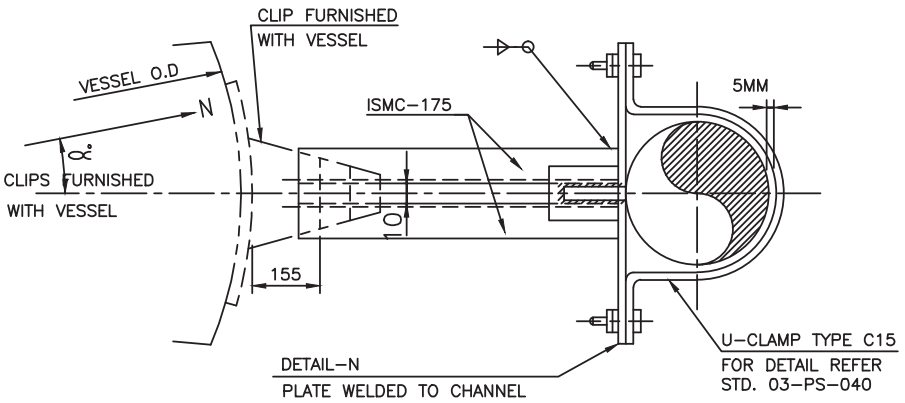
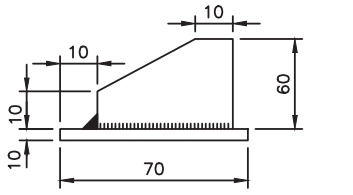
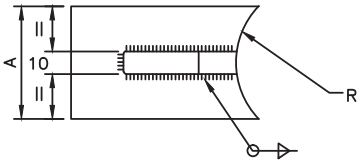
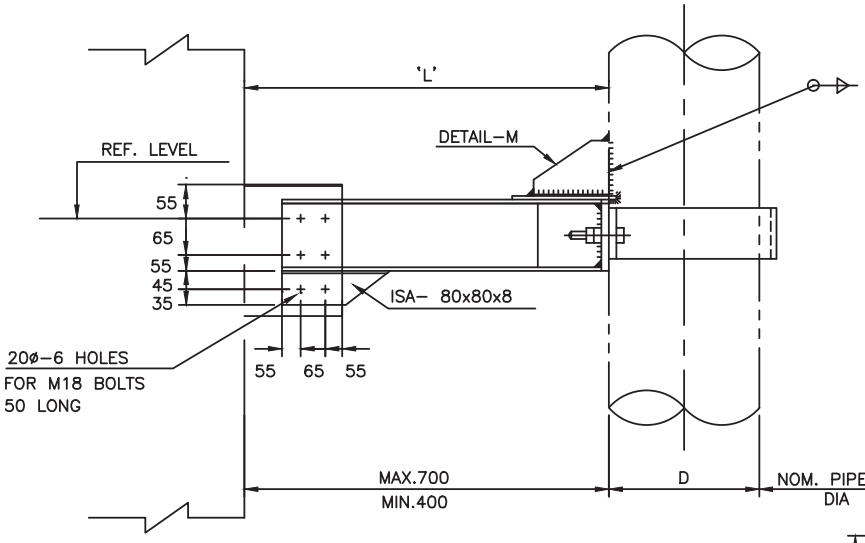
AUTOCAD



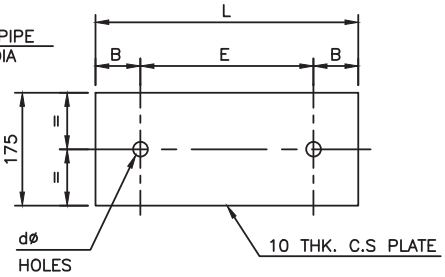






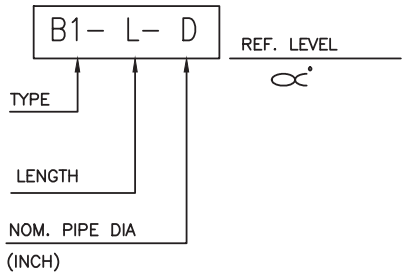
DETAIL-M

D	A	R
2"	50	30
3"	60	45
4"	80	57
6"	100	84



DETAIL-N

D	d	E	B	L
2"	14	116	25	166
3"	18	160	30	220
4"	18	180	30	240
6"	22	250	35	320



(SYMBOL)

NOTE :-

1. THIS SUPPORT CAN BE USED FOR ALLOY / SS PIPE FOR TEMP. UP TO 400°C.
2. MATERIAL FOR BOLTS IS : 1367 CLASS 10.9
   NUTS IS : 1367 CLASS 12
3. REF. STD. NO. 03-PS-118 FOR CLIP NO. 3
4. MATERIAL FOR DETAIL-M AND N SHALL BE IS-2062

MAX LOAD 2000 KG

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0	30-08-91	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	BRACKET ON VERTICAL COL. LOAD SUPPORT & VERTICAL GUIDE FOR BARE C.S. PIPE SIZE 2" THRU 6" TYPE-B1	Standard Number	Rev.
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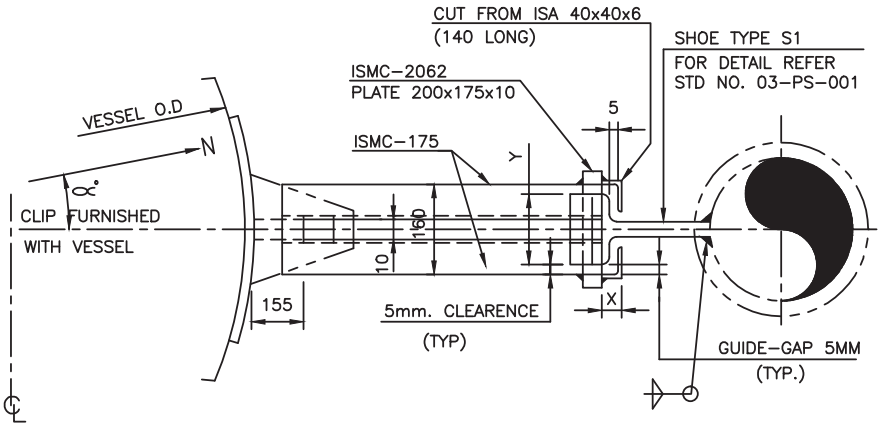
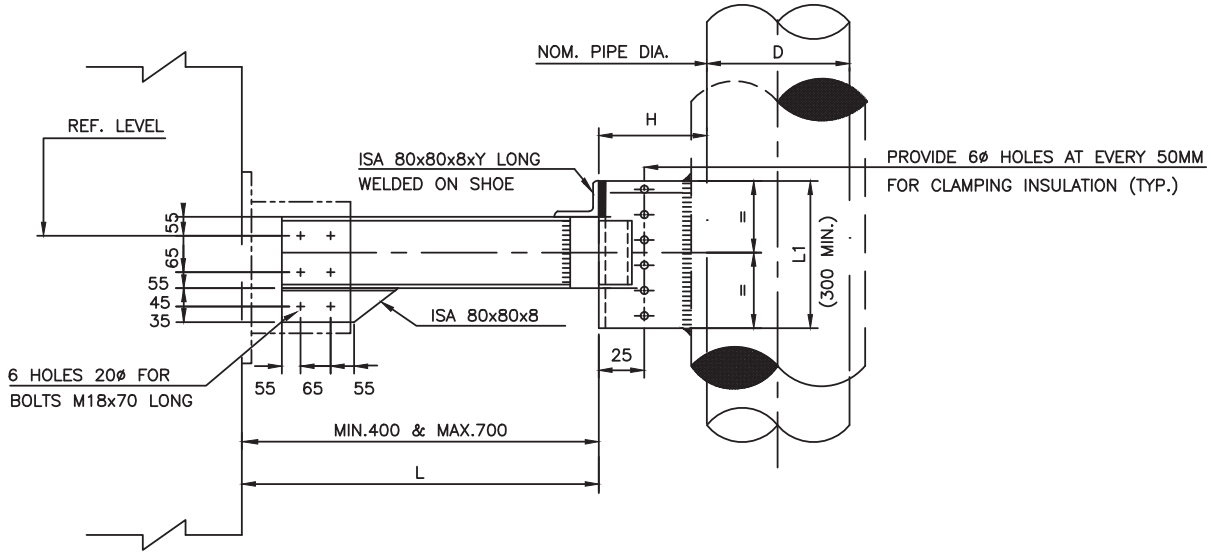
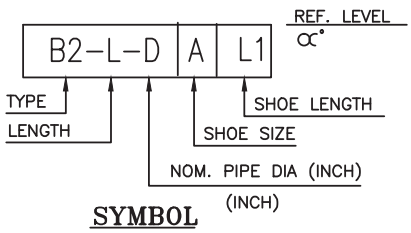
AUTOCAD







SYMBOL

SHOE DIMENSION AND MATERIAL (NOTE-3)					
INSUL. THK.	SHOE SIZE	H	CUT FROM ISMB	X	Y
UP TO 75	A	100	200	22	100
76 TO 125	B	150	300	24	140
126 TO 175	C	200	400	27	140

NOTE :

1. FOR INSULATION THICKNESS UPTO 75
   H=100, FOR INSULATION THICKNESS 76 TO 125, H=150
2. MATERIAL FOR BOLTS SHALL BE TO IS-1367 CLASS 10.9 AND NUTS TO IS-1367 CLASS 12.
3. REF. STD. NO. 03-PS-001 FOR OTHER DETAILS OF SHOE. FOR TEMPERATURE UPTO 343°C. FRO TEMP. 344°C TO 427°C REFER STD. 03-PS-006.
4. SHOE LENGTH SHALL BE TAKEN AS 300MM FOR VERTICAL MOVEMENT UPTO 100MM FOR HIGHER VERTICAL MOVEMENT, SHOE LENGTH SHALL BE SUITABLY INCREASED.
5. PLATE MATERIAL SHALL BE IS-2062 UPTO TEMP. 343°C & IS-2002/A516 FOR TEMPERATURE 344°C TO 427°C.

MAX LOAD 2000 KG

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0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	BRACKET ON VERTICAL COL. LOAD SUPPORT & VERTICAL GUIDE FOR INSULATED C.S. PIPE SIZE 2" THRU 6" TYPE-B2	Standard Number	Rev.
		03-PS-057	4
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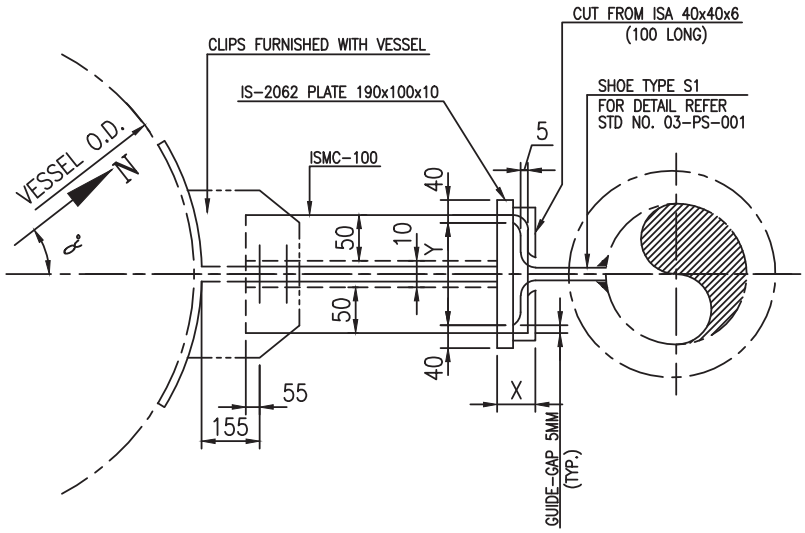
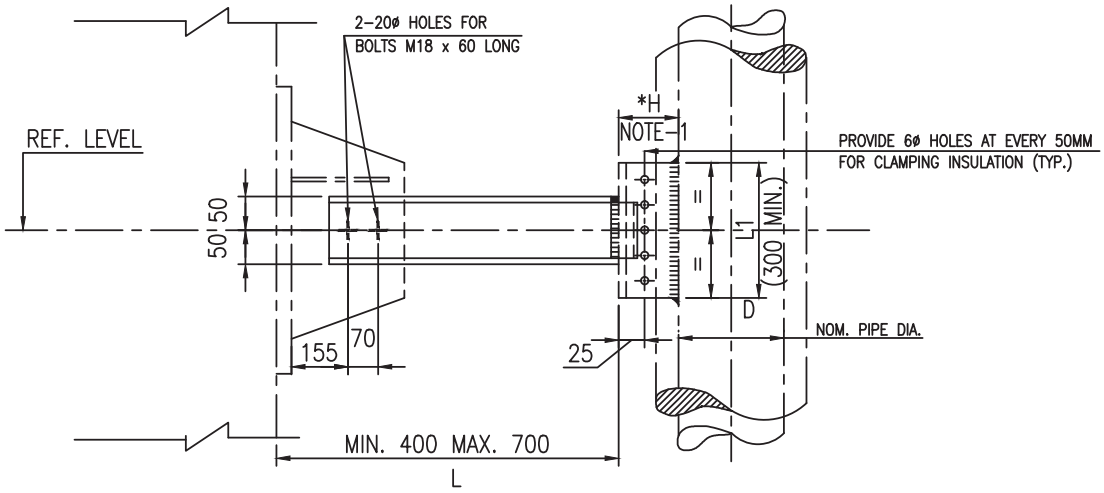
AUTOCAD



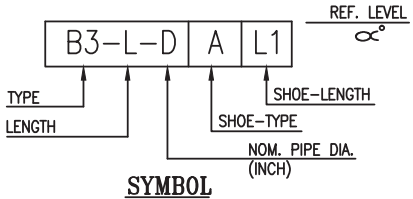


NOTE:-

1. FOR INSTALATION THICKNESS UP TO 75, H=100 AND 76 TO 125, H=150.
2. MATERIAL FOR BOLTS IS: 1367 CLASS 10.9
   NUTS IS: 1367 CLASS 12
3. REF. STD. NO. 03-PS-001 FOR OTHER DETAIL OF SHOE FOR TEMP. UPTO 343°C. FOR TEMP. 344°C TO 427° REF STD. 03-PS-006.
4. SHOE-LENGTH SHALL BE TAKEN AS 300MM FOR VERTICAL MOVEMENTS UPTO 100MM. FOR HIGHER VERTICAL MOVEMENTS, SHOE LENGTH SHALL BE SUITABLY INCREASED.
5. PLATE MATERIAL SHALL BE IS-2062 UPTO TEMP. 343°C & IS-2002/A516 FOR TEMP. 344°C TO 427°C.

SHOE DIMENSION AND MATERIAL

INSUL. THK.	SHOE TYPE	H	CUT FROM ISMB	X	Y
UP TO 75	A	100	200	22	100
76 TO 125	B	150	300	24	140
126 TO 175	C	200	400	27	140



SYMBOL

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	MYS	DEP	BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

BRACKET ON VERTICAL COLUMN
VERTICAL GUIDE FOR INSULATED
C.S. PIPE SIZE 2" THRU 6" TYPE-B3

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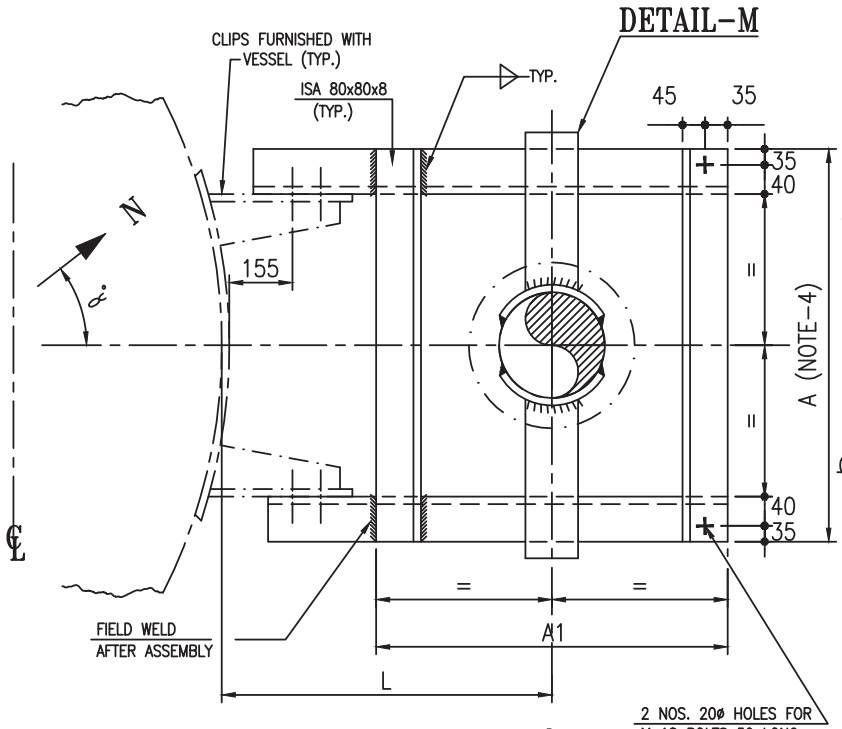
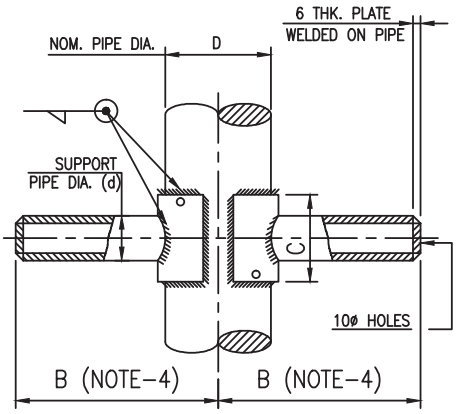
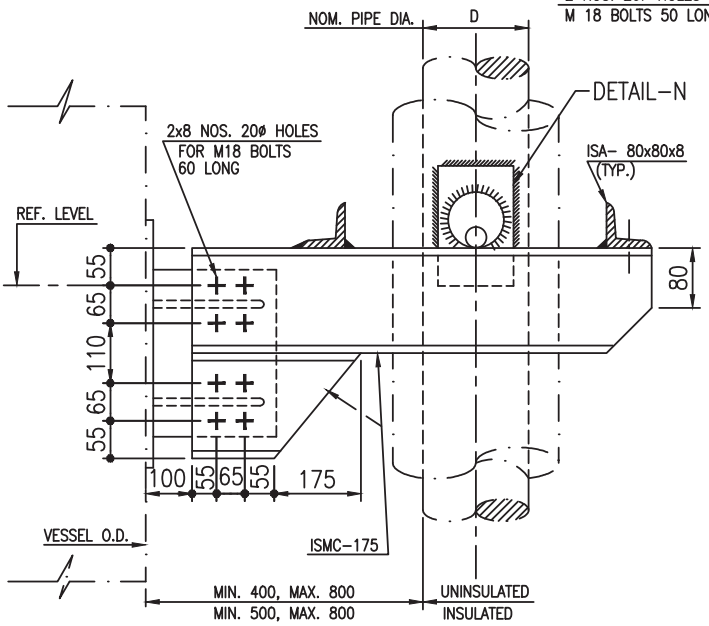
AUTOCAD

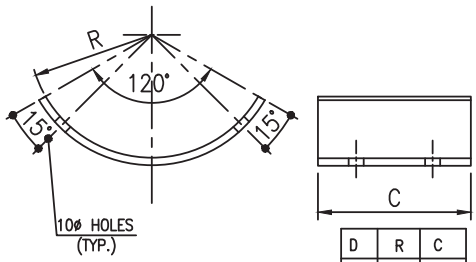




DETAIL-M
(SUPPORT PIPE MAT. SAME AS LINE PIPE)

D	d NOTE 1
8"	4" SCH.40
10"	6" SCH.40
12"	6" SCH.40





DETAIL-N
PROTECTION SHIELD (NOTE-2)

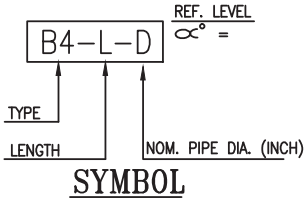
D	R	C
8"	110	230
10"	137	340
12"	162	340

MAX.LOAD 3000 kg

D	FOR BARE PIPE		FOR INSUL.THK. UPTO 75MM		FOR INSUL.THK. 76MM TO 125MM		FOR MAX.INSUL. THICKNESS	
	A	B	A	B	A	B	A	B
8"	430	225	580	300	680	350	740 (155*)	380
10"	484	252	640	330	740	380	820 (165*)	420
12"	534	277	690	355	790	405	880 (170*)	450

NOTE:-

1. IN CASE SIZE AND/OR SCH. OF SUPPORT PIPE (d) LISTED IN THE TABLE IS NOT AVAILABLE USE NEXT HIGHER SIZE AND/OR NEAREST EQUIVALENT THICKNESS AVAILABLE.
2. PROTECTION SHIELD SHALL BE CUT FROM LINE PIPE OR ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION-SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS.
3. MATERIAL OF BOLTS AND NUTS SHALL BE IS: 1367 CLASS 10.9 AND IS: 1367 CLASS 12 RESPECTIVELY.
4. FIGURES IN BRACKETS MARKED WITH AN* INDICATE THE MAXIMUM INSULATION THICKNESS APPLICABLE. IF REQUIRED, DIMENSIONS 'A' & 'B' SHALL BE CALCULATED BASED UPON THE ACTUAL INSULATION THICKNESS.



SYMBOL

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	SUD	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

BRACKET ON VERTICAL COLUMN LOAD SUPPORT FOR BARE & INSULATED PIPE SIZE 8" THRU 12" TYPE-B4

Standard Number	Rev.
03-PS-059	4
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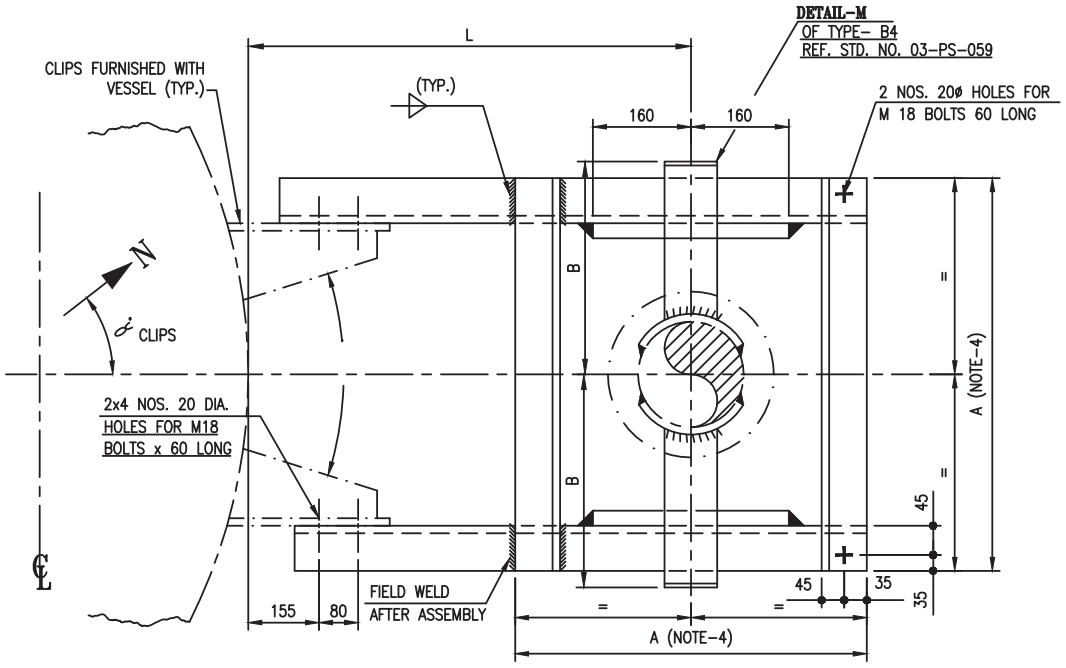
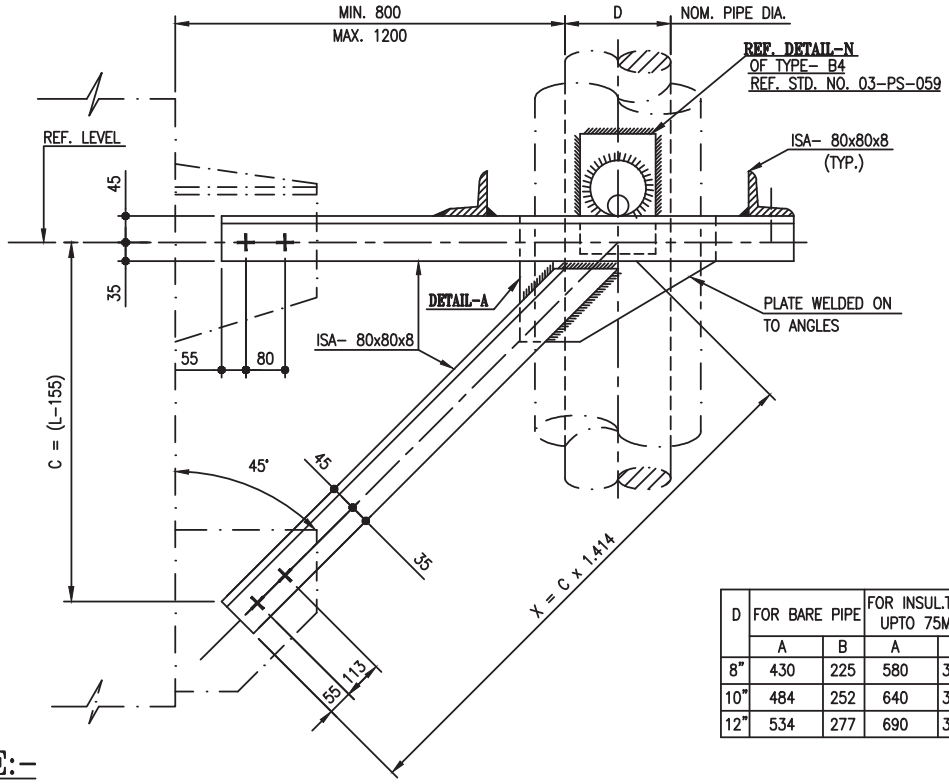
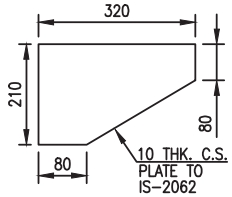
AUTOCAD





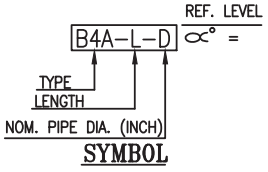


DETAIL-A

D	FOR BARE PIPE		FOR INSUL.THK. UPTO 75MM		FOR INSUL.THK. 76MM TO 125MM		FOR MAX.INSUL. THICKNESS	
	A	B	A	B	A	B	A	B
8"	430	225	580	300	680	350	740 (155*)	380
10"	484	252	640	330	740	380	820 (165*)	420
12"	534	277	690	355	790	405	880 (170*)	450

NOTE:-

1. IN CASE SIZE AND/OR SCH. OF SUPPORT PIPE (d) LISTED IN THE TABLE IS NOT AVAILABLE USE NEXT HIGHER SIZE AND/OR NEAREST EQUIVALENT THICKNESS AVAILABLE.
2. PROTECTION SHIELD SHALL BE CUT FROM LINE PIPE OR ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION-SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS.
3. MATERIAL OF BOLTS AND NUTS SHALL BE IS: 1367 CLASS 10.9 AND IS: 1367 CLASS 12 RESPECTIVELY.
4. FIGURES IN BRACKETS MARKED WITH AN* INDICATE THE MAXIMUM INSULATION THICKNESS APPLICABLE. IF REQUIRED, DIMENSIONS 'A' & 'B' SHALL BE CALCULATED BASED UPON THE ACTUAL INSULATION THICKNESS.



SYMBOL

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	SUD	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

BRACKET ON VERTICAL COLUMN LOAD SUPPORT FOR BARE & INSULATED PIPE SIZE 8" THRU 12" TYPE-B4A

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03-PS-060	4
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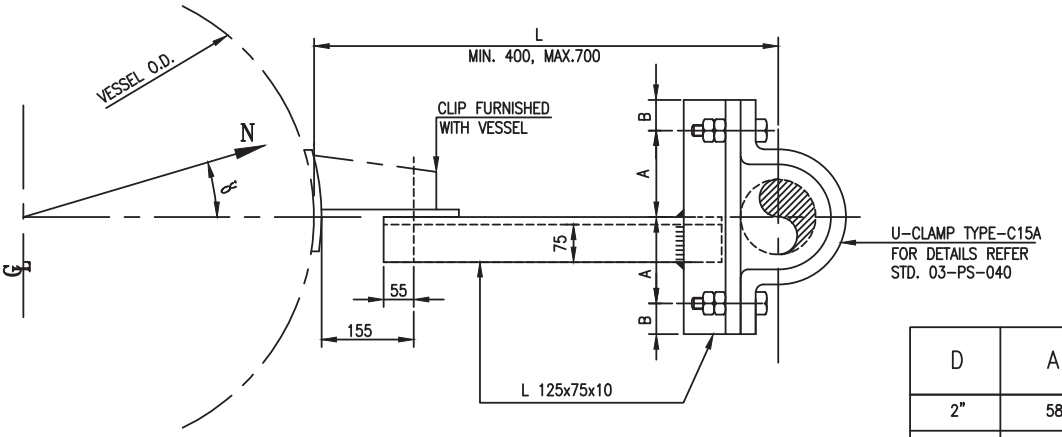
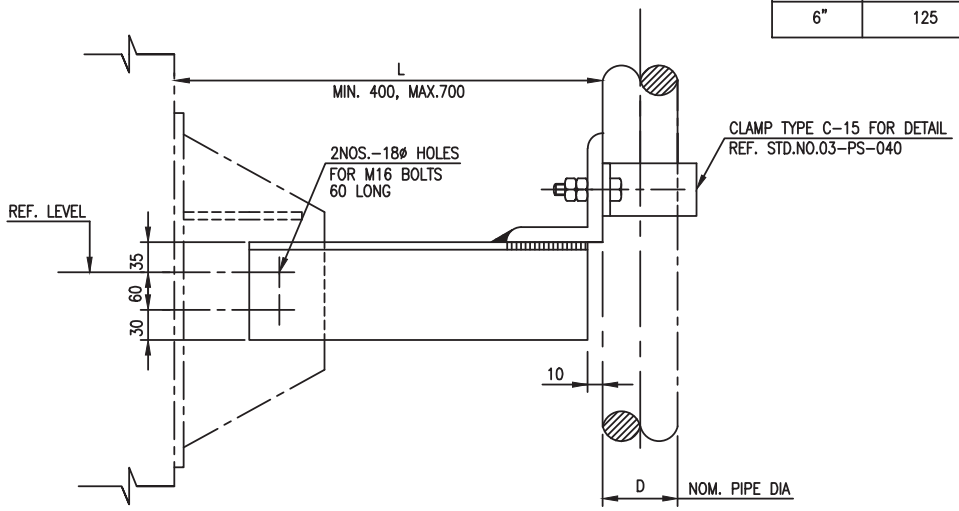
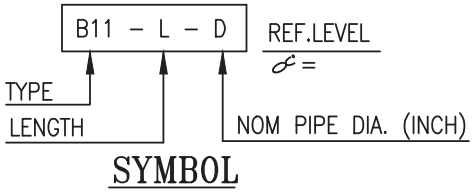
AUTOCAD



D	A	B
2"	58	25
3"	80	30
4"	90	30
6"	125	35





SYMBOL

NOTES:-

1. MATERIAL FOR BOLTS SHALL BE TO IS:1367 CLASS 10.9 AND FOR NUTS TO IS:1367 CLASS 12.
2. THIS SUPPORT SHALL ONLY BE USED FOR LINE OPERATING TEMPERATURES UPTO 232° C.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RP	DEP	SHR/BN
0	30-08-91	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	BRACKET ON VERTICAL COLUMN VERTICAL GUIDE FOR BARE C.S PIPE SIZE 2" THRU 6", TYPE-B11	Standard Number	Rev.
		03-PS-061	4
		Sheet 1 of 1	

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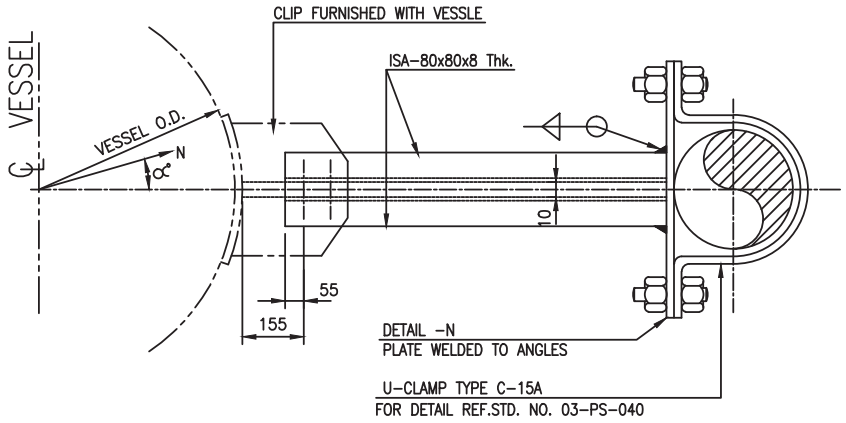
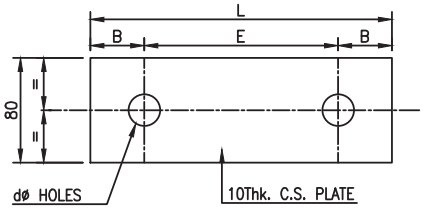
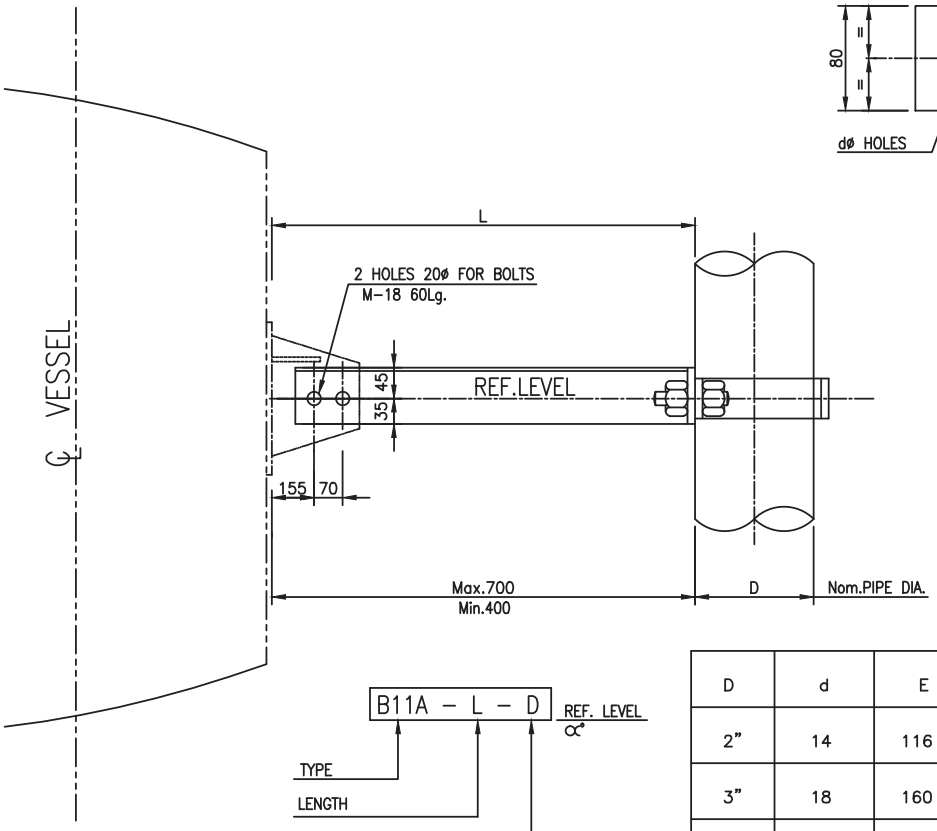




DETAIL -N



D	d	E	B	L
2"	14	116	25	166
3"	18	160	30	220
4"	18	180	30	240
6"	22	250	35	320

NOTES:-

1. MATERIAL FOR BOLTS SHALL BE TO IS:1367 CLASS 10.9 AND FOR NUTS TO IS:1367 CLASS 12.
2. THIS SUPPORT SHALL ONLY BE USED FOR LINE OPERATING TEMPERATURES UPTO 232° C.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	NRK	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	BRACKET ON VERTICAL COL. VERTICAL GUIDE FOR BARE PIPE SIZE 2" THRU 6" TYPE-B11A	Standard Number	Rev.
		03-PS-062	4
		Sheet 1of 1	

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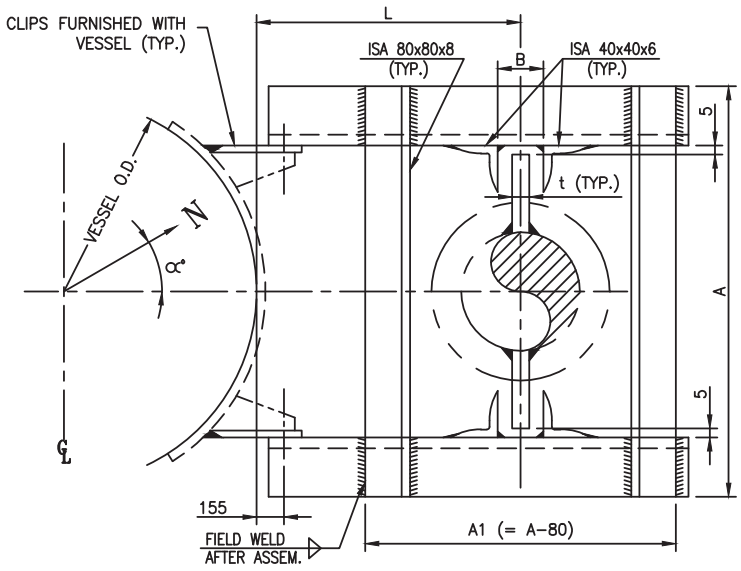


D	B	t
2" TO 4"	14	8
6" TO 8"	16	10
10" TO 24"	18	12

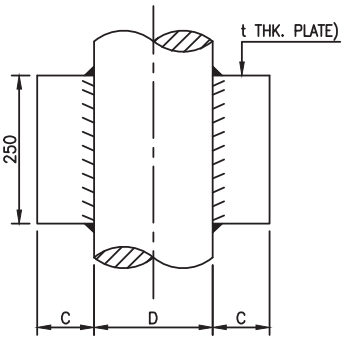
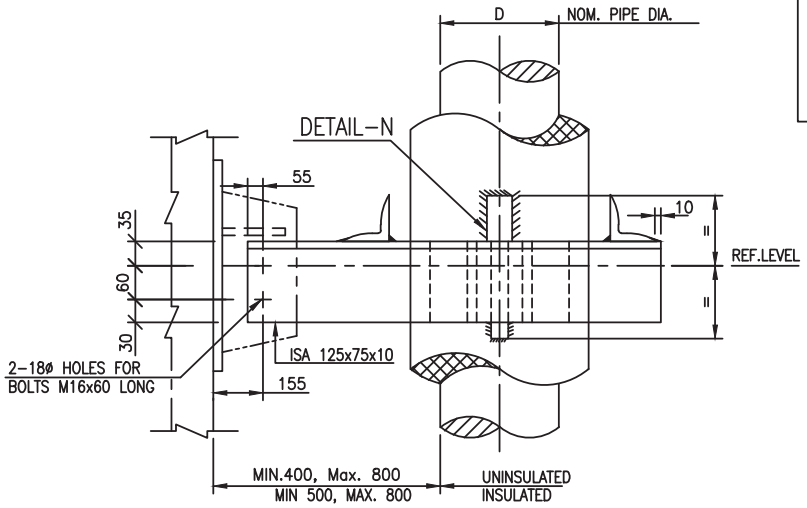
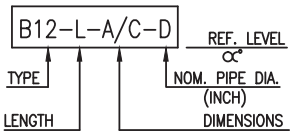


PLATE MATERIAL FOR DETAIL-N

TEMPERATURE	PLATE MATERIAL
UPTO 343°C	IS-2062
344°C TO 427°C	ASTM 516/A515 (GR.60/65/70)/IS-2002 GR.2





SYMBOL

D	FOR BARE PIPE		FOR INSUL. THK. UP TO 75MM		FOR INSUL. THK. 76MM TO 125MM		FOR MAX. INSUL. THICKNESS	
	A	C	A	C	A	C	A	C
2"	350	65	500	140	600	190	590 (120*)	185
3"	379	65	529	140	629	190	639 (130*)	195
4"	405	65	555	140	655	190	675 (135*)	200
6"	459	65	609	140	709	190	759 (150*)	215
8"	510	65	660	140	760	190	820 (155*)	220
10"	564	65	714	140	814	190	894 (165*)	230
12"	614	65	764	140	864	190	954 (170*)	235
14"	646	65	796	140	896	190	986 (170*)	235
16"	697	65	847	140	947	190	1047 (175*)	240
18"	748	65	898	140	998	190	1108 (180*)	245
20"	798	65	948	140	1048	190	1158 (180*)	245
22"	849	65	999	140	1099	190	1209 (180*)	245
24"	900	65	1050	140	1150	190	1260 (180*)	245

NOTES:-

1. UP TO 6" SIZE, USE TYPE B11A (03-PS-063) FOR BARE AND B3 (03-PS-058) FOR INSULATED PIPE IN PREFERENCE TO THIS TYPE.
2. PROTECTION SHIELD SHALL BE CUT FROM LINE-PIPE OR ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION-SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS. 10ø TELL-TALE HOLE TO BE PROVIDED.
3. MATERIAL OF BOLTS AND NUTS SHALL BE IS:1367 CLASS 10.9 AND IS:1367 CLASS 12 RESPECTIVELY.
4. FIGURES IN BRACKETS MARKED WITH AN * INDICATE THE MAXIMUM INSULATION THICKNESS APPLICABLE. IF REQUIRED, DIMENSION 'A' & 'C' SHALL BE CALCULATED BASED UPON THE ACTUAL INSULATION THICKNESS.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	RCB	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

BRACKET ON VERTICAL COLUMN
VERTICAL GUIDE FOR BARE & INSULATED
C.S. PIPE SIZE 2" THRU 24" TYPE B12

Standard Number: 03-PS-063 | Rev.: 4

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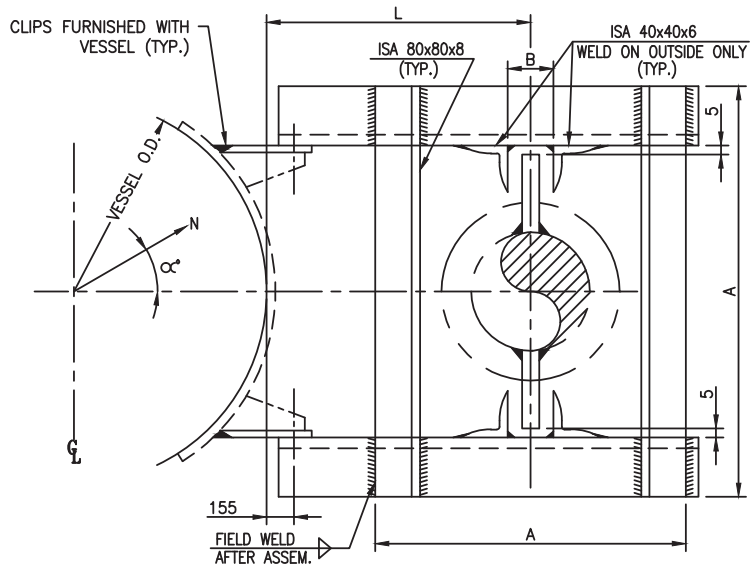
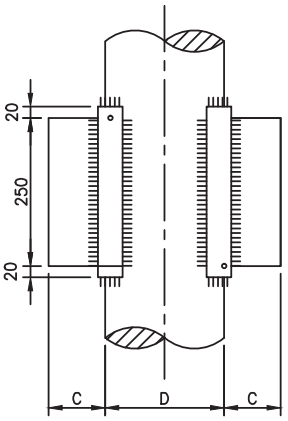
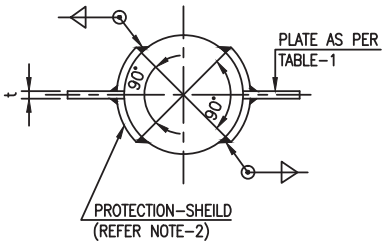






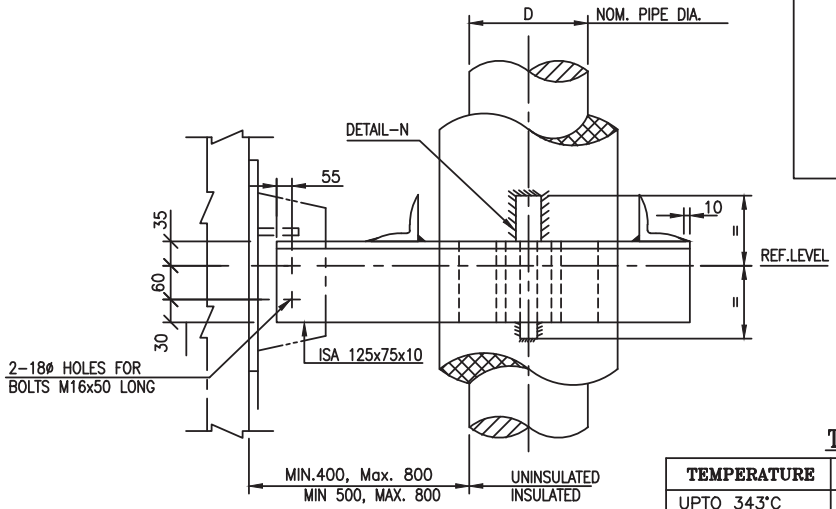
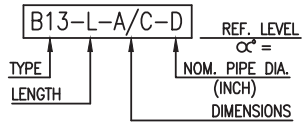


TABLE-1

TEMPERATURE	PLATE MATERIAL
UPTO 343°C	IS-2062
344°C TO 427°C	ASTM 516/A515 (GR.60/65/70)/IS-2002 GR.2
ABOVE 427°C	PIPE MATERIAL OR EQUIVALENT AISI-304/316/321/347 PLATE

D	B	t
2" TO 4"	14	8
6" TO 8"	16	10
10" TO 24"	18	12



SYMBOL

D	FOR BARE PIPE		FOR INSUL. THK. UP TO 75MM		FOR INSUL. THK. 76MM TO 125MM		FOR MAX. INSUL. THICKNESS	
	A	C	A	C	A	C	A	C
2"	350	65	500	140	600	190	590 (120*)	185
3"	379	65	529	140	629	190	639 (130*)	195
4"	405	65	555	140	655	190	675 (135*)	200
6"	459	65	609	140	709	190	759 (150*)	215
8"	510	65	660	140	760	190	820 (155*)	220
10"	564	65	714	140	814	190	894 (165*)	230
12"	614	65	764	140	864	190	954 (170*)	235
14"	646	65	796	140	896	190	986 (170*)	235
16"	697	65	847	140	947	190	1047 (175*)	240
18"	748	65	898	140	998	190	1108 (180*)	245
20"	798	65	948	140	1048	190	1158 (180*)	245
22"	849	65	999	140	1099	190	1209 (180*)	245
24"	900	65	1050	140	1150	190	1260 (180*)	245

NOTES:-

1. UP TO 6" SIZE, USE TYPE B11A (03-PS-063) FOR BARE AND B27 (03-PS-076) FOR INSULATED PIPE IN PREFERENCE TO THIS TYPE.
2. PROTECTION SHIELD SHALL BE CUT FROM LINE-PIPE OR ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION-SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS. 10ø TELL-TALE HOLE TO BE PROVIDED.
3. MATERIAL OF BOLTS AND NUTS SHALL BE IS:1367 CLASS 10.9 AND IS:1367 CLASS 12 RESPECTIVELY.
4. FIGURES IN BRACKETS MARKED WITH AN * INDICATE THE MAXIMUM INSULATION THICKNESS APPLICABLE. IF REQUIRED, DIMENSION 'A' & 'C' SHALL BE CALCULATED BASED UPON THE ACTUAL INSULATION THICKNESS.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	RCB	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

BRACKET ON VERTICAL COLUMN
VERTICAL GUIDE FOR BARE & INSULATED
AS/SS PIPE SIZE 2" THRU 24", TYPE-B13

Standard Number	Rev.
03-PS-064	4
Sheet 1of 1	

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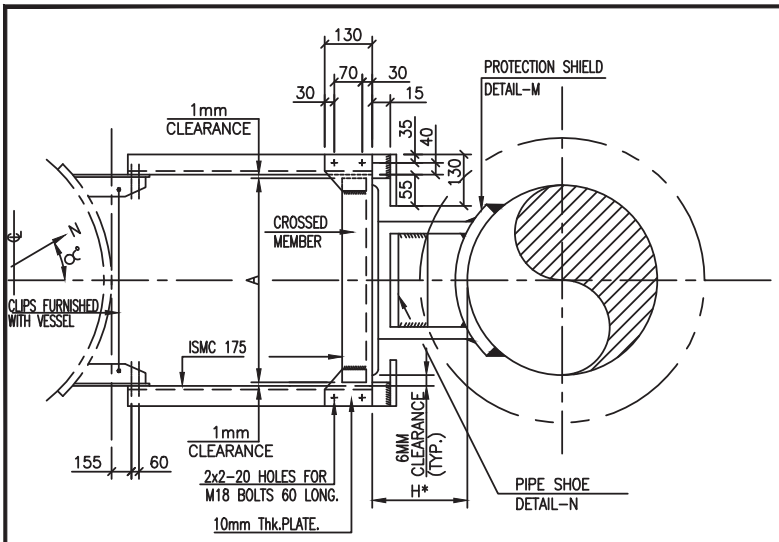
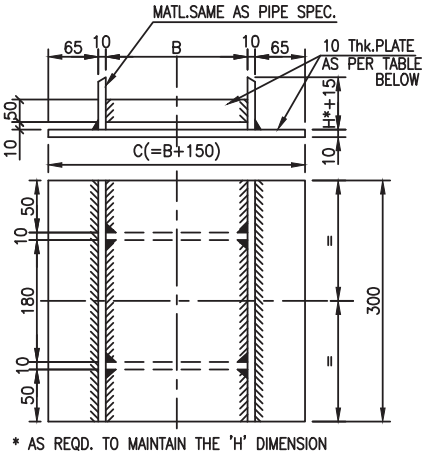
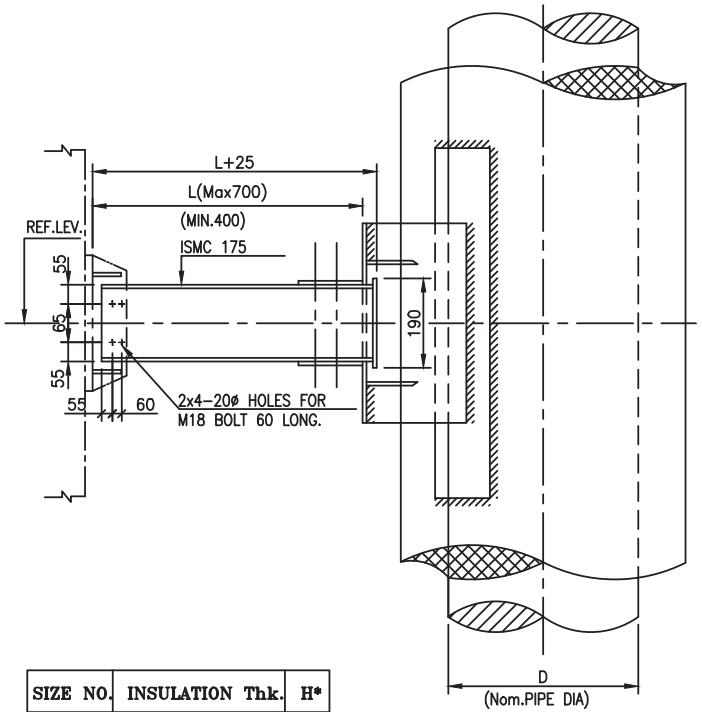
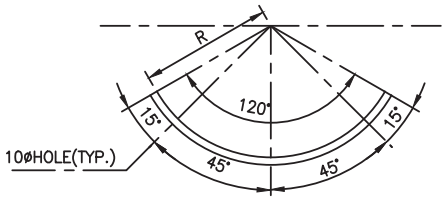
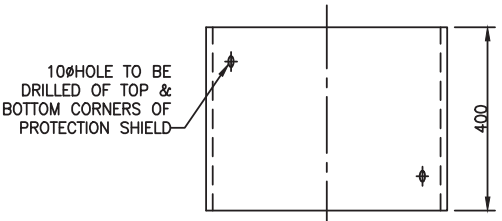




DETAIL-N







DETAIL-M
(NOTE-1)

SIZE NO.	INSULATION Thk.	H*
1	UP TO 75	100
2	76 TO 100	150
3	126 TO 175	200

PIPE MATL.	TEMPERATURE	SHOE MATERIAL	
		SIDE PLT. & RIBS	BASE PLT.
CS/ AS/ SS/	UPTO 343°C	IS-2062	IS-2062
	344°C TO 427°C	ASTM 516/A515 (GR.60/ 65/70)/IS-2002 GR.2	IS-2062
AS/SS	ABOVE 427°C	PIPE MATERIAL OR EQUIVALENT AISI-316 PLATE	

D	8"	10"	12"	14"	16"	18"	20"	22"	24"
CROSS MEMBER DIMN.-'A'	310	330	350	370	410	430	460	490	530
SHOE DIMN.-'B'	150	170	190	210	250	270	300	330	370
PROTECTION SHIELD.-'R'	110	137	162	178	203	229	254	279	305

REF. LEVEL
α° =

B16-1-L-D-L1

- TYPE
- SIZE NO.
- LENGTH
- NOM. PIPE DIA. (INCH)
- SHOE LENGTH (NOTE-3)

NOTES:-

1. PROTECTION-SHIELD SHALL BE CUT FROM LINE-PIPE OR ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION-SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS.
2. MATERIAL OF BOLTS AND NUTS SHALL BE IS-1367 CLASS 10.9 AND IS-1367 CLASS 12 RESPECTIVELY.
3. SHOE LENGTH SHALL BE TAKEN AS 300MM FOR VERTICAL MOVEMENT UPTO 100MM. FOR HIGHER VERTICAL MOVEMENT SHOE LENGTH SHALL BE SUITABLY INCREASED.

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TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

BRACKET ON VERTICAL COLUMN
VERTICAL GUIDE FOR INSULATED PIPE
SIZE 8" THRU 24" TYPE B16

Standard Number: 03-PS-065 | Rev.: 4

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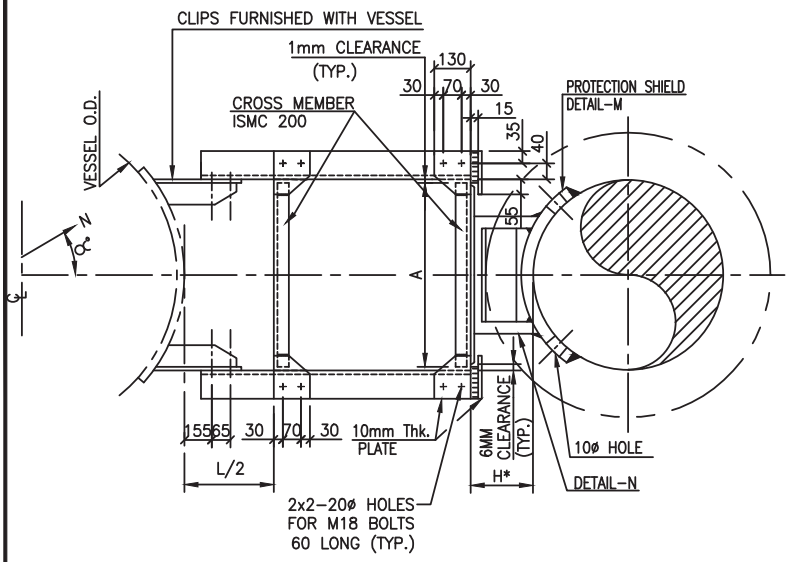
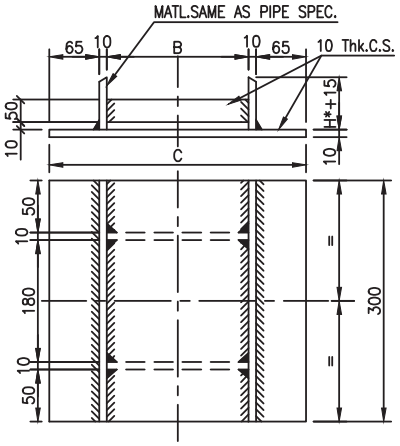
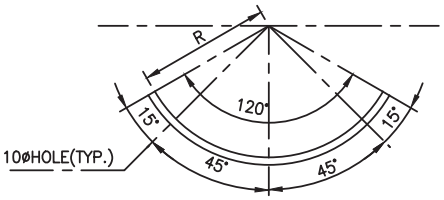
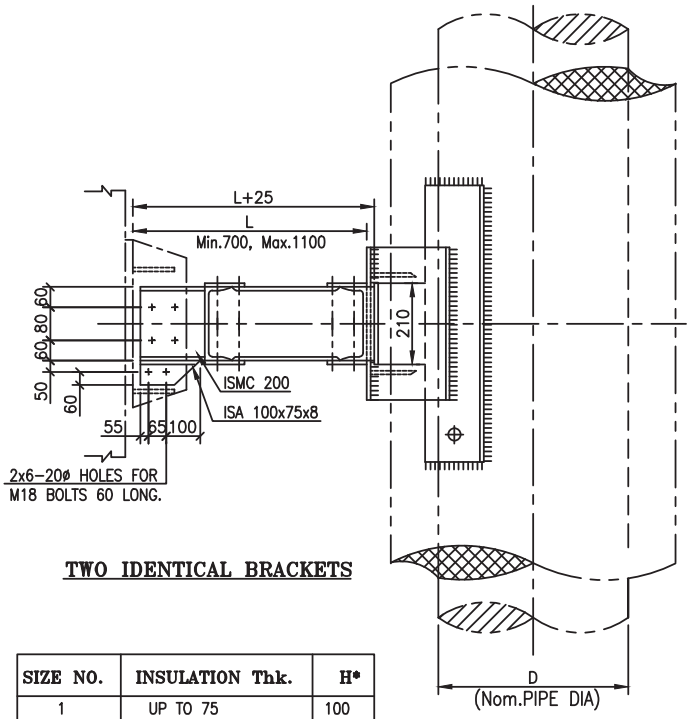


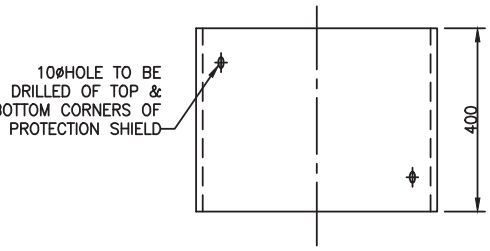


DETAIL-N





TWO IDENTICAL BRACKETS

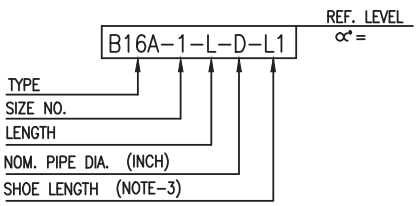


DETAIL-M
(NOTE-1)

SIZE NO.	INSULATION Thk.	H*
1	UP TO 75	100
2	76 TO 100	150
3	126 TO 175	200

PIPE MATL.	TEMPERATURE	SHOE MATERIAL	
		SIDE PLT. & RIBS	BASE PLT.
CS/ AS/ SS/	UPTO 343°C	IS-2062	IS-2062
	344°C TO 427°C	ASTM 516/A515 (GR.60/ 65/70)/IS-2002 GR.2	IS-2062
AS/SS	ABOVE 427°C	PIPE MATERIAL OR EQUIVALENT AISI-316 PLATE	

D	8"	10"	12"	14"	16"	18"	20"	22"	24"
CROSS MEMBER DIMN.-'A'	310	330	350	370	410	430	460	490	530
SHOE DIMN.-'B'	150	170	190	210	250	270	300	330	370
PROTECTION SHIELD.-'R'	110	137	162	178	203	229	254	279	305



NOTES:-

1. PROTECTION-SHIELD SHALL BE CUT FROM LINE-PIPE OR ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION-SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS.
2. MATERIAL OF BOLTS AND NUTS SHALL BE IS-1367 CLASS 10.9 AND IS-1367 CLASS 12 RESPECTIVELY.
3. SHOE LENGTH SHALL BE TAKEN AS 300MM FOR VERTICAL MOVEMENT UPTO 100MM. FOR HIGHER VERTICAL MOVEMENT SHOE LENGTH SHALL BE SUITABLY INCREASED.

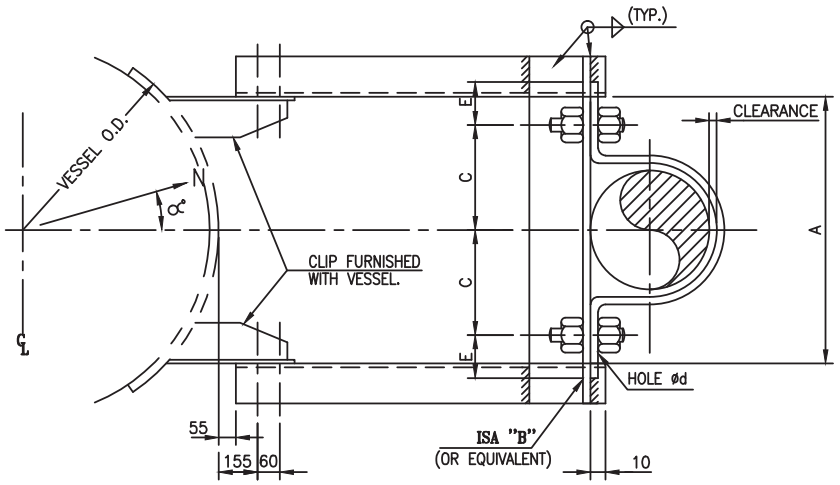
Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	RCB	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

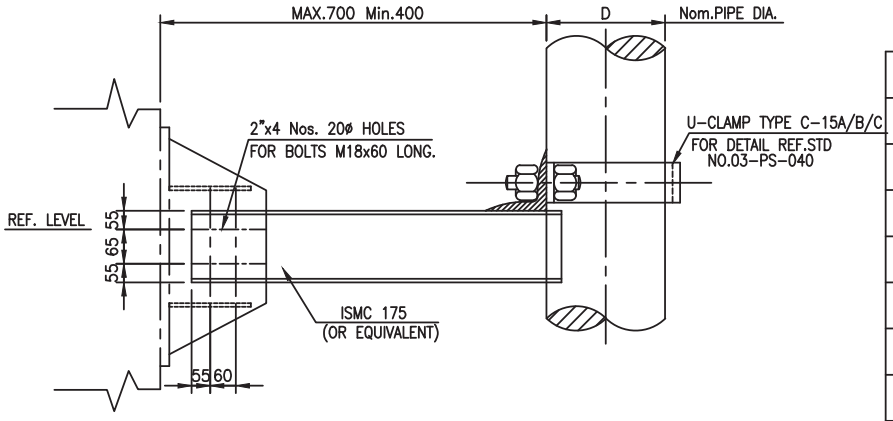
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

BRACKET ON VERTICAL COLUMN
VERTICAL GUIDE FOR INSULATED PIPE
SIZE 8" THRU 24" TYPE B16A

Standard Number	Rev.
03-PS-066	4
Sheet 1of 1	

AUTOCAD





D	C	E	d
8"	160	40	22
10"	190	40	27
12"	220	40	27
14"	230	50	27
16"	270	50	30
18"	290	60	33
20"	320	60	33
22"	340	65	39
24"	370	65	39

D	8"	10"	12"	14"	16"	18"	20"	22"	24"
A	342	396	451	482	534	589	639	691	744
B	100x100x10				130x130 x12	150x150x12			

α°= B17 – L – D REF. LEVEL =

TYPE

LENGTH

NOM.PIPE DIA. (INCH)

NOTES:–

1. MATERIAL FOR BOLTS IS:1367 CLASS 10.9, NUTS IS:1367 CLASS 12 OR EQUIVALENT.

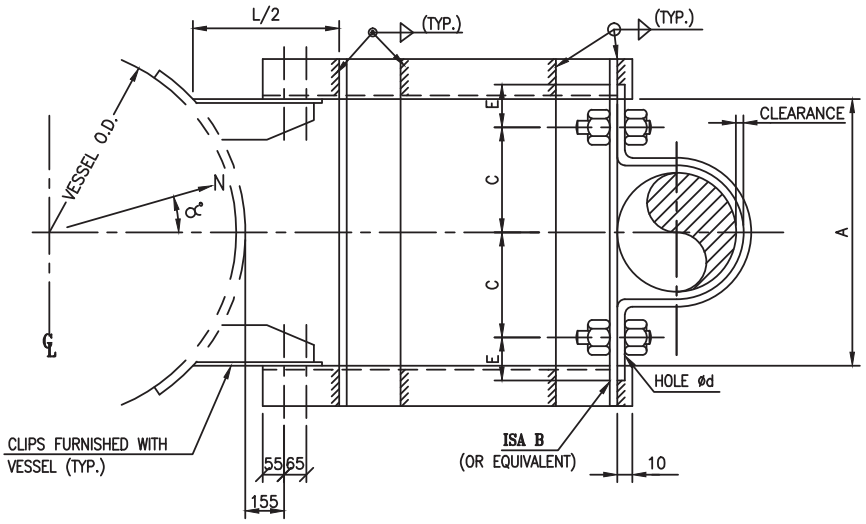
Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	20-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	RCB	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

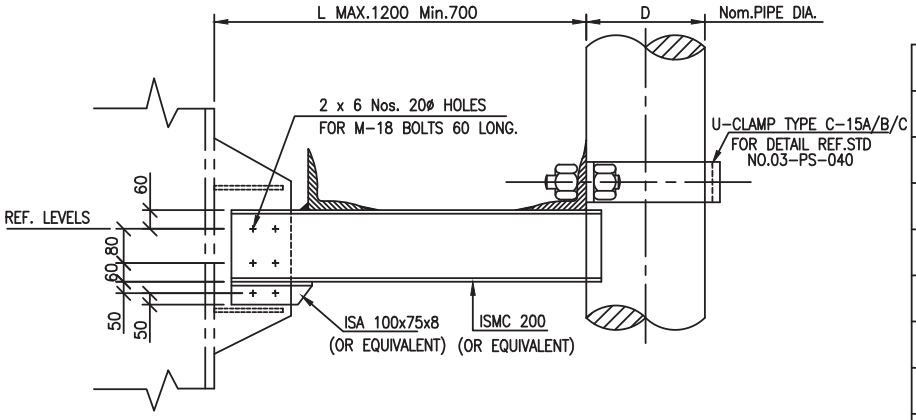
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

BRAKET ON VERTICAL COLUMN
VERT.GUIDE FOR BARE
PIPE SIZE 8" THRU 24"
TYPE-B17

Standard Number	Rev.
03-PS-067	4
Sheet 1of 1	

AUTOCAD





D	C	E	d
8"	160	40	22
10"	190	40	27
12"	220	40	27
14"	230	50	27
16"	270	50	30
18"	290	60	33
20"	320	60	33
22"	340	65	39
24"	370	65	39

D	8"	10"	12"	14"	16"	18"	20"	22"	24"
A	342	396	451	482	534	589	639	691	744
B	100x100x10				130x130 x12	150x150x12			

α° =

B17A – L – D REF. LEVEL =

TYPE

LENGTH

NOM.PIPE DIA. (INCH)

NOTES:–

1. MATERIAL FOR BOLTS IS:1367 CLASS 10.9, NUTS IS:1367 CLASS 12 OR EQUIVALENT.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	20-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	RCB	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

BRAKET ON VERT.COL.
VERT.GUIDE FOR BARE
PIPE SIZE 8" THRU 24"
TYPE-B17A

Standard Number	Rev.
03-PS-068	4
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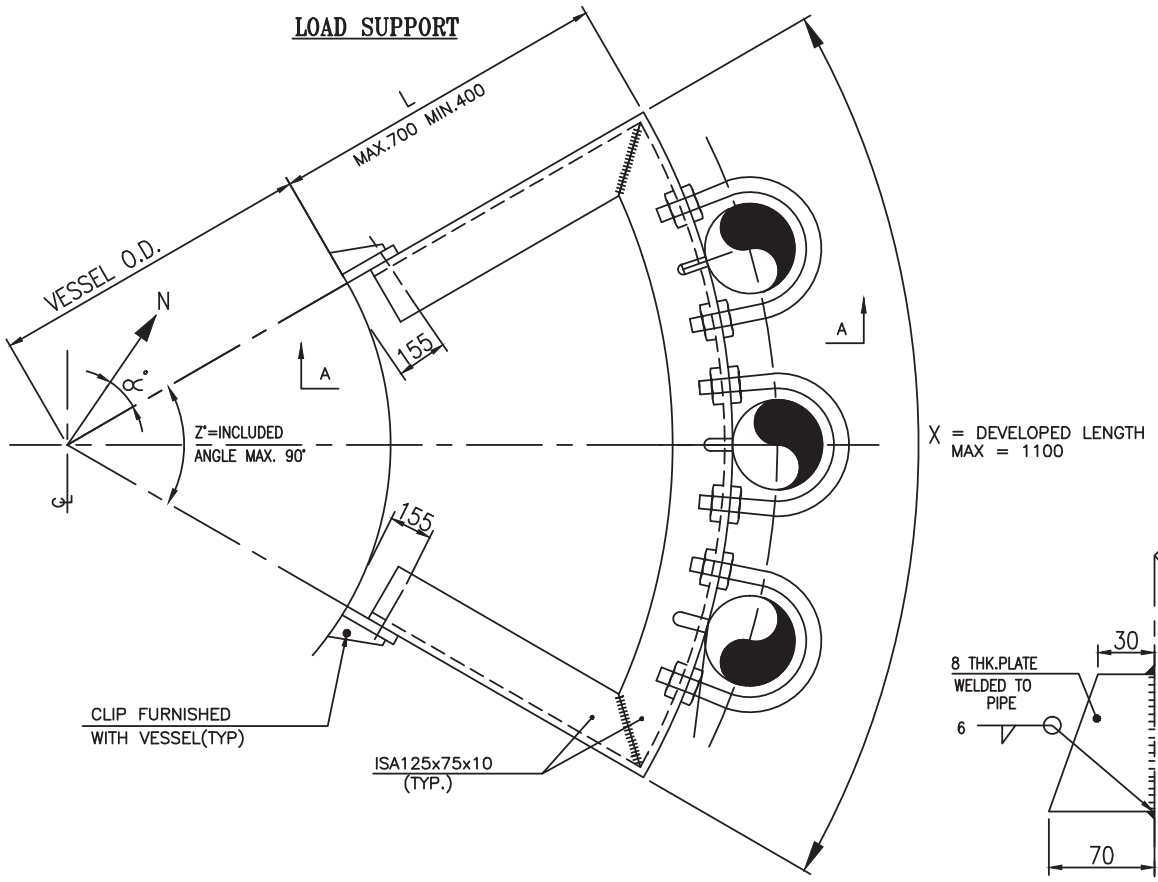
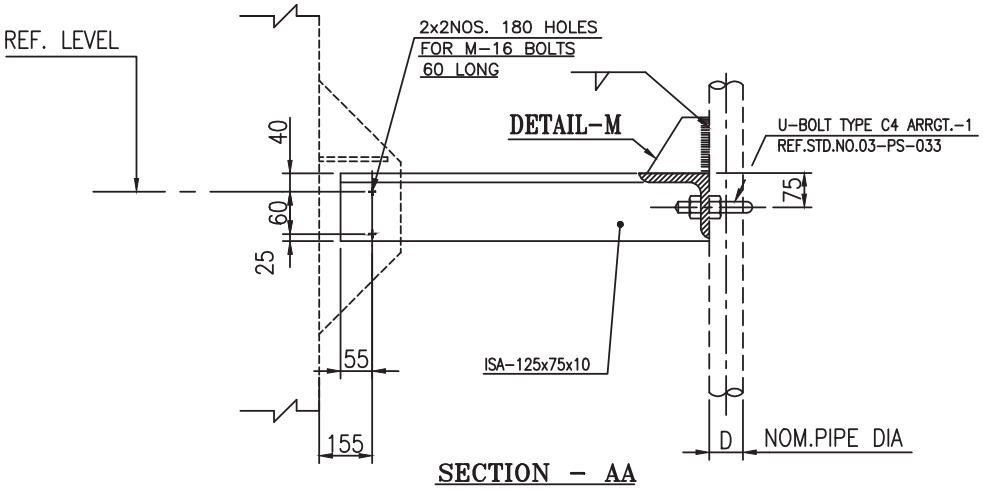
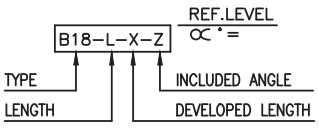
AUTOCAD



DETAIL-M
NOTE-1



SECTION - AA



SYMBOL

NOTES:-

1. PLATE MATERIAL EQUIVALENT TO THAT OF LINE-PIPE.
2. IN CASE OF INSULATED LINE, INSULATION WILL BE STRIPPED 150mm ON EITHER SIDE OF SUPPORT.
3. MATERIAL OF BOLTS AND NUTS SHALL BE IS-1367 CLASS 10.9 AND IS-1367 CLASS 12 RESPECTIVELY.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	NRK	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	BRACKET ON VERTICAL COLUMN FOR LOAD SUPPORT BARE & INSULATED PIPE SIZE SIZE 1/2" THRU 1 1/2" TYPE-B18	Standard Number	Rev.
		03-PS-069	4
		Sheet 1 of 1	

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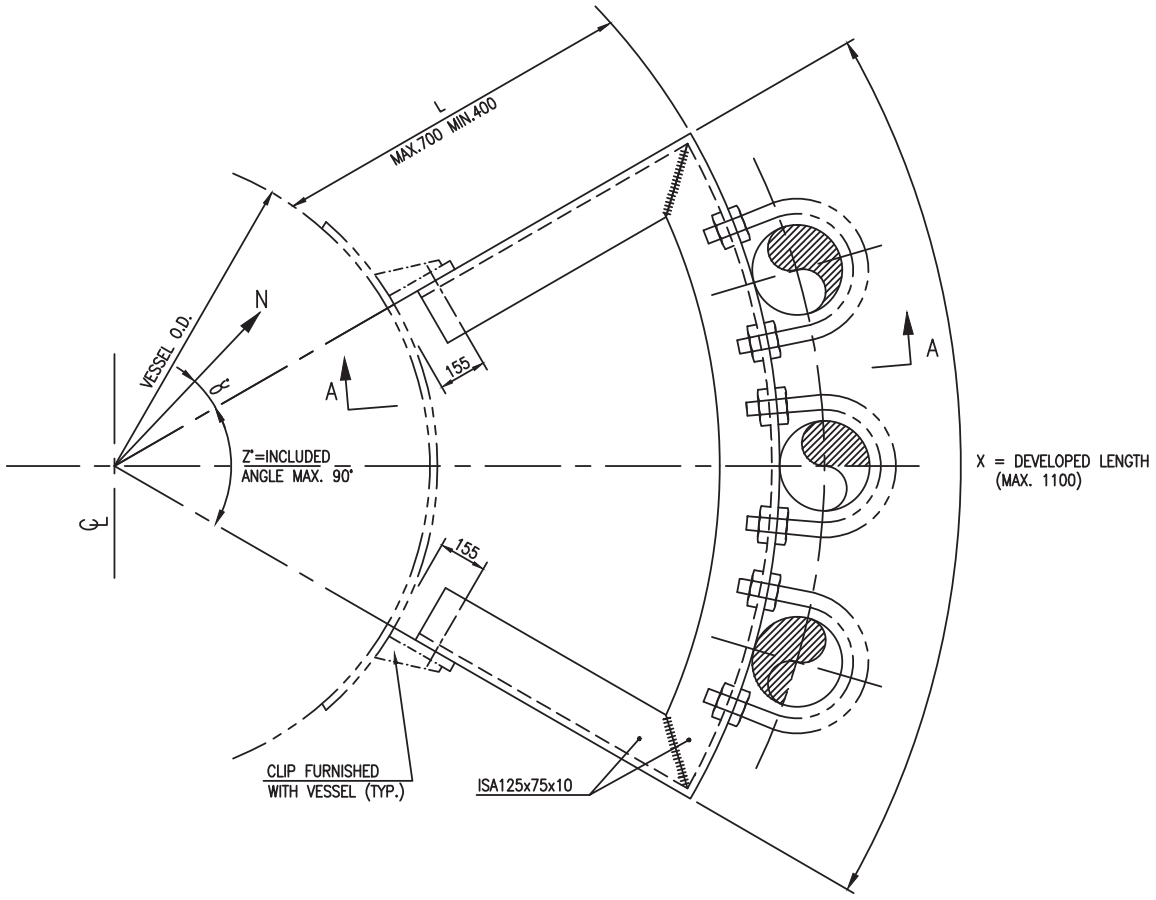
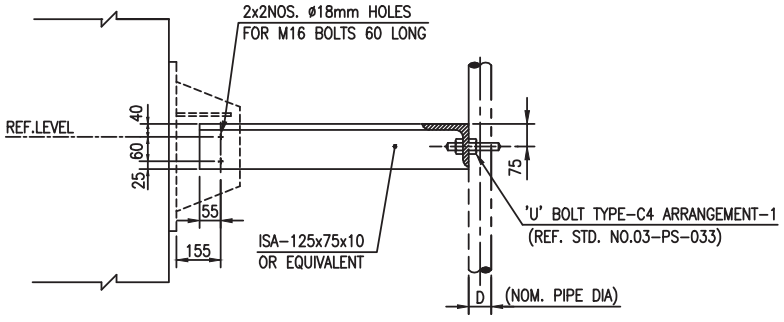


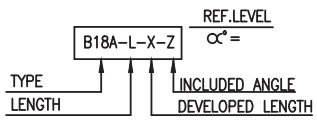
VERTICAL GUIDE



SECTION - 'AA'

NOTES:-

1. IN CASE OF INSULATED LINE, INSULATION WILL BE STRIPPED 150mm ON EITHER SIDE OF SUPPORT.
2. MATERIAL OF BOLTS AND NUTS SHALL BE IS-1367 CLASS 10.9 AND IS-1367 CLASS 12 RESPECTIVELY.

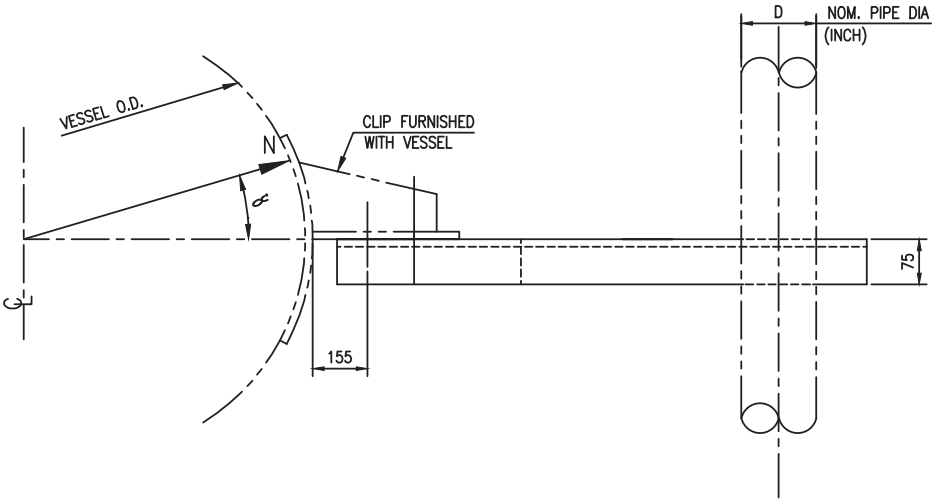


SYMBOL

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RP	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

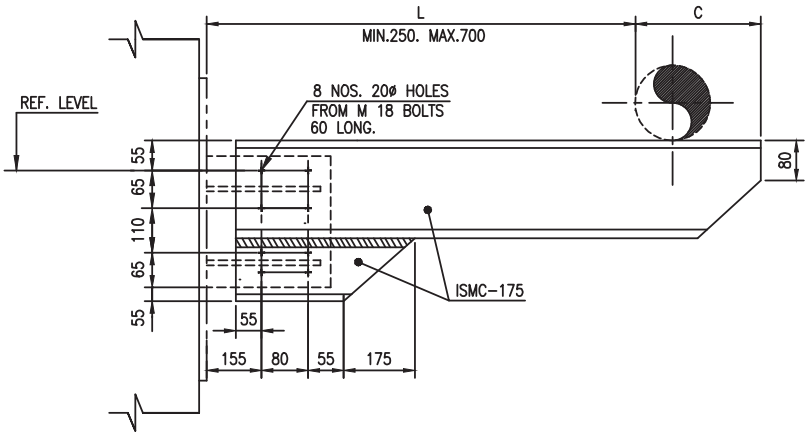
TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	BRACKET ON VERTICAL COLUMN FOR GUIDE SUPPORT BARE & INSULATED PIPE SIZE 1/2" THRU 1 1/2" TYPE-B18A	Standard Number	Rev.
		03-PS-070	4
		Sheet 1 of 1	

AUTOCAD



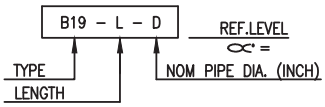
D	C
8"	310
10"	350
12"	400

LOAD MAX. 1000 KG



NOTES:-

1: MATERIAL OF BOLTS IS:1367 CLASS 10.9 AND NUTS IS:1367 CLASS 12
2: THIS TYPE OF SUPPORT CAN ALSO BE USED FOR PIPE SIZES ABOVE 12" NB PROVIDED ℄ DISTANCE OF PIPE FROM VESSEL O.D IS LESS THAN 850 MM AND LOAD IS LESS THAN 1000KG.



SYMBOL

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RP	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

BRACKET ON VERTICAL COLUMN LOAD SUPPORT FOR HORIZONTAL PIPE, SIZE 8" THRU 12" TYPE-B19

Standard Number: 03-PS-071 | Rev.: 4

Sheet 1 of 1

AUTOCAD

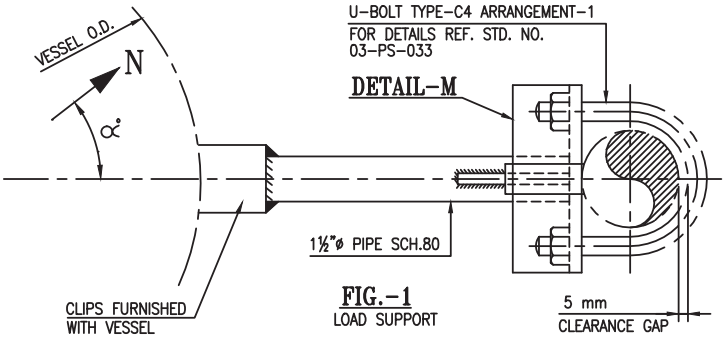
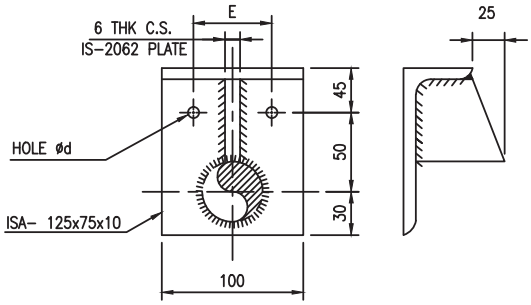


FIG.-1
LOAD SUPPORT



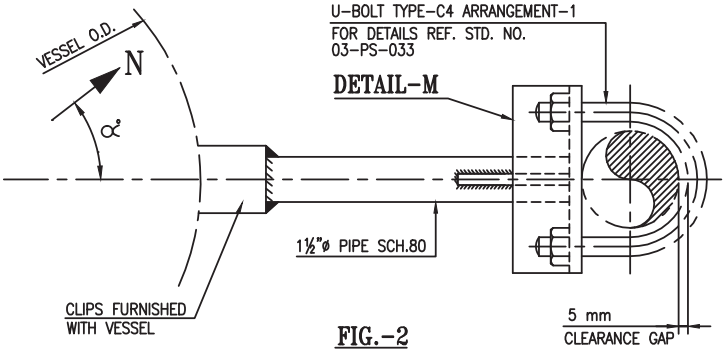
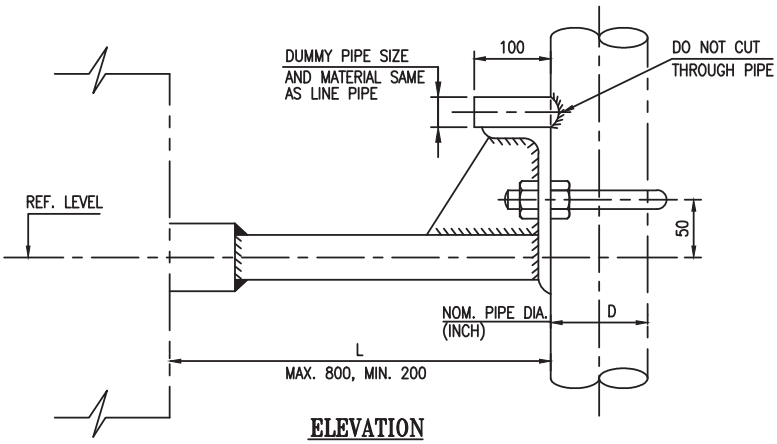


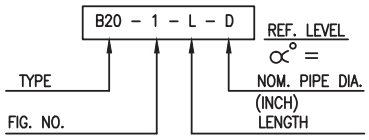
FIG.-2
GUIDE

DETAIL-M

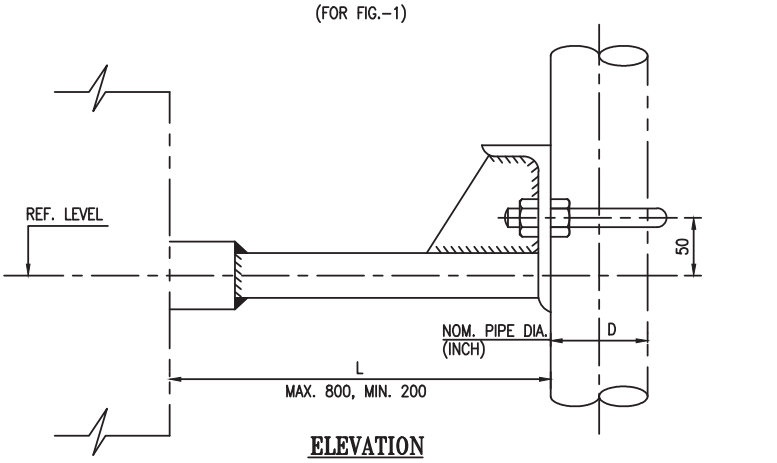
D	E	d
1/2"	34	8
3/4"	39	8
1"	48	10
1½"	63	10



ELEVATION
(FOR FIG.-1)



SYMBOL



ELEVATION
(FOR FIG.-2)

NOTES:-

1. IN CASE OF INSULATED PIPE LINE INSULATION SHALL BE STRIPPED 150mm ON EITHER SIDE OF SUPPORT.
2. BOLTS SHALL BE TURNED FROM CS ROD MATERIAL CONFORMING TO IS-2062 GR.A WITH DIMENSIONS TO IS-1367 CLASS 10.9 AND NUTS SHALL BE TO IS-1367 CLASS 12.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RP	DEP	SHR/BN
0	30-08-91	ISSUED AS STANDARD	SDM	AKR	KPS

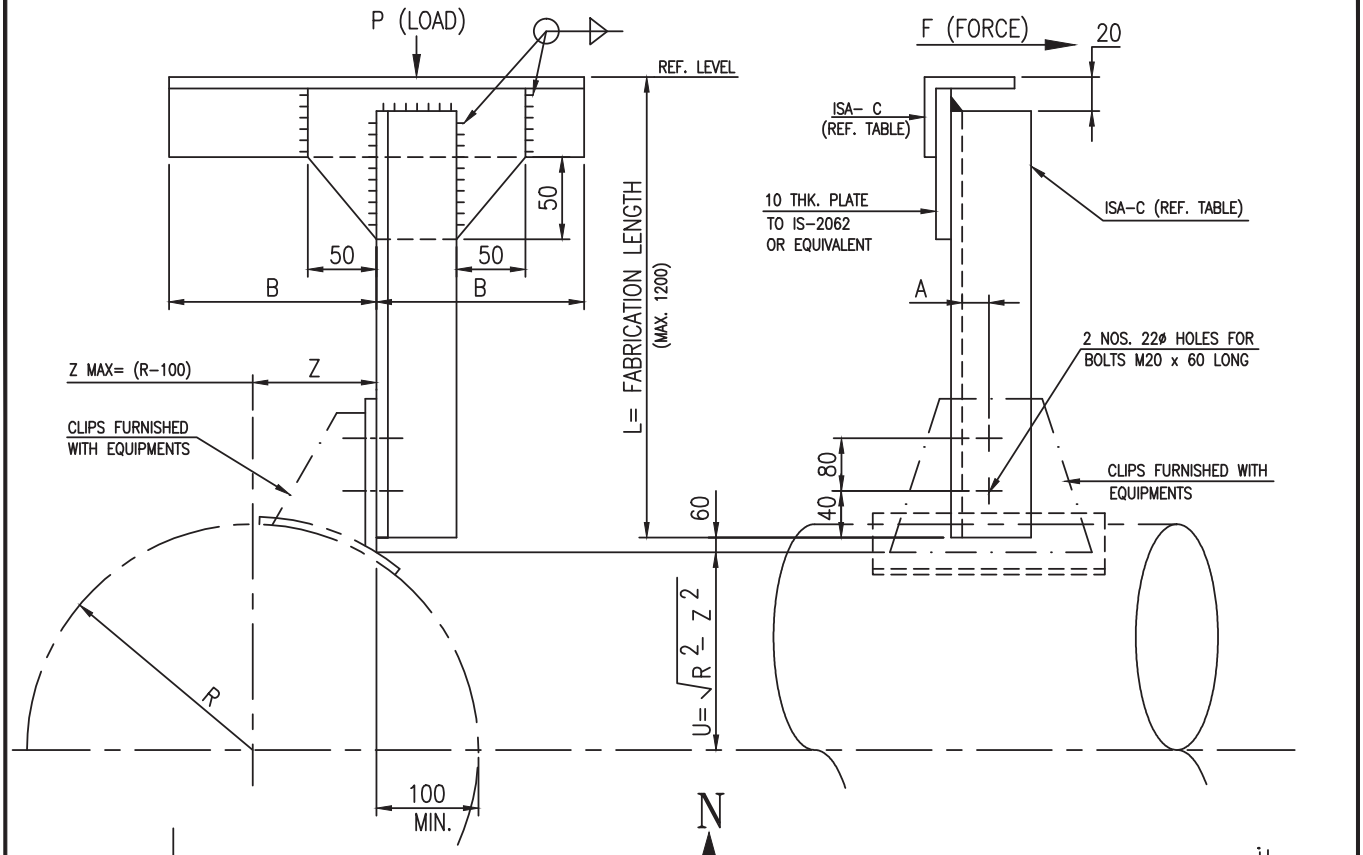
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

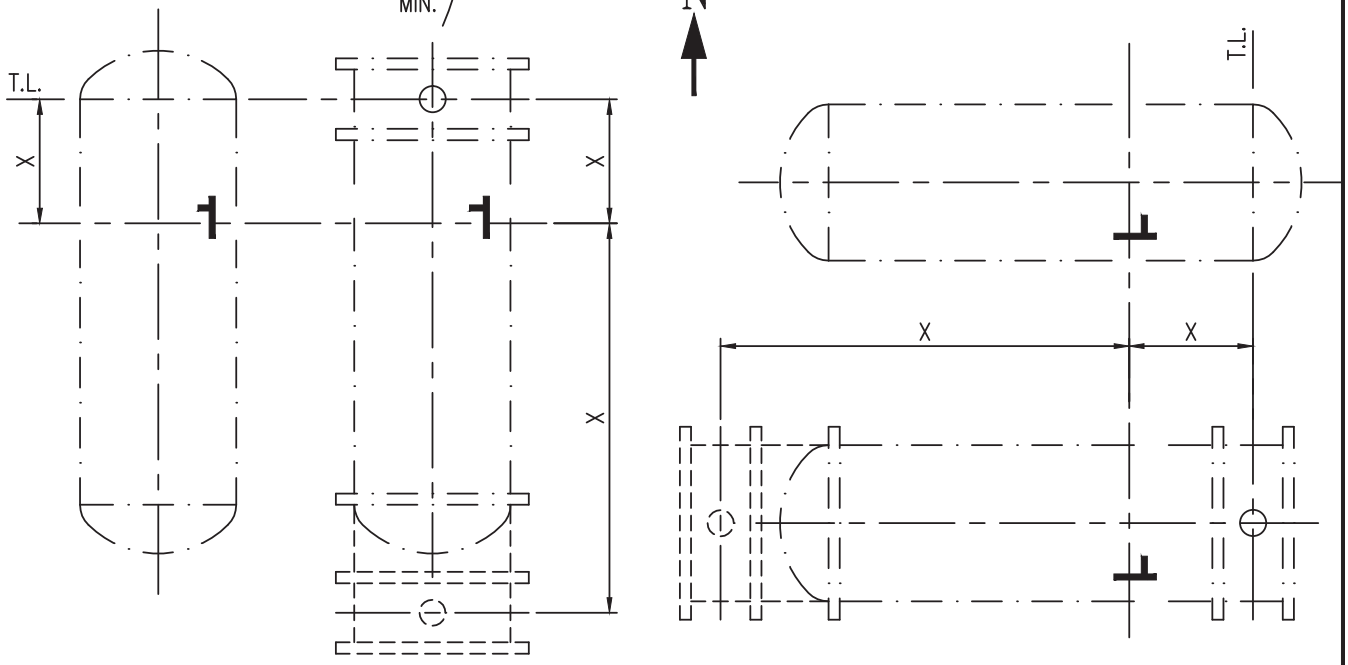
BRACKET ON VERTICAL COL. LOAD SUPPORT & VERT. GUIDE FOR BARE & INSULATED PIPE SIZE 1½" & BELOW TYPE-B20

Standard Number: 03-PS-072 | Rev.: 4

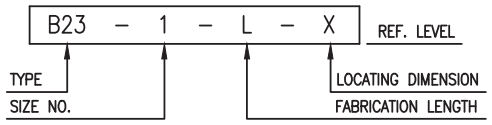
Sheet 1of 1

AUTOCAD





SIZE NO.	P(MAX) Kgs.	F(MAX) Kgs.	C	L (MIN)	A	B
1	500	270	80x80x8	315	45	250
2	1000	500	100x100x10	335	60	300
3	1600	800	130x130x12	365	80	350



SYMBOL

NOTE:-

MATERIAL FOR BOLTS IS:1367 CLASS 10.9 AND NUTS IS:1367 CLASS 12

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	NRK	DEP	SHR/BN
0	30-08-91	ISSUED AS STANDARD	SDM	AKR	KPS

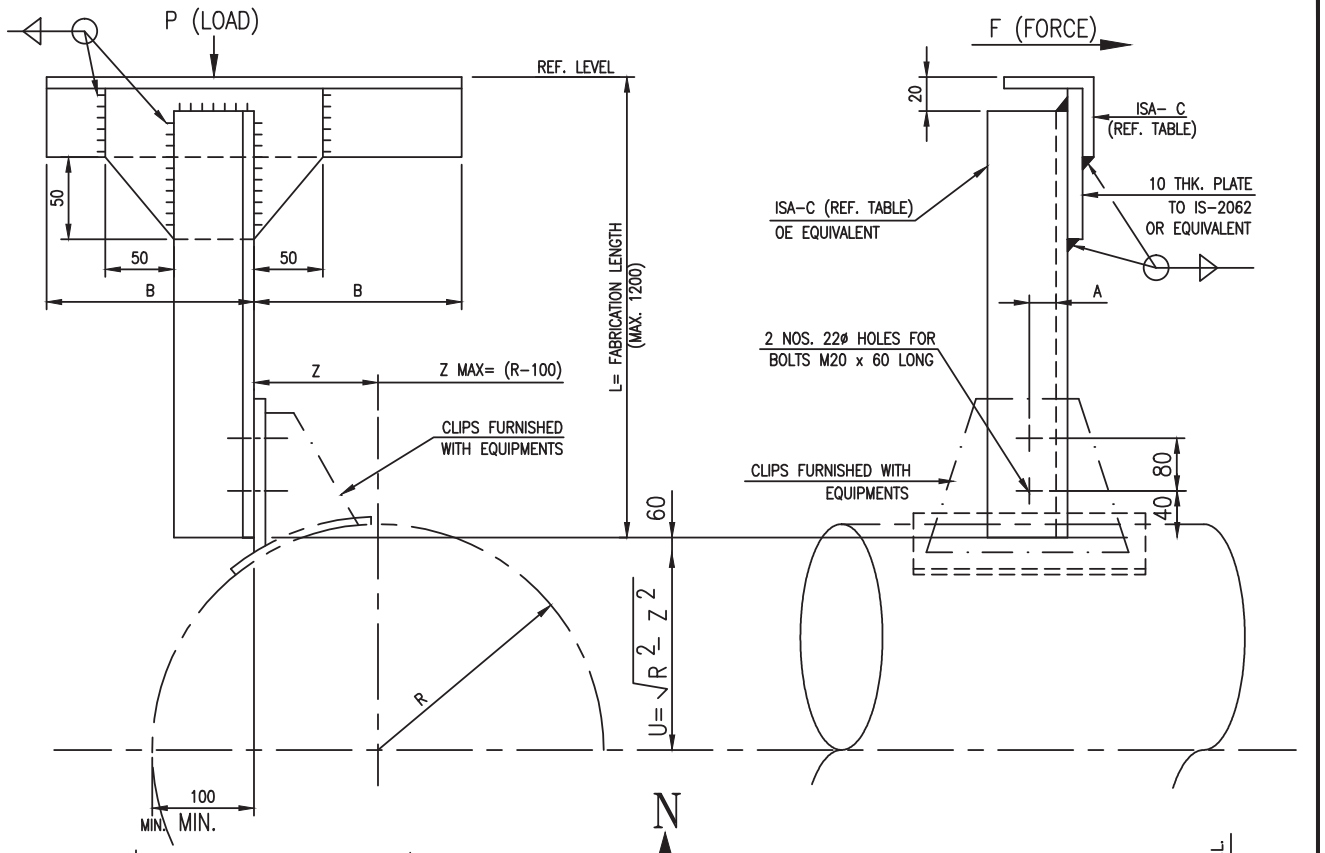
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

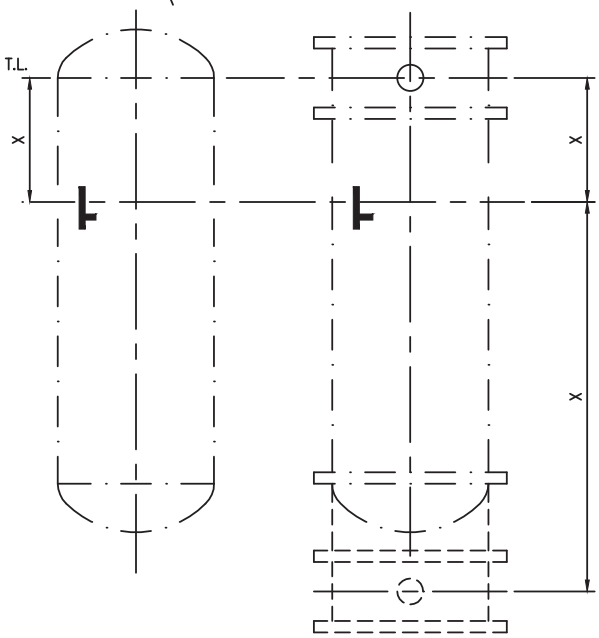
PIPE SUPPORT BRACKET
FROM HORIZONTAL EQPT.
TYPE-B23

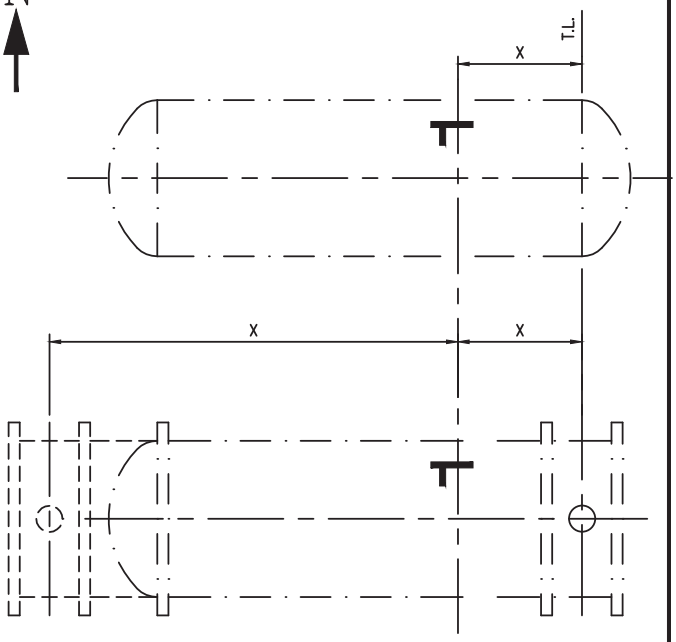
Standard Number 03-PS-073 Rev. 4

Sheet 1 of 1

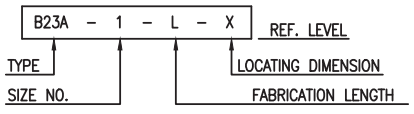
AUTOCAD







SIZE NO.	P(MAX) Kgs.	F(MAX) Kgs.	ISA-C	L (MIN)	A	B
1	500	270	80x80x8	315	45	250
2	1000	500	100x100x10	335	60	300
3	1600	800	130x130x12	365	80	350



SYMBOL

NOTE:-

MATERIAL OF BOLTS AND NUTS SHALL BE IS-1367 CLASS 10.9 AND IS-1367 CLASS 12 RESPECTIVELY, UNLESS OTHERWISE SPECIFIED.

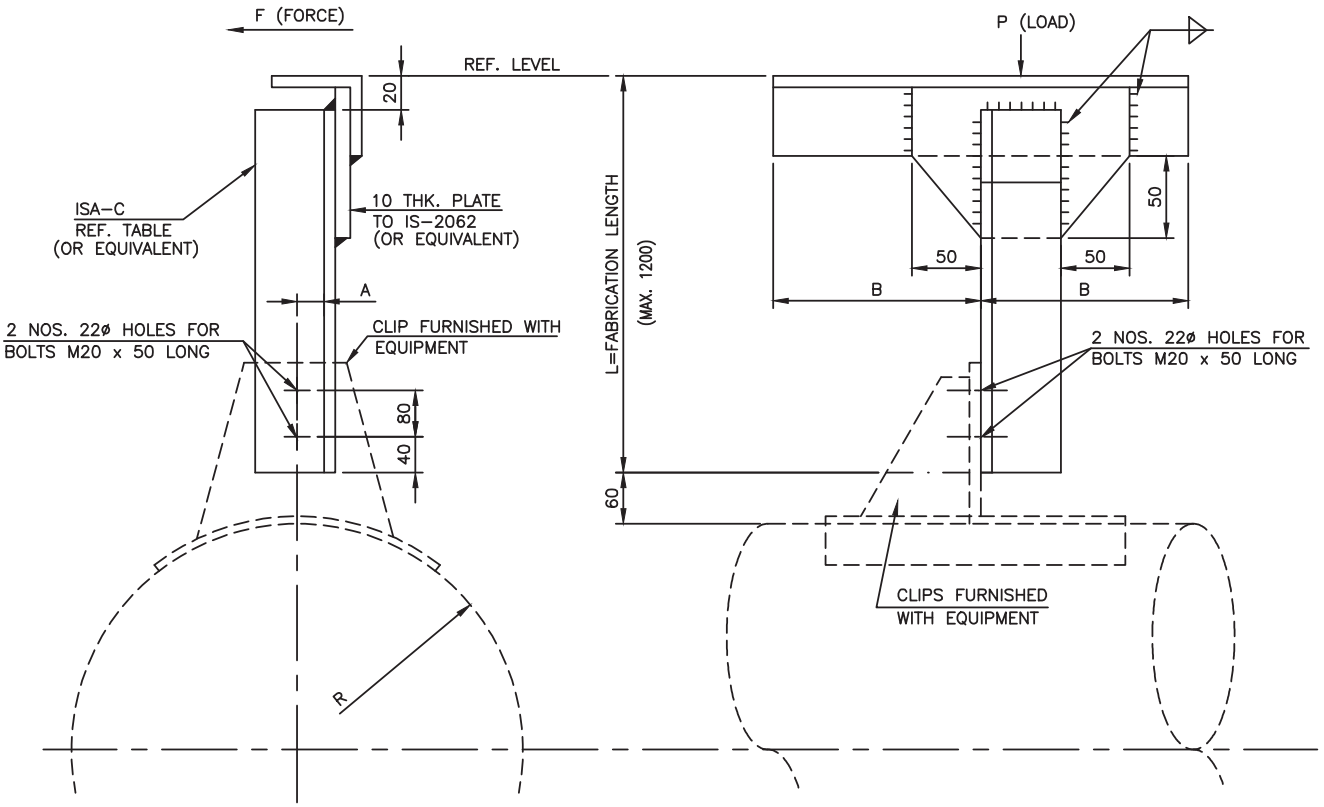
Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RP	DEP	SHR/BN
0	30-08-91	ISSUED AS STANDARD	SDM	AKR	KPS

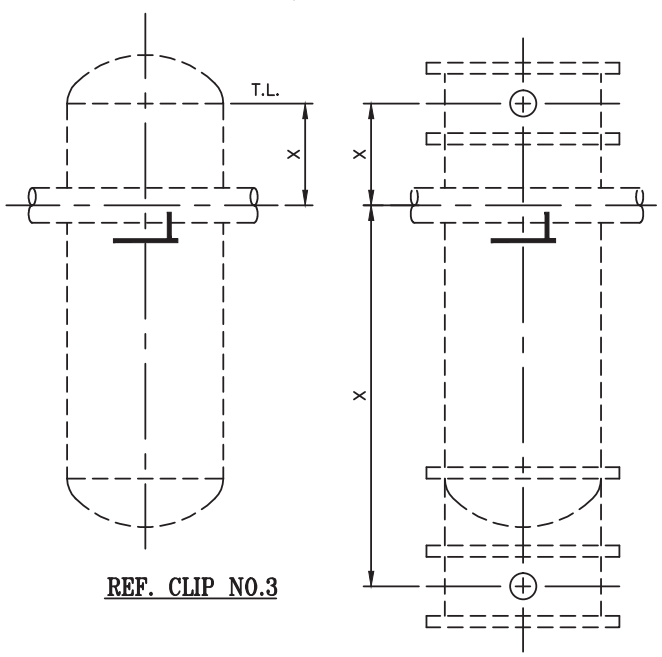
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PIPE SUPPORT BRACKET
FROM HORIZONTAL EQPT.
TYPE-B23A

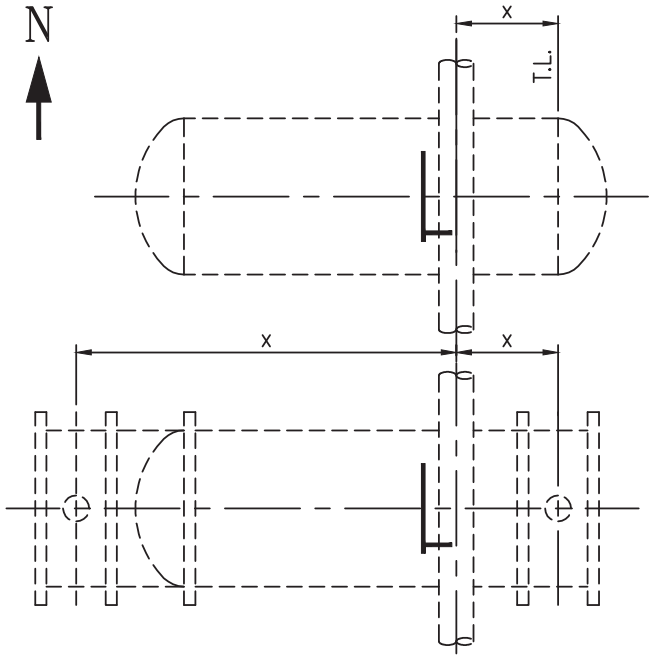
Standard Number	Rev.
03-PS-074	4
Sheet 1 of 1	

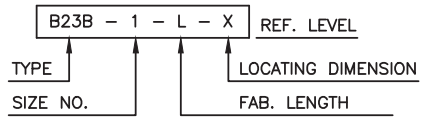
AUTOCAD





REF. CLIP NO.3





SYMBOL

SIZE NO.	P(MAX) Kgs.	F(MAX) Kgs.	ISA–C (OR EQUIVALENT)	L (MIN)	A	B
1	500	270	80x80x8	315	45	250
2	1000	500	100x100x10	335	60	300
3	1600	800	130x130x12	365	80	350

NOTE:–

MATERIAL OF BOLTS IS:1367 CLASS 10.9 AND NUTS IS:1367 CLASS 12 RESPECTIVELY, (OR EQUIVALENT).

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	20–04–18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RP	DEP	SHR/BN
0	30–08–91	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PIPE SUPPORT BRACKET FROM HORIZONTAL EQUIPMENT
TYPE–B23B

Std./Doc. Number	Rev.
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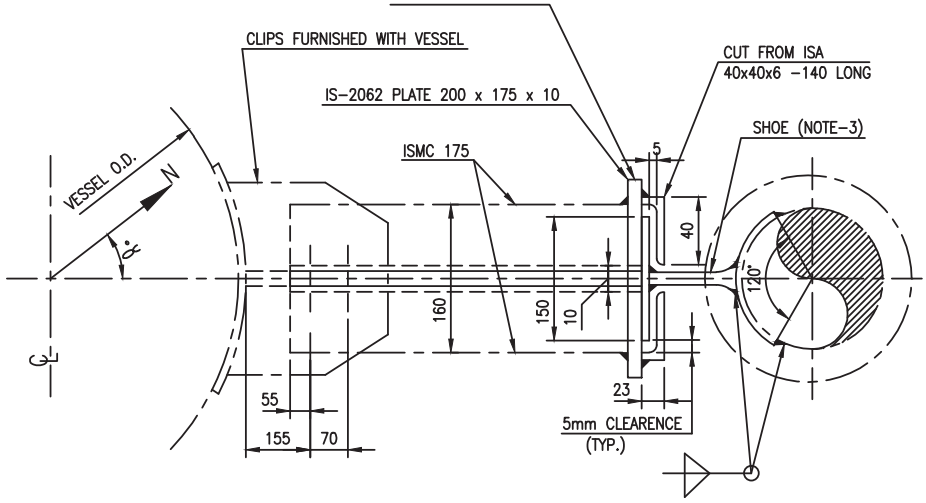
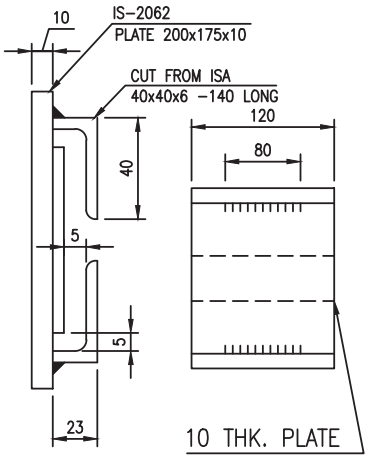
Sheet 1 of 1	

AutoCAD

H	X
100	110
150	160

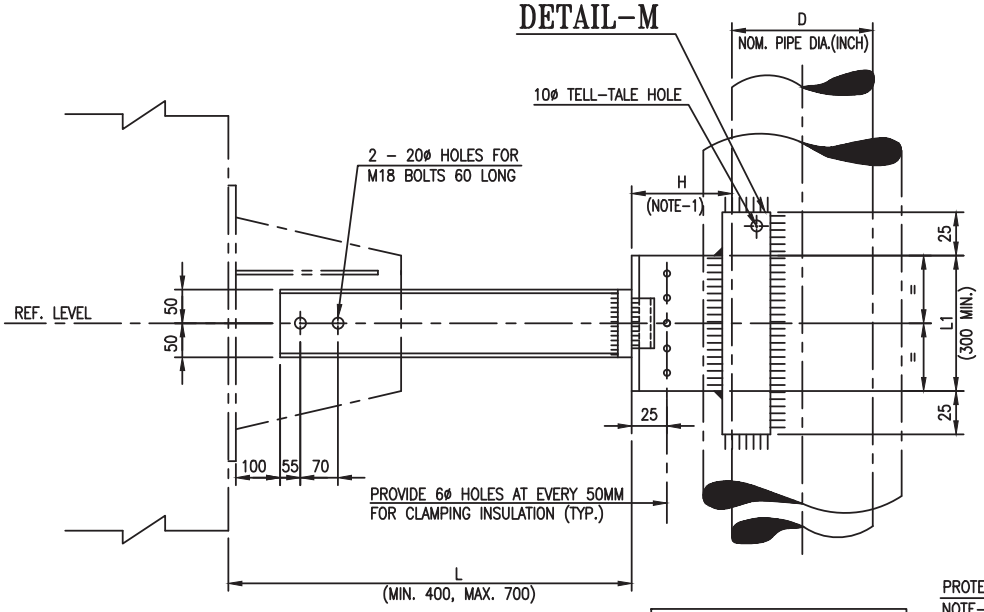
DETAIL-N

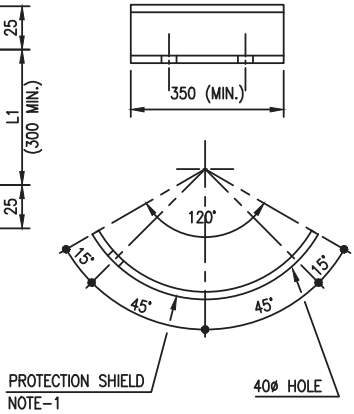




DETAIL-N

DETAIL-M



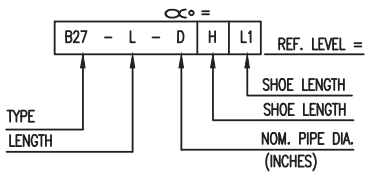


VERTICAL GUIDE

DETAIL-M

NOTE:-

1. FOR INSULATION THICKNESS UPTO 75, H=100 (CUT FROM ISMB 200) FOR INSULATION 76 TO 125 H= 150 (CUT FROM ISMB 300)
2. FOR TEMP. ABOVE 400°C SHOE SHALL BE FABRICATED FROM PLATE EQUIVALENT TO PIPE SPEC. (8 THK. PLATE)
3. PROTECTION-SHIELD SHALL BE CUT FROM LINE PIPE OR ROLLED FROM PLATE OF MATERIAL EQUIPMENT TO THAT OF PIPE. THICKNESS OF PROTECTION-SHILED SHALL BE SAME AS THAT OF LINE-PIPE OF 12MM, WHIEVER IS LESS.
4. MATERIAL FOR BOLTS IS: 1367 CLASS 10.9 AND NUTS IS: 1367 CLASS 12 RESPECTIVELY.
5. SHOE LENGTH SHALL BE TAKEN AS 300 MM FOR VERTICAL MOVEMENT UPTO 100 MM. HIGHER VERTIVAL MOVEMENT SHOE LENGTH SHALL BE SUITABLY INCREASED.



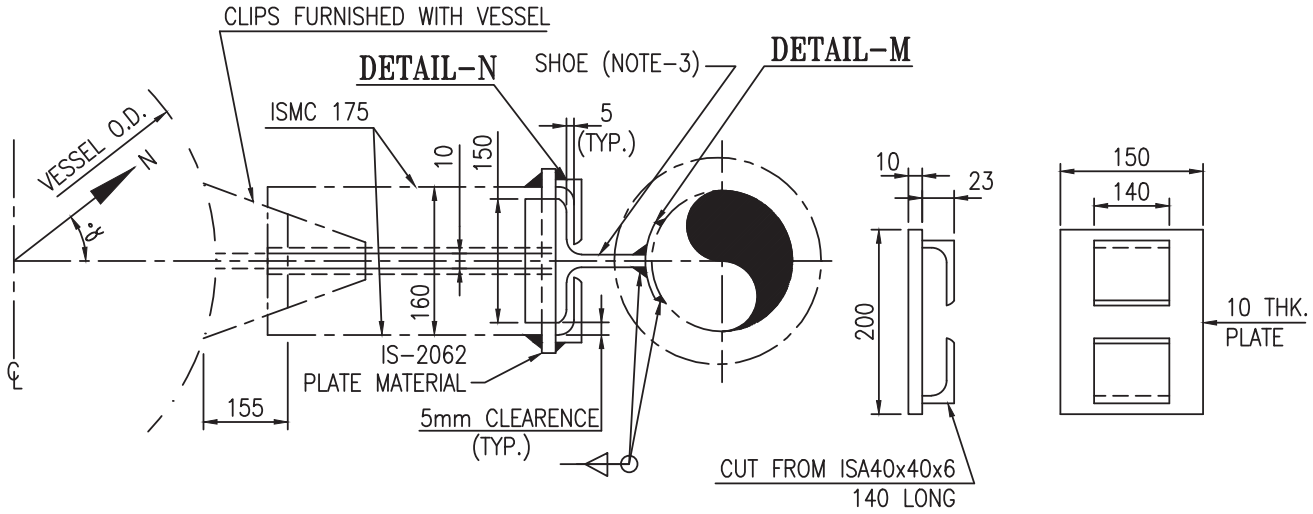
Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	20-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RP	DEP	SHR/BN
0	30-08-91	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

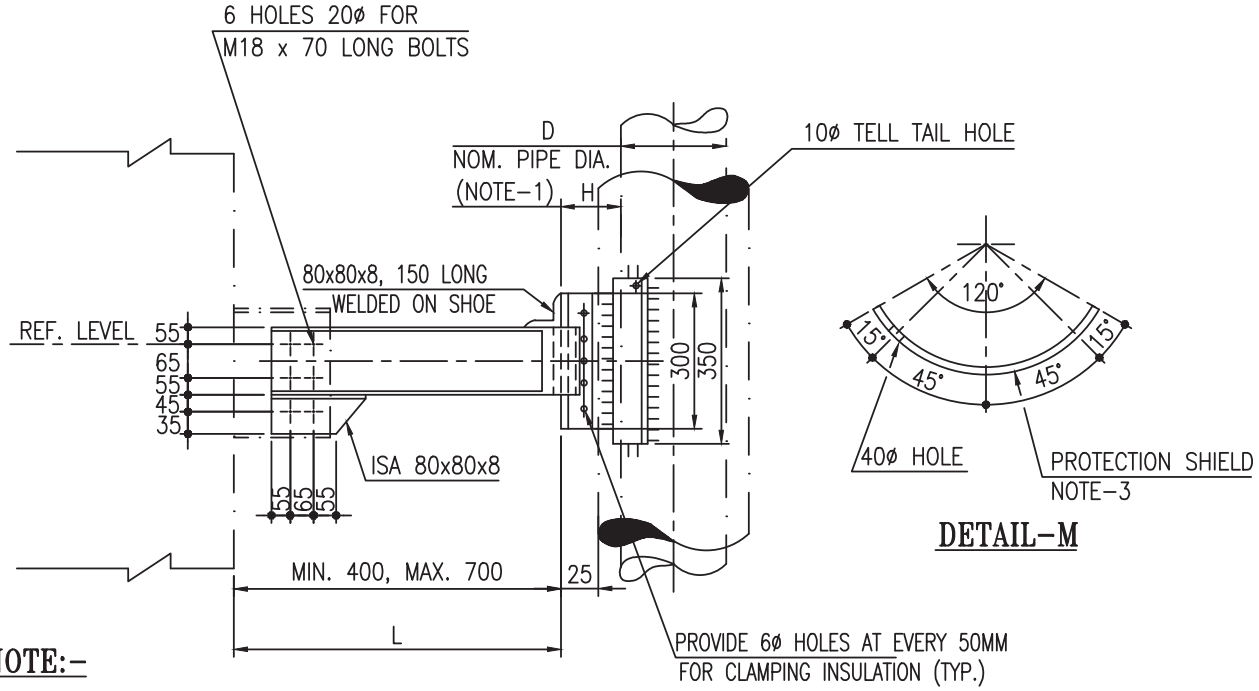
BRACKET ON VERTICAL COLUMN LOAD SUPPORT & VERTICAL GUIDE FOR INSULATED ALLOY STEEL/SS PIPE SIZE 2" THRU 6" TYPE-B27/ B27A

Std./Doc. Number	Rev.
03-PS-076	4
Sheet 1of 1	

AutoCAD



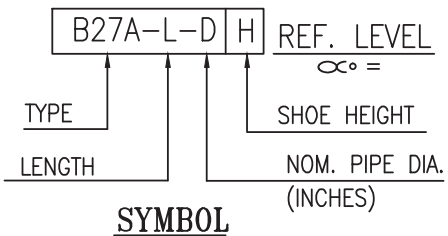
DETAIL-N



DETAIL-M

NOTE:-

1. FOR INSULATION THICKNESS UPTO 75, H=100 (CUT FROM ISMB 200) FOR INSULATION 76 TO 125, H= 150 (CUT FROM ISMB 300)
2. FOR TEMP. ABOVE 400°C SHOE SHALL BE FABRICATED FROM PLATE EQUIVALENT TO PIPE SPEC. (8 THK. PLATE)
3. PROTECTION SHIELD CUT FROM LINE PIPE OR ROLLED. FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION SHEILD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS.
4. MATERIAL FOR BOLTS IS: 1367 CLASS 9
   AND NUTS IS: 1367 CLASS 12



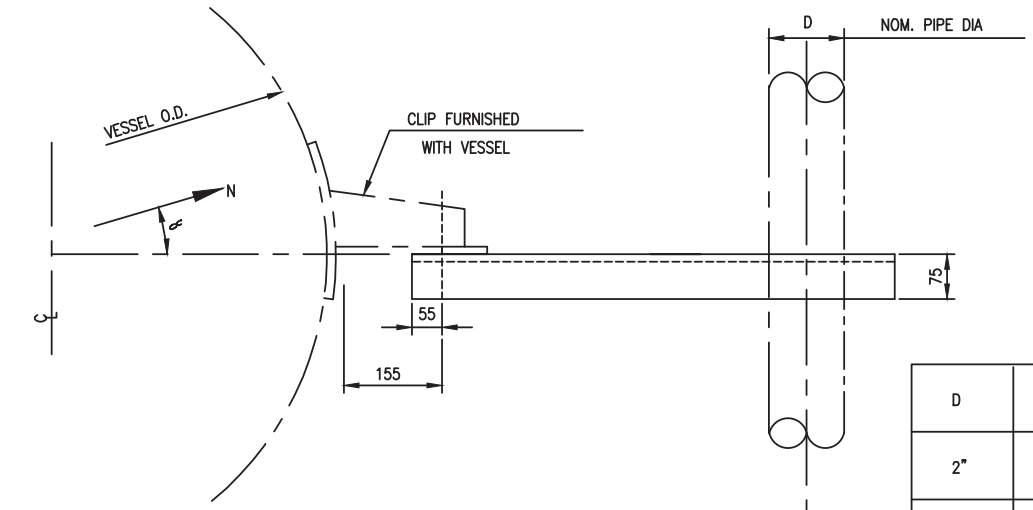
SYMBOL

MAX. LOAD 2000 KG

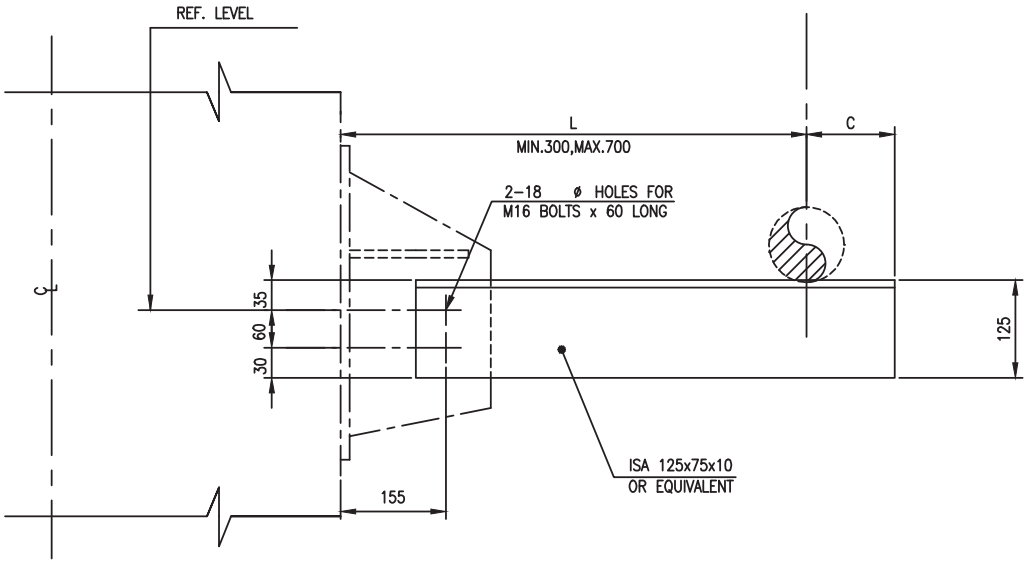
Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION IMPLEMENTATION.	PK	DEP	SHR/BN
0	30-08-91	ISSUED AS STANDARD	SDM	AKR	KPS

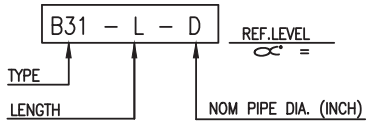
TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	BRACKET ON VERTICAL COLUMN LOAD SUPPORT & VERTICAL GUIDE FOR INSULATED A.S./S.S. PIPE SIZE 2" THRU 6" TYPE-B27A	Std./Doc. Number	Rev.
		03-PS-077	4
		Sheet 1of 1	

AutoCAD



D	C
2"	160
3"	190
4"	210
6"	275





SYMBOL

NOTES:-

1: MATERIAL FOR BOLTS IS:1367 CLASS 10.9 AND NUTS IS:1367 CLASS 12 OR EQUIVALENT.

MAX LOAD 400KG

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10–04–18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RCB	DEP	SHR/BN
0	30–08–91	ISSUED AS STANDARD	SDM	AKR	KPS

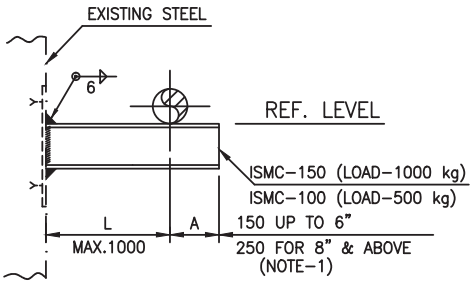
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

BRACKET ON VERTICAL COL.
FOR HORIZONTAL PIPE
SIZE 2" THRU 6" TYPE–B31

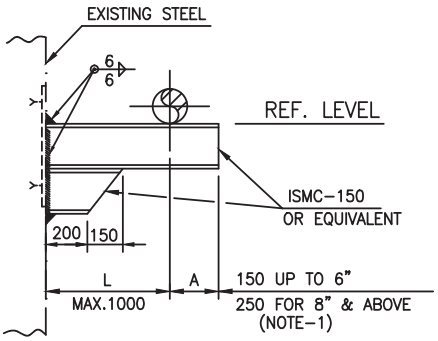
Std./Doc. Number: 03–PS–078 | Rev.: 4

Sheet 1 of 1

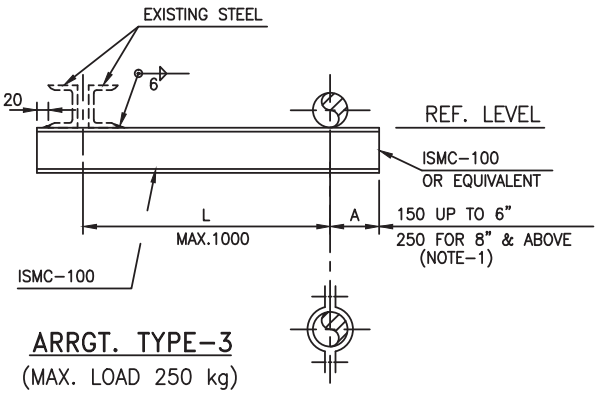
AutoCAD



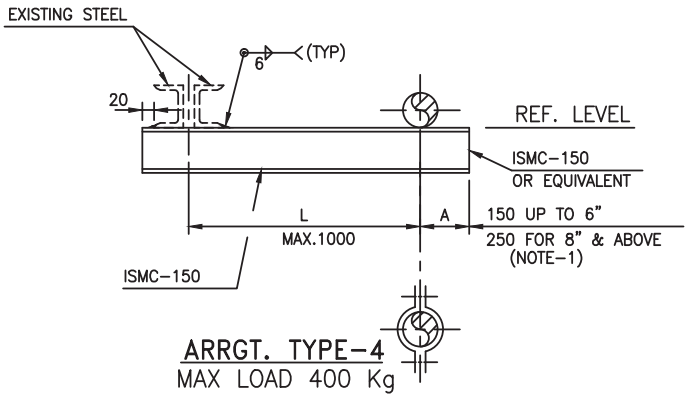
ARRANGT. TYPE-1
(MAX. LOAD 1000 kg)



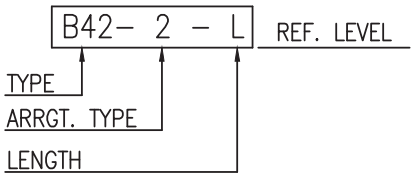
ARRANGT. TYPE-2
(MAX. LOAD 1500 kg)



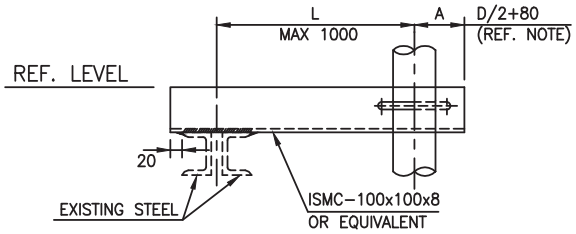
ARRGT. TYPE-3
(MAX. LOAD 250 kg)



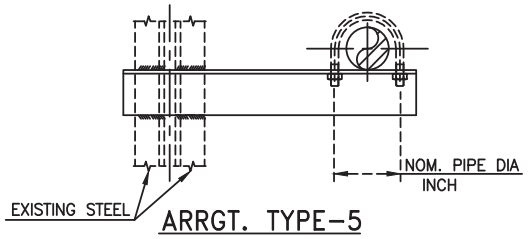
ARRGT. TYPE-4
MAX LOAD 400 Kg



SYMBOL



ARRGT. TYPE-5



ARRGT. TYPE-5

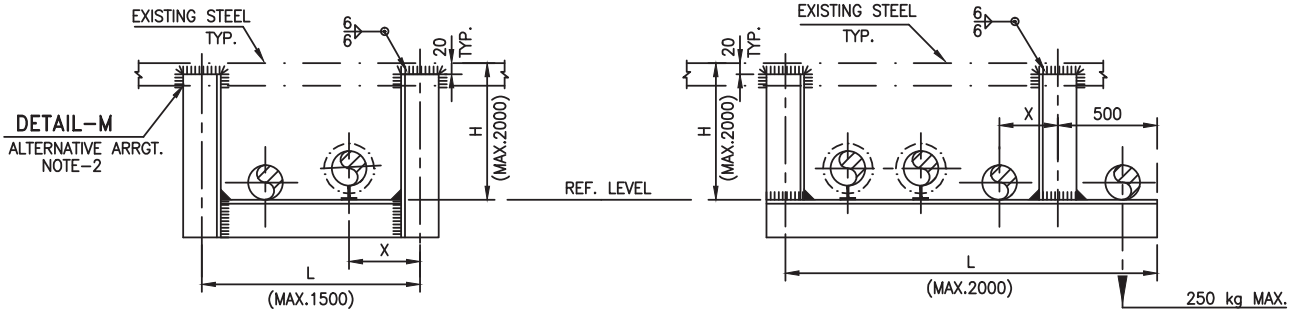
NOTES:-

1. IN CASE SUPPORT SUCH AS U-BOLT, U-CLAMP OR SHOE ARE CALLED ALONG WITH THIS SUPPORT DIMENSION, A MAY BE INCRESED AS PER REQUIREMENT CASE BY CASE.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RCB	DEP	SHR/BN
0	30-08-91	ISSUED AS STANDARD	SDM	AKR	KPS

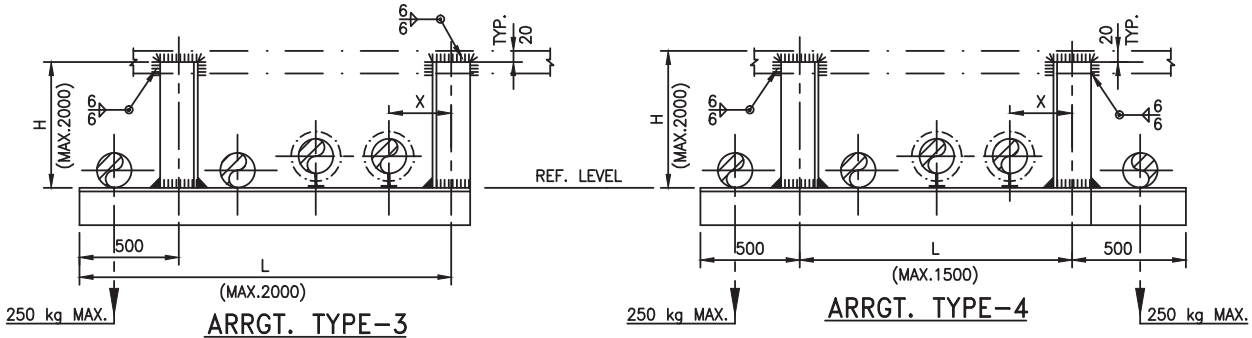
TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	PIPE SUPPORT BRACKETS TYPE-B42	Standard Number 03-PS-082	Rev. 4
		Sheet 1of 1	

AUTOCAD



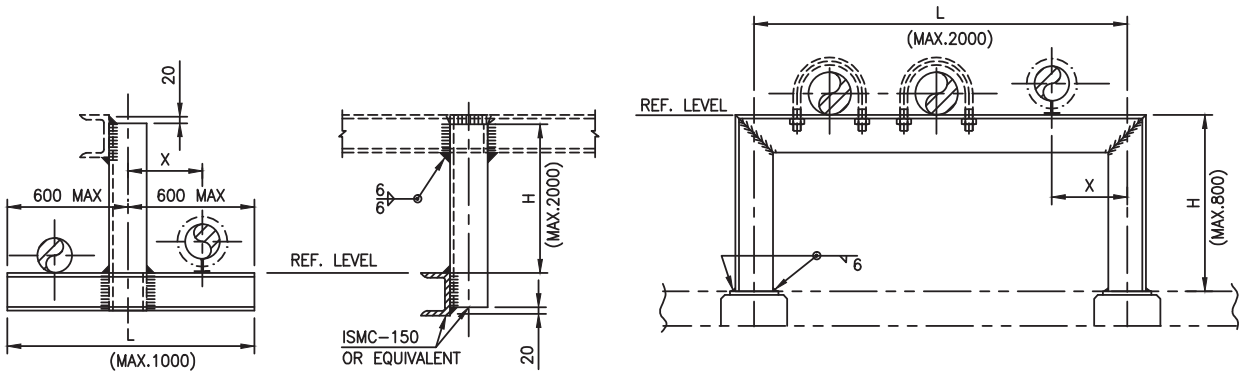
ARRGT. TYPE-1

ARRGT. TYPE-2



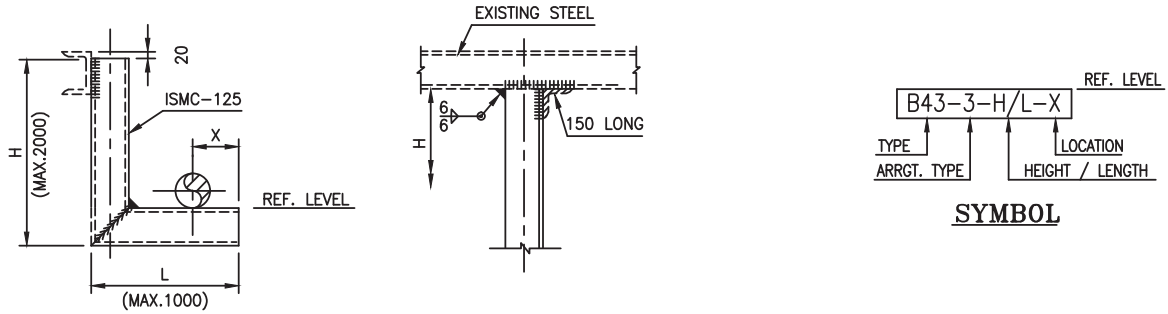
ARRGT. TYPE-3

ARRGT. TYPE-4



ARRGT. TYPE-5

ARRGT. TYPE-6



ARRGT. TYPE-7
(MAX.LOAD 750 Kg)

ALTERNATIVE ARRGT. (TYP.)
DETAIL-M
NOTE-2
(APPLICABLE TO ALL ARRGT. TYPES)

SYMBOL

NOTES:-

1. FABRICATE FROM ISA 80x80x8, UNLESS OTHERWISE NOTED.
2. THE ATTACHMENT OF SUPPORTING STEEL TO EXISTING SHALL BE TO SUIT AVAILABLE EXISTING STEEL.

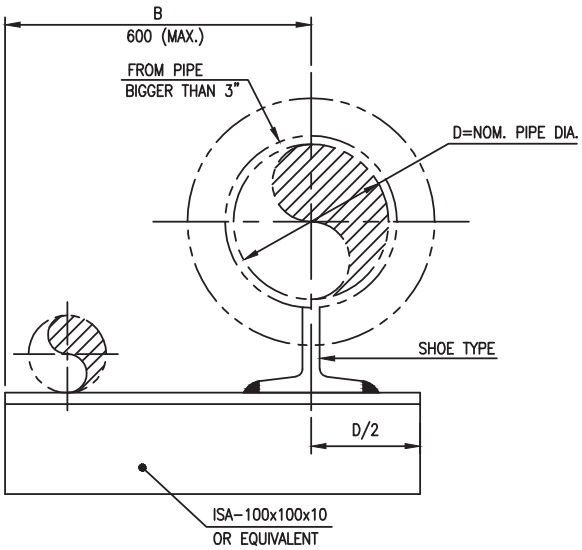
Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RCB	DEP	SHR/BN
0	30-08-91	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

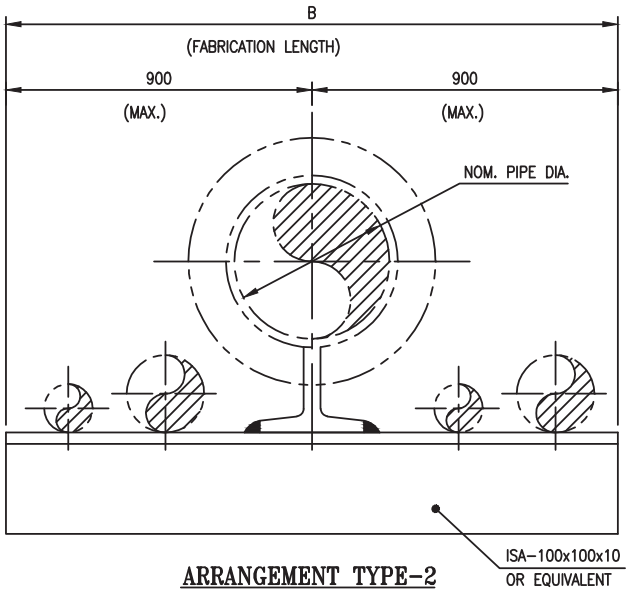
PIPE SUPPORT BRACKETS
TYPE-B43

Standard Number	Rev.
03-PS-083	4
Sheet 1of 1	

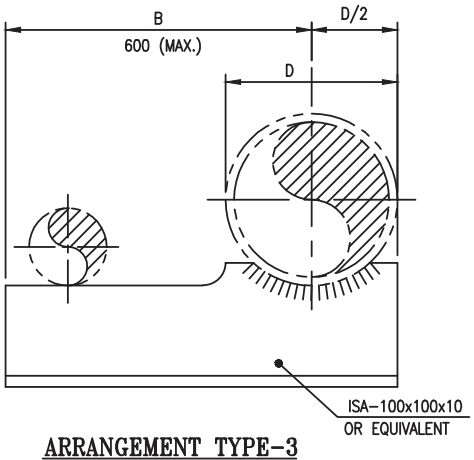
AUTOCAD



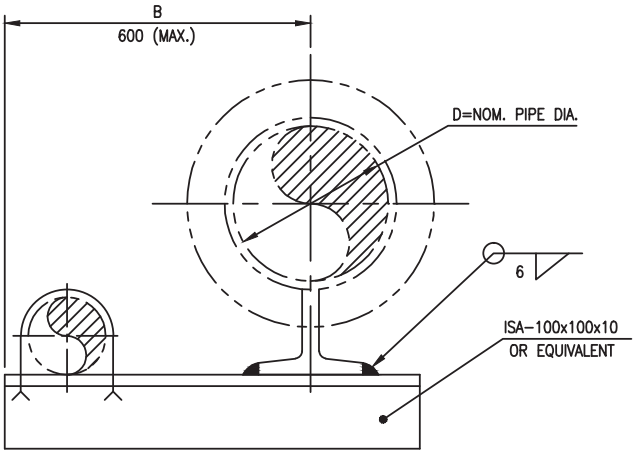
ARRANGEMENT TYPE-1
(FOR UNBALANCED LOAD)



ARRANGEMENT TYPE-2
(FOR BALANCED LOAD)

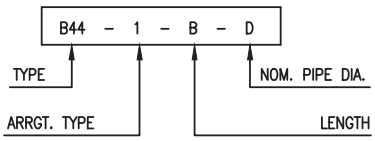


ARRANGEMENT TYPE-3
(FOR UNBALANCED LOAD)



ARRANGEMENT TYPE-4
(FOR UNBALANCED LOAD)

D	MAX ALLOWABLE LOAD (Kgs)
3"	30
4"	140
6"	700
8"	2000
10" THRU 24"	4000



SYMBOL

NOTE:-

AVOID USE FOR THIS SUPPORT FROM CRITICAL LINES AND LINES ABOVE 200°C.

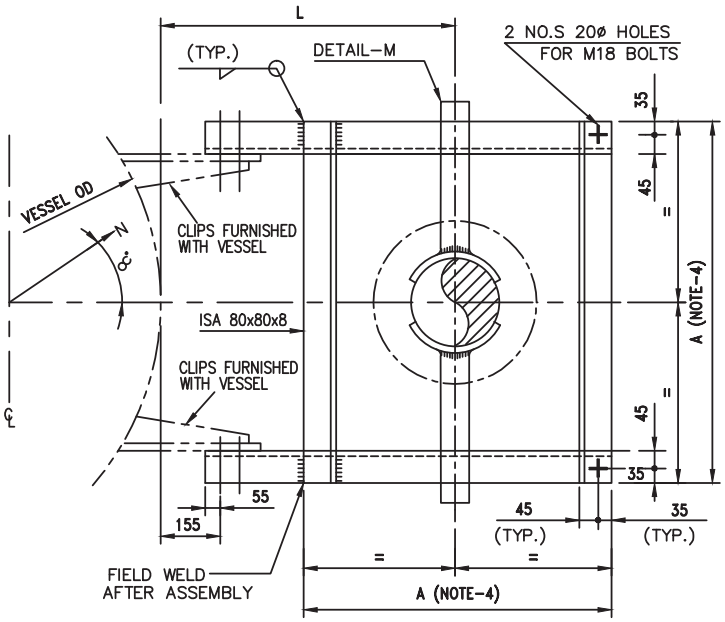
Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RCB	DEP	SHR/BN
0	15-02-92	ISSUED AS STANDARD	SDM	AKR	KPS

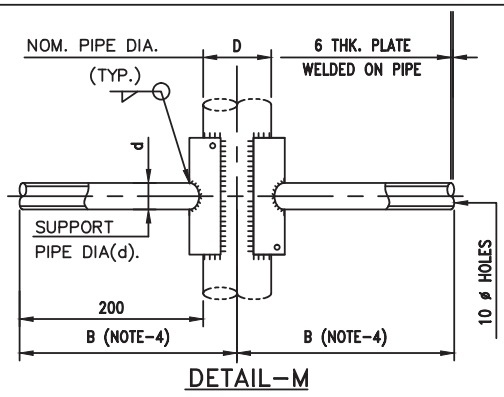
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PIPE SUPPORT BRACKET
FROM PIPE 3" THRU 24"
TYPE-B44

Standard Number	Rev.
03-PS-084	4
Sheet 1 of 1	

AUTOCAD



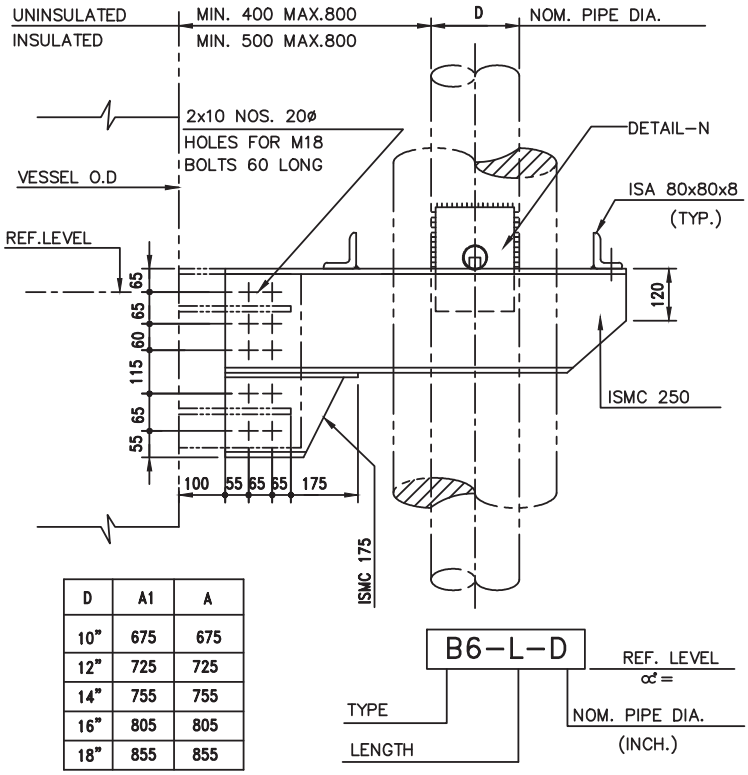


DETAIL-M

(SUPPORT PIPE MATERIAL SAME AS LINE PIPE.)

D	d (NOTE-2)
10"	6" SCH. 40
12"	6" SCH. 40
14"	6" SCH. 40
16"	8" SCH. 40
18"	8" SCH. 40

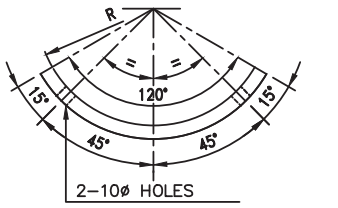
D	R	C
10"	137	340
12"	162	340
14"	178	340
16"	203	440
18"	229	440

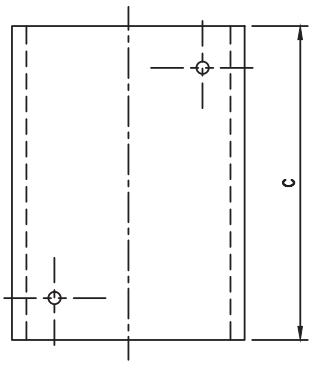


D	A1	A
10"	675	675
12"	725	725
14"	755	755
16"	805	805
18"	855	855

SYMBOL

D	FOR BARE PIPE		FOR INSUL. THK. UP TO 75MM		FOR INSUL. THK. 76MM TO 125MM		FOR MAX. INSUL. THICKNESS	
	A	B	A	B	A	B	A	B
10"	484	252	640	330	740	380	820 (165*)	420
12"	534	277	690	355	790	405	880 (170*)	450
14"	566	293	720	370	820	420	910 (170*)	465
16"	617	319	770	395	870	445	970 (175*)	495
18"	668	344	820	420	920	470	1030 (180*)	525





DETAIL-N
PROTECTION SHIELD (NOTE-1)

MAX. LOAD 5000 kg

NOTES:-

1. IN CASE SIZE AND/OR SCH. OF SUPPORT PIPE (d) LISTED IN THE TABLE IS NOT AVAILABLE USE NEXT HIGHER SIZE AND/OR THICKNESS AVAILABLE.
2. PROTECTION-SHIELD SHALL BE CUT FROM LINE-PIPE OR ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE THICKNESS OF PROTECTION-SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS.
3. MATERIAL OF BOLTS AND NUTS SHALL BE IS-1367 CLASS 10.9 AND IS-1367 CLASS 12 RESPECTIVELY.
4. FIGURES IN BRACKETS MARKED WITH AN * INDICATE THE MAXIMUM INSULATION THICKNESS APPLICABLE. IF REQUIRED, DIMENSION 'A' & 'B' SHALL BE CALCULATED BASED UPON THE ACTUAL INSULATION THICKNESS.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RCB	DEP	SHR/BN
0	08-01-07	ISSUED AS STANDARD	SOB	NCS	BN

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

BRACKET ON VERTICAL COLUMN LOAD SUPPORT FOR BARE/INSULATED PIPE SIZE 10" THRU 18"-TYPE B6,-B6A

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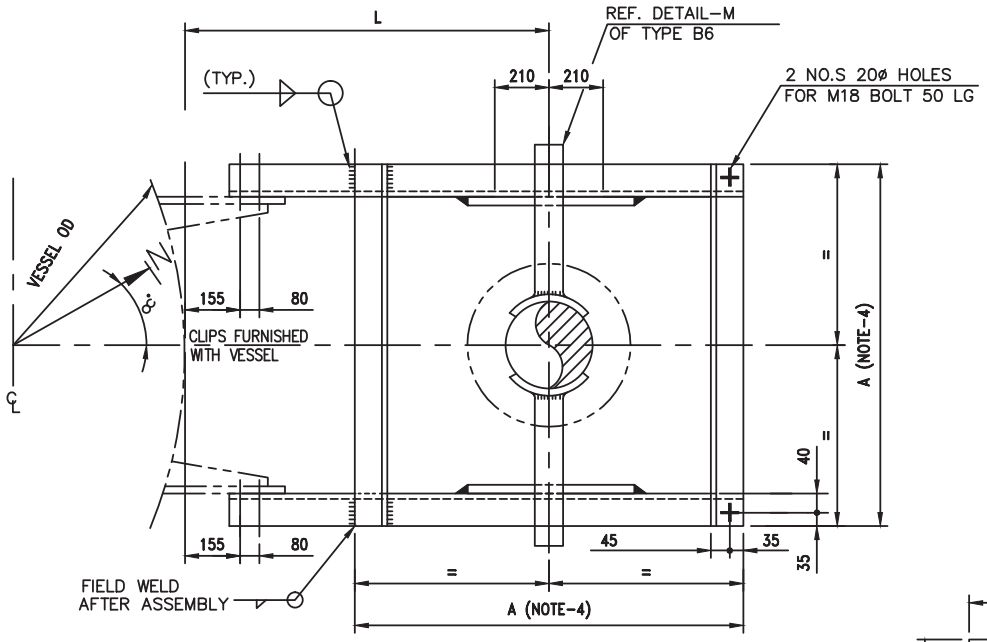
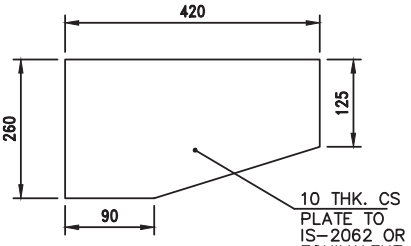
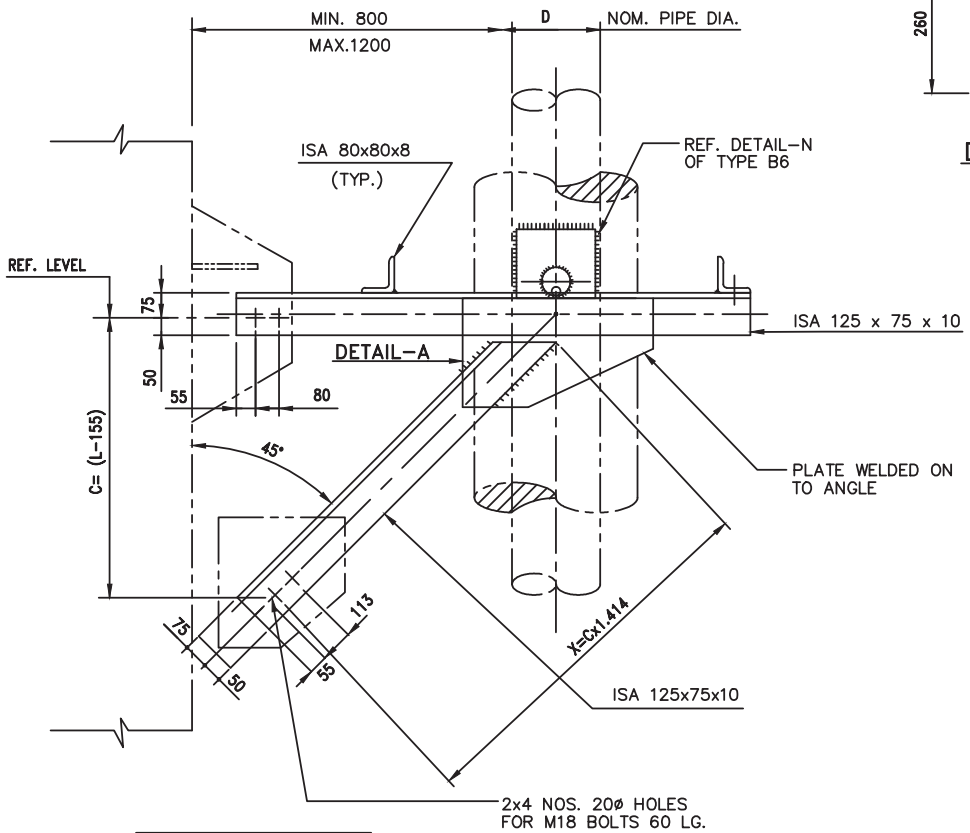
03-PS-091	4
Sheet 1 of 2	

AUTOCAD





DETAIL–A



B6A – L – D

REF. LEVEL

α° =

TYPE

NOM. PIPE DIA.(INCH.)

LENGTH

SYMBOL

D	FOR BARE PIPE		FOR INSUL. THK. UP TO 75MM		FOR INSUL. THK. 76MM TO 125MM		FOR MAX. INSUL. THICKNESS	
	A	B	A	B	A	B	A	B
10"	484	252	640	330	740	380	820 (165*)	420
12"	534	277	690	355	790	405	880 (170*)	450
14"	566	293	720	370	820	420	910 (170*)	465
16"	617	319	770	395	870	445	970 (175*)	495
18"	668	344	820	420	920	470	1030 (180*)	525

NOTES:–

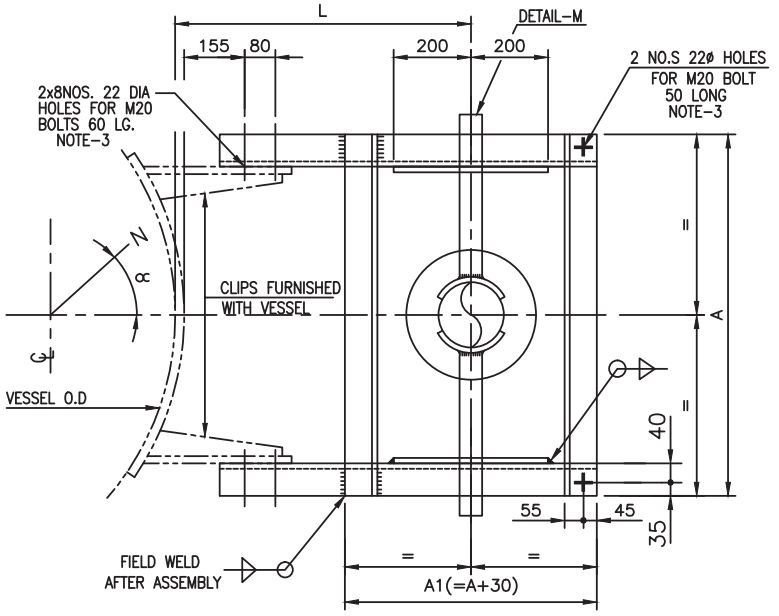
FOR NOTE NO. 1 THRU 3 AND FOR DETAIL–N AND M REFER PAGE 1 OF 2.

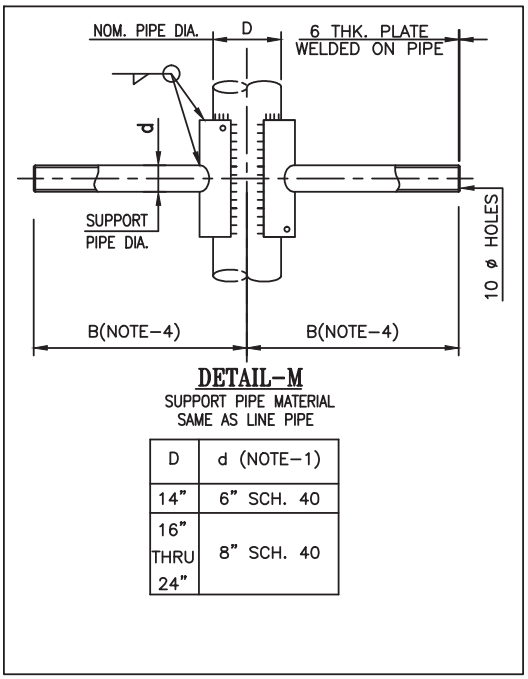
4. FIGURES IN BRACKETS MARKED WITH AN * INDICATE THE MAXIMUM INSULATION THICKNESS APPLICABLE. IF REQUIRED, DIMENSION 'A' & 'B' SHALL BE CALCULATED BASED UPON THE ACTUAL INSULATION THICKNESS.

MAX. LOAD 5000 kg

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	BRACKET ON VERTICAL COLUMN LOAD SUPPORT FOR BARE AND INSULATED PIPE SIZE 10" THRU 18"–TYPE B6– AND B6A	Std./Doc. Number	Rev.
		03–PS–091	4
		Sheet 2 of 2	

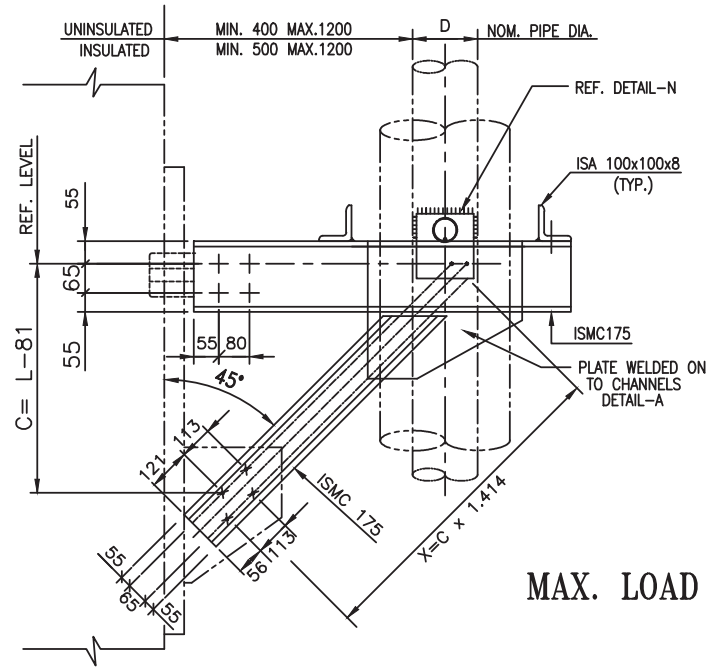
AutoCAD

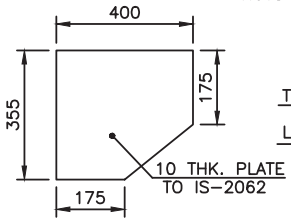




DETAIL-M
SUPPORT PIPE MATERIAL SAME AS LINE PIPE

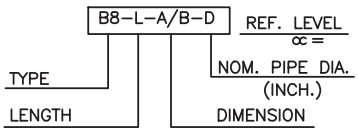
D	d (NOTE-1)
14"	6" SCH. 40
16" THRU 24"	8" SCH. 40





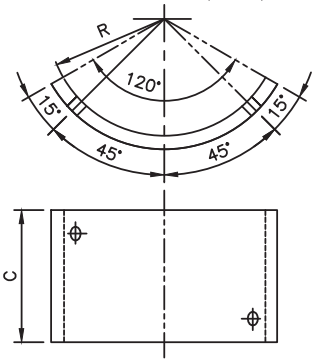
DETAIL-A

MATERIAL:
BOLT IS: 1367 CLASS 10.90
NUTS IS: 1367 CLASS 12



SYMBOL

DETAIL-N
PROTECTION SHIELD (NOTE-2)



MAX. LOAD 10000 kg

D	FOR BARE PIPE		FOR INSUL. THK. UP TO 75MM		FOR INSUL. THK. 76MM TO 125MM		FOR INSUL. THK. THICKNESS	
	A	B	A	B	A	B	A	B
14"	566	293	720	370	820	420	910 (170*)	465
16"	617	319	770	395	870	445	970 (175*)	495
18"	668	344	820	420	920	470	1030 (180*)	525
20"	718	369	870	445	970	495	1080 (180*)	550
22"	769	395	920	470	1020	520	1130 (180*)	575
24"	820	420	970	495	1070	545	1180 (180*)	600

D	R	C
14"	175	340
16"	203	440
18"	229	
20"	254	
22"	279	
24"	305	

NOTE:-
1. IN CAES SIZE AND / OR SCH. OF SUPPORT PIPE (d) LISTED IN THE TABLE IS NOT AVAILABLE USE NEXT HIGHER SIZE AND / OR NEAREST EQUIVALENT THICKNESS AVAILABLE
2. PROTECTION SHIELD SHALL BE CUT FROM LINE PIPE OR ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS.
3. MAT. OF BOLTS SHALL BE IS: 1367 CLASS 10.9 & NUTS SHALL BE IS: 1367 CLASS 12.
4. FIGURE IN BRACKET MARKED WITH AN * INDICATE THE MAXIMUM INSULATION THICKNESS APPICABLE. IF REQUIRED, DIMENSION 'A' & 'B' SHALL BE CALCULATED BASED UPON THE ACTUAL INSULATION THICKNESS.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION & ISSUED FOR IMPLIMENTATION	AJW	DEP	SHR/BN
0	08-01-07	ISSUED AS STANDARD	SOB	NCS	BN

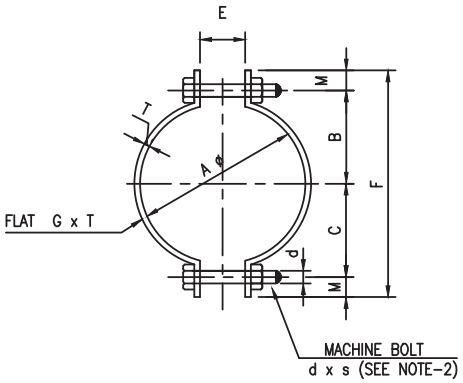
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

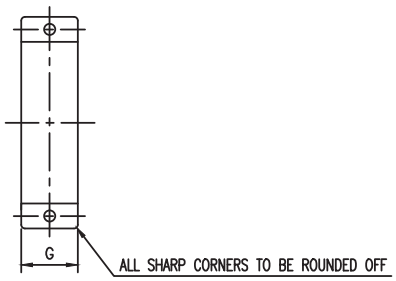
BRACKET ON VERTICAL COLUMN LOAD SUPPORT FOR BARE AND INSULATED PIPE, SIZE 14" THRU 24"-TYPE B8

Standard Number: 03-PS-092 | Rev.: 4

Sheet 1 of 1

AUTOCAD





D	DIMENSIONS								BOLT SIZE (REF. NOTE-2)		MAX LOAD (Kg)
	A	B	C	G	M	E	r	T	M/C BOLTS	M/C BOLTS	
½"	22	35	35	35	18	15	9	6	M12 x 55	M12 x 70	450
3/4"	27	40	40								
1"	35	45	45								
1½"	50	50	50								
2"	62	60	55								
3"	92	80	75								
4"	116	90	85	50	25	20	12	8	M16 x 70	M16 x 95	800
6"	170	125	120	70	30	25			M20 x 80	M20 x 110	1200
8"	222	160	155								
10"	276	190	185	80	40	28	15	10	M22 x 95	M22 x 135	1500
12"	327	220	215								
14"	358	230	225	100	40	30	18	12	M24 x 100	M24 x 150	2100
16"	410	270	265								
18"	460	290	285								
20"	511	320	315	100	50	33	20	14	M27 x 120	M27 x 170	2800
24"	613	370	365								

CLAMP TYPE	MATERIAL	
	CLAMP	BOLTS AND NUTS
C1A	IS-2062 OR EQUIVALENT	IS-1367 CLASS 10.9 IS-1367 CLASS 12
C1B	ASTM A516/A515 (GR.60/65/70)/ OR EQUIVALENT IS-2002 GR.2	ASTM A193 GR.B7 ASTM A194 GR.2H
C1C	SS-316 PLATE	ASTM A193 GR.B16 ASTM A194 GR.4

PIPE MATL.	TEMPERATURE	CLAMP TYPE
CS	UPTO 343°C	C1A
	344°C TO 427°C	C1B
AS	ABOVE 427°C	C1C
SS	ALL TEMP.	C1C

NOTES:-

1. FOR C.S. PIPE MATERIAL M/C BOLTS SHALL BE USED, WHEREAS FOR ALLOY STEEL & STAINLESS STEEL PIPE, STUD-BOLTS SHALL BE USED.
2. WHERE EVER THE PIPE CLAMPS ARE SUBJECTED TO VIBRATION AN ADDITIONAL CHECK NUT WILL BE USED. BOLT/STUD BOLT LENGTH SHALL BE SUITABLY INCREASED TO ACCOMMODATE THE CHECK NUT.

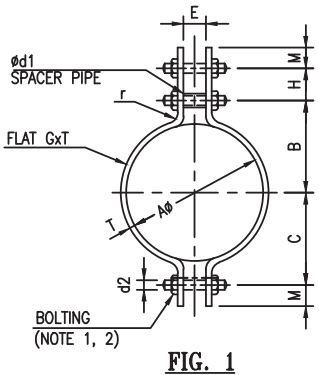
Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RCB	DEP	SHR/BN
0	15-02-92	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PIPE CLAMP FOR
BARE PIPE (1/2"-24") TYPE -C1

Standard Number	Rev.
03-PS-031	4
Sheet 1of 1	

AUTOCAD



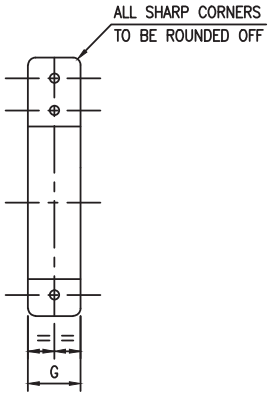


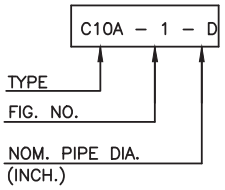
FIG. 1

D=NOM.PIPE DIA.IN INCHES

D	DIMENSIONS											BOLT SIZE(REF.NOTE-2)		MAX. ALLOWABLE LOAD IN Kgs.
	A	B	C	H UPTO 450°C	H ABOVE 450°C	T	G	M	d1 NB	E	r	M/C BOLTS	STUD BOLTS	
1/2"	22	35	35	70	95	6	35	18	1/2"	15	9	M12x55	M12x70	450
3/4"	27	40	40	75	100									
1"	35	45	45	75	100									
1½"	50	50	50	85	115									
2"	62	60	55	85	115									
3"	92	80	75	100	130									
4"	116	90	85	105	135	8	50	25	3/4"	20	12	M16x70	M16x95	800
6"	170	125	120	120	160	8	70	30	1"	25		M20x80	M20x110	1200
8"	222	160	155	120	155									
10"	276	190	185	125	170	10	80	40	1½"	28	15	M24x95	M24x135	1500
12"	327	220	215	125	170									
14"	358	230	225	135	175	12	100	40		30	18	M24x100	M24x150	2100
16"	410	270	265	120	165									
18"	460	290	285	135	180									
20"	511	320	315	130	175	14		50		33	20	M27x120	M27x170	2800
24"	613	370	365	145	190									

CLAMP PIPE	MATERIAL	
	CLAMP	BOLTS AND NUTS
C3A	IS-2062	IS-1367 CLASS 10.9 IS-1367 CLASS 12
C3B	ASTM A516/A515 (GR.60/65/70)/ IS-2002 GR.2	ASTM A193 GR.B7 ASTM A194 GR.2H
C3C	SS-316 PLATE	ASTM A193 GR.B16 ASTM A194 GR.4

PIPE MATL.	OPERATING TEMPERATURE	CLAMP TYPE
CS	UPTO 343°C	C3A
AS	344°C TO 427°C	C3B
	ABOVE 427°C	C3C
SS	ALL TEMP.	C3C



SYMBOL

NOTES:-

1. WHEREVER THE PIPE CLAMPS ARE SUBJECTED TO VIBRATION AN ADDITIONAL LOCK-NUT SHALL BE USED. M/C-BOLT/STUD-BOLT LENGTH SHALL BE SUITABLY INCREASED TO ACCOMODATE THE LOCK-NUT.
2. FOR CARBON STEEL PIPE, M/C-BOLTS SHALL BE USED, WHEREAS FOR ALLOY STEEL AND STAINLESS STEEL PIPE, STUD-BOLTS SHALL BE USED.
3. SPACER-PIPE MATERIAL SHALL BE EQUIVALENT TO CLAMP MATERIAL.

PIPE CLAMP
FOR LIGHT DUTY BARE / INSULATED PIPE

Rev.	Date	Description	Prpd.	Chkd.	Appd.
0	30-04-18	ISSUED AS STANDARD	RP	DEP	SHR/BN

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PIPE CLAMP FOR
INSULATED CS/AS/SS PIPE SIZE
1/2"THRU 24' TYPE-C10A/B/C

Standard Number	Rev.
03-PS-126	0
Sheet 1of 2	

AUTOCAD

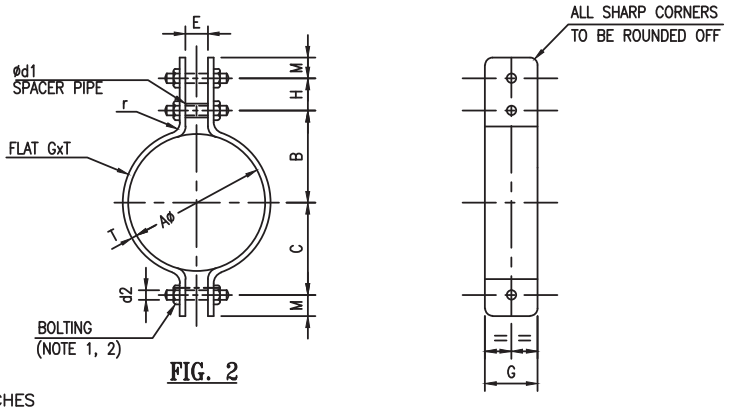


FIG. 2

D=NOM.PIPE DIA.IN INCHES

D	DIMENSIONS											BOLT SIZE(REF.NOTE-2)		MAX. ALLOWABLE LOAD (Kg.)
	A	B	C	H UPTO 450°C	H ABOVE 450°C	T	G	M	d1 NB	E	r	M/C BOLTS	STUD BOLTS	
1/2"	22	35	35	70	95	6	35	18	1/2"	15	9	M12x55	M12x70	450
3/4"	27	40	40	75	100									
1"	35	45	45	75	100									
1½"	50	50	50	85	115									
2"	62	60	55	85	115									
3"	92	80	75	100	130	10	50	25	3/4"	30	15	M16x75	M16x110	800
4"	116	90	85	105	135		100	40	1½"					
6"	170	125	120	120	160	12					18	M24x100	M24x125	1950
8"	222	160	155	120	155									
10"	276	190	185	125	170	16	120	45		35	24	M27x125	M27x160	2600
12"	327	220	215	125	170									
14"	358	230	225	135	175									
16"	410	270	265	120	165									
18"	460	290	285	135	180		140	60				M30x125	M30x160	3000
20"	511	320	315	130	175									
24"	613	370	365	145	190	20		65		40	30	M36x150	M36x180	4500

CLAMP PIPE	MATERIAL	
	CLAMP	BOLTS AND NUTS
C10A	IS-2062	IS-1367 CLASS 10.9 IS-1367 CLASS 12
C10B	ASTM A516/A515 (GR.60/65/70)/ IS-2002 GR.2	ASTM A193 GR.B7 ASTM A194 GR.2H
C10C	SS-316 PLATE	ASTM A193 GR.B16 ASTM A194 GR.4

PIPE MATL.	OPERATING TEMPERATURE	CLAMP TYPE
CS	UPTO 343°C	C10A
AS	344°C TO 427°C	C10B
	ABOVE 427°C	C10C
SS	ALL TEMP.	C10C

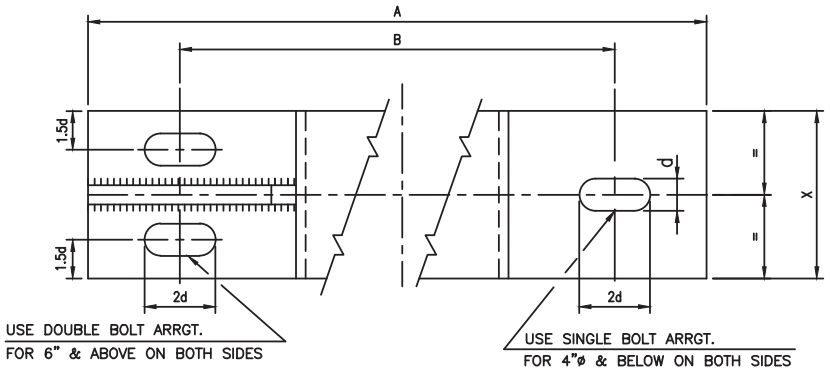
PIPE CLAMP
FOR HEAVY DUTY BARE / INSULATED PIPE

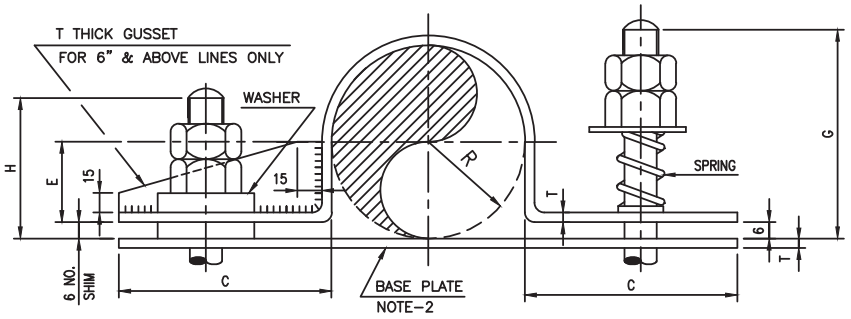
AUTOCAD

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

HEAVY PIPE CLAMP FOR
INSULATED CS/AS/SS PIPE SIZE
1/2"THRU 24' TYPE-C10A/B/C

Standard Number	Rev.
03-PS-126	0
Sheet 2 of 2	





PIPE SIZE	X	T	A	B	C	E	R	BOLT	d	G	H	SPRING (NOTE 1 & 3)		
												O.D	COIL SIZE (INCHES)	FREE LENGTH
1"	65	5	184	124	75	–	17	6	8	60	35	20	5/32 X 3/32	25
1 1/2"	65	5	198	138	75	–	25	6	8	60	35	20	5/32 X 3/32	25
2"	80	6	240	170	90	–	30	10	12	70	40	25	7/32 X 7/64	25
3"	80	6	270	200	90	–	45	10	12	70	40	25	7/32 X 7/64	25
4"	80	6	294	224	90	–	58	10	12	70	40	25	7/32 X 7/64	25
6"	115	10	400	310	115	70	85	12	14	90	50	40	9/32 X 3/32	40
8"	115	10	452	352	115	100	111	12	14	90	50	40	9/32 X 5/32	40
10"	140	10	506	405	115	125	138	20	22	120	65	45	3/8 X 3/16	50
12"	140	12	556	466	115	145	163	20	22	130	70	45	3/8 X 3/16	50
14"	140	12	588	498	115	165	179	20	22	130	70	45	3/8 X 3/16	50
16"	140	12	642	552	115	190	205	20	22	130	70	45	3/8 X 3/16	50
18"	140	12	690	600	115	215	230	20	22	130	70	45	3/8 X 3/16	50
20"	160	12	742	642	115	240	256	24	26	150	100	50	7/16 X 7/32	65
24"	160	12	844	744	115	290	307	24	26	150	100	50	7/16 X 7/32	65

C11A – D

TYPE — NOM. PIPE DIA. INCH

SYMBOL

PIPE MATL.	OPERATING TEMPERATURE	CLAMP MATERIAL	CLAMP TYPE
CS	UPTO 232°C	IS-2062	C11A
AS			
SS	UPTO 232°C	SS-316	C11C

NOTES:-

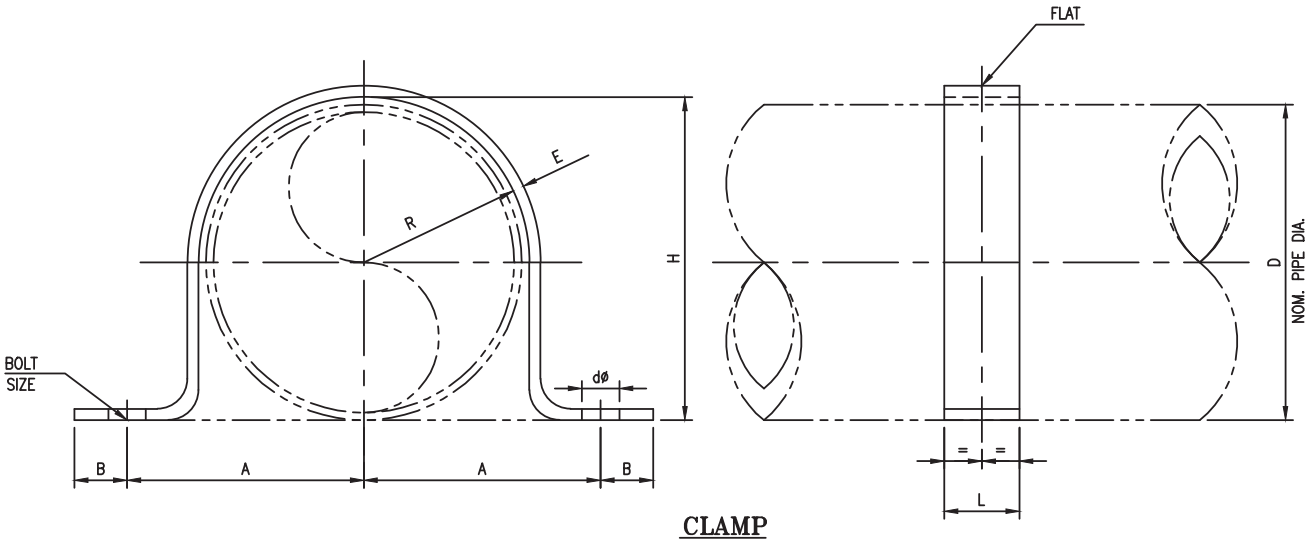
1. SPRING COIL DETAILS ARE ONLY INFORMATIVE. BASED ON AVAILABILITY, EQUIVALENT SPRING COIL MAY BE USED.
2. BASE PLATE NOT REQUIRED FOR INSTALLATION ON STEEL MEMBERS, USE WELDING STUDS WHERE MEMBERS ARE NOT ALLOWED TO DRILLED.
3. FIBER STRESS OF SPRING COIL = 6624 KG/SQ.CM (80, 000 PSI) AND MODULUS OF ELASTICITY = 0.88 x 10E6 KG/SQ.CM (12.6 x 10E6 PSI).

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	ISH	DEP	SHR/BN
0	21-05-93	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PIPE HOLD DOWN CLAMP FOR BARE PULSATING PIPE SIZE 1" THRU 24" TYPE-C11A/C11C

Standard Number	Rev.
03-PS-036	4
Sheet 1of 1	

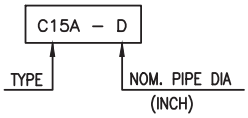


CLAMP

D	D1	R	A	B	H	L	E	dø	DEV. LENGTH OF FLAT	ALLOW LOAD Kgs	BOLT SIZE
3/4"	27	17	35	20	30	30	6	12	160	450	M10 x 45
1"	34	20	43	20	37	30	6	12	190		
1½"	49	28	52	20	52	40	6	14	230		M12 x 50
2"	60	33	58	25	64	50	6	14	260		
3"	89	48	80	30	93	60	6	18	360	850	M16 x 60
4"	115	61	90	30	119	60	6	18	430		
6"	169	88	125	35	173	80	8	22	610	1350	M20 X 70
8"	220	114	160	40	226	80	8	22	750		
10"	274	141	190	40	280	100	10	27	900	1950	M24 x 75
12"	324	166	220	40	330	100	10	27	1030		
14"	356	182	230	50	362	100	10	27	1110		
16"	407	208	270	50	413	120	12	30	1280	2600	M27 x 70
18"	458	233	290	60	464	140	16	33	1410	3800	M30 x 95
20"	508	258	320	60	514	140	16	33	1550		
22"	559	284	340	65	565	140	16	39	1670		M36 x110
24"	610	309	370	65	616	140	16	39	1810		

PIPE MATL.	OPERATING TEMPERATURE	CLAMP TYPE
CS	UPTO 343°C	C15A
AS	344°C TO 427°C	C15B
SS	ALL TEMP.	C15C

CLAMP PIPE	MATERIAL	
	CLAMP	BOLTS AND NUTS
C15A	IS-2062 *	IS-1367 CLASS 10.9 IS-1367 CLASS 12 *
C15B	ASTM A516/A515 GR.60/65/70 OR IS-2002 GR.2	ASTM A193 GR.B B7 ASTM A194 GR.2H
C15C	SS-316 PLATE	ASTM A193 GR.B B7 ASTM A194 GR.2H



SYMBOL

NOTES:-

1. WHEREVER THE PIPE CLAMPS ARE SUBJECTED TO VIBRATION AN ADDITIONAL LOCK-NUT SHALL BE USED. M/C-BOLT/STUD-BOLT LENGTH SHALL BE SUITABLE INCREASED TO ACCOMODATE THE LOCK-NUT
2. FOR CARBON STEEL PIPE, M/C-BOLTS SHALL BE USED, WHEREAS FOR ALLOY STEEL AND STAINLESS STEEL PIPE, STUD-BOLTS SHALL BE USED.
3. (*) OR EQUIVALENT.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RP	DEP	SHR/BN
0	30-08-91	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PIPE U-CLAMP FOR BARE CS/AS/SS PIPE SIZE 3/4" THRU 24" TYPE C15A/C15B/C15C

Standard Number	Rev.
03-PS-040	4
Sheet 1of 1	

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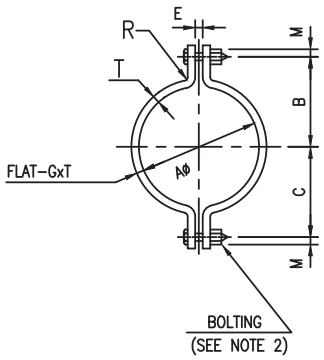
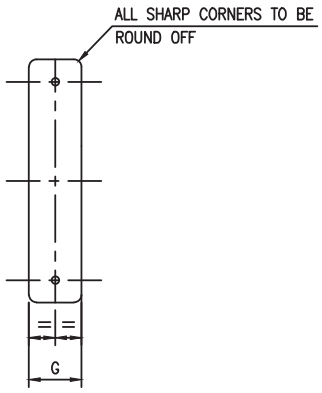




D=NOM.PIPE DIA.IN INCHES

D	MAX. LOAD Kg.	DIMENSIONS								BOLT SIZE(REF.NOTE-2)	
		A	B	C	G	M	E	r	T	M/C BOLTS	STUD BOLTS
1/2"	450	22	35	35	35	18	15	9	6	M12x55	M12x70
3/4"		27	40	40							
1"		35	45	45							
1½"		50	50	50							
2"		62	60	55							
3"	800	92	80	75	50	25	30	15	10	M16x75	M16x110
4"		116	90	85	100	40					
6"	1950	170	125	120				18	12	M24x100	M24x125
8"		222	160	155							
10"	2600	276	190	185	120	45	35	24	16	M27x125	M27x160
12"		327	220	215							
14"		358	230	225							
16"		410	270	265							
18"	3000	460	290	285	140	60	35	24	16	M30x125	M30x160
20"		511	320	315							
24"	4500	613	370	365	140	65	40	30	20	M36x150	M36x180

PIPE MATL.	OPERATING TEMPERATURE	CLAMP TYPE
CS / AS	UPTO 343°C	C16A
	343°C TO 427°C	C16B
	ABOVE 427°C	C16C
SS	ALL TEMP.	C16C

CLAMP PIPE	MATERIAL	
	CLAMP	BOLTS AND NUTS
C16A	IS-2062	IS-1367 CLASS 10.9 IS-1367 CLASS 12
C16B	ASTM A516/A515 (GR.60/65/70)/ IS-2002 GR.2	ASTM A193 GR.B7 ASTM A194 GR.2H
C16C	SS-316 PLATE	ASTM A193 GR.B16 ASTM A194 GR.4

NOTES:-

1. FOR C.S. PIPE MATERIAL M/C BOLTS SHALL BE USED, WHEREAS FOR ALLOY STEEL & STAINLESS STEEL PIPE, STUD-BOLTS SHALL BE USED.
2. WHERE EVER THE PIPE CLAMPS ARE SUBJECTED TO VIBRATION AN ADDITIONAL CHECK NUT WILL BE USED. BOLT/STUD BOLT LENGTH SHALL BE SUITABLY INCREASED TO ACCOMMODATE THE CHECK NUT.

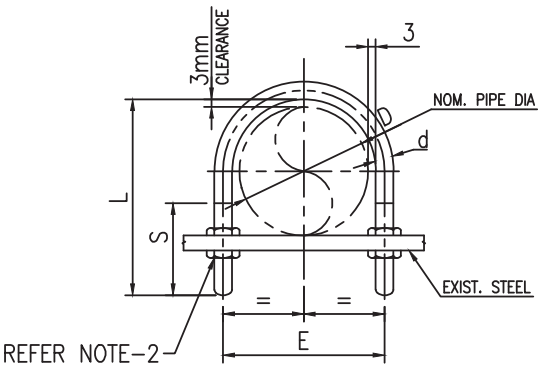
Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	10-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION.	RCB	DEP	SHR/BN
0	23-06-92	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

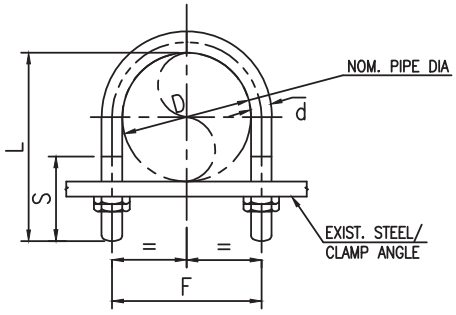
HEAVY PIPE CLAMP FOR BARE PIPE
CS/AS/SS
SIZE 1/2"THRU 24'
TYPE-C16A/C16B/C16C

Standard Number	Rev.
03-PS-041	4
Sheet 1of 1	

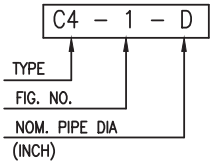
AUTOCAD



GUIDE ARRANGEMENT TYPE-1
(1/2" TO 24")



FIXED ARRANGEMENT TYPE-2
(1/2" TO 24")



SYMBOL

D	O.D. (mm)	"U" BOLT					ALLOWED LOAD (KG)
		L	E	F	d	S	
½"	22	65	34	28	6	50	150
3/4"	27	70	39	33	6	50	
1"	34	75	48	42	8	55	300
1½"	49	90	63	57	8	55	
2"	60	105	74	68	8	60	
3"	89	145	107	101	12	80	700
4"	114	170	133	127	12	80	
6"	169	240	191	185	16	100	1200
8"	220	290	242	236	16	100	
10"	274	345	296	290	16	100	
12"	324	420	350	344	20	130	2000
14"	356	450	382	376	20	130	
16"	407	500	433	427	20	130	
18"	458	565	489	483	25	140	2800
20"	508	620	539	533	25	140	
24"	610	720	641	635	25	140	

NOTES:-

1. BOLTS SHALL BE TURNED FROM CS ROD MATERIAL CONFIRMING TO IS-2062 GR.A WITH DIMENSION TO IS-1367 CLASS CLASS 10.9 AND NUTS SHALL BE TO IS-1367 CLASS 12.
2. WHEREVER THE U-BOLTS ARE SUBJECTED TO VIBRATION AN ADITIONAL LOCK-NUT SHALL BE USED. U-BOLT LENGTH SHALL BE SUITABLY INCREASED TO ACCOMODATE THE LOCK-NUT.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	AJW	DEP	SHR/BN
0	03-05-92	ISSUED AS STANDARD	SDM	AKR	KPS

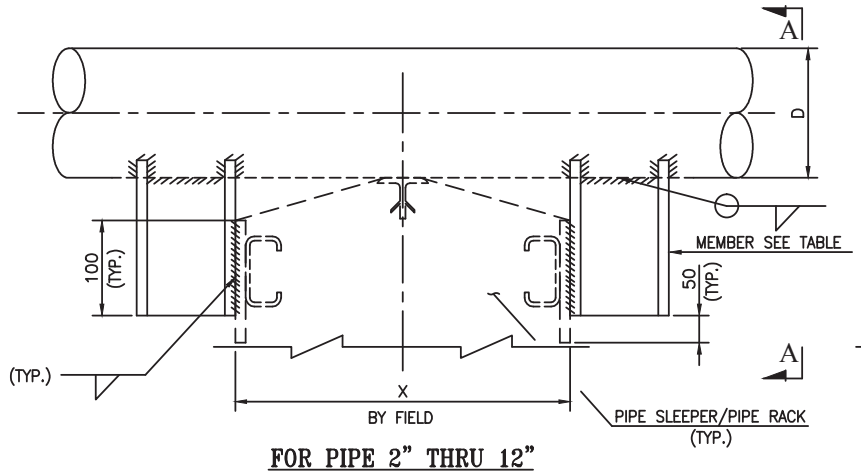
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

U-BOLT FOR BARE C.S.PIPE
SIZE 1/2" THRU 24" TYPE-C4
(FOR OPERATING TEMP.UPTO 343°C)

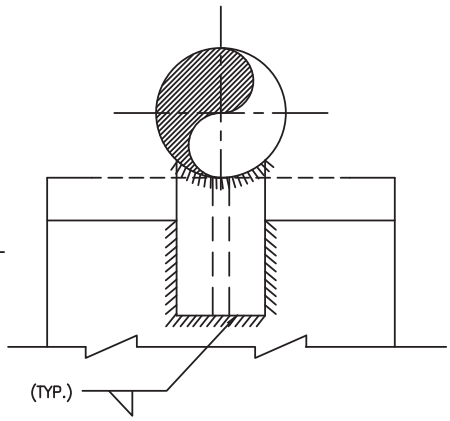
Standard Number	Rev.
03-PS-033	4
Sheet 1of 1	

AUTOCAD

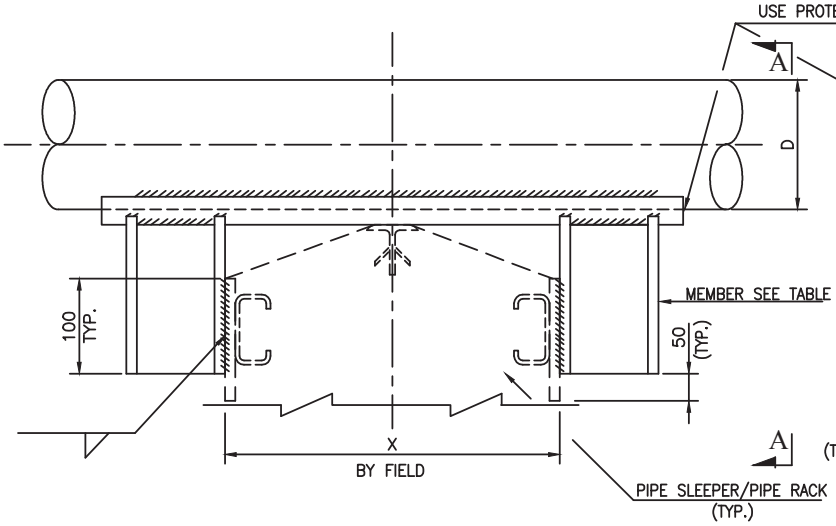
D(INCH.)	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
MEMBER	ISA-50 x10t	ISA-50 x10t	ISMB-100		ISMB-150				ISMB-200		ISMB-250	



FOR PIPE 2" THRU 12"
NOTE-2 & 3)

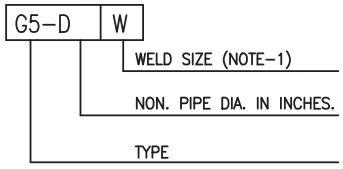


VIEW A-A



FOR PIPE 14" THRU 24"

VIEW A-A



SYMBOL

NOTES:-

1. LOADS ON FILLET WELD OF ANCHOR SHALL BE LIMITED TO THE VALUES TABULATED ABOVE AGAINST VARIOUS TEMPERATURES, FOR THE RESPECTIVE WELD-SIZE. FOR RUNNING LENGTH OF WELD. LOADS MAY BE INTERPOLATED FOR INTERMEDIATE TEMPERATURES.
2. FOR AS AND SS LINES. FOR SIZES 2" THRU 12", PROTECTION-SHIELD AS PER NOTE-3 IS TO BE PROVIDED.
3. PROTECTION-SHIELD SHALL BE CUT FROM LINE-PRE OR ROLLED FROM PLATE OF MATERIAL EQUIVALENT TO THAT OF PIPE. THICKNESS OF PROTECTION-SHIELD SHALL BE SAME AS THAT OF LINE-PIPE OR 12MM, WHICHEVER IS LESS.
4. ALSO SUPPORTING DETAILS FOR PIPE-SIZE 2" THRU 6". REFER 03-PS-112 (G4). CROSS-GUIDE GAP SHALL BE MADE ZERO AND RESTRAINT FACE SHALL BE WELDED TO SLEEPER INSERT PLATES ON EITHER SIDE.

MAXIMUM ALLOWABLE LOAD ON FILLET-WELD OF RESTRAINT (KG/CM)					
WELD SIZE (MM)	TEMPERATURE (IN DEG.C)				
	200	250	300	350	400
6	340	250	220	200	170
8	450	340	300	270	220
10	560	420	370	330	280

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	30-04-18	GENERAL REVISION AND ISSUED FOR IMPLEMENTATION	AJW	DEP	SHR/BN
0	23-09-02	ISSUED AS STANDARD	SDM	AKR	KPS

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

ANCHOR FOR BARE PIPE ON SLEEPER/RCC BEAM SIZE 2" THRU 24" TYPE-G5 (UPTO 343°C)

Standard Number: 03-PS-032 | Rev.: 4

Sheet 1of 1

AUTOCAD

MRPL Engineering Design Basis

For

Spare Parts

Rev. No	Date	Purpose
0	04/06/16	Issued for Design
1	**30.05.17**	**(updated Mechanical Part only)**

Spare Parts required to be supplied

% - Shall mean as % of Total installed quantity

Set – Implies one complete set of components that form part of an assembly or sub-assembly in a given tag (not considering standby)(Ex: 1 Set of Radial Bearings for tags XXXA/B shall mean 1 DE Bearing & 1 Non Drive end bearings).

Item Required	Quantity	Remarks
1. Rotating Machinery		
1.1. Special Purpose Centrifugal Pump (Single & Two Stage)		
Shaft with impeller	1 No	For a set of interchangeable pumps
Mechanical Seal Cartridge	1 No	Of Each Type (NDE & DE Separately) per pump tag (excluding standby)
Mechanical Seal Faces	100%	
Mechanical Seal Packings	200%	
Pump Gaskets	200%	Including O rings (if any)
Radial Bearings	1 Set for DE & NDE separately.	Only for Hydrodynamic/ Hydrostatic bearings. Not applicable for anti-friction bearings
Thrust Bearings	1 Set of Pads	Only for Hydrodynamic/ Hydrostatic bearings. Not applicable for anti-friction bearings. Active & Inactive Separately
Filters/Strainers	400%	One strainer to be with fine mesh
Bearing Isolator	1 No	Of each size interchangeable across pumps
Coupling Disc Pack/ Transmission Element	100%	
Coupling Bolts, Washers Etc	100%	
1.2. Special Purpose Centrifugal Pump (Multi Stage)		
Rotor	1 No	Balanced, To be tested during MRT
Mechanical Seal Cartridge	1 No	Of Each Type (NDE & DE Separately)
Mechanical Seal Faces	100%	
Mechanical Seal Packings	200%	
Pump Gaskets	200%	Including O rings (if any)
Radial Bearings	1 Set	Only for Hydrodynamic/ Hydrostatic bearings. Not applicable for anti-friction bearings
Thrust Bearings	1 Set of Pads	Only for Hydrodynamic/

Item Required	Quantity	Remarks
		Hydrostatic bearings. Not applicable for anti-friction bearings. Active & Inactive Separately
Filters/Strainer	400%	One strainer to be with fine mesh
Bearing Isolator	1 No	Of each size interchangeable across pumps
Coupling Disc Pack/ Transmission Element	100%	
Coupling Bolts, Washers Etc	100%	
1.3. Vertical Centrifugal Pumps		
Complete Pump	1	Assembled, with mechanical seal if 1W+1Store standby
Impeller , Shaft with couplers	1 Set	If it is 1W+1S
Interstage Bushes	1 Set	
Mechanical Seal Faces	100%	
Mechanical Seal Packings	200%	
Coupling Disc Pack/ Transmission Element	100%	
Coupling Bolts, Washers Etc	100%	
Set of gaskets	200%	Including O rings(if any)
1.4. Centrifugal Pumps – General Purpose, Water Service		
Shaft with imepller	1 No	
Mechanical Seal Faces	100%	
Mechanical Seal Packings	200%	
Pump Gaskets	200%	Including O rings (if any)
Coupling Disc Pack/ Transmission Element	100%	
Coupling Bolts, Washers Etc	100%	
1.5. Single Screw Pumps		
Casing Insert	1 no	
Rotor	1 No	
Mechanical Seal Cartridge	1 No	Of Each Type (NDE & DE Separately)
Mechanical Seal Faces	100%	
Mechanical Seal Packings	200%	
Pump Gaskets	200%	Including O rings (if any)
Bearing Isolator	1 No	Of each size interchangeable across pumps
Coupling Disc Pack/ Transmission Element	100%	
Coupling Bolts, Washers Etc	100%	
1.6. Twin Screw Pumps		

Item Required	Quantity	Remarks
Set of Screw with shaft	1 matched set of male and female screws	
Casing Insert/Barrel	1 No	
Mechanical Seal Cartridge	100% of one pump	Consisting of 4 cartridges, 2 for DE and 2 for NDE
Mechanical Seal Faces	100%	
Mechanical Seal Packings	200%	
Pump Gaskets	200%	Including O rings (if any)
Bearing Isolator	1 No	Of each size interchangeable across pumps
Coupling Disc Pack/ Transmission Element	100%	
Coupling Bolts, Washers Etc	100%	
Timing gears	100% of one pump	
1.7. Triple Screw Pumps		
Complete Cartridge	1 Set consisting of screws and holder	
Mechanical Seal Cartridge	100% of one pump	Consisting of 4 cartridges, 2 for DE and 2 for NDE
Mechanical Seal Faces	100%	
Mechanical Seal Packings	200%	
Pump Gaskets	200%	
Coupling Disc Pack/ Transmission Element	100%	
Coupling Bolts, Washers Etc	100%	
Set of Gaskets	200%	Including O rings(if any)
1.8. Sundyne pumps		
Gasket Kit	200%	
Repair Kit	200%	
Impeller with Inducer,Shaft	100%	
Mechanical seal faces	200%	
Mechanical seal packings	200%	
Gear Box spares as per Gear Box spares EDB as per 1.21		
Internal Lube Oil Pump	1 no	
Coupling spares	100% of one pump	
1.9. Reciprocating Plunger Pumps		
Plunger Packings	100%	
Suction & Discharge Valves	100%	
Set of Gaskets	200%	Including O rings(if any)
Power end spares	50%	
1.10. Controlled volume Pump (Diaphragm)		
Diaphragm	200%	
Relief and Replenishing Valve	100%	
Suction & Discharge Valves	100%	

Item Required	Quantity	Remarks
Set of Gaskets	200%	Including O rings(if any)
Power end spares	50%	As per Mfr Recommendation
1.11. Reciprocating Compressors		
Piston Rings	200%	
Rider Rings	200%	
Rod Packings	100%	
Valves (complete)	100% of one compressor	Consisting of Suction & Discharge valves – 100% as installed in one compressor
Valve Internals	100%	Consists of Valve Springs, Caps, Plates/ Rings/ Puppets/ Bullets
Unloader Diaphragms	50%	
Gaskets & O-Rings	200%	
Lubricator Elements	1 Set	Quantity required for one compressor
Belts	100%	Where installed
Coupling Flexible Element	100% of one compressor	With hardware bolts nuts etc
Cylinder Liners	100% of one compressor	Quantity required for one compressor
1.12. Centrifugal(& Axial) Compressors and Blowers		
Rotor	100% of one compressor	Completely balanced and including Balance Drum, Thrust Collar and Coupling Hub. To be tested during MRT
Dry Gas Seals (Where installed)	100% of one compressor	Quantity required for one compressor, to be tested along with seals installed in the compressor
Radial Bearings	100% of one compressor	
Thrust Bearings	100% of one compressor	Active & Inactive Separately (only pads)
Coupling Drive Element	100% of one compressor	
Coupling bolts	100% of one compressor	
Gaskets & O-Rings	200%	
Gas Filters	600%	
1.13. Centrifugal & Axial Fans		
Impeller & Shaft	100% of one fan	
Bearings /Bearing Blocks	100% of one fan	Other than anti-friction (except 4 point bearings)
Coupling spares	100% of one fan	
1.14. Integrally geared Centrifugal Compressors		
Bearings	100% of one compressor	Includes High Speed and low Speed bearings
Seals	100% of one compressor	
Coupling Disc Pack/ Transmission Element	100% of one compressor	

Item Required	Quantity	Remarks
Coupling Bolts, Washers Etc	100% of one compressor	
1.15. Oil Flooded Screw compressors		
Radial Bearings	100% of one compressor	
Thrust Bearings	100% of one compressor	
Inlet Strainer	100% of one compressor	
Coalescer & Separator Elements	100% of one compressor	
Gaskets & O-Rings	200% of one compressor	
Timing gears	100% of one compressor (if applicable)	
1.16. Diaphragm compressors		
Diaphragms	200% of one compressor	
Valves	100% of one compressor	Consisting of Suction & Discharge valves – 100% as installed in one compressor
Valve Internals	100% of one compressor	Consists of Valve Springs, Caps, Plates/ Rings/ Puppets/ Bullets
Gaskets & O-Rings	200% of one compressor	
1.17. Roots Blowers		
Rotor	100% of one blower	
Bearings	100% of one compressor	Other than Anti-Friction (However 4 point bearings shall be supplied)
Gaskets	100% of one compressor	Including O rings
Timing gears	100% of one blower	
1.18. Dry Screw compressors & blowers		
Coupling Drive Element	100% of one compressor/blower	
Coupling bolts	100% of one compressor/blower	
Gaskets & O-Rings	200% of one compressor/blower	
Shaft Seals	100% of one compressor/blower	
Bearings	100%of one compressor/blower	Other than Anti-Friction (However 4 point bearings shall be supplied)
Timing gears	100%of one compressor/blower	
1.19. Steam Turbines (API 611)		
Rotor (wheel+shaft)	1	To be tested as part of MRT
Mechanical Seal	100% of 1 turbine	Where installed
Carbon Rings	200% of 1 turbine	Where installed
Bearings	100% of 1 turbine	
Governor	100% of 1 turbine	Where Mechanical/ Hydro mechanical governors are

Item Required	Quantity	Remarks
		installed
Governor Drive Gears	100% of 1 turbine	
Governor Valve packings	100% of 1 turbine	
1.20. Steam Turbine (API 612)		
Rotor	1	Including thrust collar and coupling hub, fully balanced and To be tested as part of MRT
Radial Bearings	100% of 1 turbine	
Thrust Bearings	100% of 1 turbine	Active & Inactive Separately (only pads)
Coupling Drive Element	100% of 1 turbine	Only if not specified in driven equipment
Coupling bolts	100% of 1 turbine	Only if not specified in driven equipment
Inlet Valve packings	100%	
Stop Valve packings	100%	
E/H Convertors	1 No	Per type of E/H installed
1.21. Gear Box		
Radial Bearings	100% of one GB	
Thrust Bearing	100% of one GB	
Gasket set	200%	
Oil seals	200%	
Set of Gears	100% of one GB	For each type
1.22. Air Fin Cooler Fans		
Bearing Block	1 No	For each block type, completely assembled with shaft, bearings etc
Belts	20% (Min 2 Nos)	For each type
Fan blades	1 set	1 set For each model
TLB,Drive pulley	1 set	1 set for each model
1.23. Lubrication System		
Lube Oil Filter Elements	600% if paper/ glass fibre/ cellulose media or non cleanable 100% if SS Wire Mesh and Cleanable	
Main Oil Pump (except Centrifugal Pump)	1 No	Complete Unit (For centrifugal pump – see relevant section)
Accumulator bladder	100%	
Accumulator Charging Kit	1 Set	
Main Oil Pump Coupling	100%	For direct shaft driven MOP
2. Filtration Systems		
2.1. Coalescer		
Coalescer Elements	200%	

Item Required	Quantity	Remarks
Separator Elements	200%	Where installed
2.2. Bag Filters		
Filter Bags	200%	
2.3. Basket Filters		
Filter Baskets	100%	
3. Heat Exchangers		
Gaskets	400%	
Floating Head Bolts	50%	
Test Ring & Test Flange	1 Set	Per exchanger Min one set, for group of exchangers 50% of installed no. Of exchangers
4. Fired Heaters		
Burner Tips	50% (For Oil Fired) – Min 2 25% (For Gas Fired) – Min 2 1No Pilot Tip	Tips shall include outer tips, atomisers, spuds etc.
Oil Burner Gun Assembly	25% (Min 2 Nos)	
Gas Burner Assembly	1 Set	
Pilot Assembly	1 Set	
Tubes	10% (Min one full length)	Per Size
Tube Support Hangars	10%	Including hangars, locking plates etc
Burner Tiles	1 Set	Includes Regen tiles etc (necessary for replacement in one)
Soot blower spares	1 set	As per mfr recommendation
SOB SPARES	1 SET	As per mfr recommendation
5. Static Equipment		
5.1. Columns		
Tray Clamps	20%	Of all types
Trays	1 No	Of each type
Demisters	50%	
Packings	25%	Or as per Licensors package
5.2. Vessels		
Demister	50%	Of installed qty
5.3 Ejectors		
Nozzle	50%	
Gasket	100%	
6. Piping		
6.1. Valves		
Full Valves	5%	Of total installed subject to following – 5% quantity shall not

Item Required	Quantity	Remarks
		exceed 10 No's, Minimum 1 valve spare)
Gaskets/Packings	25%	Of installed qty
Stem	5%	Of installed qty or min 1 per type/size
Disc	5%	Of installed qty or min 1 per type/size
6.2. Steam Traps		
Complete Traps	10%	Of each type installed
Spares for Steam traps	20%	Of each type installed
6.3 Pipe line strainer		
Strainer element	10%	Of each type installed
6.3 Special MOC Fittings		
Pipe fittings	5%	Of each type installed
6.4 Bellows	100%	Non metallic bellows
6.5 PSV Spares		
Bellows	50%	
Set of Gaskets	100%	
Nozzle	20%	Of each size/type interchangeable
Disc holder	10%	Of each size/type interchangeable
Disc	10%	Of each size/type interchangeable
Pilot assembly of Pilot op PSV	100%	
Spring	1 no	Of each size/type interchangeable
Stem	10%	
7 Special equipment not covered above		
Spares As recommended by Manufacturer	As required	

Spare Philosophy for Instrumentation

a) Mandatory Spares:

1. Control / On-Off Valves / Pneumatic Cylinders / Pneumatic Dampers / PCV:
   i. Actuator Diaphragm, O-ring & Repair Kit indicating respective part numbers & Actuator Model Numbers - 10%, subjected to min 1 No of each type.
   ii. Seat Ring, Seal Ring, Gland packing, soft Seat, Repair kit (including Body & Bonnet Gaskets) indicating respective part numbers, Valve & valve Size - 10%, subjected to min 1 No of each type.
   iii. AFR, Limit Switch, SOV, Positioner, Position Transmitter, Air Operated Valve, Air Lock Relay, Non Return Valve, Quick Exhaust Valve, Speed Regulator, etc – 10%, subjected to min 1 No of each type.

2. Level Gauge:
   i. Level gauge Gaskets, Gauge glasses, valves (for Level Gauges / Rotameter, as applicable) – 10%, subjected to min 1 No of each type.

3. Radar/Ultrasonic/Tuning Fork/Servo/Nucleonic LT, Thermal Mass Flowmeter/Vortex flowmeter/Ultrasonic Flowmeter/Flame Scanners / Pyrometer / Any other electronic Instruments:
   ii. Complete set of detector & Transmitter (incl all types of electronic cards, dedicated Power Supply units and/or cards & display units used) indicating respective part numbers. - 10%, subjected to min 1 No of each type.
   iii. Set of all Special Cables used indicating respective part numbers – 10%, subjected to min 1 No of each type.
   iv. Electronic assembly parts for Coriolis Mass flow meters 10%, subjected to min 1 No of each type

4. Gas Detectors, Sensors & other Pressure/Temperature/Level/Flow/DP Transmitters, Loop Powered Indicators, Gauges, RTD's, Thermocouples & Thermowells– 10%, subjected to min 1 No of each type.
5. Speed Probes & Speed Indicator/Transmitter – 10%, subjected to min 1 No of each type.
6. Installation Materials like Isolation Valves, Valve Manifolds, Tube Fittings, Tubes (shall be of approx 6 mtrs per tube), Cable Glands with Shroud – 10%
7. Process Switches (Pressure, Temperature, Flow, Level, Vibration) - 10%, subjected to min 1 No of each type.

8. <u>Hydraulically Operated Valves:</u> 10% subjected to min 1 No of each type of

8.1 Trip SOV

8.2 I/H Converter

8.3 Limit Switches

8.4 Position Transmitter (incl Probe)

9. **<u>Analysers:</u>** SOV's, Changeover valves, peristaltic Pump, complete set of O-rings, IR lamps, complete set of fuses, IR lamp, internal thermocouples/RTD's, critical orifice, 10% of each type of fitting, 18 mtrs of tubing (internal tubing), FID, FPD, Filters, Pressure regulators, Power Supply Modules, All types of electronic cards, temperature controller, digital high accuracy flowmeters (wherever air to fuel ratios or vent flows are to be set) – 10%, subjected to min 1 No of each type.

10. **<u>MMS System:</u>** Speed Probes, Speed Transmitter, all types of MMS Cards, MCB's, MMS Probes, MMS RTD's, MMS Special Cables & Proximitors. -10%, subjected to min 1 No of each type.

11. <u>DCS/PLC/MMS/ASC/Speed Governor/any other microprocessor based system:</u>

11.1 All Types of Cards, FTA & Power Supplies	-5% subjected to minimum one of each type of module
11.2 Prefab Cables, Switches, Lamps & MCB's	-5% subjected to minimum one of each type cable.
11.3 Display Unit (Complete Unit)	– 10%, subjected to min 1 No of each type.

12. Barriers/Isolators/Relays/Fieldbus Power Conditioner/Fieldbus Junction Boxes/other types of Junction Boxes/LCP Lamps/LCP Push Buttons/Selector Switches/ ESD Switches / Reset Switches, All types of Annunciator Cards, Power Supply Units - 10%, subjected to min 1 No of each type.

13. MCT Blocks – 20% of each type

14. Fuses – 100%

15. Printing Consumables – For 6 months operation.

16. CCTV cameras: Complete Camera Set, Media converter, joystick, keyboard: 10%, subjected to min 1 No of each type

b) <u>Commissioning Spares:</u>

Shall consider AFR, AFR Gauges, all positioner models, all SOV models & coils, all applicable sizes of tube fittings & tube ferrules, Transmitter O-rings, Prefab hook-up O-rings, Temperature Gauge glasses, Temperature Gauges, Pressure Gauge glasses, Pressure/DP Gauges, Level Gauge 3-way valves, etc, soft parts for servicing of control & on/off valves.

c) Installed Spares:

1) System end (DCS / PLC / CCTV / TFMS / Gas Detection System / Annunciator System / MMS / VMS / Any other Automation System / Hard Wired Console) – incl in packages & brought-out's - 25% (min)

Note: Shall be wired from Card Level to Field Terminal Block Level (incl all Barriers, Isolators, Relays, Fieldbus Power Conditioners, duct space, all I/O modules, processor capacity, communication processor capacity & power supply capacities).

d) Spare Space (for Future):

1) System end (DCS / PLC / CCTV / TFMS / Gas Detection System / Annunciator System / MMS / VMS / Any other Automation System / Hard Wired Console) – incl in packages & brought-out's – 20% (min)

Note: Future space shall include any additional cabinet, rack, chassis, terminals, mounting space for FCU/CIU, Barriers, Isolators, Relays, Fieldbus Power Conditioners, Power Supply Units, MCB's, Switches, Lamps, I/O modules, cabinet ducting space, marshalling cabinets etc.

DIMENSIONAL TOLERANCE FOR PRESSURE VESSELS

DIMENSIONAL TOLERANCE FOR PRESSURE VESSELS SHALL BE AS LISTED BELOW EXCEPT WHEN SPECIFIED OTHERWISE IN VESSEL DATA SHEET.

1. OUTSIDE SURFACE OF SHELL CYLINDER MAY BE OUT OF ALIGNMENT / STRAIGHTNESS NOT MORE THAN 6 mm IN ANY 6 METRE OF CYLINDER LENGTH, SUBJECT TO A MAXIMUM OF 20 mm IN THE TOTAL LENGTH.

2. THE MAXIMUM PERMISSIBLE OFFSET FOR LONGINTUDINAL JOINTS SHALL BE 6 mm AND FOR CIRCUMFERENTIAL JOINTS 12 mm.

3. a) OUT–OF–ROUNDNESS (OVALITY) OF VESSEL SHALL BE AS PER ASME CODE, WITH THE ADDITIONAL LIMITATION THAT FOR VESSELS WITH INTERNAL TRAYS ANY DIAMETER MAY NOT VARY MORE THAN ±0.5 PERCENT FROM THE NOMINAL DIAMETER, WITH A MAXIMUM VARIATION IN DIAMETER FROM NOMINAL OF 12 mm.

   b) OUTSIDE CIRCUMFERENCE OF SHELL SHALL BE WITHIN THE FOLLOWING LIMITS:
   ± 10 mm FOR NOMINAL DIAMETER 1200 mm AND UNDER.
   ± 12 mm FOR NOMINAL DIAMETER 1200 mm THROUGH 2400 mm
   ± 20 mm FOR NOMINAL DIAMETER ABOVE 2400 mm.

   c) FOLLOWING TOLERANCE ON DIAMETER SHALL APPLY THROUGHOUT ITS LENGTH FOR VESSELS WITH TRAYS AND / OR PACKING

2000 mm AND UNDER:	±0.5%
2001 mm TO 4000 mm:	>±10MM OR ±0.35%
4001 mm TO 8000 mm:	GREATER OR ±14mm OR ±0.25%

4. TOLERANCE FOR LENGTH OF VESSEL SHALL BE ±5 mm PER 3000 mm SUBJECT TO A MAXIMUM OF 15 mm.

5. THE SKIRT LENGTH FOR VERTICAL VESSELS SHALL BE HELD WITHIN A TOLERANCE OF ± 6 mm.

6. ELEVATION FROM REFERENCE PLANE MAY VARY TO THE EXTENT OF ± 12 mm FOR MANHOLES, ± 6 mm FOR NOZZLES AND ± 3 mm FOR INTERNAL SUPPORT EXCEPT THAT LOCATIONS OF MANHOLES AND NOZZLES NEAR TRAYS SHALL NOT VARY MORE THAN ± 3 mm FROM THE TRAY.

7. PROJECTION OF FLANGE FACE FROM SHELL CENTER LINE / TANGENT LINE MAY VARY ±5 mm FOR NOZZLE AND ±12 mm FOR MANWAY.

8. CIRCUMFERENCE AND RADIAL DEVIATION OF NOZZLES, MANWAY AND SUPPORTS FROM THE TRUE POSITION SHALL NOT VARY MORE THAN ±3 mm.

9. MANWAY TOLERANCE SHALL BE ± 12 mm FOR ELEVATION, ORIENTATION AND PROJECTION AND 6 mm FOR TILT.

10. TOLERANCE FOR CENTRE TO CENTRE DISTANCE BETWEEN ANY PAIR OF INSTRUMENT CONNECTION SHALL BE AS FOLLOW:–

DISTANCE BETWEEN NOZZLES:	±1mm.
ORIENTATION:	±1mm.
NOZZLE FACE INCLINATION:	±¼°

11. THE MAXIMUM HORIZONTAL OR VERTICAL DEFLECTION OF THE MACHINED SURFACES OF THE FLANGE GASKET CONTACT FACES OF NOZZLES SHALL NOT BE MORE THAN ±½°.

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1	25.07.11	ISSUED DUE TO CHANGE OF ORGANISATION NAME	RKD	VMS	RAPS
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VESSEL TOLERANCES

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12. TOLERANCE BETWEEN ADJACENT TRAY PLATES SHALL NOT BE MORE THAN ±3 mm

13. BOLT HOLE ORIENTATION OF NOZZLES MAY VERY ±2mm AT BOLT CIRCLE.

14. ALL TOLERANCES OF TRAY SUPPORTS TO BE AS PER TRAY SPECIFICATIONS / DRAWING.

15. THE TOLERANCE FOR MAXIMUM VARIATION OF TRAY SUPPORTS WITH RESPECT TO THE VESSEL SHELL SHALL NOT EXCEED 0.1 DEG. FROM NORMAL.

16. TOLERANCE FOR DISTANCE BETWEEN HORIZONTAL VESSEL CENTRE LINE AND BOTTOM OF SADDLE SUPPORTS SHALL BE ±3 mm.

17. CENTRE TO CENTRE DISTANCE BETWEEN SADDLE SUPPORT AND SADDLE BOLT HOLES SHALL NOT EXCEED ±3 mm.

18. THE BASE RING BOLT CIRCLE DIAMETER MAY VARY BY ±5 mm FOR ANY DIAMETER MEASURED AT POINTS 90° APART. DISTANCE BETWEEN TWO CONSECUTIVE HOLES MAY VARY BY ±5mm

19. a) DEVIATION OF SUPPORT BASE FROM HORIZONTAL MAY BE AS FOLLOWS.

VESSEL DIA 1500mm AND UNDER	3mm
VESSEL DIA OVER 1500mm TO 2000mm	5mm
VESSEL DIA OVER 2000mm TO 4000mm	6mm
VESSEL DIA OVER 4000mm TO 5000mm	8mm
VESSEL DIA OVER 5000mm	10mm

b) DEVIATION OF SUPPORT BASE FOR BRACKET TYPE SUPPORT / SADDLE SUPPORT FROM HORIZONTAL MAY BE ±1°.

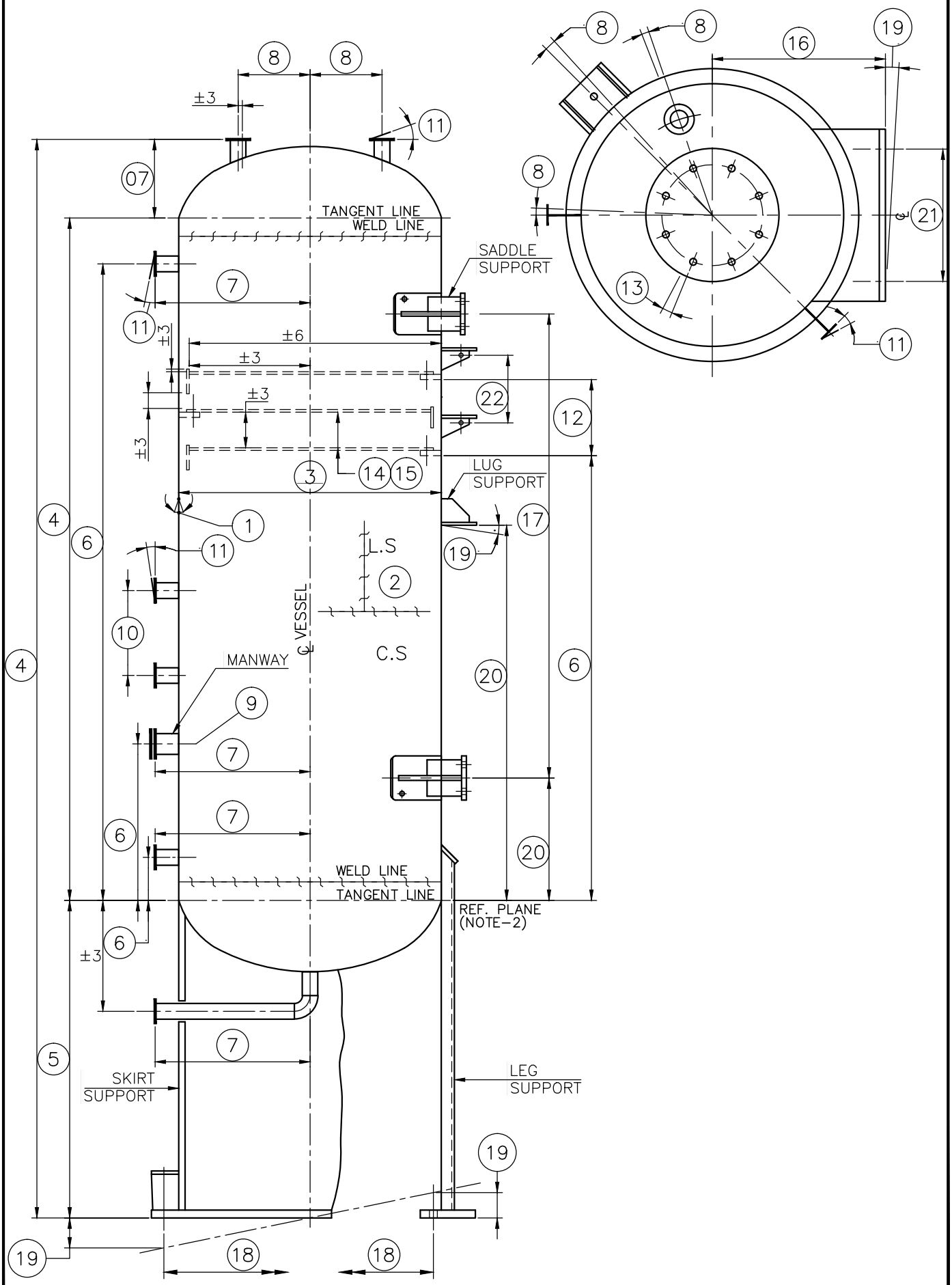
20. TOLERANCE FOR DISTANCE FROM REFERENCE PLANE TO BASE OF VERTICAL SUPPORT AND CENTRE LINE OF SADDLE SUPPORT MAY VARY ±6mm.

21. DISTANCE BETWEEN CL TO CL OF SUPPORTS AND BOLT LINES IN SUPPORTS FOR HORIZONTAL VESSELS MAY VARY ±3mm.

22. TOLERANCE FOR CENTRE TO CENTRE DISTANCE BETWEEN ANY PART OF EXTERNAL STRUCTURAL ATTACHMENT SHALL NOT VARY MORE THAN ±3mm.

NOTE:–

1. TOLERANCE SHALL NOT BE CUMMULATIVE AND INTERPRETATION SHALL BE BASED ON STRINGENT OF ABOVE TOLERANCE NORMS.
2. REFERENCE LINE SHALL BE LIGHTLY PUNCH MARKED INSIDE AND OUTSIDE AROUND THE CIRCUMFERENCE OF THE SHELL PLATE ON THE TANGENT LINES OF THE VESSEL.



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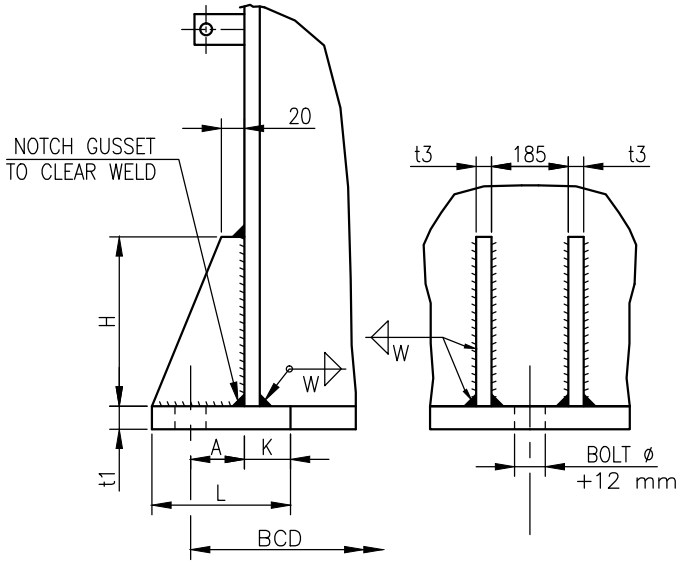
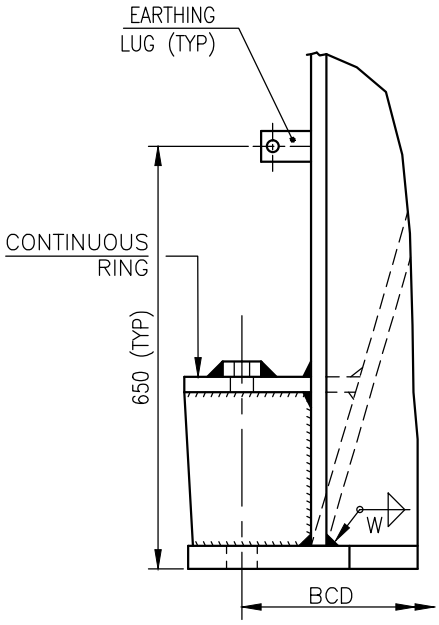


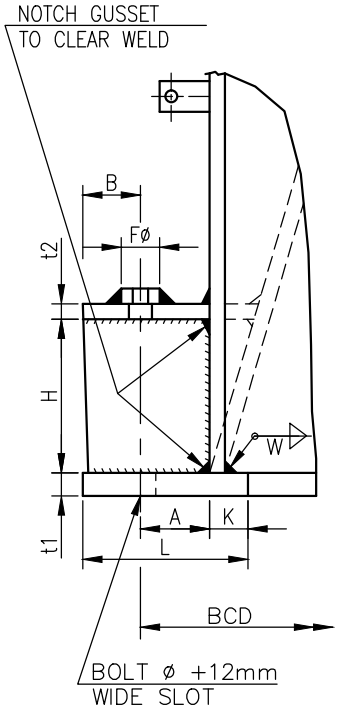
TYPE–1

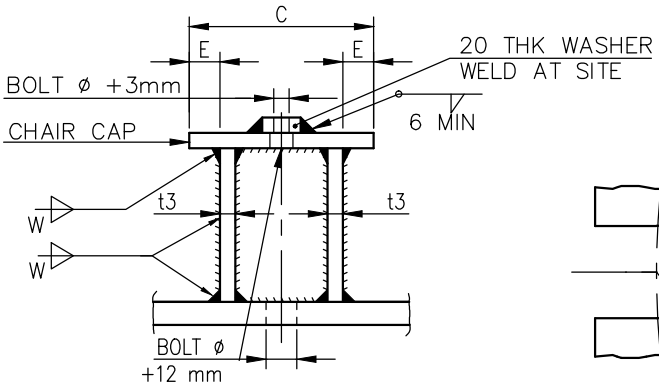


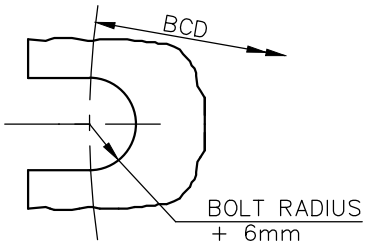
ALL OTHER DIMENSIONS
SAME AS TYPE–2

TYPE–3

(FOR CONTINUOUS RING ONLY)







SLOT DETAIL

TYPE–2

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2	11.01.18	GENERAL REVISION & REISSUED AS STANDARD	RKD	HAS	RRP
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NEW DELHI

SKIRT BASE DETAILS

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SKIRT BASE DETAILS

BOLTø	t1 *	t2 *	t3 *	A	B	C	E	F	H	K	L *	W	TYPE	REMARKS
24	20	–	10	60	–	–	–	–	250	75	165	10	1	
27	20		10	60	–	–	–	–	250	80	170	10		
30	25	25	12	55	60	150	12	60	300	80	180	10	2 AND 3	
33	25	25	12	58	65	150	12	70	300	80	185	10		
36	25	25	12	66	70	150	12	80	300	90	200	10		
39	32	25	12	70	70	160	14	80	300	95	215	12		
42	32	25	12	72	70	160	14	90	300	100	230	12		
45	32	25	12	80	75	160	14	90	300	105	245	14		
48	32	30	14	83	75	160	16	100	380	110	260	14		
52	38	30	14	87	80	175	16	110	380	110	275	14		
56	38	30	16	91	85	175	18	120	380	115	280	14		
60	38	35	18	95	85	175	20	120	430	125	285	14		
64	38	35	18	104	90	180	25	130	430	135	300	16		
68	42	40	20	108	90	180	25	140	450	145	320	16		
72	42	40	20	112	95	185	25	150	450	150	340	16		

NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. BOLT CIRCLE DIAMETER (B.C.D), NUMBER AND SIZE OF THE BOLT SHALL BE AS PER ENGINEERING DRAWING.
* 3. DIMENSIONS t1,t2,t3 AND 'L' ARE TO BE CHECKED IN EVERY CASE.
4. NO. OF BOLTS USED IS TO BE A MULTIPLE OF 4 AND BOLTS SHALL STRADDLE VESSEL CENTRE LINE.
5. CIRCULAR WASHERS SHALL BE SHIPPED LOOSE AND WELDED AT SITE AFTER ANCHOR BOLTS IN POSITION.
6. IN CASE OF ANY CONFLICT, ENGINEERING DRAWING SHALL GOVERN.
7. CIRCUMFERENTIAL CENTER TO CENTER DISTANCE BETWEEN BOLTS SHALL BE AT LEAST 400 mm, IF THIS IS LESS THAN 400 mm PROVIDE FLARED SKIRT WITH HALF APEX ANGLE NOT EXCEEDING 30°.

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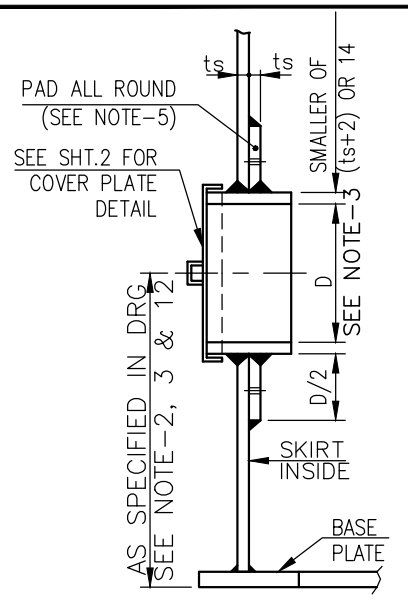
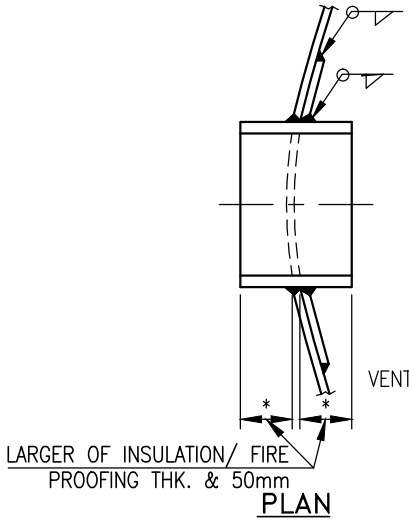
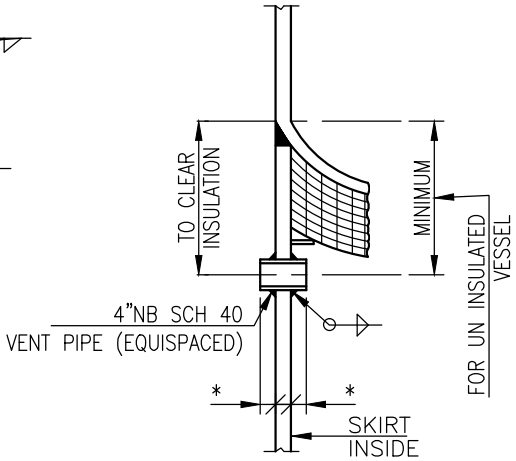
16-QMP-05-3C



ACCESS OPENING



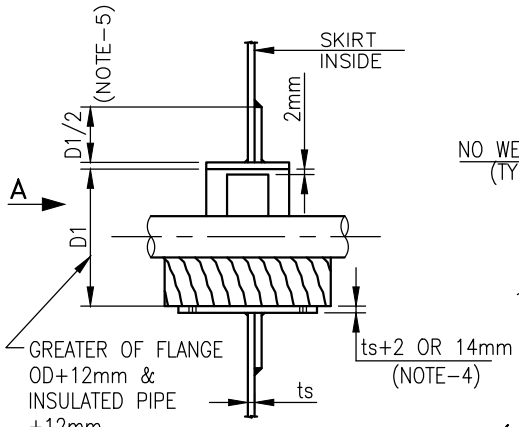
PLAN



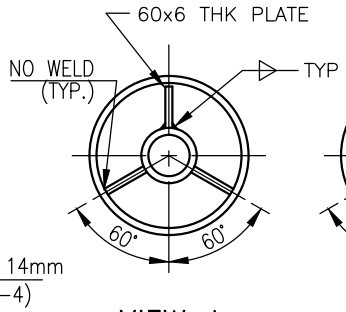
VENT
(SEE NOTE-4)

ACCESS OPENING/PIPE OPENING/
VENT OPENING LENGTH(TYP)

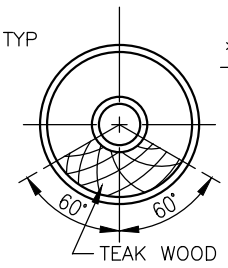
* LARGER OF INSULATION/ FIRE PROOFING THK. & 50mm



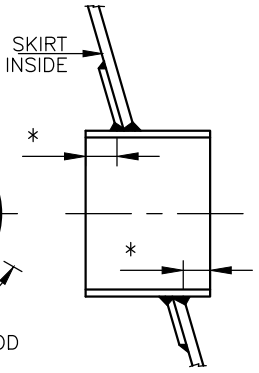
PIPE OPENING



VIEW A
(HOT TYPE VESSEL)



VIEW A
(COLD TYPE VESSEL)



FLARED SKIRT

NOTES: –

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. ACCESS OPENING SHALL BE LOCATED BETWEEN ANCHOR BOLTS AND SHOULD CLEAR ANCHOR CHAIR BOLTS & NUTS BY ATLEAST 100 mm.
3.

SKIRT DIAMETER	ACCESS OPENING DIA (D)	NO.OF ACCESS OPENING	NO.OF VENTS
UP TO 1000	400	1	2
OVER 1000 UP TO 1500	450	1	3
OVER 1500 UP TO 3000	500	1	3
OVER 3000	500	2	4

4. MINIMUM SIZE OF PIPE SLEEVE SHALL BE 6" NB SCH 40. USE SCH 40 UPTO 10"NB PIPE SLEEVE. FOR 12" NB AND ABOVE, PIPE SLEEVE MAY BE FABRICATED FROM PLATE OF THICKNESS MIN OF ts+2 OR 14 mm.
5. ALL OPENINGS 300 DIA AND ABOVE SHALL HAVE REINFORCEMENT PADS WELDED INSIDE THE SKIRT.
6. ACCESS OPENING SHALL BE LOCATED IN SUCH A WAY THAT IT IS NOT BLOCKED BY BOTTOM HEAD.
7. IN FLARED SKIRT OPENING DETAIL IS SAME AS THAT FOR CYLINDRICAL SKIRT.
8. WOOD SUPPORT WHERE EVER APPLICABLE TO BE FIXED IN THE PIPE SLEEVE BY TWO WOOD SCREWS.
9. ACCESS OPENING, PIPE OPENING, VENT SHALL BE OF SAME MATERIAL AS THAT OF SKIRT.
10. ALL FILLET WELDS SHALL BE 6 mm MINIMUM WHERE EVER APPLICABLE.
11. IN CASE OF ANY CONFLICT, ENGINEERING DRAWING SHALL GOVERN.
12. CENTRE LINE OF ACCESS OPENING SHALL BE 850mm (MINIMUM) ABOVE BOTTOM BASE RING FOR ANCHOR BOLTS OF SIZE M45 & BELOW AND 1100mm (MINIMUM) FOR ANCHOR BOLTS OF SIZE ABOVE M45.

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2	11.01.18	GENERAL REVISION & REISSUED AS STANDARD	RKD	HAS	RRP
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0	29.11.95	ISSUED AS STANDARD	HS	TK	SNB

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NEW DELHI

SKIRT OPENING DETAILS

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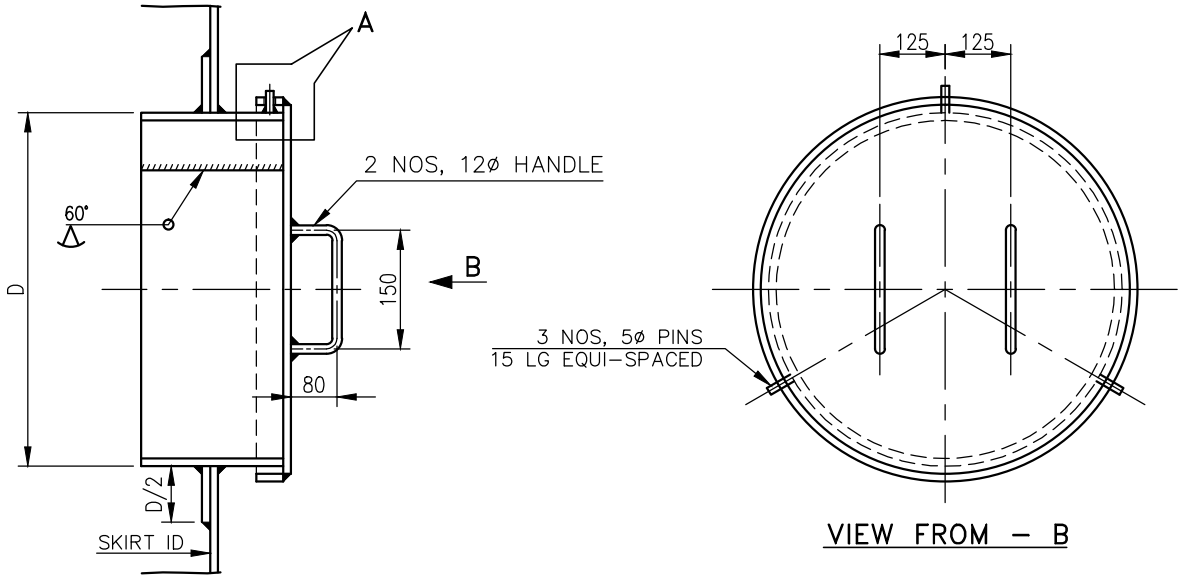
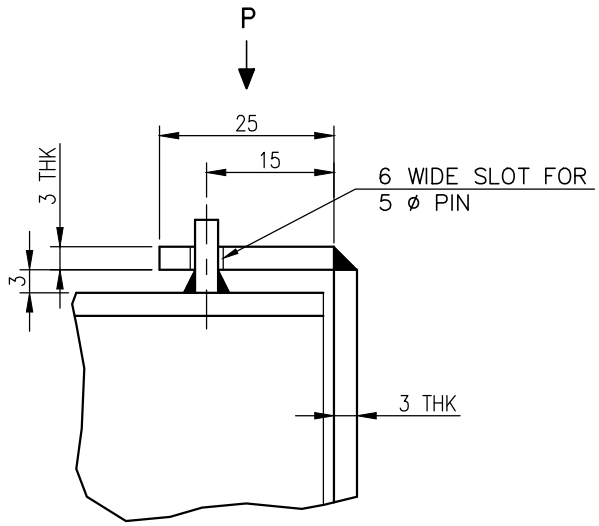
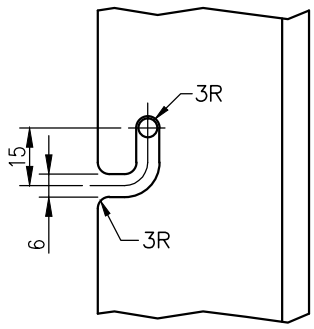


VIEW FROM – B



DETAIL – A



VIEW – P

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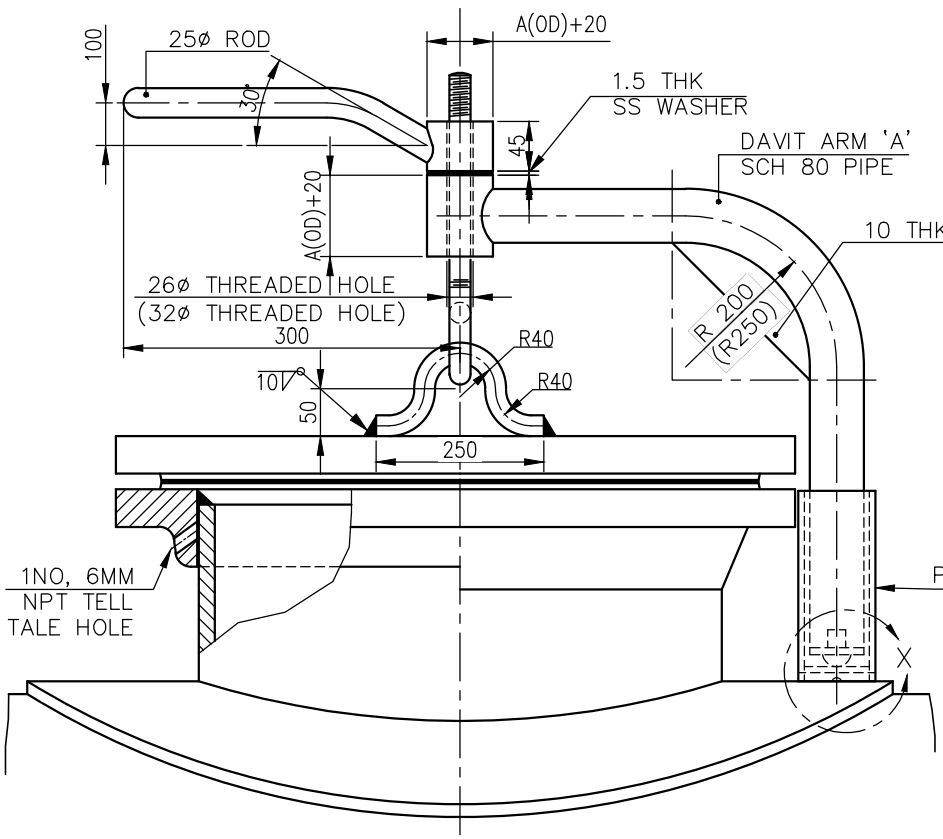
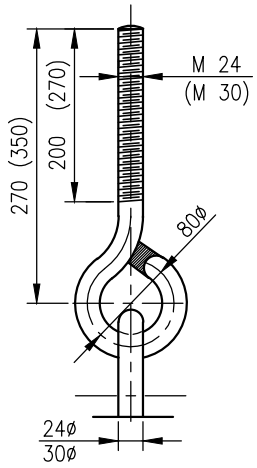
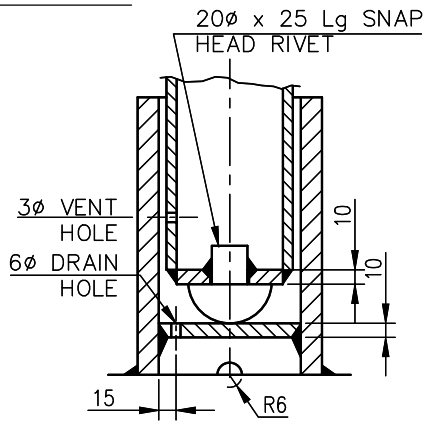
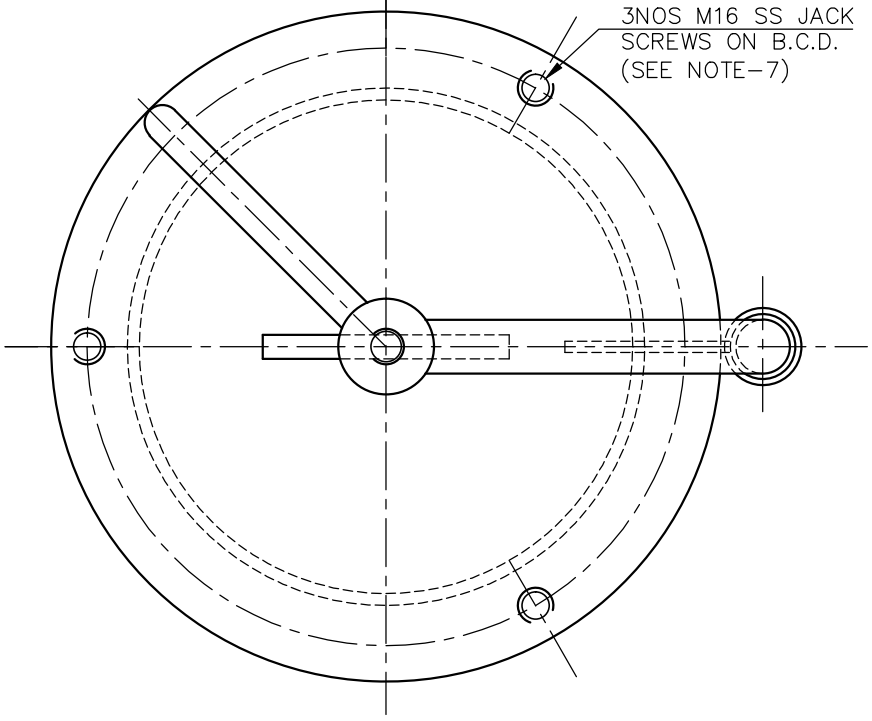




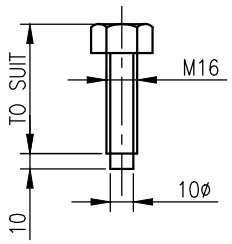
DETAIL OF EYE BOLT

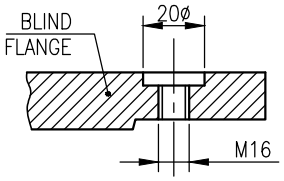


DETAIL X



MANHOLE AXIS VERTICAL





DETAIL OF JACK SCREW

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2	11.01.18	GENERAL REVISION & REISSUED AS STANDARD	RKD	HAS	RRP
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MANHOLE WITH DAVIT

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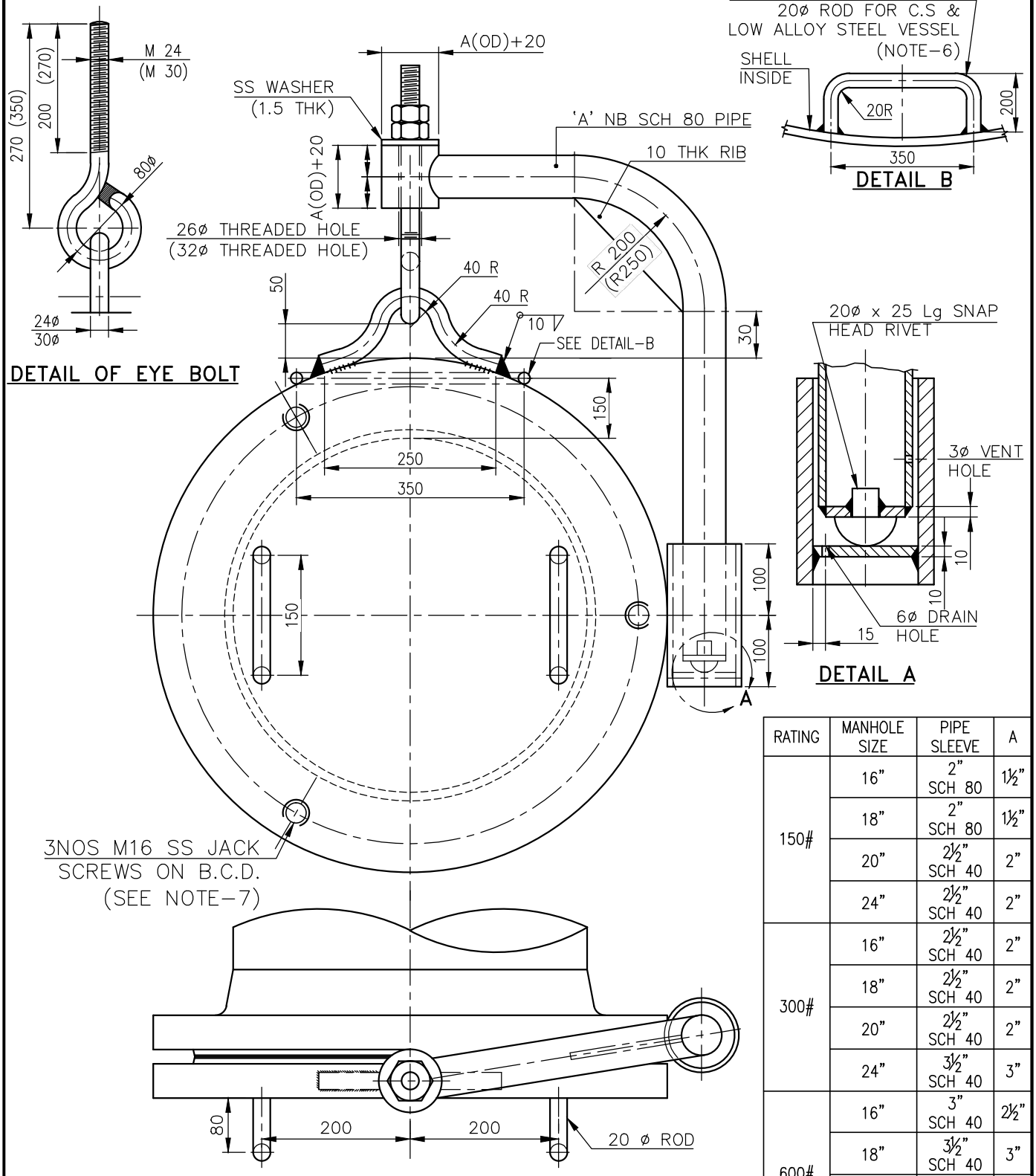

MANHOLE AXIS HORIZONTAL

RATING	MANHOLE SIZE	PIPE SLEEVE	A
150#	16"	2" SCH 80	1½"
	18"	2" SCH 80	1½"
	20"	2½" SCH 40	2"
	24"	2½" SCH 40	2"
300#	16"	2½" SCH 40	2"
	18"	2½" SCH 40	2"
	20"	2½" SCH 40	2"
	24"	3½" SCH 40	3"
600#	16"	3" SCH 40	2½"
	18"	3½" SCH 40	3"
	20"	5" SCH 80	4"
	24"	5" SCH 80	4"
900#	16"	5" SCH 80	4"
	18"	5" SCH 80	4"

NOTES

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. DIMENSIONS SHOWN IN BRACKETS INDICATE CORRESPONDING DIMENSIONS FOR 900# RATING.
3. MATERIAL OF COMPONENTS SHALL BE C.S UNLESS OTHERWISE SPECIFIED.
4. THE SLEEVE PIPE SHOULD BE IN TRUE VERTICAL POSITION WITH TOLERANCE OF ±½° AFTER WELDING TO THE FLANGE.
5. ALL FILLET WELDS TO BE 6mm MINIMUM UNLESS MENTIONED OTHERWISE.
6. EDGES SHALL BE ROUNDED OFF IF SQUARE ROD IS USED FOR HANDGRIP.
7. B.C.D OF JACK SCREWS IS TO BE SUITABLY CHANGED IF MANHOLE STUDS INTERFERE WITH JACK SCREWS.

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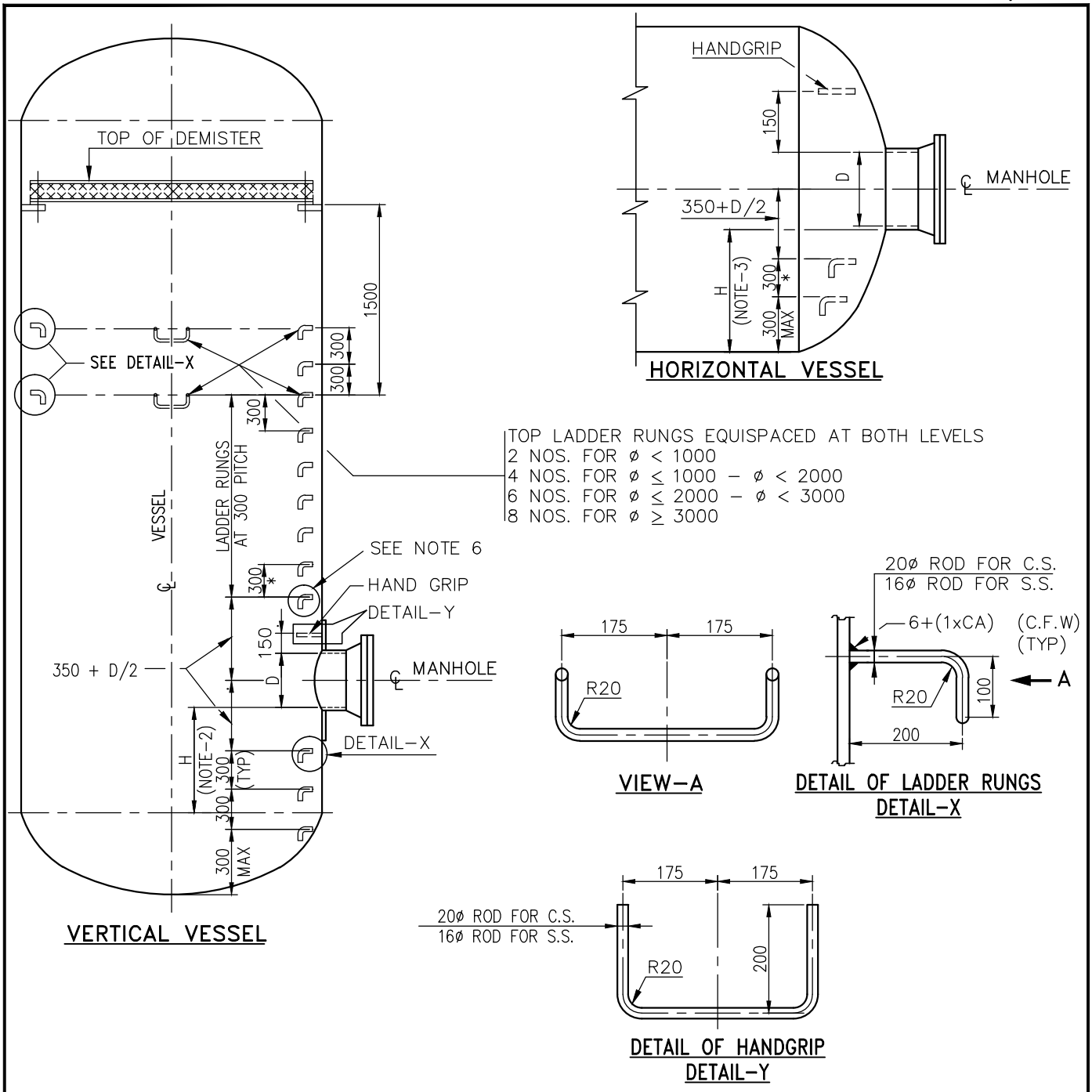

NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. VERTICAL VESSELS SHALL BE PROVIDED WITH LADDER RUNGS IF DIMENSION H ≥ 300mm. IF VESSEL DIAMETER ≥ 2500mm LADDER RUNGS ARE REQUIRED FOR DISHED HEADS ALSO.
3. HORIZONTAL VESSELS SHALL BE PROVIDED WITH LADDER RUNGS IF DIMENSION H ≥ 1000mm.
4. IF NECESSARY FOR ASSEMBLIES SMALL VARIATIONS OF SPACING OF LADDER RUNGS ARE PERMISSIBLE. HOWEVER SPACING OF LADDER RUNGS SHALL BE EQUAL TO EACH OTHERS.
5. * SQUARE RODS MAY BE USED FOR HAND GRIP/LADDER RUNGS IF FABRICATED FROM PLATE AND EDGES ARE ROUNDED OFF.
6. IN CASE THERE IS NO DEMISTER, ONLY HAND GRIP SHALL BE PROVIDED.
7. MATERIAL SHALL BE AS PER VESSEL DRAWING.
8. ORIENTATION OF LADDER RUNGS & HANDGRIP SHALL BE SAME AS OF MANHOLE.

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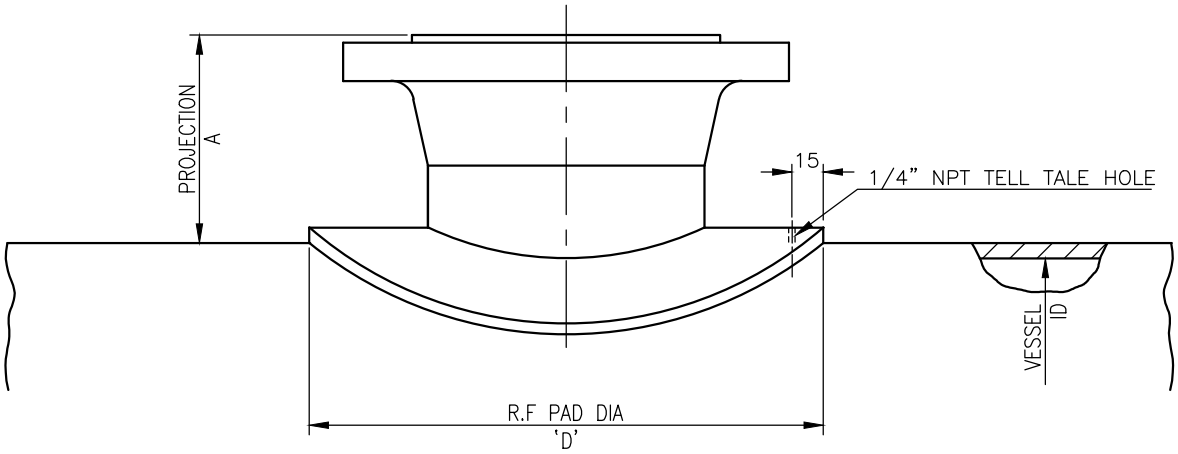

NOMINAL PIPE DIA	EXTERNAL PIPE DIA	R.F PAD DIA 'D'		PROJECTION (A) SEE NOTE 4 & 5			
		SHELL WELD EFFY=0.85	SHELL WELD EFFY=1.0	150#	300#	600#	900#
≤ 50 (2")	STD.	–	–	150	150	150	150
80 (3")	88.9	170	180	200	200	200	200
100 (4")	114.3	210	230	200	200	200	200
150 (6")	168.3	310	340	200	200	200	250
200 (8")	219.0	410	440	200	200	250	250
250 (10")	273.0	500	540	200	200	250	300
300 (12")	323.8	590	640	200	200	250	300
350 (14")	355.6	650	700	250	250	250	300
400 (16")	406.4	740	800	250	250	250	300
450 (18")	457.2	840	900	250	300	300	350
500 (20")	508.0	930	1000	250	300	300	350
600 (24")	609.6	1120	1200	250	300	300	400

NOTES:–

1. ALL DIMENSIONS ARE IN mm UNLESS MENTIONED SPECIFICALLY.
2. DETAILS DIMENSIONS AND NOTES IN DESIGN DRAWING SHALL SUPERSEDE THOSE SHOWN IN THIS STANDARD.
3. CHECK REINFORCEMENT PAD REQUIREMENT IN SPECIAL CASES LIKE EXTERNAL LOADING AND NON–RADIAL TYPE NOZZLES.
4. PROJECTION VALUES INDICATED ARE APPLICABLE UPTO 100 mm INSULATION THICKNESS. FOR HIGHER INSULATION THICKNESS NOZZLE PROJECTION SHALL BE "A + INSULATION THK–100".
5. FOR TANGENTIAL AND HILL SIDE NOZZLES PROJECTIONS TO BE CALCULATED SPECIFICALLY.
6. IN CASE OF CONFLICT ENGINEERING DRAWING SHALL GOVERN.
7. PROJECTION 'A' FOR S.R NOZZLES SHALL BE BASED ON DESIGN OF REINFORCEMENT.
8. PROVIDE 1/4" NPT TELL TALE FOR NOZZLES:– 1 NO < 20 INCH,
   2 NOS ≥ 20 INCH,
   4 NOS > 36 INCH.
9. TESTING OF R.F PAD TELL TALE HOLE SHALL NOT BE PLUGGED. SAME SHALL BE FILLED WITH HARD GREASE ONLY.
10. R.F. PAD SHALL BE EXTENDED LOCALLY FOR MANHOLE DAVIT SUPPORT, IF REQUIRED.

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TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

NOZZLE REINFORCEMENT AND PROJECTION

Standard Number: 02–CS–008 | Rev.: 2

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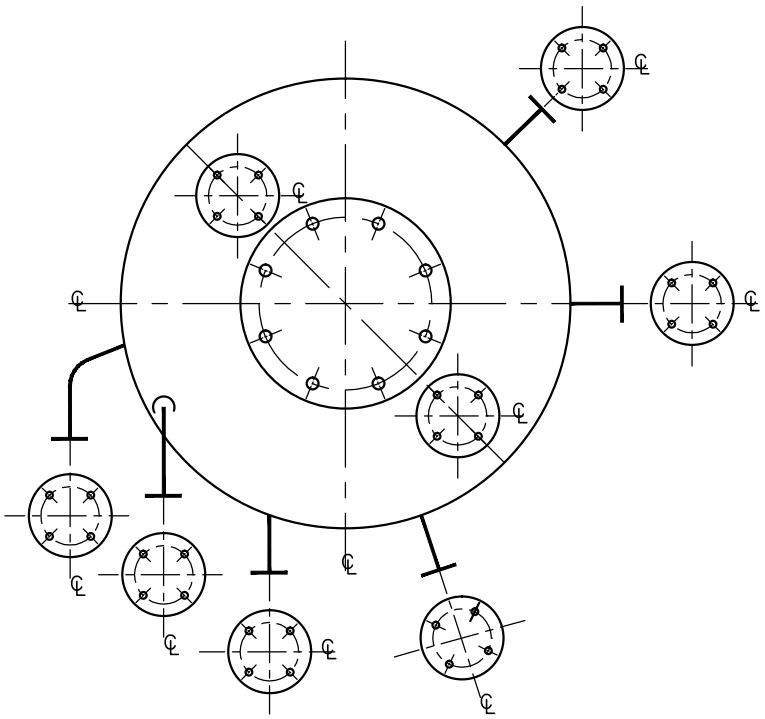
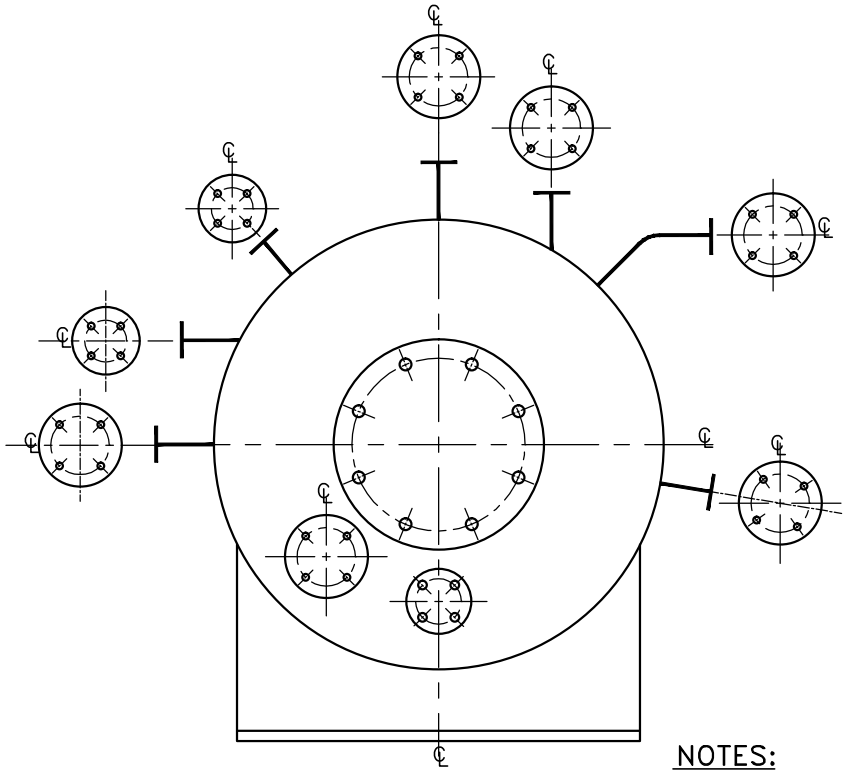
AutoCAD



VERTICAL VESSEL
(PLAN)



HORIZONTAL VESSEL
(ELEVATION)

NOTES:

1. ANY DEVIATION FROM THIS ARRANGEMENT WILL BE INDICATED IN MECHANICAL DATA SHEET.
2. BOLT HOLES TO STRADDLE CENTRE LINES (℄).

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TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

STANDARD BOLT HOLE ORIENTATION

Standard Number: 02-CS-009 | Rev.: 2

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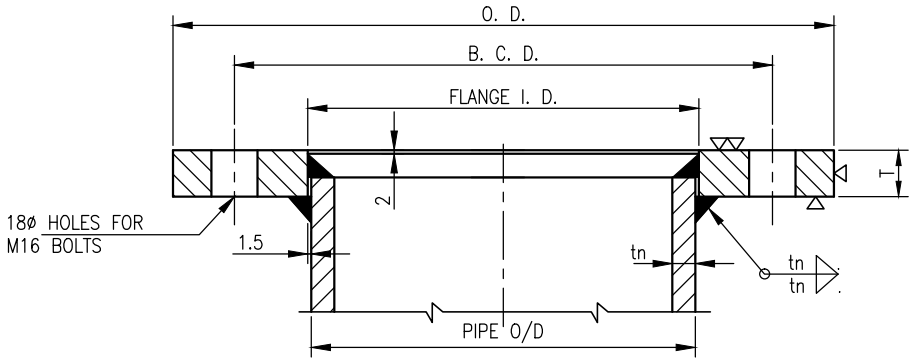
AutoCAD



NOMINAL PIPE SIZE (INCHES)	I.D	B.C.D	O.D	NUMBER OF BOLTS	THICKNESS OF FLANGE – T	
					CARBON STEEL	S. STEEL OR MONEL.
1.5	51	110	160	4	16	10
2	63	120	170	4	16	10
3	92	150	200	4	16	10
4	117	180	230	4	16	10
6	171	240	290	4	16	10
8	222	290	340	8	20	12
10	276	350	400	8	20	12
12	327	400	450	8	20	12
14	358	430	480	12	24	16
16	409	480	530	12	24	16
18	460	530	580	12	24	16
20	511	580	630	12	24	16
24	613	680	730	12	24	16

NOTES:–

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. FLANGE DIMENSIONS ARE FURNISHED AFTER MACHINING.
3. FULL FACED GASKET SHALL BE USED.
4. MOC. FOR BOLTS SHALL BE SS, UNLESS OTHERWISE SPECIFIED ELSEWHERE.
5. DIMENSIONS EXCEPT THICKNESS OF INTERNAL FLANGES OF SIZE 1" OR LESS SHALL BE AS PER ASME B16.5 CLASS 150. FLANGE THICKNESS AND FACING SHALL BE EQUIVALENT TO 1–½" FLANGE COVERED IN THIS STANDARD.

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TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

INTERNAL FLANGES

Standard Number: 02–CS–010 | Rev.: 2

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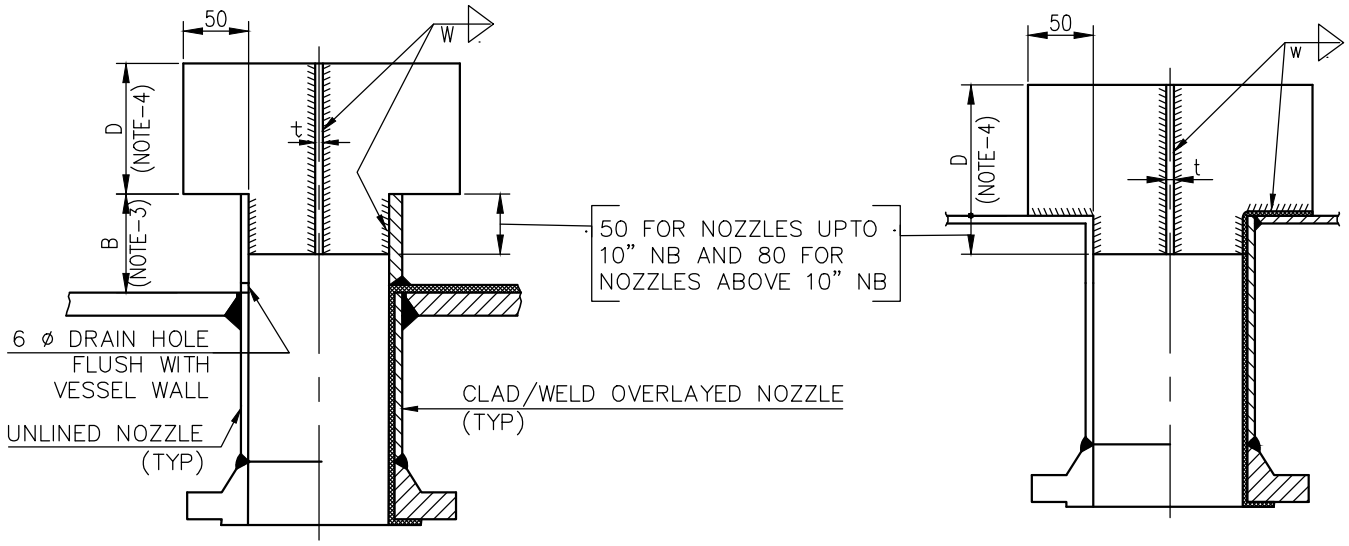
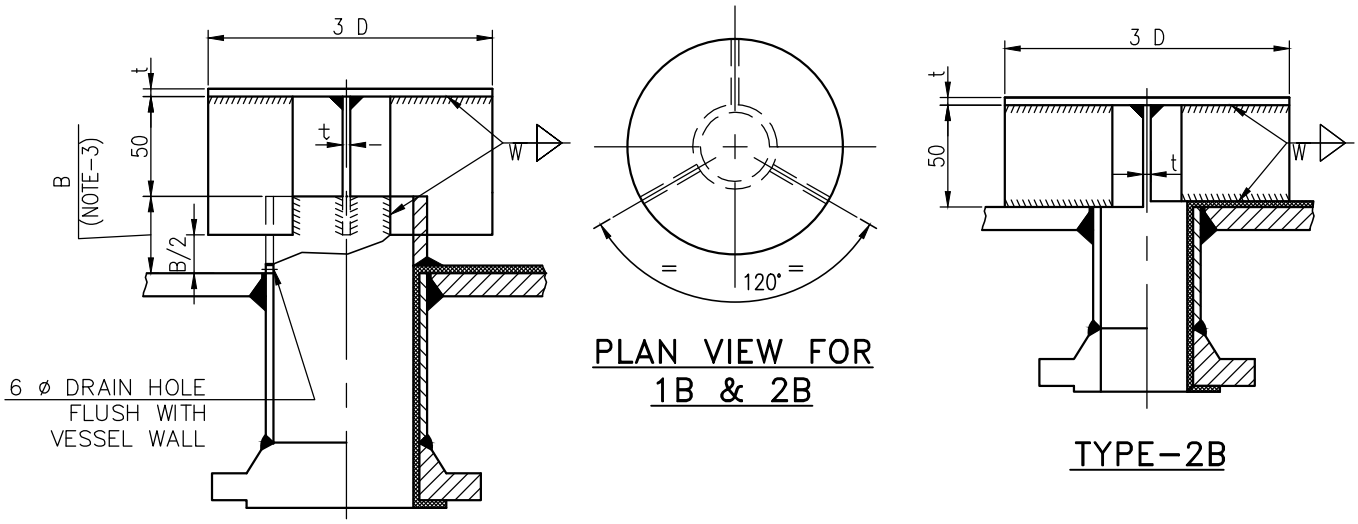
AutoCAD



TYPE–1A

TYPE–2A

FOR NOZZLES ≥ 4" NB



PLAN VIEW FOR 1B & 2B

TYPE–2B

TYPE–1B

FOR NOZZLES ≤ 4" NB

VESSEL MATERIAL	CARBON STEEL / LOW ALLOY STEEL				HIGH ALLOY/FOR ALLOY CLAD/ LINED (NOTE–2)	SS/NON–CORROSIVE SERVICE
CORROSION ALLOWANCE	1.5	3	4.5	6	–	–
THICKNESS 't'	6	8	12	14	5	6
WELD SIZE 'W'	6	6	8	8	5	6

NOTES:–

1. ALL DIMENSION'S ARE IN MM UNLESS OTHERWISE STATED.
2. FOR HIGH ALLOY OR STAINLESS STEEL CLADED / LINED VESSELS, BAFFLE AND SLEEVE MATERIAL SHALL BE SAME AS THAT OF HIGH ALLOY & SS LINING / CLADED.
3. REFER ENGINEERING DRAWING FOR DIMENSION 'B'.
4. 'D' DENOTES NOMINAL PIPE SIZE NOZZLE.
5. IN CASE OF CONFLICT ENGINEERING DRAWING SHALL GOVERN.

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NEW DELHI

VORTEX BREAKER

Standard Number: 02–CS–011 | Rev.: 2

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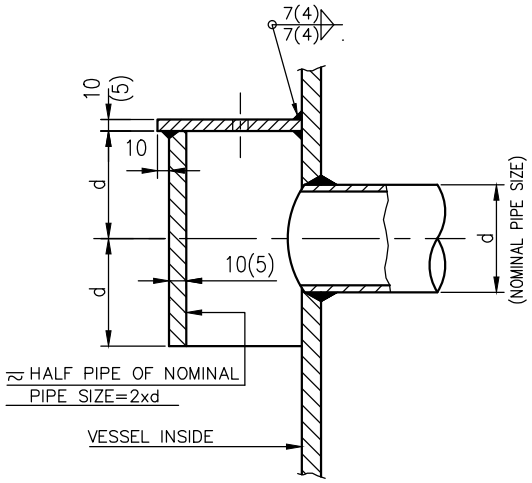
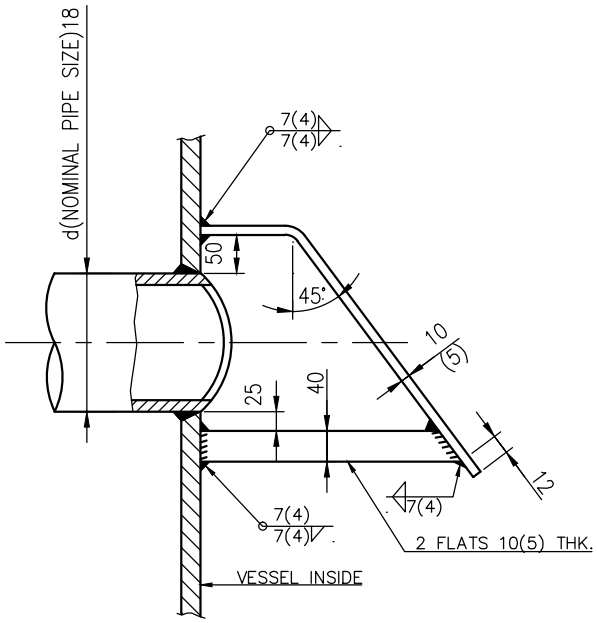
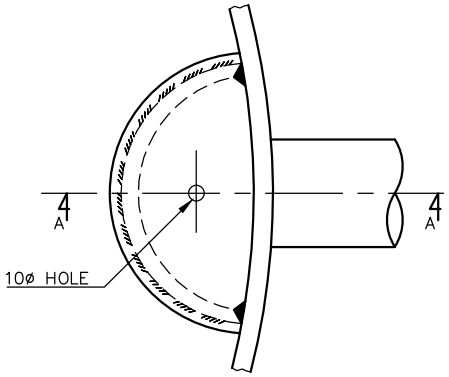
AutoCAD



SECTION–AA

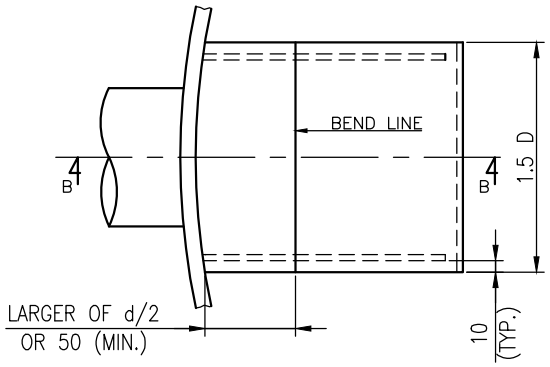


SECTION–BB



PLAN

TYPE–1



PLAN

TYPE–2

NOTES: –

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE NOTED.
2. MATERIALS SHALL BE AS PER ENGINEERING DRAWING.
3. THICKNESS IN BRACKETS ARE FOR HIGH ALLOY/NON FERROUS MATERIALS.
4. IN CASE OF CONFLICT ENGINEERING DRAWING SHALL GOVERN.

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TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

INLET DEFLECTOR BAFFLE

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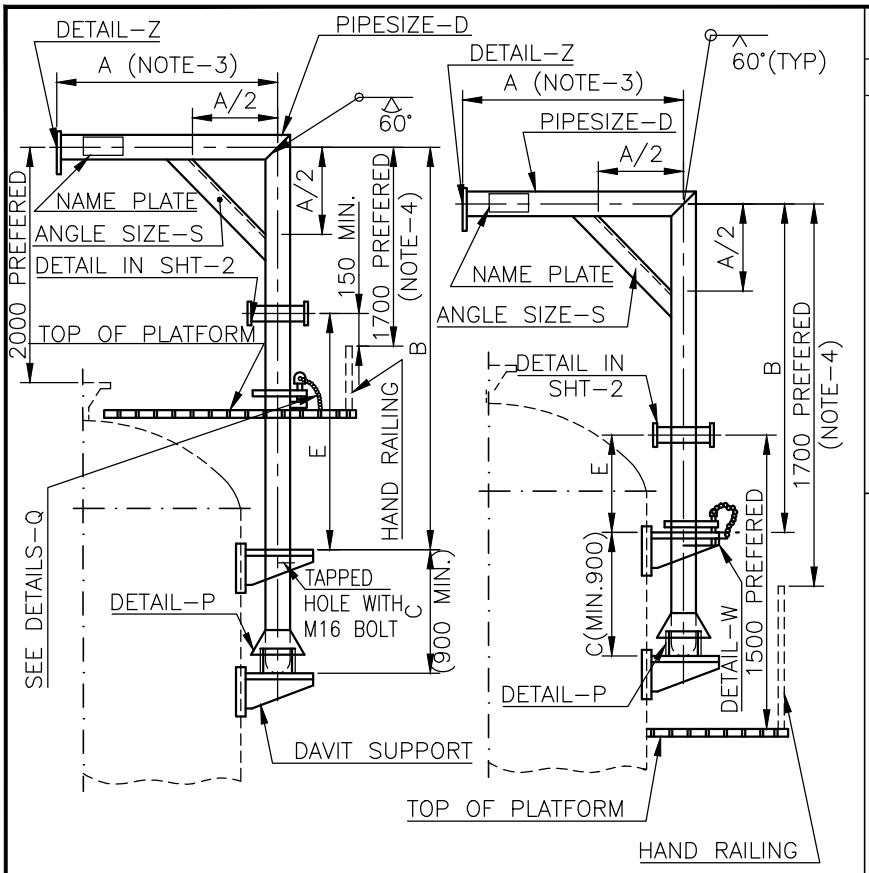
AutoCAD

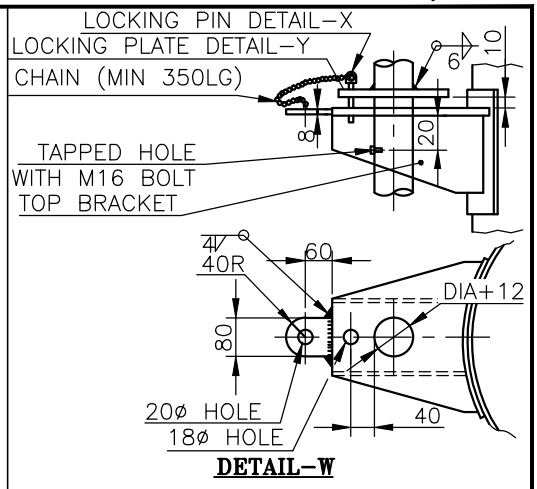


(TYPE-1)

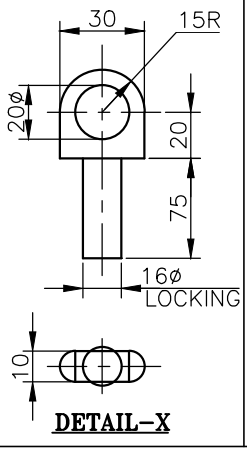
DAVIT FOR TOP MOUNTED PLATFORM

(TYPE-2)

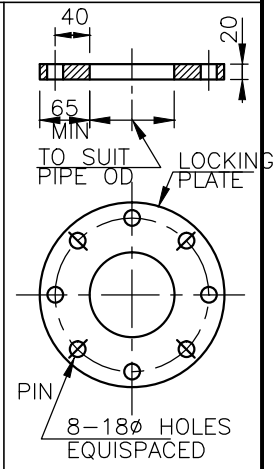
DAVIT FOR SIDE MOUNTED PLATFORM



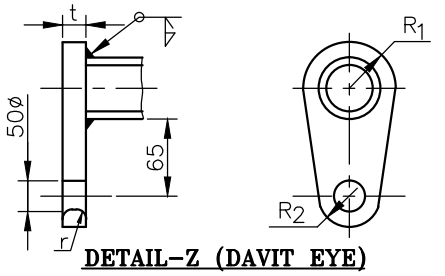
DETAIL-W



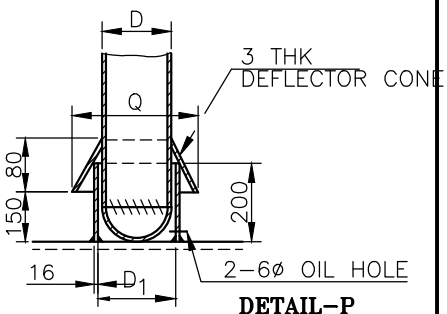
DETAIL-X



DETAIL-Y



DETAIL-Z (DAVIT EYE)



DETAIL-P

D	D_1	Q
4"	120	180
6"	175	230
8"	225	280

A(MAX) (mm)	B (mm)	CAPACITY kgs	PIPE SIZE D	ANGLE SIZE S	R_1	R_2	r	t
1000	≤ 3000	500	4"øxSCH 160	75x75x6	75	60	10	20
		1000	6"øxSCH 160	100x100x8	110	60	12	25
		1500	8"øxSCH 80	150x150x10	140	60	12	25
		2000	8"øxSCH 160	150x150x10	140	60	15	30
1500		500	6"øxSCH 80	100x100x6	110	60	10	20
		1000	8"øxSCH 80	150x150x10	140	60	12	25
		1500	8"øxSCH 160	150x150x10	140	60	12	25
2000		500	6"øxSCH 160	100x100x6	110	60	10	20
		1000	8"øxSCH 160	150x150x10	140	60	12	25
		1500	8"øxSCH 160	150x150x10	140	60	12	25
2500		500	8"øxSCH 80	150x150x10	140	60	10	20
		1000	8"øxSCH 160	150x150x10	140	60	12	25
		1500	8"øxSCH 160	150x150x10	140	60	12	25

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TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PIPE DAVIT

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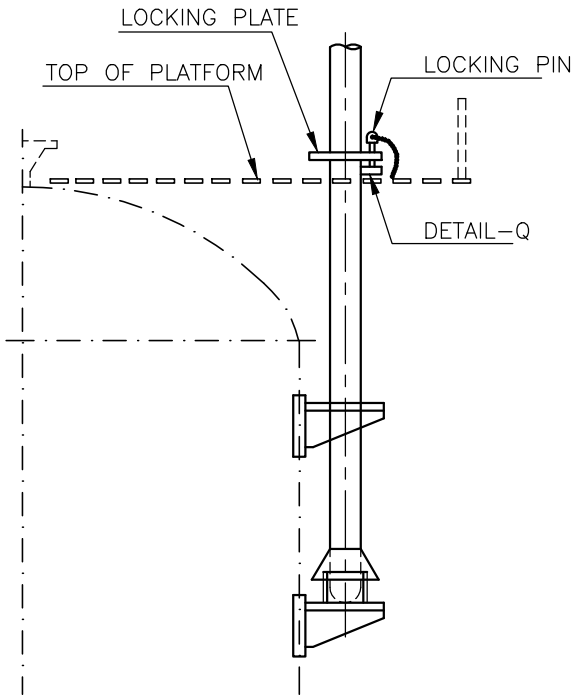
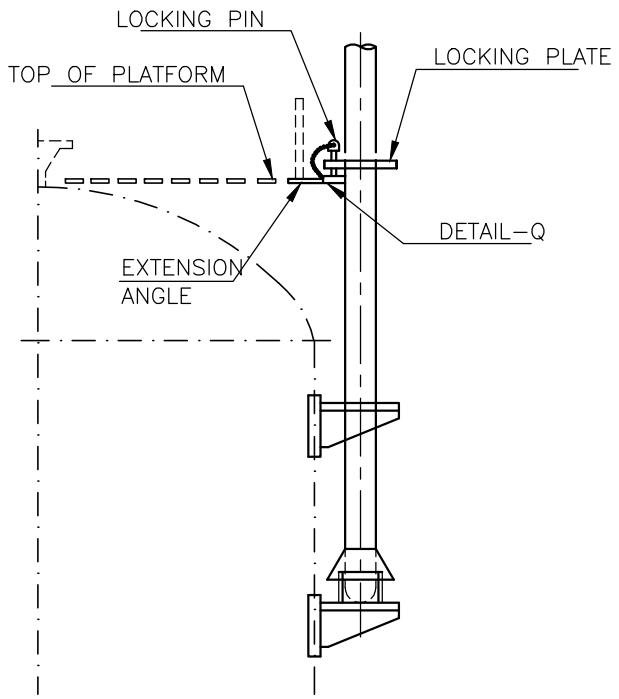
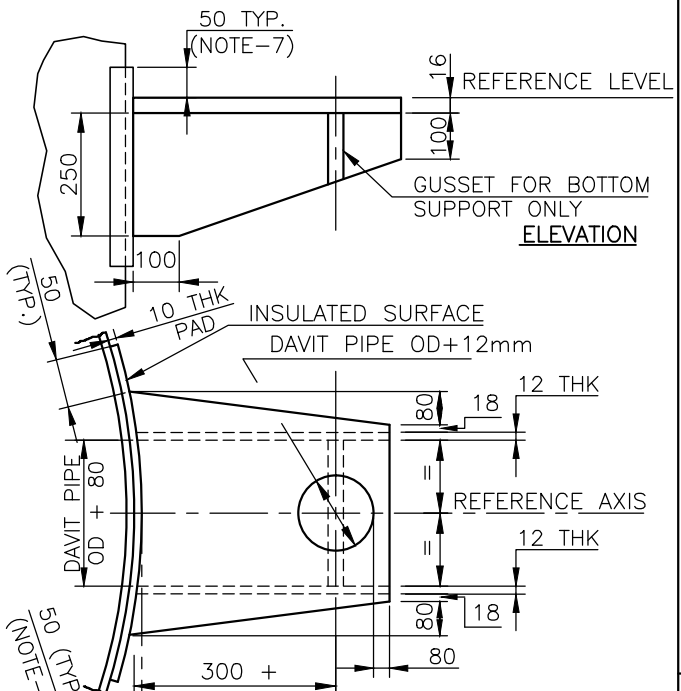
AutoCAD



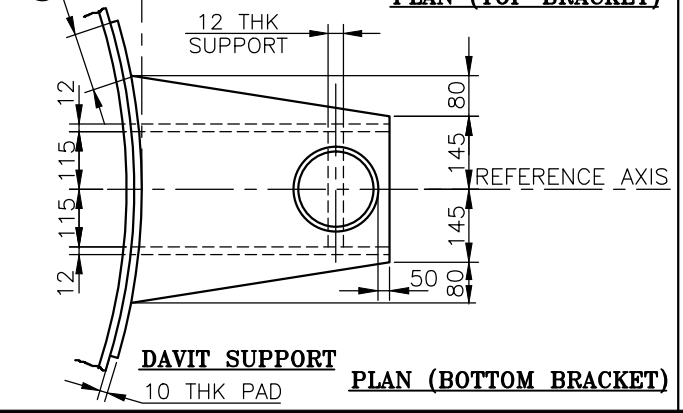
LOCKING ARRANGEMENT OF DAVIT PIPE PASSING THROUGH PLATFORM



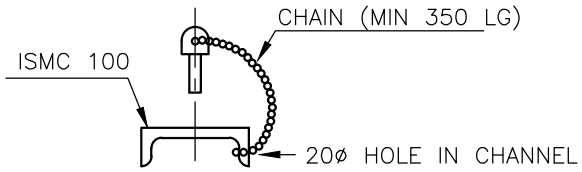
LOCKING ARRANGEMENT OF DAVIT PIPE PASSING THROUGH SIDE OF PLATFORM

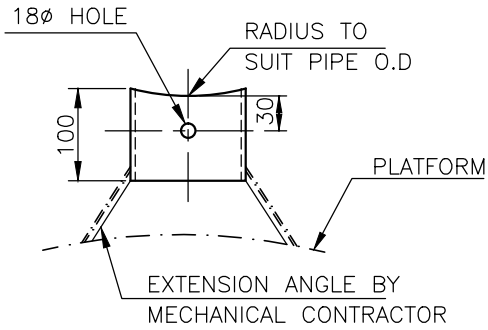


PLAN (TOP BRACKET)

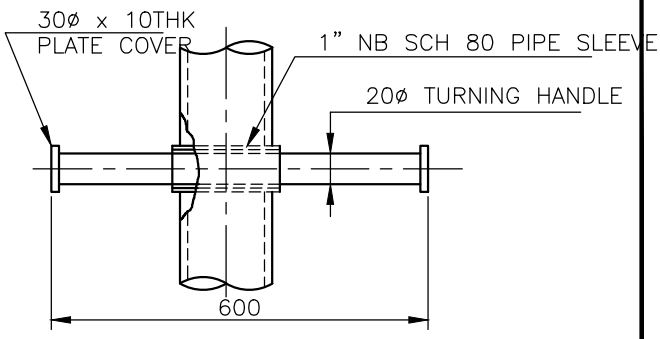


PLAN (BOTTOM BRACKET)





DETAIL–Q



TURNING HANDLE DETAIL

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	PIPE DAVIT	Standard Number	Rev.
		02–CS–014	2
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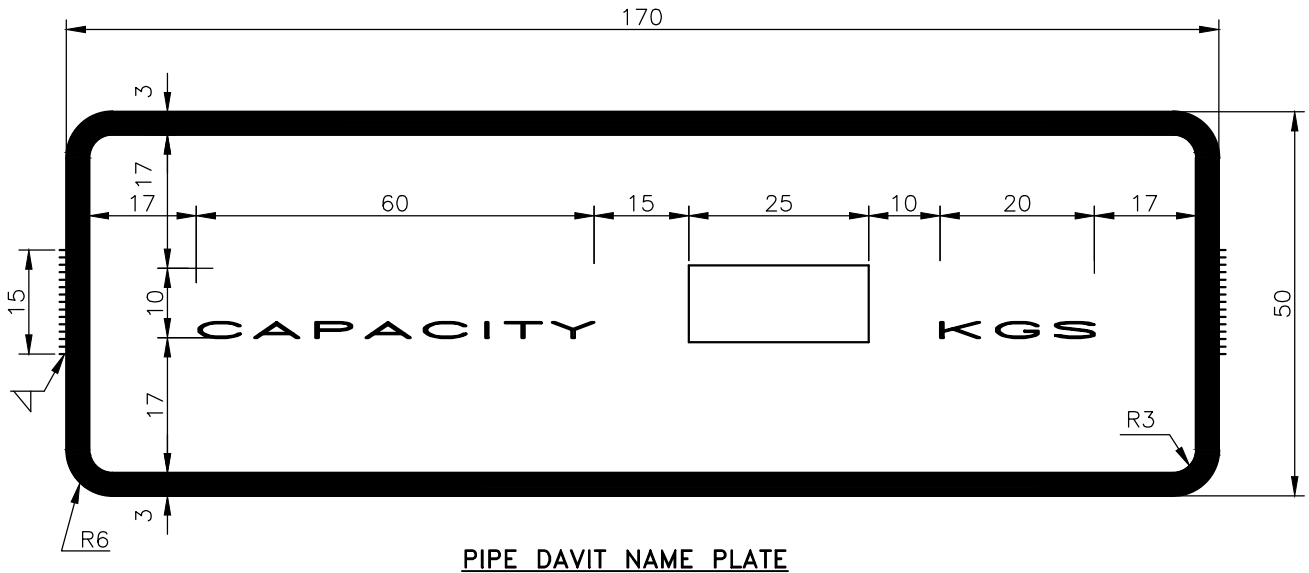
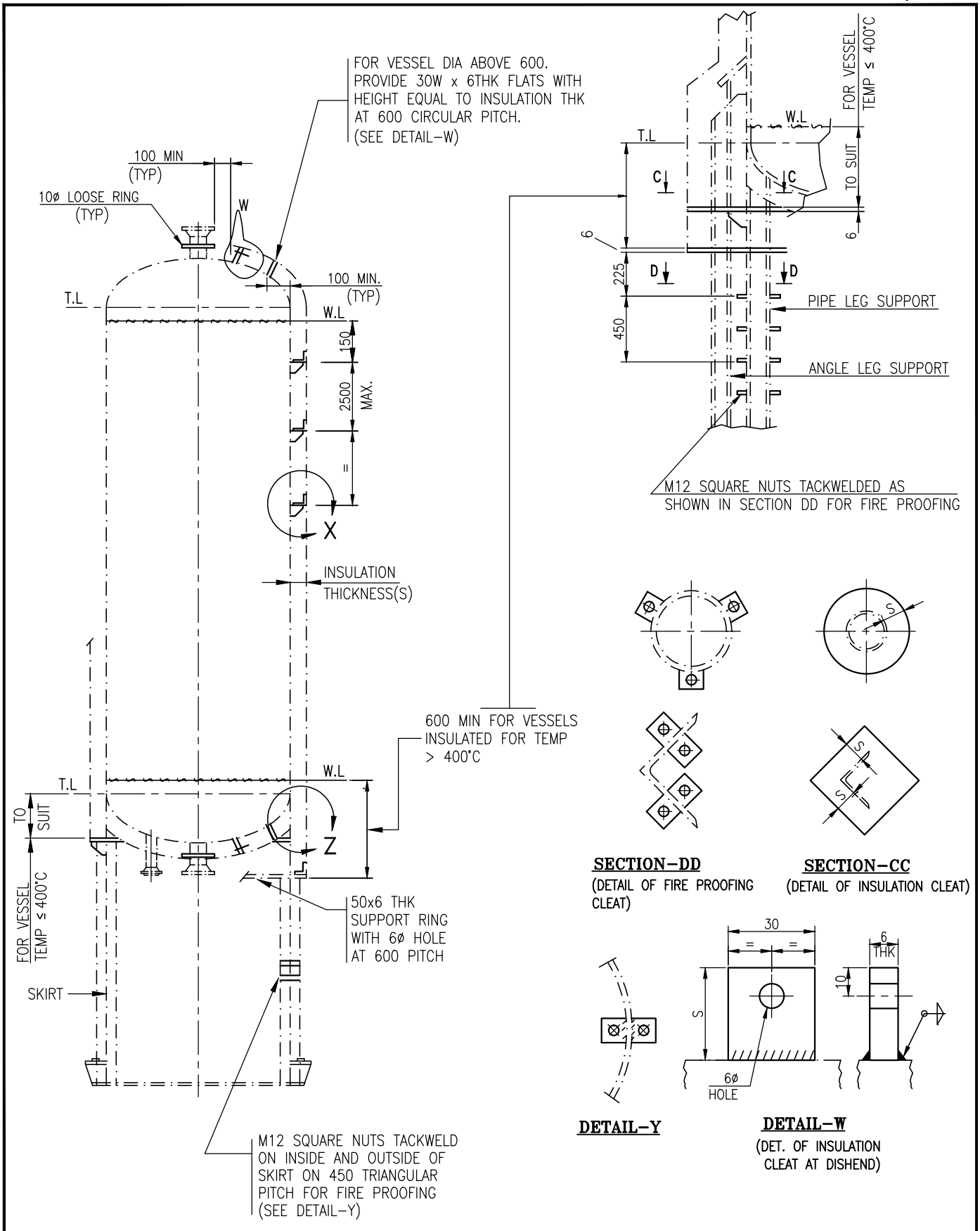
AutoCAD



PIPE DAVIT NAME PLATE
(SS-304, 2mm THK)

NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. NAME PLATE SHALL HAVE BLACK BACK GROUND WITH LETTERS RAISED POLISHED FACE.
3. DIMENSION 'A' SHALL BE SUCH THAT THE DAVIT EYE EXTENDS PREFERABLY BY 900 mm OUTSIDE THE PLATFORM.
4. REFER ENGINEERING DRAWING FOR DIMENSIONS A, B, C, E, CAPACITY OF DAVIT AND INSULATION THICKNESS.
5. DAVIT USED SHALL CLEAR HANDRAIL OF THE EQUIPMENT.
6. MATERIAL OF PIPE SHALL BE SA 53/IS:1978 OR EQUIVALENT AND STRUCTURAL PARTS SHALL BE SA-36/IS:2062 OR EQUIVALENT.
7. FOR THIN WALLED EQUIPMENT, DESIGNER SHALL ANALYSE THE STIFFNESS OF SHELL AT THE BRACKET LOCATIONS.
8. LOCKING PLATE (DETAIL-Y), LOCKING PIN (DETAIL-X) WITH CHAIN, DEFLECTOR CONE (DETAIL-P) AND LOCKING SUPPORT CHANNEL (DETAIL-Q) SHALL BE SUPPLIED LOOSE BY FABRICATOR AND WELDED AT SITE BY MECHANICAL CONTRACTOR.
9. ALL FILLET WELD SHALL BE LARGER OF 6mm OR 0.7 t min., WHERE 't' min. IS THINNEST PART WELDED.
10. DETAIL DIMENSIONS AND NOTES IN ENGINEERING DRAWING TAKE PRECEDENCE OVER THOSE SHOWN HERE.
11. IN CASE OF CONFLICT ENGINEERING DRAWING SHALL GOVERN.



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NEW DELHI

FIRE PROOFING AND INSULATION SUPPORTS FOR VERTICAL VESSEL

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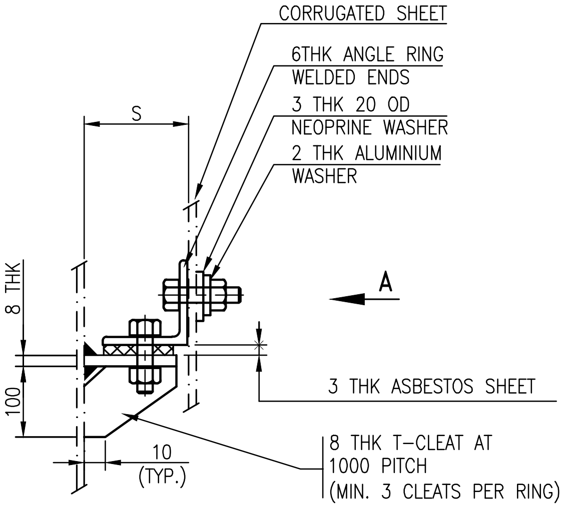
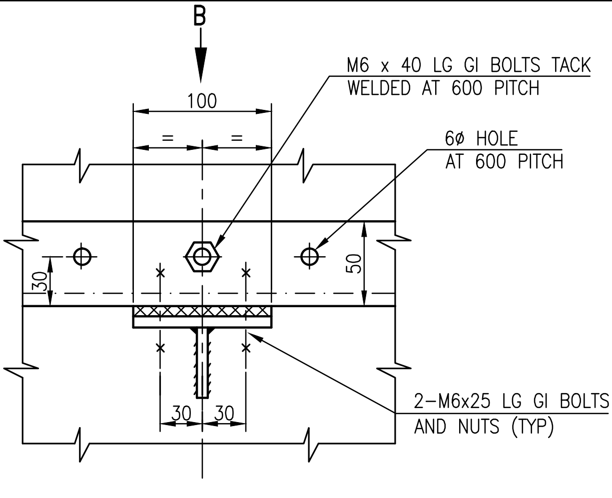
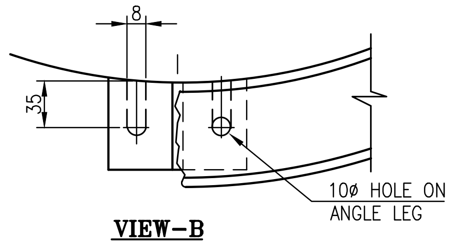
AutoCAD



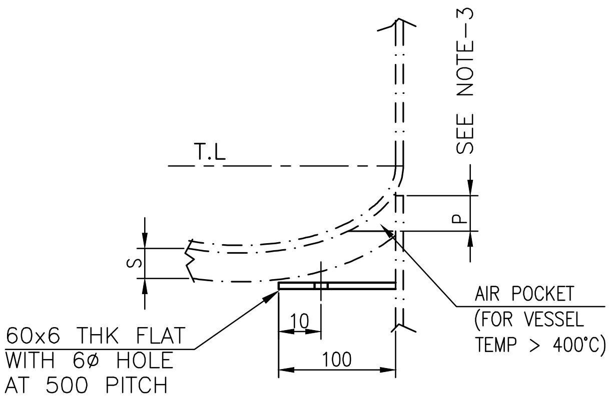
DETAIL-X



VIEW-A



VIEW-B



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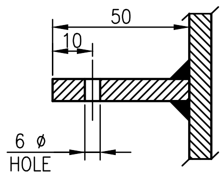
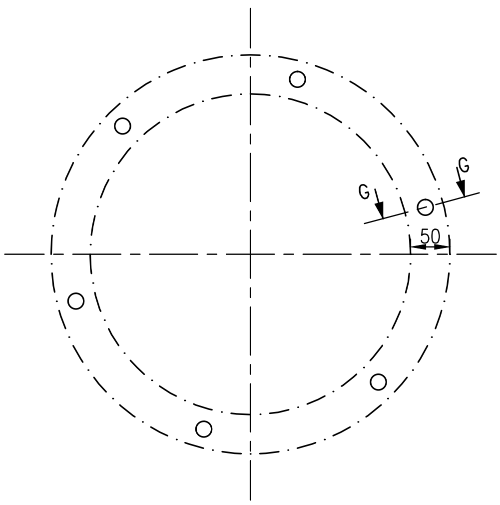


SECTION-GG



FOR FIRE PROOFING

NOTES:-
1. ALL DIMENSIONS ARE IN mm
2. FOR MATERIAL SPECIFICATION REFER ENGINEERING DRAWING.
3. 'P' SHALL BE EQUAL TO 175 mm FOR VESSELS UPTO 3000mm DIAMETER AND 300 mm FOR VESSELS ABOVE 3000 mm DIAMTER.
4. DETAILS, DIMENSIONS AND NOTES ON ENGINEERING DRAWING SHALL TAKE PRECEDENCE OVER THOSE SHOWN HERE IN.
5. CLIPS SHALL CLEAR WELD SEAMS AND INSULATION RING SHALL BE SUITABLY NOTCHED INCASE OF INTERFERENCE WITH NOZZLES / ATTACHMENTS
6. ONLY T-CLEATS WITH ASBESTOS SHEET AND GI BOLTINGS, ANGLE RING ALONG WITH TACK WELDED BOLTS, INSULATION SUPPORT CLEATS WELDED TO EQUIPMENT, LOOSE RINGS AND M12 NUTS SHALL BE SUPPLIED BY THE EQUIPMENT FABRICATOR.

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	FIRE PROOFING AND INSULATION SUPPORTS FOR VERTICAL VESSEL	Standard Number	Rev.
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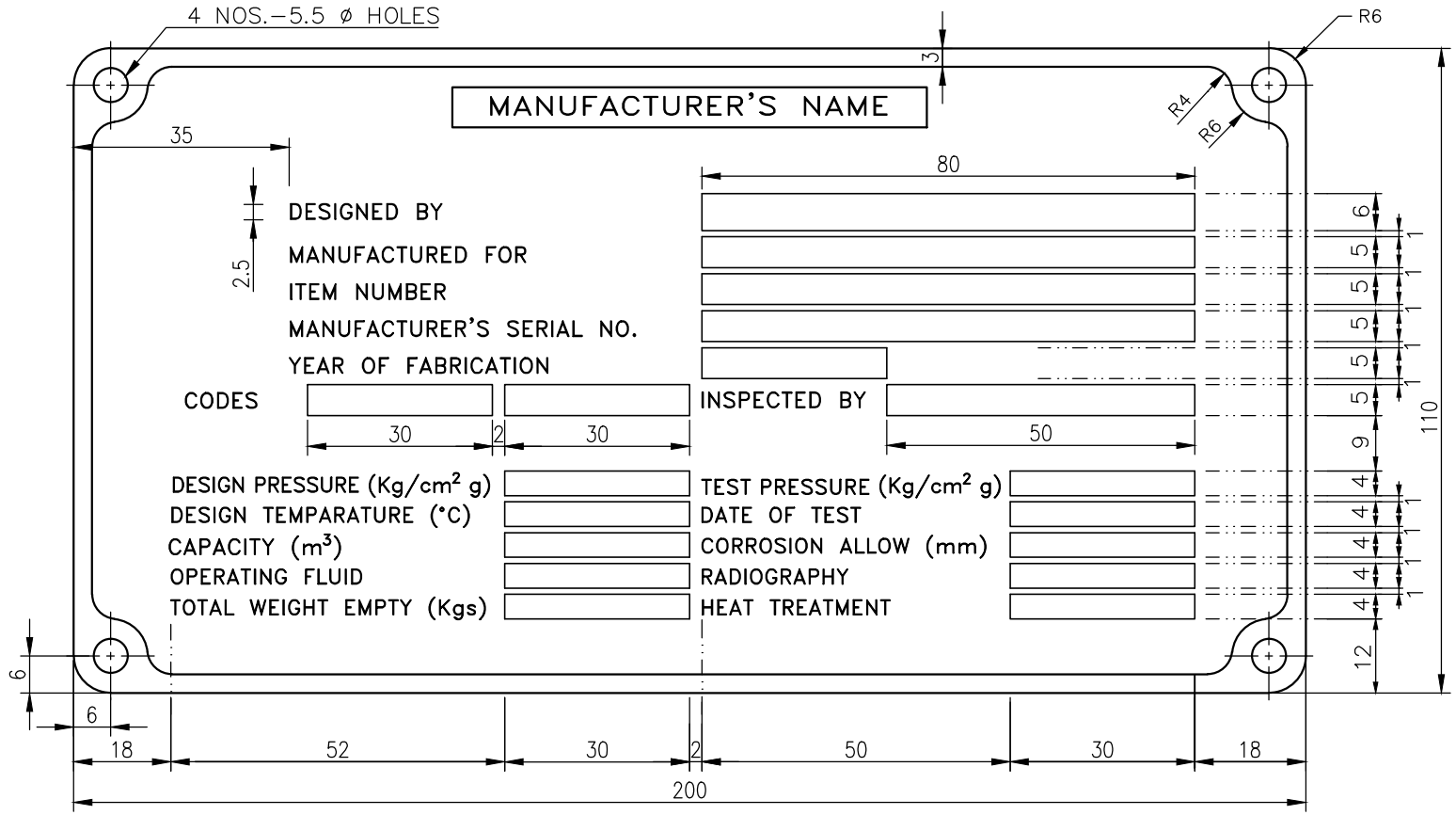
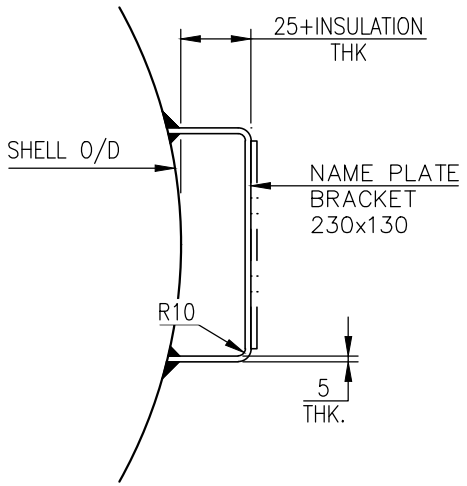
AutoCAD





DETAIL OF BRACKET

NOTES:–
1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. ALL LETTERS BLOCKS AND BORDER SHALL BE RAISED POLISHED FACE.
3. BACKGROUND SHALL BE BLACK.
4. NAME PLATE SHALL BE TACK WELDED TO THE BRACKETS. WHERE NOT POSSIBLE IT MAY BE REVITTED WITH 4 NOS 5ø ROUND HEADED SS RIVETS LENGTH TO SUIT BRACKET.
5. NAME PLATE SHALL BE OF STAINLESS STEEL OF 2 mm THK.

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NEW DELHI

MANUFACTURER'S NAME PLATE (VESSELS)

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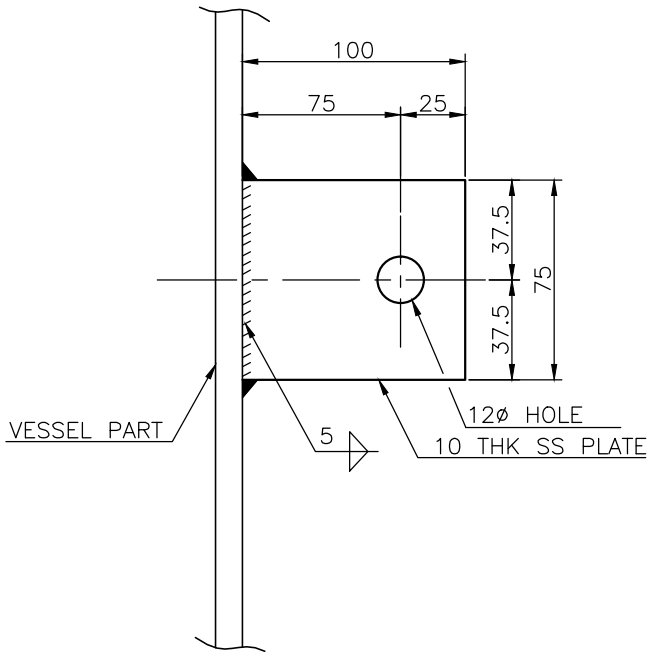
AutoCAD



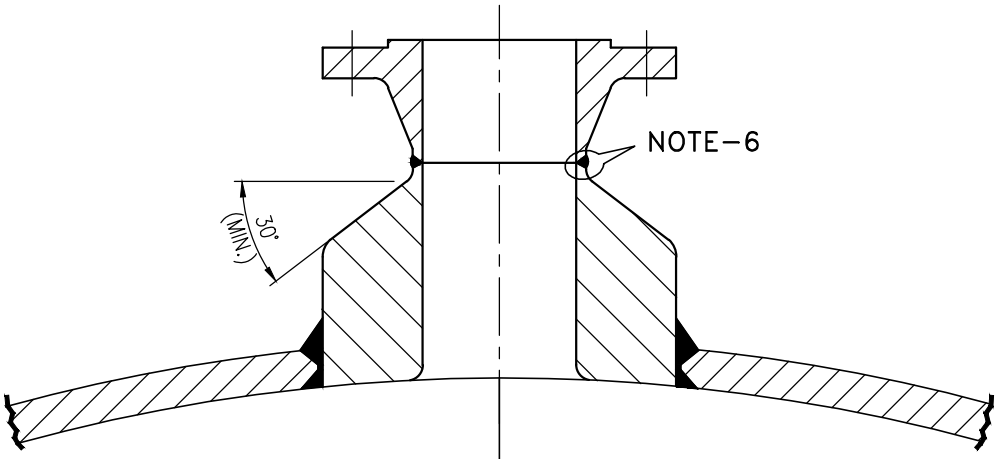
NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. ALL EQUIPMENTS ARE TO BE PROVIDED WITH MINIMUM TWO (2) NOS EARTHING LUGS.
3. EARTHING LUGS SHALL BE LOCATED DIAMETRICALLY OPPOSITE ON NORTH–SOUTH CENTRE LINE ON SKIRT SUPPORTED EQUIPMENT, ON ANY TWO LEGS OF THREE LEG SUPPORTED VERTICAL VESSEL, ON DIAMETRICALLY OPPOSITE LEGS OF FOUR LEG SUPPORTED VERTICAL VESSEL AND ON EACH SADDLE OF HORIZONTAL VESSEL. TWO EARTHING LUGS ARE TO BE LOCATED ON EACH SADDLE OF HORIZONTAL VESSEL OF LENGTH GREATER THAN 20 METRES.
4. DO NOT WELD EARTHING LUG ON PRESSURE PART.
5. EARTHING LUG NOT TO BE PAINTED.
6. IN CASE OF CONFLICT ENGINEERING DRAWING SHALL GOVERN.

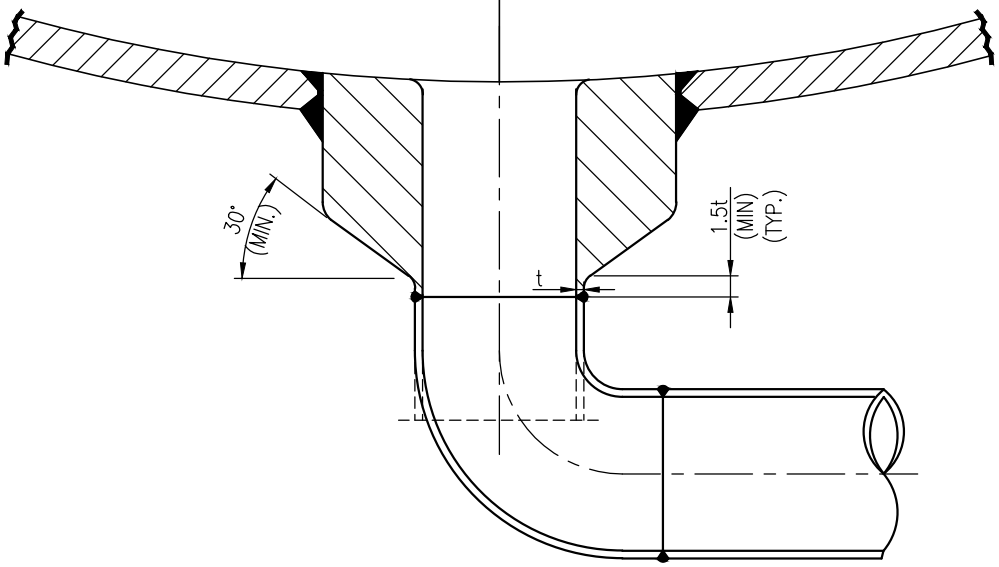
Rev.	Date	Description	Prpd.	Chkd.	Appd.
2	11.01.18	GENERAL REVISION & REISSUED AS STANDARD	RKD	HAS	RRP
1	25.07.11	ISSUED DUE TO CHANGE OF ORGANISATION NAME	RKD	VMS	RAPS
0	04.12.95	ISSUED AS STANDARD	HS	TK	SNB

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	EARTHING LUG	Standard Number: 02–CS–019 (Rev. 2) Sheet 1 of 1

AutoCAD



SELF REINFORCED NOZZLE



SELF REINFORCED WELD END

NOTES :-

1. DESIGN CALCULATIONS FOR ALL THE DIMENSIONS OF SR NOZZLES / WELD ENDS SHALL BE REVIEWED & APPROVED BY TESPL.
2. ANY DEVIATION IN THE OVERALL NOZZLE PROJECTION FROM THE SPECIFIED DESIGN DATA SHALL BE MADE ONLY AFTER OBTAINING PRIOR APPROVAL FROM TESPL.
3. METHOD OF CONNECTION AND RADIOGRAPHY REQUIREMENTS SHALL BE AS PER ASME SEC.VIII DIV.1/DIV.2.
4. FOR VESSEL THICKNESS > 40mm SR NOZZLE MAY BE USED OR AS SPECIFIED ON ENGINEERING DRAWING.
5. ALL SHARP CORNERS SHALL BE ROUNDED-OFF SMOOTH.
6. FLANGES MAY BE FORGED INTEGRALLY WITH S.R NOZZLE NECK.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
2	11.01.18	GENERAL REVISION & REISSUED AS STANDARD	RKD	HAS	RRP
1	25.07.11	ISSUED DUE TO CHANGE OF ORGANISATION NAME	RKD	VMS	RAPS
0	04.12.95	ISSUED AS STANDARD	HS	TK	SNB

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

S.R. NOZZLE NECK

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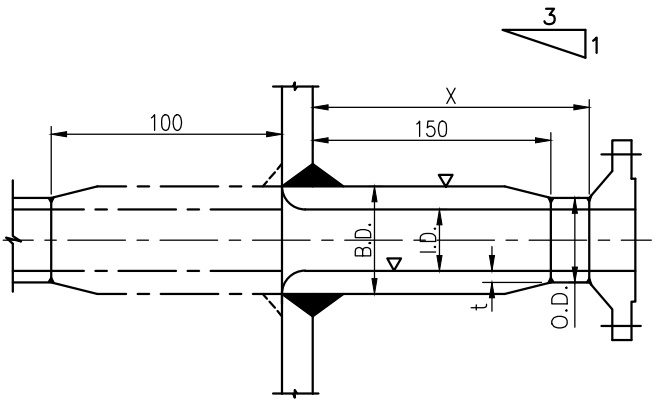
AutoCAD



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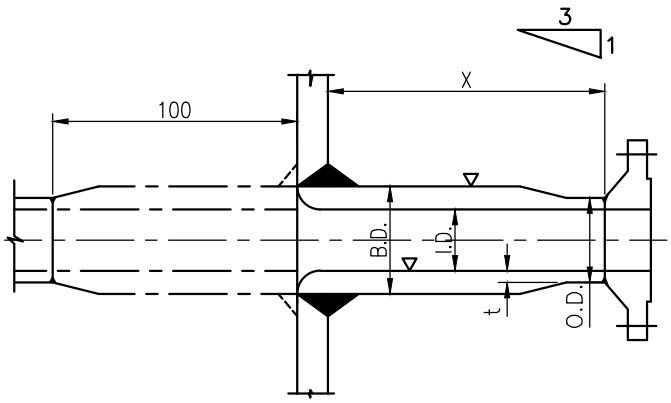

150⩽X⩽225

ANSI–150–600 CLASS W.N.

SIZE NB	O.D.	B.D.	PIPE SCH.	I.D.	t	PIPE SCH.	I.D.	t	PIPE SCH.	I.D.	t
15	21.3	40	80	13.84	3.73	160	11.74	4.78	XXS	6.36	7.47
20	26.7	45	80	18.88	3.91	160	15.58	5.56	XXS	11.06	7.82
25	33.4	55	80	24.3	4.55	160	20.7	6.35	XXS	15.22	9.09
30	42.2	70	80	32.5	4.85	160	29.5	6.35	XXS	22.8	9.7
40	48.3	80	80	38.14	5.08	160	34.02	7.14	XXS	27.9	10.2
50	60.3	105	80	49.22	5.54	160	42.82	8.74	XXS	38.1	11.1

ANSI–150–600 CLASS W.N.

SIZE NB	O.D.	B.D.	PIPE SCH.	I.D.	t	PIPE SCH.	I.D.	t	PIPE	t
15	21.3	40	80	13.84	3.73	160	11.74	4.78	XXS	7.47
20	26.7	45	80	18.88	3.91	160	15.58	5.56	XXS	7.82
25	33.4	55	80	24.3	4.55	160	20.7	6.35	XXS	9.09
30	42.2	70	80	32.5	4.85	160	29.5	6.35	XXS	9.7
40	48.3	80	80	38.14	5.08	160	34.02	7.14	XXS	10.2
50	60.3	105	80	49.22	5.54	160	42.82	8.74	XXS	11.1

NOTES :-

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.
2. ALL PIPES FOR NECKS TO BE SEAMLESS AND FROM FORGED MATERIALS. NO NEGATIVE TOLERANCES ON FORGING NECK THICKNESS.
3. FLANGE DIMENSIONS AND FACING ARE AS PER ASME–B16.5 (LATEST).
4. FOR TYPE OF FACINGS SEE VESSEL DRAWING.
5. SET ON NOZZLE ATTACHMENT TO VESSEL IS NOT PERMITTED.
6. THE ABOVE ARRANGEMENT SHALL BE USED ON VESSELS WHEN THICKNESS OF VESSEL EXCEED 40MM. THK.
7. FOR DIV.2, VESSELS. ABOVE MAY BE USED AFTER ENSURING REINFORCEMENT CHECK.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
2	11.01.18	GENERAL REVISION & REISSUED AS STANDARD	RKD	HAS	RRP
1	25.07.11	ISSUED DUE TO CHANGE OF ORGANISATION NAME	RKD	VMS	RAPS
0	04.12.95	ISSUED AS STANDARD	HS	TK	SNB

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

DETAILS OF FORGED NOZZLES

Standard Number	Rev.
02–CS–021	2

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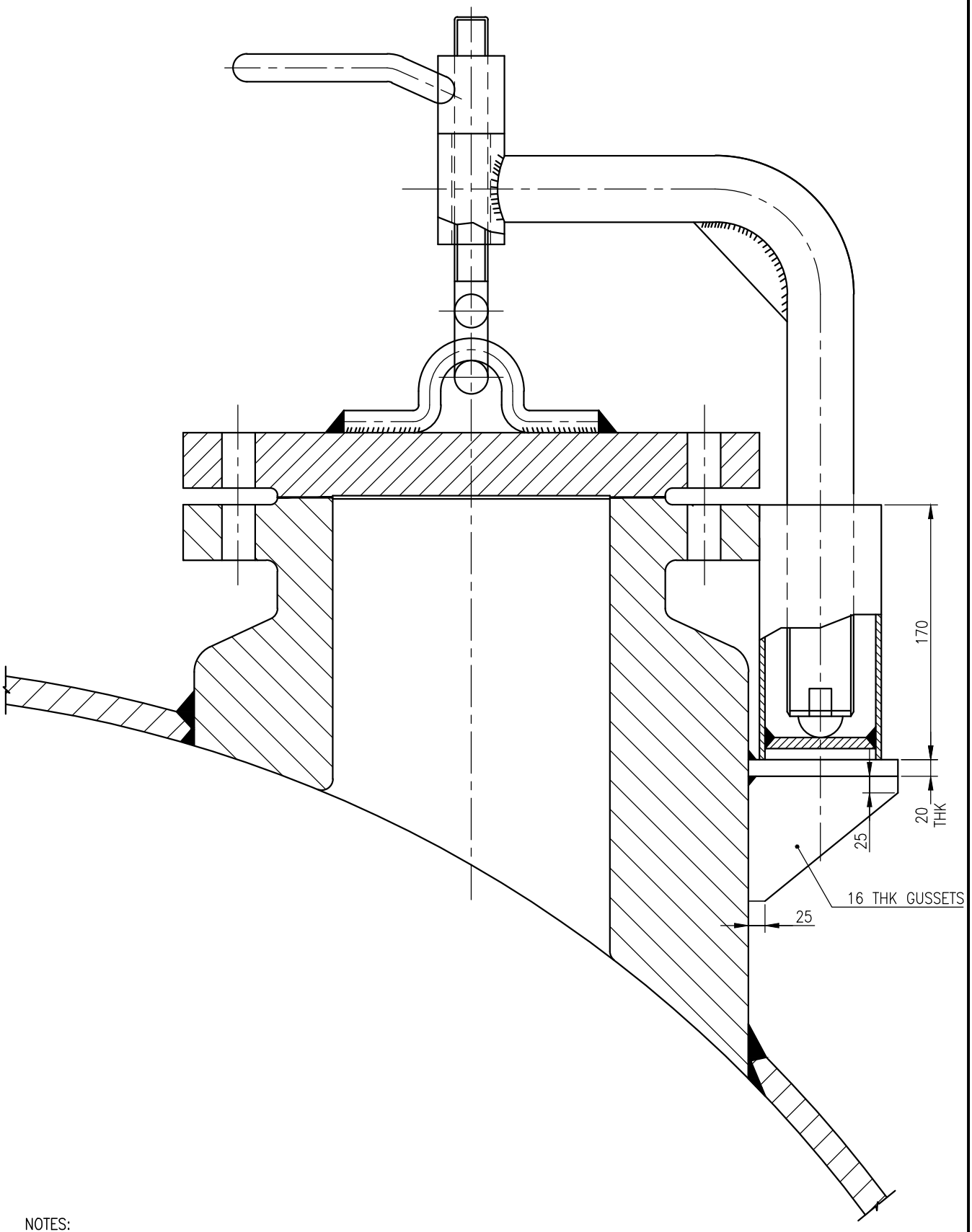
AutoCAD

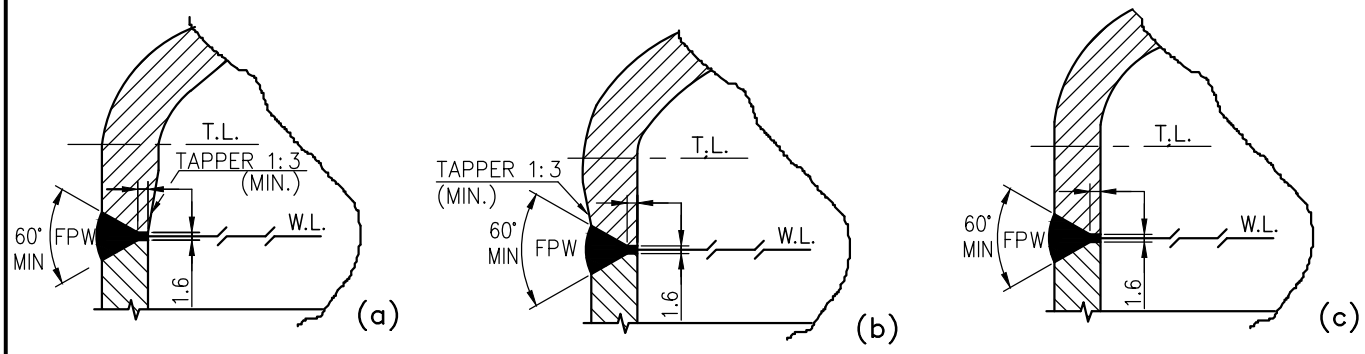


NOTES:
1. FOR DAVIT DETAILS & DIMENSIONS REFER STD. 02-CS-006.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
2	11.01.18	GENERAL REVISION & REISSUED AS STANDARD	RKD	HAS	RRP
1	25.07.11	ISSUED DUE TO CHANGE OF ORGANISATION NAME	RKD	VMS	RAPS
0	04.12.95	ISSUED AS STANDARD	HS	TK	SNB

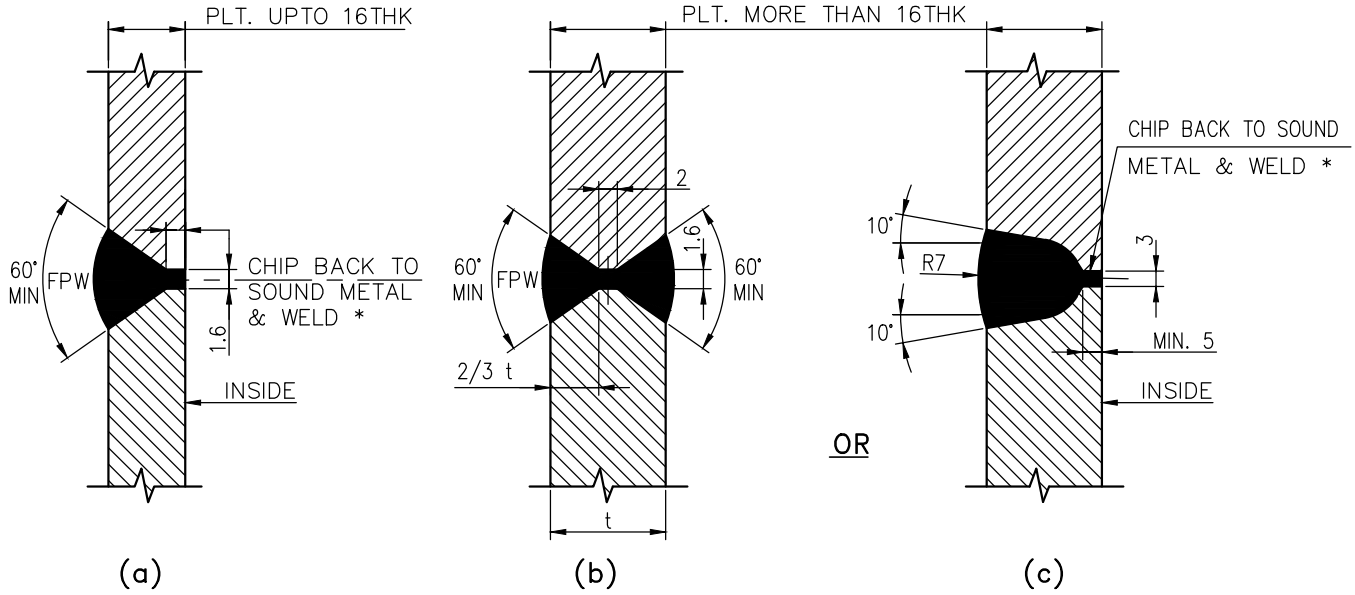
TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	DETAIL OF MANHOLE DAVIT FOR S.R.NOZZLE	Standard Number	Rev.
		02-CS-022	2
		Sheet 1 of 1	

AutoCAD



TYP. SHELL TO DISHED END WELD ARRANGEMENT (W-1)

(ROOT SIDE GROUND TO SOUND METAL AND SEAL WELD)



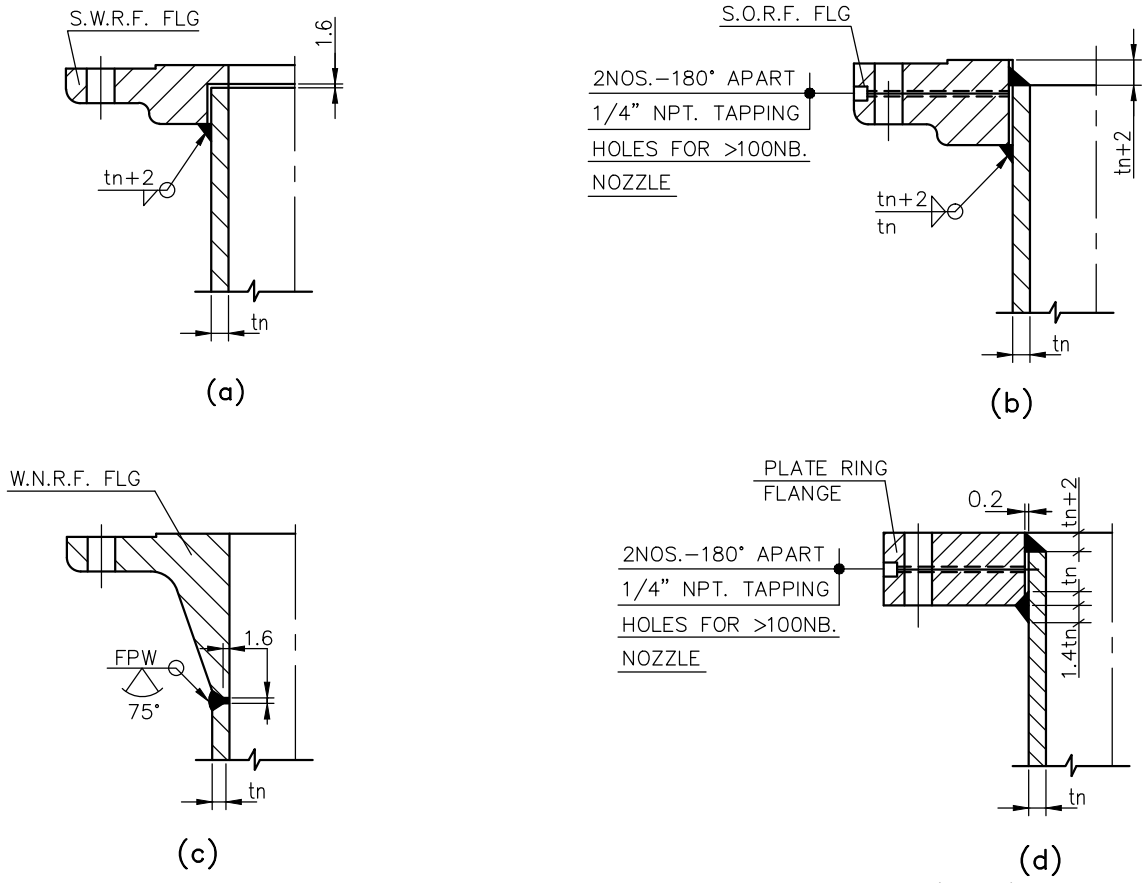
TYP. LONG'L & CIRCUM. WELDING DETAILS (W-2)

* WHEN THE SECOND SIDE IS NOT ACCESSIBLE FOR WELDING, ROOT RUN TO BE MADE BY TIG PROCESS.

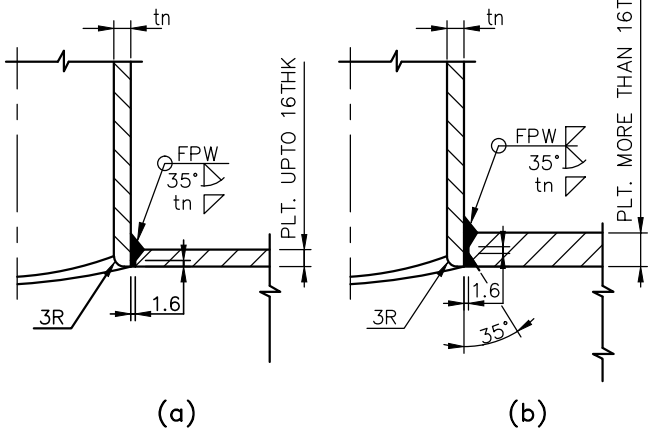
Rev.	Date	Description	Prpd.	Chkd.	Appd.
2	11.01.18	GENERAL REVISION & REISSUED AS STANDARD	RKD	HAS	RRP
1	25.07.11	ISSUED DUE TO CHANGE OF ORGANISATION NAME	RKD	VMS	RAPS
0	04.12.95	ISSUED AS STANDARD	HS	TK	SNB

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	TYP. WELD DETAILS	Standard Number	Rev.
		02-CS-023	2
		Sheet 1 of 2	

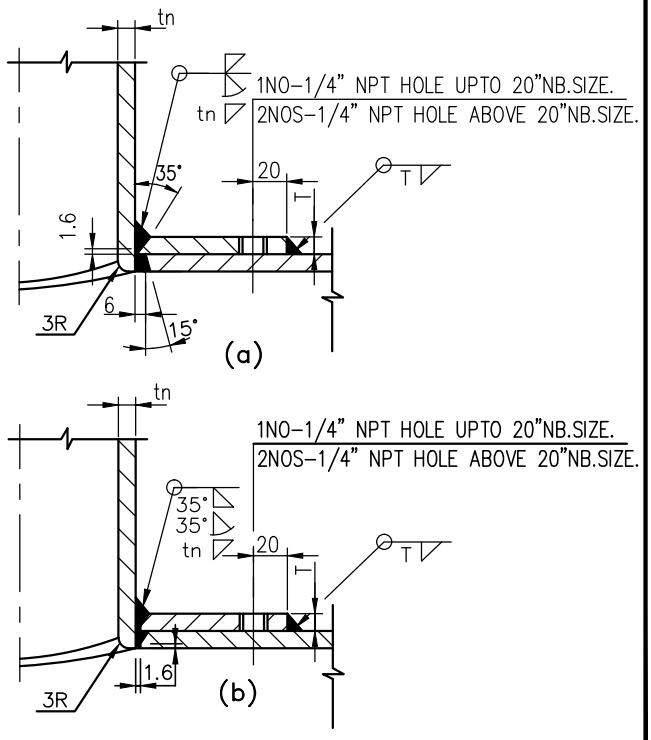
AutoCAD



TYP. WELD DETAIL OF NOZZLE TO FLANGE (W-3)



TYP. WELD DETAIL OF NOZZLE TO SHELL/ DISHED END WITHOUT RF. PAD (W-4)



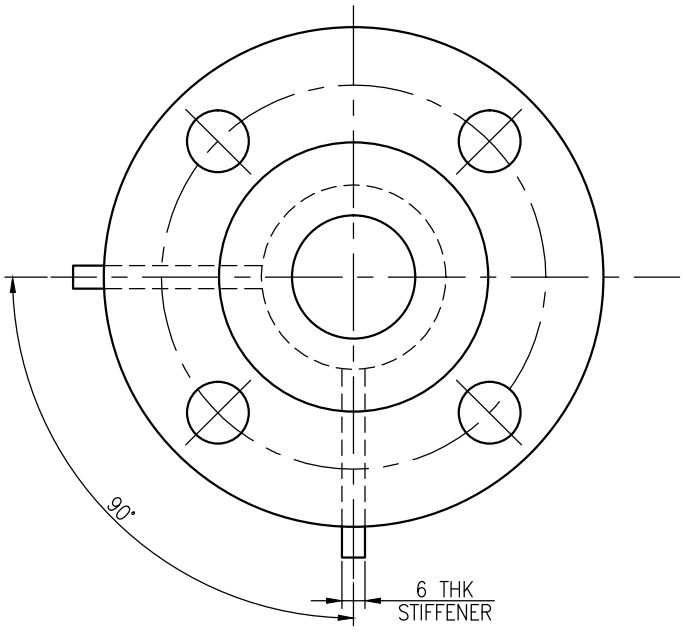
TYP. WELD DETAIL OF NOZZLE TO SHELL/ DISHED END WITH RF. PAD (W-5)

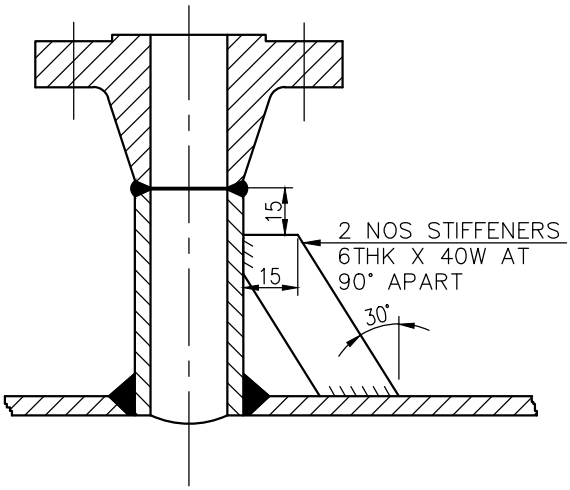
NOTE:

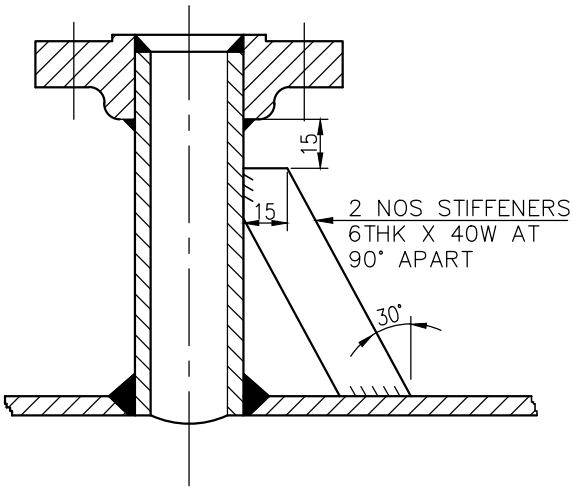
1. FILLET WELD SIZE (tn,T) MAY BE LIMITED MEETING CODE REQUIREMENTS.

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	TYP. WELD DETAILS	Standard Number	Rev.
		02-CS-023	2
		Sheet 2 of 2	

AutoCAD



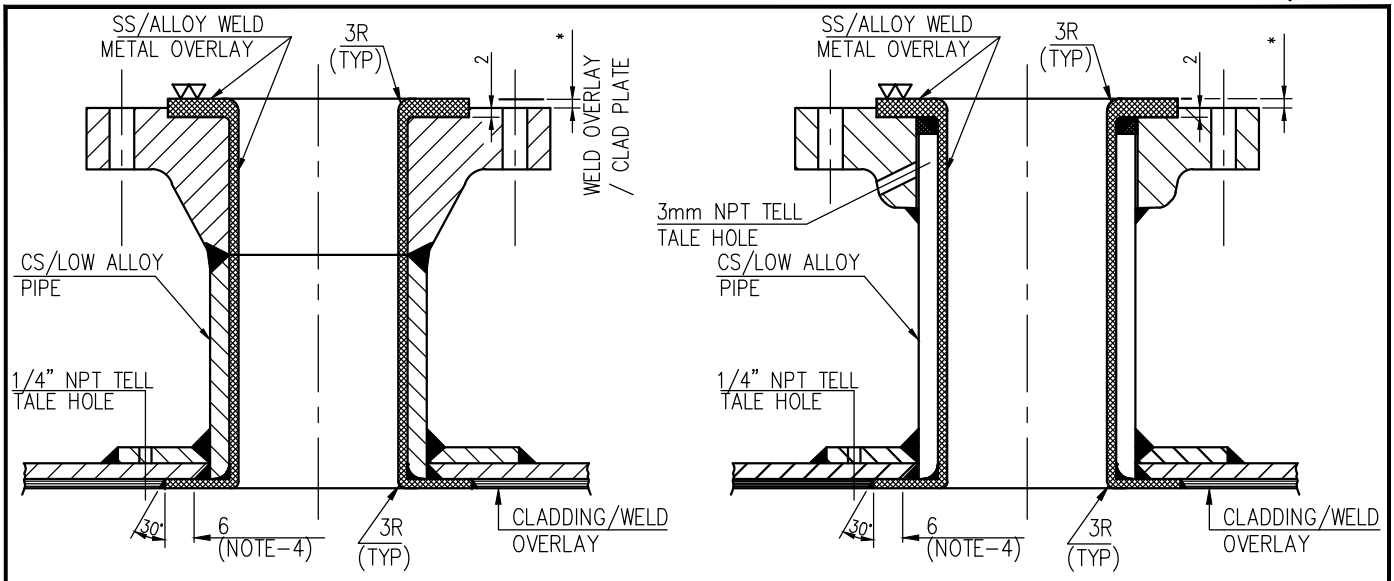




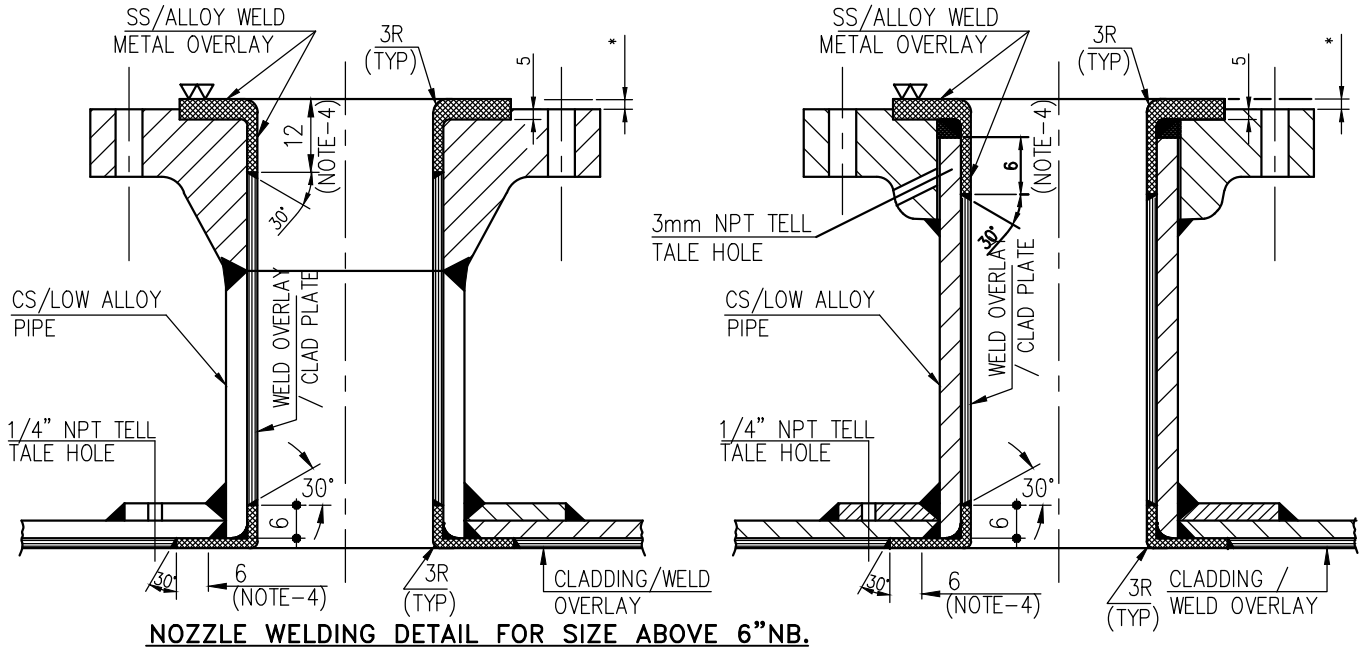
Rev.	Date	Description	Prpd.	Chkd.	Appd.
2	11.01.18	GENERAL REVISION & REISSUED AS STANDARD	RKD	HAS	RRP
1	25.07.11	ISSUED DUE TO CHANGE OF ORGANISATION NAME	RKD	VMS	RAPS
0	14.12.95	ISSUED AS STANDARD	HS	TK	SNB/PK

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	STIFFENERS FOR NOZZLES 2" NB. AND BELOW	Standard Number: 02-CS-025 (Rev. 2) Sheet 1 of 1

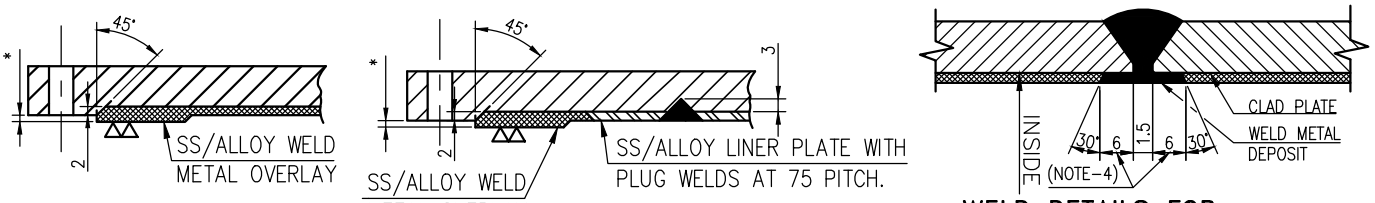
AutoCAD



NOZZLE WELDING DETAIL FOR SIZE UPTO 6"NB.



NOZZLE WELDING DETAIL FOR SIZE ABOVE 6"NB.



WELD DETAILS FOR CIRCUMFERANCE & LONGITUDINAL JOINTS

* FINISHED RAISED FACE AS WELL AS RTJ SHALL BE AS PER APPLICABLE STANDARD

NOTES:-

1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SPECIFIED.
2. THE MACHINED/FINISHED THICKNESS OF WELD OVERLAY SHALL NOT BE LESS THAN CLADDING THK. IN VESSEL PLT.
3. ON FLANGE THE WELD OVERLAY SHALL BE UPTO RAISED FACE.
4. CLAD PLATE SHALL BE CHIPPED BACK BEFORE WELD METAL DEPOSIT IS MADE.
5. WELD DEPOSIT SHALL BE OF MINIMUM TWO LAYER CONSTRUCTION WITH TWO THIRD OF WELD DEPOSIT THICKNESS HAVING THE SAME DENSITY AS THAT OF PARENT MATERIAL.

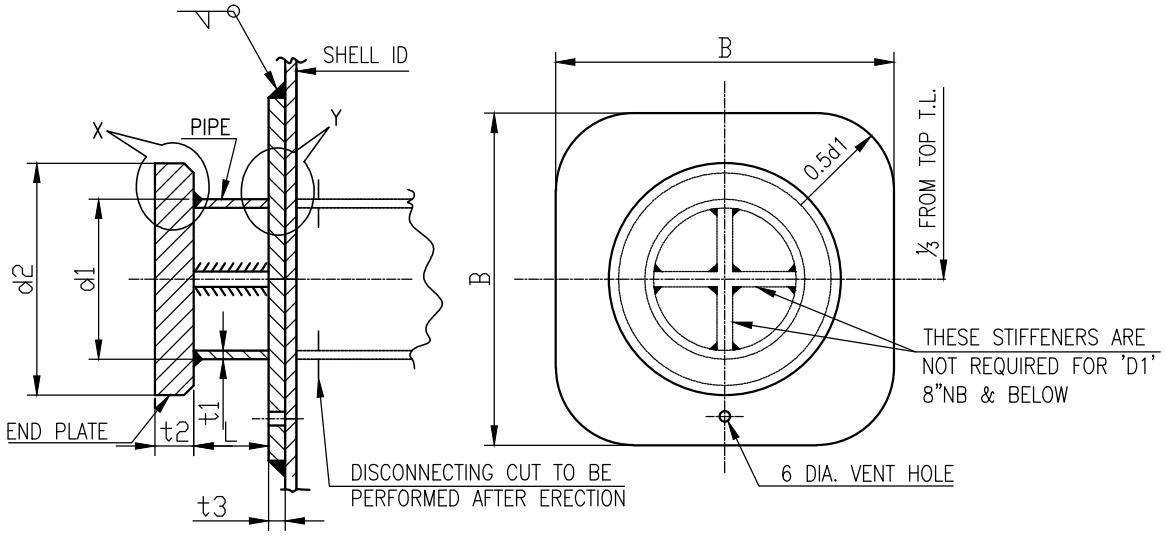
Rev.	Date	Description	Prpd.	Chkd.	Appd.
2	11.01.18	GENERAL REVISION & REISSUED AS STANDARD	RKD	HAS	RRP
1	25.07.11	ISSUED DUE TO CHANGE OF ORGANISATION NAME	RKD	VMS	RAPS
0	28.02.98	ISSUED AS STANDARD	HS	ARK	SNB/PK

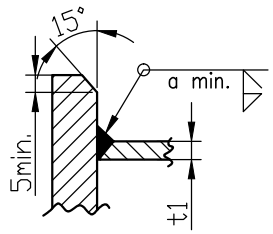
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

ALLOY LINER DETAILS

Standard Number	Rev.
02-CS-027	2
Sheet 1 of 1	

AutoCAD





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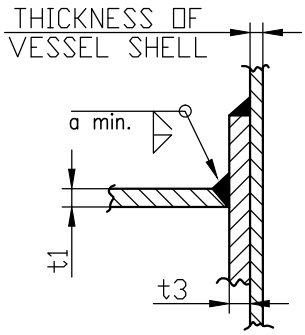
DETAIL-X



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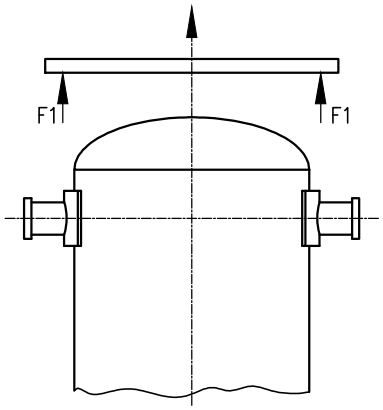
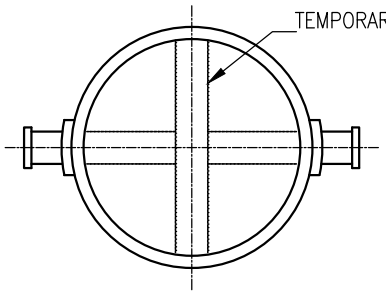
DETAIL-Y



ADMISSIBLE FORCE PER TRUNNION 'F1'	PIPE			END PLATE		REINFORCEMENT PLATE	
TONNE	d1	t1	L	d2	t2	t3	B
W≤4	4"	SCH 40	50	160	20	8	230
W≤10	6"	SCH 80	75	240	20	8	340
W≤20	8"	SCH 80	100	340	30	14	440
W≤40	10"	SCH.XS	130	400	30	16	550
W≤60	14"	SCH 60	140	480	30	18	710
W≤85	16"	SCH 60	160	530	30	20	810
W≤100	18"	18 THK	180	590	35	22	900
W≤200	20"	20 THK	200	750	40	25	1000
W≤300	24"	25 THK	300	900	50	25	1200



ARRANGEMENT OF TEMPORARY BRACING IF REQUIRED

NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2. THE ADMISSIBLE FORCES ARE APPROXIMATE VALUES. THE MANUFACTURER SHALL SUBMIT STRESS ANALYSIS DOCUMENTS REFLECTING THE REQUIRED DIMENSIONS AND THE LOADS FOR THE VESSEL OR ITEM OF EQUIPMENT.
3. REINFORCEMENT PAD MATERIAL SHALL OF THE SAME AS THAT OF SHELL MATERIAL
4. TEMPORARY BRACING IF PROVIDED SHALL BE REMOVED AFTER ERECTION.

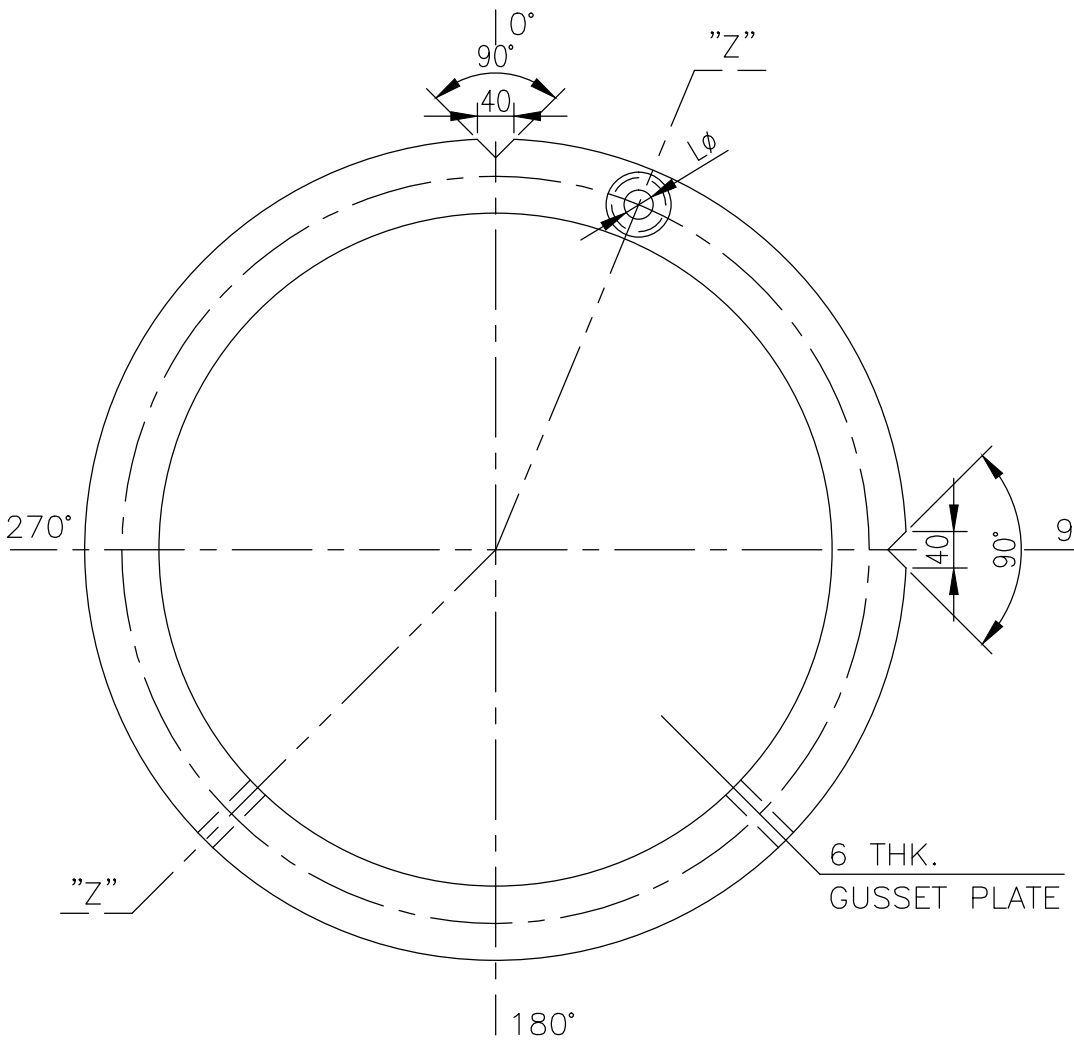
Rev.	Date	Description	Prpd.	Chkd.	Appd.
2	11.01.18	GENERAL REVISION & REISSUED AS STANDARD	RKD	HAS	RRP
1	25.07.11	ISSUED DUE TO CHANGE OF ORGANISATION NAME	RKD	VMS	RAPS
0	02.02.10	ISSUED AS STANTARD			

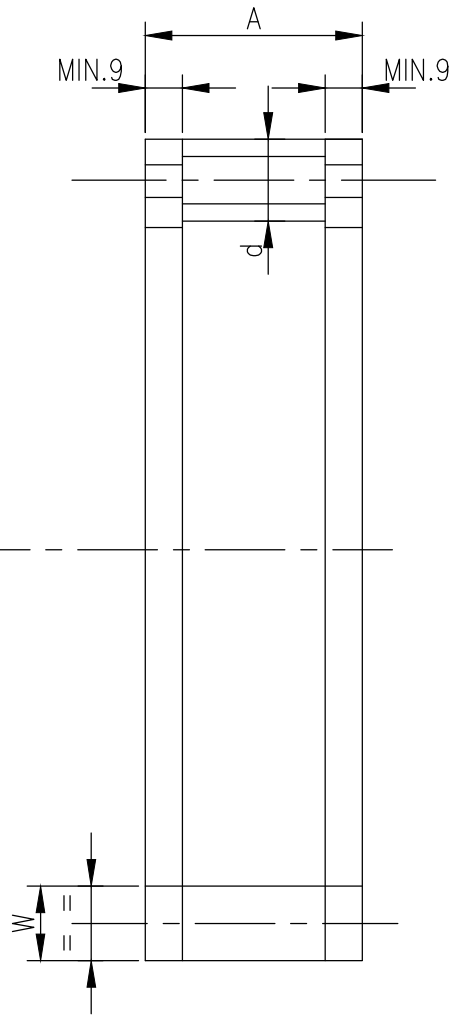
TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

LIFTING TRUNNIONS

Standard Number	Rev.
02-CS-032	2
Sheet 1 of 1	

AutoCAD





SECTION 'Z – Z"

BOLT SIZE	M 24	M 30	M 36	M 42	M 48	M 56	M 64	M 72	M 80	M 90	M 100
A	262	264	314	316	316	369	369	422	475	475	475
W	100	100	110	120	130	150	160	170	180	200	220
L	26	33	39	45	52	62	70	78	86	96	107
d	1-1/2"	1-1/2"	2"	2"	2-1/2"	3"	3"	4"	4"	6"	6"

NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. MATERIALS SHALL BE AS FOLLOWS :
   PLATE A283 GR.C OR EQUIVALENT
   PIPE A53 GR.B OR EQUIVALENT
3. BOLT HOLES IN TEMPLATE AND BASE RING OF VESSEL SHALL BE DRILLED USING THE SAME GAUGE PLATE.
4. THE REINFORCEMENT OF TEMPLATE SHALL BE DESIGNED NOT TO DEFORM DURING TRANSPORTATION.
5. ORINETATION MARK 0°, 90°, 180°, 270° AND ITEM NO. SHALL BE MARKED BY WHITE PAINT ON THE UPPER FACE OF TEMPLATE.
6. DIVIDED TEMPLATES SHALL BE REINFORCED FOR TRANSPORTATION, ETC. AND ARRANGED FOR EASY SITE ASSEMBLING.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
0	14.06.2021	ISSUED AS STANDARD	VSN	APH	HAS

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TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

TEMPLATES

Standard Number	Rev.
9680-02-OT-001	0

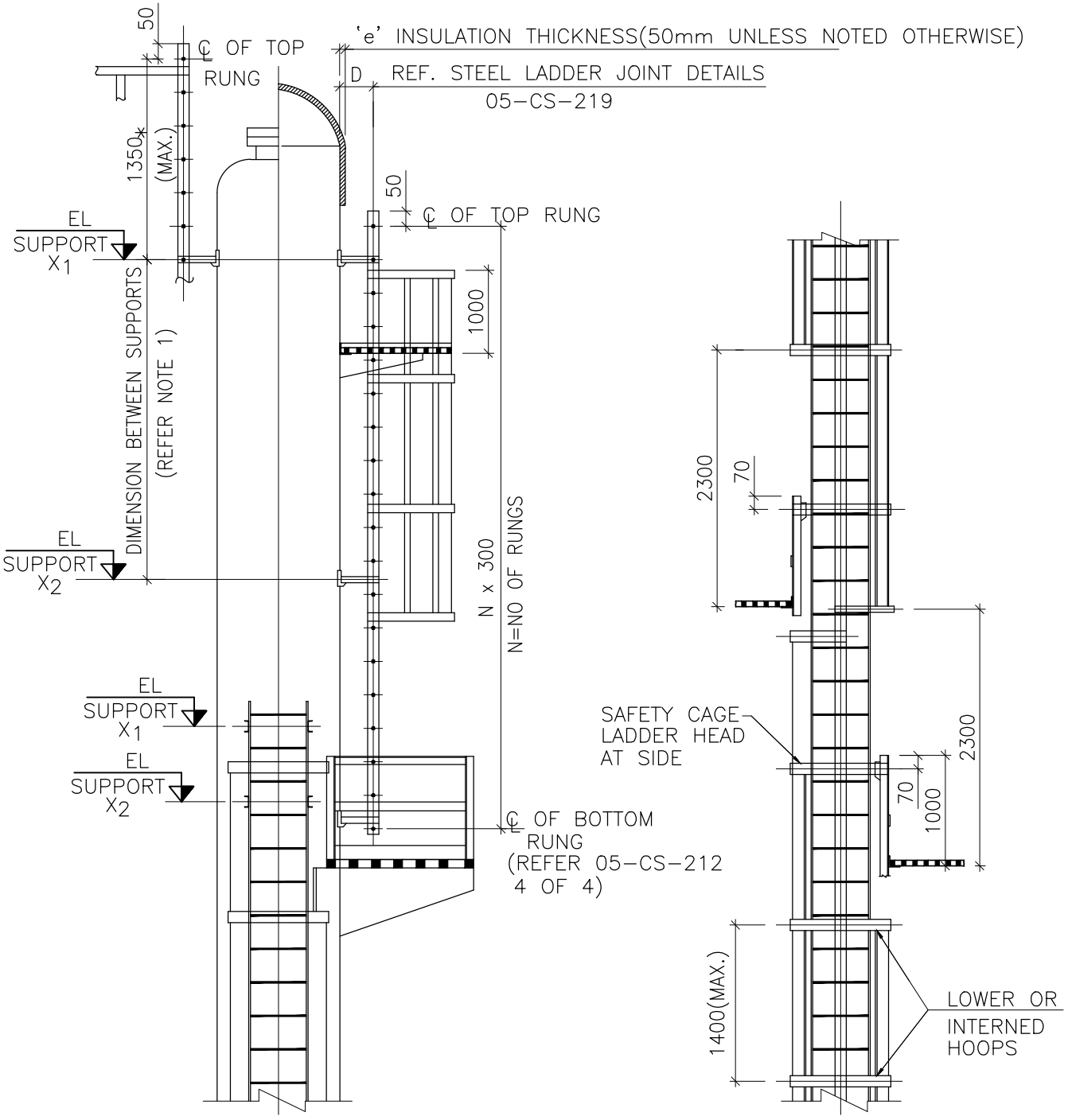
Sheet 1 of 1

NOTES:-

1. LADDER POSTS SHALL BE OF FLAT (75x10) UPTO 3.50m MAX. BETWEEN SUPPORTS, ISMC 100 UPTO 7.0m MAX. BETWEEN SUPPORTS.
2. RUNGS SHALL BE 20ø.
3. SUPPORT TYPE 'X1' CORRESPONDS TO FIXED SUPPORT AND 'X2' CORRESPONDS TO SLINDING SUPPORT.
4. SUPPORT ELEVATION X_1, X_2, CORRESPONDS TO C OF BOLT HOLES.
5. SUPPORT X_1 IS CAPABLE TO SUSTAIN A LOAD FOR 9000 LONG LADDER ONLY.
6. LADDER SHALL BE GIVEN A SUITABLE SLOPE, IF NECESSARY, TO AVOID FOULING WITH ANCHOR CHAIRS.

Rev.	Date	Description	Prpd.	Chkd.	Appd.
4	09.05.18	GENERALLY REVISED AND ISSUED FOR IMPLEMENTATION	MSS	RUA	ROS
3	05.08.11	REVISION DUE TO CHANGE OF ORGANISATION NAME AND ISSUED FOR IMPLEMENTATION	KS	RD	MKB
0	25.09.00	GENERAL REVISION	AM	JMN	MKD

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	DETAIL OF STEEL LADDER	Standard Number	Rev.
		05-CS-212	4
		Sheet 1 of 4	



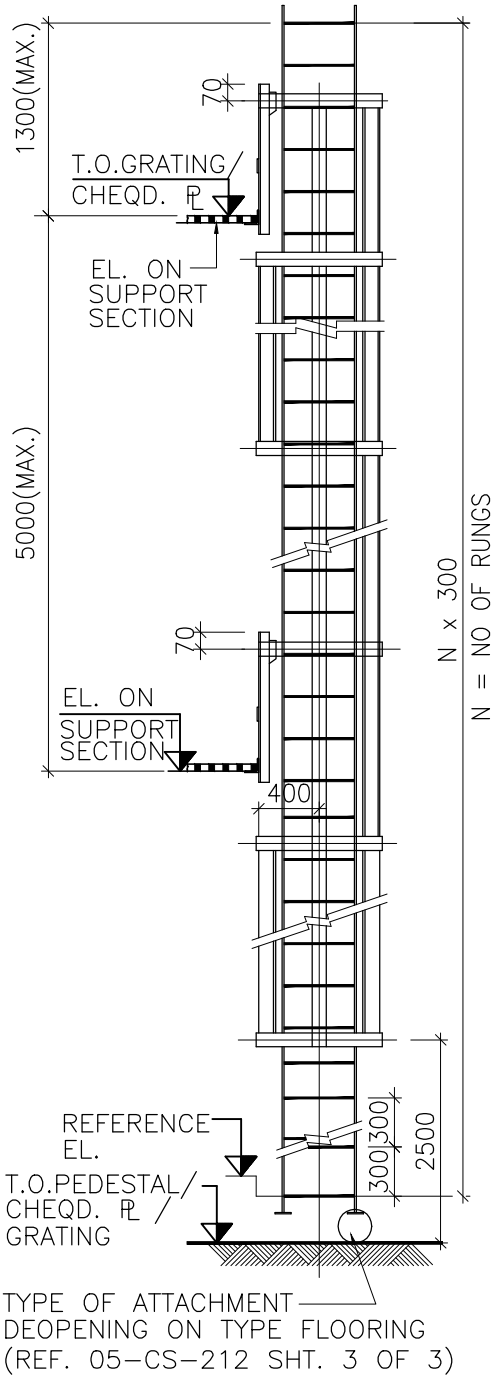
LADDER FOR SIDE ENTRY

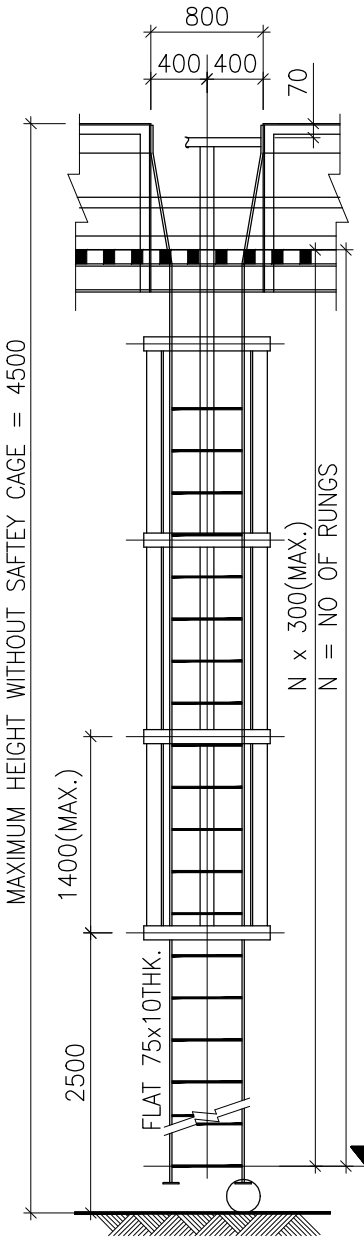
LADDER FOR SIDE ENTRY

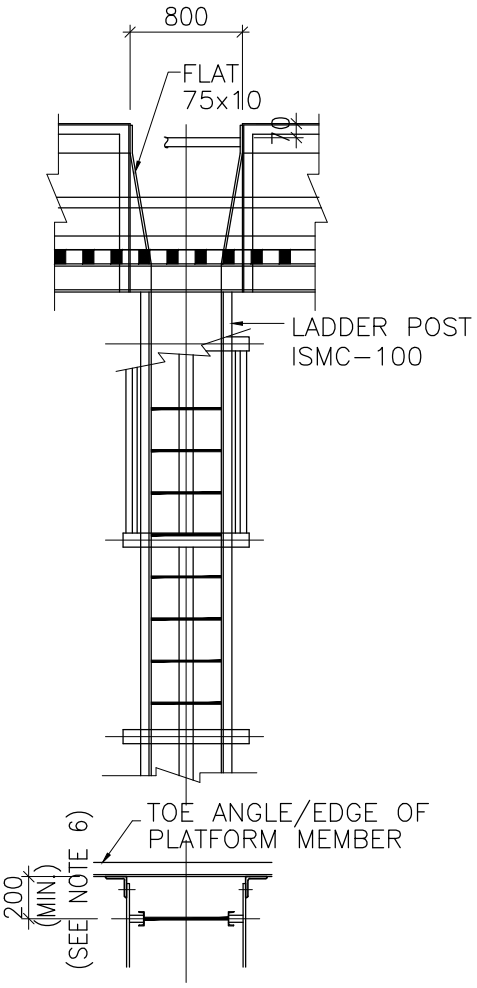
VESSEL DIA (mm)	DISTANCE 'D' (mm)
UPTO 800	200 + e
>800 ⩽3200	260 + e
>3200 ⩽8000	275 + e

*MC 100 SHALL BE ADOPTED FOR DISTANCE MORE THAN 1350 UPTO 2000.

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	DETAIL OF STEEL LADDER	Standard Number	Rev.
		05-CS-212	4
		Sheet 2 of 4	







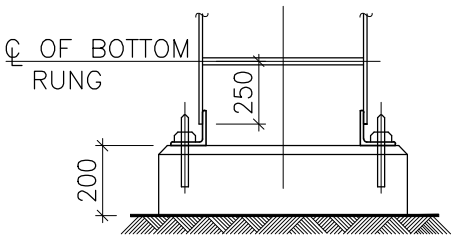
LADDER FOR FRONT ENTRY

LADDER FOR SIDE ENTRY

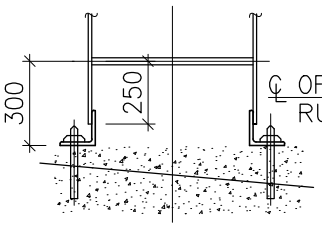
LADDER FOR FRONT ENTRY

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	DETAIL OF STEEL LADDER	Standard Number	Rev.
		05-CS-212	4
		Sheet 3 of 4	

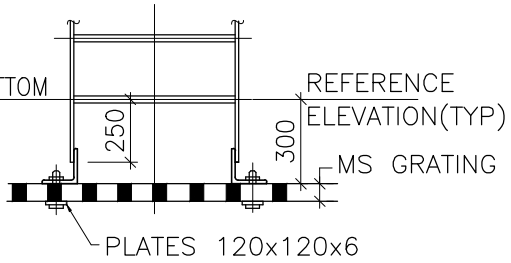
TYPE OF ATTACHMENT	NATURE OF SUPPORT SECTION	REMARKS
A_1, A_2 B_1, B_2 C_1, C_2, D_1, D_2	SITE WITHOUT PAVING CONCRETE FLOOR CHEQUERED PLATE/GRATING FLOOR	A_1, B_1, C_1, D_1 : FIXED TYPE A_2, B_2, C_2, D_2 : SLIDING TYPE



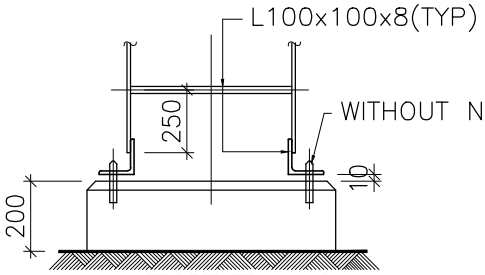
TYPE A1



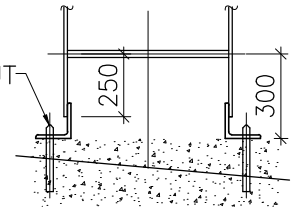
TYPE B1



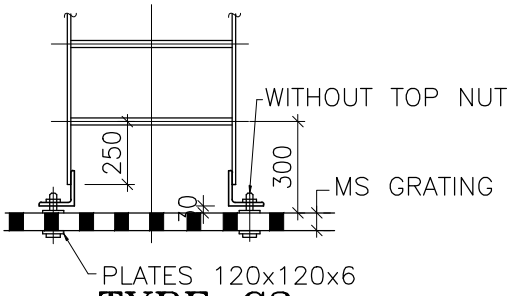
TYPE C1



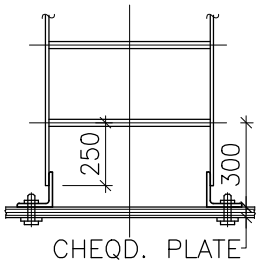
TYPE A2



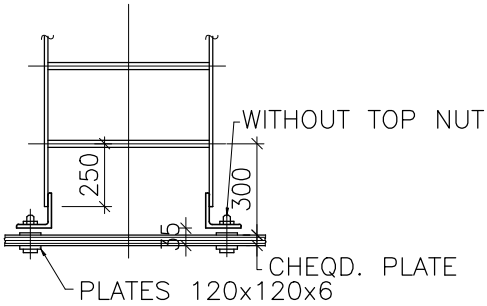
TYPE B2



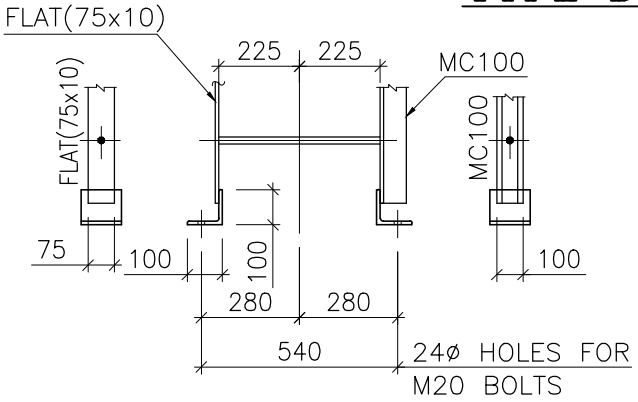
TYPE C2



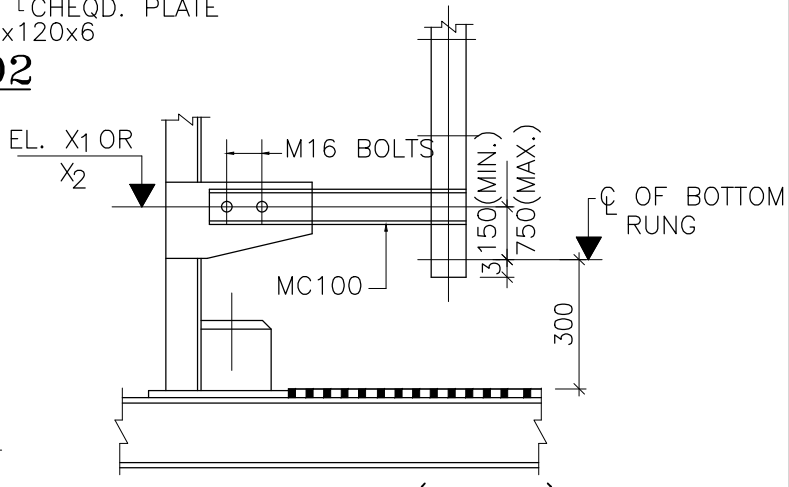
TYPE D1



TYPE D2



LADDER BOTTOM DETAILS



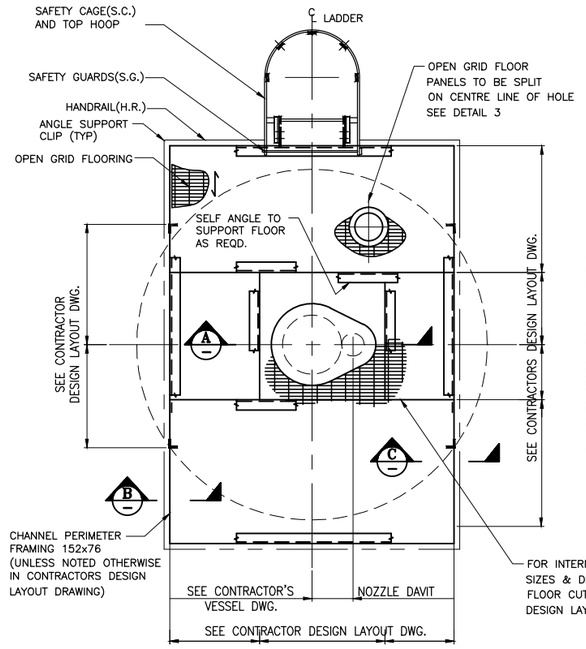
TYPE E(FREE)

NOTES:-

IN CASE OF TOWERS BOTTOM RUNG SHALL BE 300mm FROM FGL/HPP.

TRIUNE ENERGY SERVICES PVT. LTD. NEW DELHI	DETAIL OF STEEL LADDER	Standard Number 05-CS-212	Rev. 4
		Sheet 4 of 4	

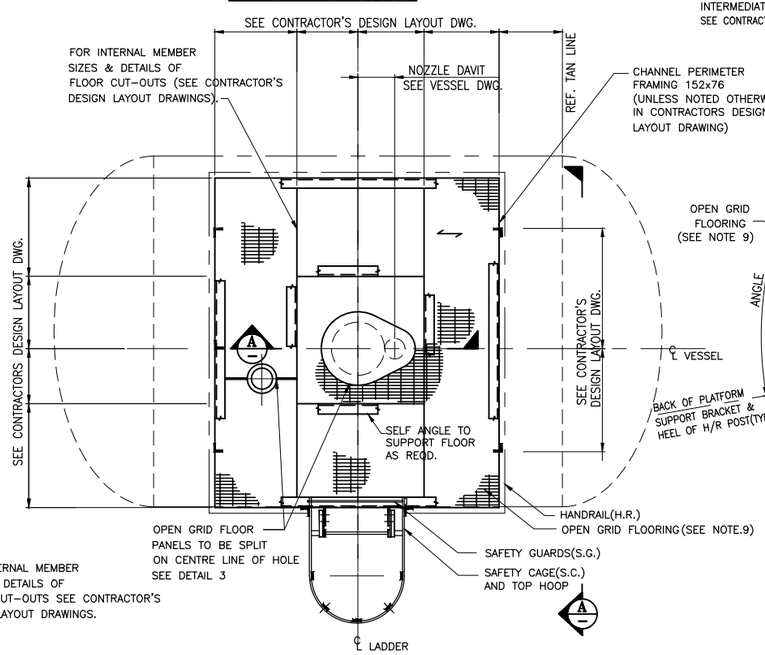
VERTICAL VESSELS



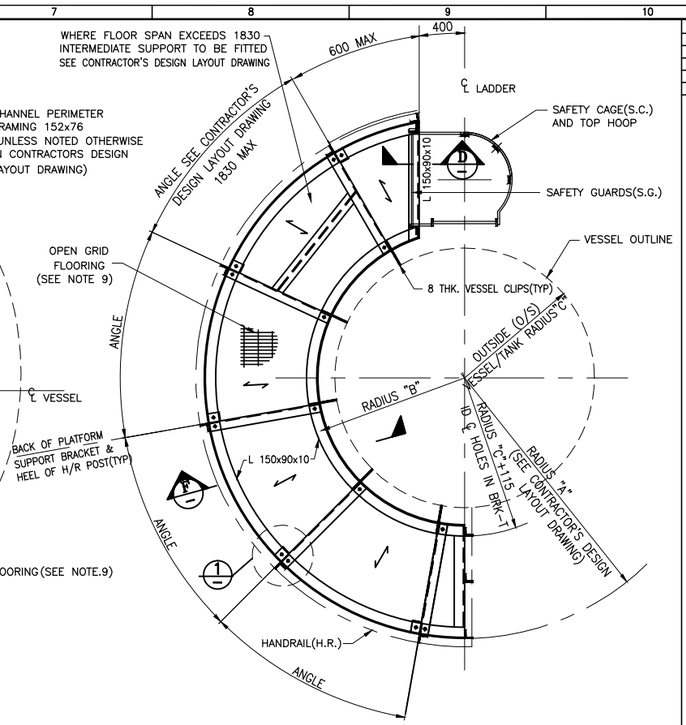
PLAN ON TOP HEAD PLATFORM FOR VERTICAL VESSELS

SHIP IN ONE PIECE UNLESS OTHERWISE NOTED ON CONTRACTOR'S DESIGN LAYOUT DRAWING

HORIZONTAL VESSELS



PLAN ON RECTANGULAR PLATFORM FOR HORIZONTAL VESSELS

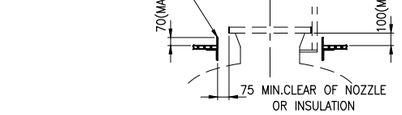


PLAN ON CIRCULAR PLATFORM FOR VERTICAL VESSELS/TANKS

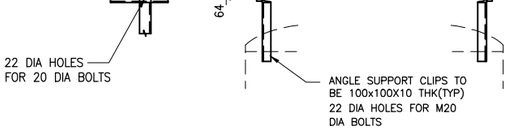
REFERENCE DRAWING	DRAWING NO.
LADDER DETAILS	05-CS-212/303
HANDRAIL DETAILS	05-CS-214/304
STEEL STAIRS	05-CS-205
TILES AND WALKWAY	05-CS-263

GENERAL NOTES:

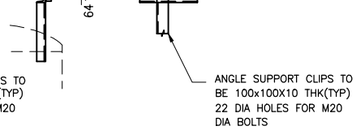
1. ALL DESIGN MATERIALS FABRICATION & WORKMANSHIP TO BE IN ACCORDANCE WITH THE FOLLOWING RELEVANT TES STANDARDS SPECIFICATIONS AND RECOMMENDED PRACTICES:
   - STANDARD FOR BASIC CIVIL ENGINEERING DESIGN DATA.
   - RECOMMENDED PRACTICES FOR ENGINEERING DESIGN BASIS OF CIVIL AND STRUCTURAL WORK.
   - STANDARD FOR STRUCTURAL STEEL WORKS –MATERIALS, FABRICATION AND ERECTION.
   - STANDARD FOR PAINTING AND COATING OF METAL SURFACES NEW CONSTRUCTION.
   - LOSS PREVENTION REQUIREMENT.
2. DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
3. STRUCTURAL STEEL SHAPES AND AND PLATES SHALL CONFORM TO BS EN 10025 GRADE S 275 JR OR IS:2062/ASTM A36 OR EQUIVALENT.
4. BOLTS SHALL CONFORM TO BS 4190 GRADE 4.6 OR ASTM A307, NUTS SHALL BE AS BS EN ISO 898.
5. PLATFORM STEEL WORK AND OPEN GRID FLOOR PANELS TO BE HOT DIP GALVANIZED TO BS EN ISO 1461.
6. ALL ELEVATIONS ARE GIVEN TO TOP OF STEEL (TOS) UNLESS OTHERWISE NOTED.
7. ON CIRCULAR PLATFORMS THE HANDRAIL POSTS ARE TO LOCATED AS SHOWN.
8. FOR PLATFORM LIVE LOADS SEE STANDARDS BASIC CIVIL ENGINEERING DESIGN DATA.
9. OPEN GRID FLOORING TO BE SERRATED RECTANGULAR OPEN GRID TYPE LOAD BEARING BARS 30mm DEEP x5mm THK AT 30mm CENTERS WITH 10mm TWISTED CROSS BAR BARS AT 100mm CENTERS IN TRANSVERSE DIRECTION.
10. OPEN GRID FLOORING TO BE ATTACHED TO SUPPORTING STEEL WORK USING APPROVED MANUFACTURER'S STANDARD CLIPS. ALL CUT-OUT, HOLES IN OPEN GRID FLOORING SHALL BE SHOP FABRICATED UNLESS OTHER NOTED.
11. CUTS-OUTS/HOLES AND EDGES OF OPEN GRID FLOOR PANELS SHALL BE BANDED AND WELDED PROPERLY.
12. NO WELDING TO THE VESSEL SHELL IN THE FIELD WILL BE PERMITTED.
13. MEMBER AND THE BOLT SIZES ARE GIVEN FOR GUIDANCE. THEY MUST BE CONFIRMED BY CONTRACTOR'S DETAIL DESIGN.
14. GALVANIZED CHEQUERED FLOOR PLATES WITH RAISED PATTERN (NON-SLIP), MIN 6mm THK(EXCLUDING PATERN) SHALL BE USED FOR PLATFORMS WHERE SPILLAGE IS LIKELY,ATTACHED TO SUPPORTS BY COUNTER SUNK BOLT.
15. FOR VESSEL CLIPS SUPPORTING PLATFORMS SEE VESSELS DRAWINGS.



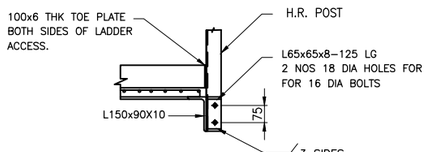
SECTION (A)



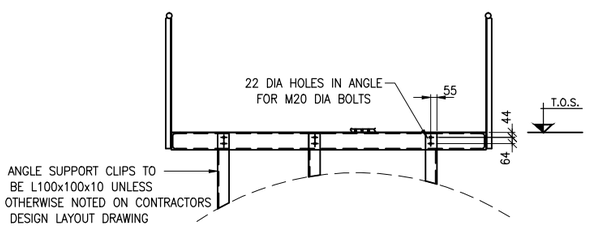
SECTION (B)



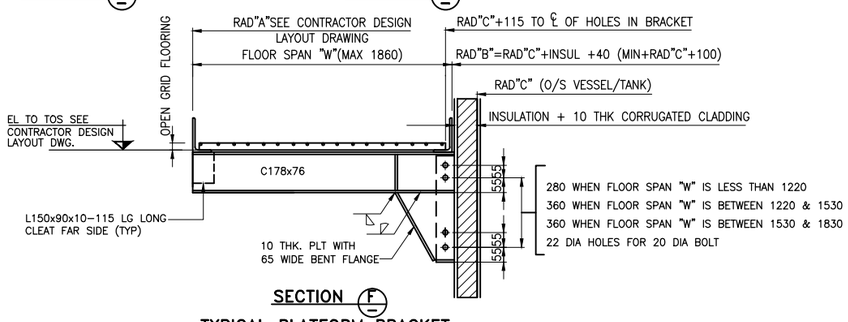
SECTION (C)



SECTION (D)

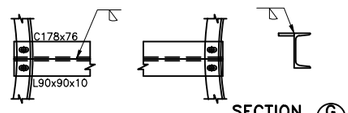


SECTION (E)



SECTION (F)

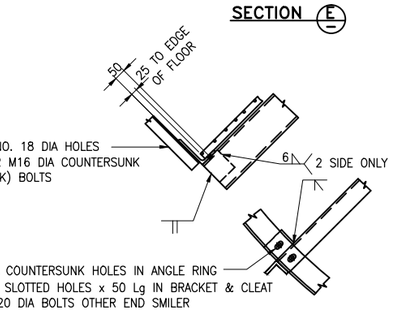
TYPICAL PLATFORM BRACKET



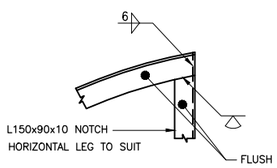
SECTION (G)

PLAN

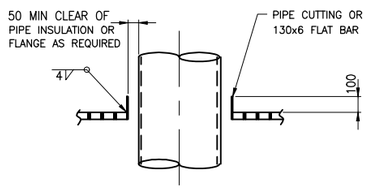
THIS TRANSPORTATION SPLICE TO BE USED WHEN THE PLATFORM CIRCULAR LENGTH WOULD OTHERWISE EXCEED A SEMI CIRCLE (180°)



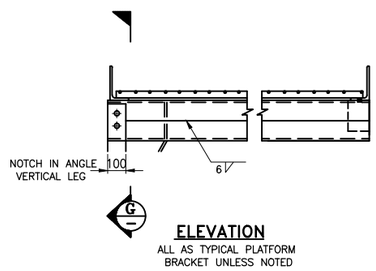
DETAIL (1)



DETAIL (2)



DETAIL (3) PIPE PENETRATION



ELEVATION

ALL AS TYPICAL PLATFORM BRACKET UNLESS NOTED

TYPICAL BRACKET DETAIL AT PLATFORM TRANSPORTATION SPLICE

(FOR LOCATION SEE CONTRACTOR DESIGN DRAWING)

REV.NO.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
0	08.04.18	ISSUED FOR IMPLEMENTATION	PBD	RUA	ROS

OWNER:

ENGINEERING CONSULTANT:

TRIUNE ENERGY SERVICES PVT. LTD.
NEW DELHI

PROJECT :

TITLE :

STANDARD DETAILS OF CIRCULAR AND RECTANGULAR PLATFORMS

SCALE	JOB NO.	DRAWING NO.	REV.
~	–	05-CS-265	0

LIST OF DEVIATIONS

Req. No.	**9680-02-MR-201**	**Bidder's Name**	
Project	**EPCM SERVICES FOR INSTALLATION OF LPG AMINE ABSORBER SYSTEM IN PFCC UNIT AT MRPL, MANGALURU**		
Bidder's Sign & Date		**Bidder's Company Seal**	
Item	**LPG AMINE CONTACTOR (DA-33211)**		

S. No.	Document		Clause Refered	Proposed Deviation	Reason
	Number & Title	Rev			

Notes:

1. **Bidder shall use this format only. Deviations indicated in any other form shall not be acceptable.**
2. **Use extra sheets wherever required.**

LIST OF START UP & COMMISSIONING SPARES

Req. No.	**9680-02-MR-201**	**Bidder's Name**	
Project	**EPCM SERVICES FOR INSTALLATION OF LPG AMINE ABSORBER SYSTEM IN PFCC UNIT AT MRPL, MANGALURU**		
Bidder's Sign & Date		**Bidder's Company Seal**	
Item	**LPG AMINE CONTACTOR (DA-33211)**		

S. No.	Part No.	Description	Qty.	Unit Rate	Total

Notes:

1. **Bidder shall mention the currency in USD/INR.**
2. **Use extra sheets wherever required.**

LIST OF TWO YEAR NORMAL OPERATION SPARE PARTS

Req. No.	**9680-02-MR-201**	**Bidder's Name**	
Project	**EPCM SERVICES FOR INSTALLATION OF LPG AMINE ABSORBER SYSTEM IN PFCC UNIT AT MRPL, MANGALURU**		
Bidder's Sign & Date		**Bidder's Company Seal**	
Item	**LPG AMINE CONTACTOR (DA-33211)**		

S. No.	Part No.	Description	Qty (nos.)		Delivery (in weeks)	Unit Rate	Total
			Per Eqpt. / Item	Recommended			

Notes:

1. Bidder shall mention the currency in USD/INR.
2. Use extra sheets wherever required.

Triune Energy Services Pvt. Ltd. **New Delhi**	**LPG AMINE CONTRACTOR**	**Document Number**	**Rev.**
		Sheet 1 of 1	

LIST OF SPECIAL TOOLS & TACKLES

Req. No.	**9680-02-MR-201**	**Bidder's Name**	
Project	**EPCM SERVICES FOR INSTALLATION OF LPG AMINE ABSORBER SYSTEM IN PFCC UNIT AT MRPL, MANGALURU**		
Bidder's Sign & Date		**Bidder's Company Seal**	
Item	**LPG AMINE CONTACTOR (DA-33211)**		

S. No.	Part No.	Description	Qty (nos.)	Unit Rate	Total

Notes:

1. Bidder shall mention the currency in USD/INR.
2. Use extra sheets wherever required.

LIST OF MANDATORY SPARES

Req. No.	**9680-02-MR-201**	**Bidder's Name**	
Project	**EPCM SERVICES FOR INSTALLATION OF LPG AMINE ABSORBER SYSTEM IN PFCC UNIT AT MRPL, MANGALURU**		
Bidder's Sign & Date		**Bidder's Company Seal**	
Item	**LPG AMINE CONTACTOR (DA-33211)**		

S. No.	Part No.	Description	Qty. (nos.)	Unit Rate	Total

Notes:

1. Bidder shall mention the currency in USD/INR.
2. Use extra sheets wherever required.

Triune Energy Services Pvt. Ltd. New Delhi	**LPG AMINE CONTRACTOR**	**Document Number**	**Rev.**
		Sheet 1 of 1	

Vendor Weight Control Data Sheet

Req. No.	**9680-02-MR-201**	**Bidder's Name**	
Project	**EPCM SERVICES FOR INSTALLATION OF LPG AMINE ABSORBER SYSTEM IN PFCC UNIT AT MRPL, MANGALURU**		
Bidder's Sign & Date		**Bidder's Company Seal**	
Item	**LPG AMINE CONTACTOR (DA-33211)**		

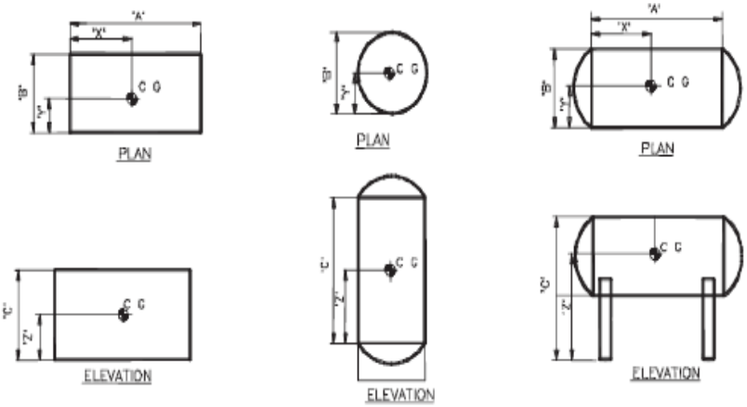
TOLERANCE CODE ● (fill appropriate circle) ○ PRELIMINARY EST. ○ DESIGN EST. ○ M.T.O (CALC) ○ WEIGHED ○ TOLERANCE ±%

WEIGHT DATA (TONNES)

DRY | OPERATING | TEST

OTHER TEMPORARY WEIGHTS	DESCRIPTION (LIST SEPARATELY IF NECESSARY)	TOTAL TONNES

DIMENSIONAL DATA (MILLIMETERS)



OVERALL SIZES
DIMENSION 'A'
DIMENSION 'B'
DIMENSION 'C'

CENTER OF GRAVITY		
DIM.	DRY	OPERAT.
'X'		
'Y'		
'Z'		

NOTES:
1. ALL OFFERS MUST INCLUDE THIS DATA SHEET DULY FILLED IN BY THE VENDOR, SIGNED, DATED & SEAL AFFIXED.
2. ALL FINISHED ITEMS SHALL BE WEIGHED. FOR THOSE ITEMS HEAVIER THAN 1 TONNE, A WEIGHT CERTIFICATE SHALL BE PROVIDED AS PER FORM-H.
3. SEPARATE SHEETS TO BE COMPLETED FOR EACH SEPARATELY INSTALLED SKID/ITEM
4. ORIGIN OF X,Y AND Z TO BE INDICATED.