

## TECHNICAL AMENDMENT NO: 01

**ITEM DESCRIPTION : RWTP/RODMP/CPU/ZLDP FOR P-25**  
**BIDDING DOCUMENT NO. : B269-475-17-44-PA-T-8701**  
**DISCIPLINE : WATER DEPT.**

0	25.01.2021	ISSUED AS TECHNICAL AMENDMENT	SC/DD	VS	PKG
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

The terms, conditions and specifications of Bidding Document stand modified to the extent indicated under column “MODIFICATIONS/ADDITION/DELETION”. All other terms & conditions, stipulations and specifications of bidding document shall remain unaltered.

S. No.	Part No / Vol No	Page No.	Section / Document no.	Clause No / Item No	Subject	Modifications / Additions/Deletion
1.	Part 2	Pg 759 of 7166	Doc No. B269-472-17-44-SS-1001 Rev 1	-	Scope of Work/Supply for RWTP	<p><b><u>Modification:</u></b></p> <p>Following rows shall be added in Clause no. 3 of battery limit conditions:</p> <ol style="list-style-type: none"> <li>1. Incoming Lines: Caustic- Nor Pressure is 2kg/cm2.g, Max Pressure is 4 kg/cm2.g Nor Temp: 45 degree, Max Temp: 65 degree</li> <li>2. Outgoing Lines: Acid to ETP battery limit- Nor Pressure: 1.5 kg/cm2.g, Max Pressure is 4 kg/cm2.g Nor Temp: Ambient, Max- 65 degree</li> </ol>
2.	Part 2	Pg 867 of 7166	Doc.no. B269-472/475/476-17-44-SS-1003 Rev 1	-	Scope of Work/Supply Operation and Maintenance- RWTP/RODMP/CPU/ZLDP	<p><b><u>Modification:</u></b></p> <p>The document B269-472/475/476-17-44 SS-1003 Rev 2 is attached which shall supersede the previous revision.</p>
3.	Part 2	Pg 968 of 7166	Doc. No. B269-472-17-44-DB-1001 Rev 2,	-	Design Basis – RWTP	<p><b><u>Modification:</u></b></p> <p>The document B269-472-17-44-DB-1001 Rev 3 is attached which shall supersede the previous revision.</p>

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4.	Part 4	1. Pg 1967 2. Pg 1969 3. Pg 1971 of 7166	Doc. No. 1. B269-472-17-44-DS-034 2. B269-472-17-44-DS-036 3. B269-472-17-44-DS-038	-	Process Datasheet of CEB dosing tank-I, CEB dosing tank-II, CEB dosing tank-III	<b><u>Modification:</u></b> Agitator requirement in the tanks stands deleted
5.	Part 4	1. Pg 1931 2. Pg 1934 3. Pg 1935 4. Pg 1951 5. Pg 1953 6. Pg 1962 7. Pg 1973 8. Pg 1935 of 7166	Process datasheet No. 1. B269-472-17-44-DS-1003, Rev 1 2. B269-472-17-44-DS-1004, Rev 1 3. B269-472-17-44-DS-1005, Rev 1 4. B269-472-17-44-DS-1019, Rev 1 5. B269-472-17-44-DS-1020, Rev 1 6. B269-472-17-44-DS-1029, Rev 1 7. B269-472-17-44-DS-1040, Rev 1 8. B269-472-17-44-DS-1007, Rev 1	-	1. Lamella Clarifier 2. UF feed sump 3. UF Feed Pumps 4. Centrifuge 5. Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> /PAC dosing tank 6. PE dosing Pumps 7. NaClO <sub>2</sub> unloading Pump 8. UF Skids	<b><u>Modification:</u></b> The following Process datasheets are attached which shall supersede the previous revision:  1. B269-472-17-44-DS-1003, Rev 2 2. B269-472-17-44-DS-1004, Rev 2 3. B269-472-17-44-DS-1005, Rev 2 4. B269-472-17-44-DS-1019, Rev 2 5. B269-472-17-44-DS-1020, Rev 2 6. B269-472-17-44-DS-1029, Rev 2 7. B269-472-17-44-DS-1040, Rev 2 8. B269-472-17-44-DS-1007, Rev 2
6.	Part 5	Pg 2433 of 7166	B269-472-17-44-1001, Rev 0.	-	Schematic Flow Diagram-RWTP	<b><u>Modification:</u></b> The document no.B269-472-17-44-1001, Rev 1 is attached which shall supersede the previous revision

S. No.	Part No / Vol No	Page No.	Section / Document no.	Clause No / Item No	Subject	Modifications / Additions/Deletion
7.	Part 5	1. Pg 2437 2. Pg 2445 3. Pg 2451 of 7166	P&ID No. 1. B269-472-17-44-1111, Rev 1 2. B269-472-17-44-1119, Rev 1 3. B269-472-17-44-1125, Rev 1	-	1. Battery Limits 2. Treated water reservoir 3. Sludge & Centrate Sump	<b><u>Modification:</u></b> The following P&IDs are attached which shall supersede the previous revision:  1. B269-472-17-44-1111, Rev 2 2. B269-472-17-44-1119, Rev 2 3. B269-472-17-44-1125, Rev 2
8.	Part 4	Pg 1894 of 7166	Doc No. B269-475-17-44-EL-1001, Rev 3	-	Equipment List of RO-DM plant	<b><u>Modification:</u></b> The document B269-475-17-44-EL-1001 Rev 4 is attached which shall supersede the previous revision.
9.	Part 4	1. Pg 2000 2. Pg 2019 3. Pg 2021 4. Pg 2025 5. Pg 2029 6. Pg 2035 7. Pg 2065 8. Pg 2111 9. Pg 2114 10. Pg 2117 11. Pg 2044 of 7166	Process datasheet No. 1. B269-475-17-44-DS-1007, Rev 2 2. B269-475-17-44-DS-1023, Rev 2 3. B269-475-17-44-DS-1025, Rev 2 4. B269-475-17-44-DS-1028, Rev 2 5. B269-475-17-44-DS-1031, Rev 2 6. B269-475-17-44-DS-1036, Rev 2 7. B269-475-17-44-DS-1062, Rev 2 8. B269-475-17-44-DS-1106, Rev 1 9. B269-475-17-44-DS-1109, Rev 1 10. B269-475-17-44-DS-1112, Rev 1 11. B269-475-17-44-DS-1044, Rev 0	-	1. Filter Feed Pumps-I 2. RO-I Cartridge Filter Feed Pumps 3. RO-I Feed Pumps 4. RO-II Feed Pumps 5. RO-III Feed Pumps 6. MB Feed Pumps 7. RO-IV Feed Pumps 8. CEB-I (HCl) Tank 9. CEB-II (NaOH) Tank 10. CEB-I (NaOCl) Tank 11. HRSCC-II	<b><u>Modification:</u></b> The following Process datasheets are attached which shall supersede the previous revision:  1. B269-475-17-44-DS-1007, Rev 3 2. B269-475-17-44-DS-1023, Rev 3 3. B269-475-17-44-DS-1025, Rev 3 4. B269-475-17-44-DS-1028, Rev 3 5. B269-475-17-44-DS-1031, Rev 3 6. B269-475-17-44-DS-1036, Rev 3 7. B269-475-17-44-DS-1062, Rev 3 8. B269-475-17-44-DS-1106, Rev 2 9. B269-475-17-44-DS-1109, Rev 2 10. B269-475-17-44-DS-1112, Rev 2 11. B269-475-17-44-DS-1044, Rev 1



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10.	Part 5	Pg 2163 of 7166	Process Datasheet No. B269-476-17-44-DS-1002 REV 1	-	CPU Feed Pumps	<b><u>Modification:</u></b> The document B269-476-17-44-DS-1002 REV 2 is attached which shall supersede the previous revision.
11.	Part 4	Pg 1919 of 7166	Document No. B269-81-17-44-EL-1001, REV 0	-	Equipment List for CPU(PNCP Area)	<b><u>Modification:</u></b> The document B269-81-17-44-EL-1001, REV 1 is attached which shall supersede the previous revision.
12.	Part 5	Pg 2183 of 7166	Process Datasheet No. B269-81-17-44-DS-1001 REV 0	-	Unpolished Condensate Feed Pumps	<b><u>Modification:</u></b> The document B269-81-17-44-DS-1001, REV 1 is attached which shall supersede the previous revision.
13.	Part 5	Pg 2184 of 7166	Process Datasheet No. B269-81-17-44-DS-1002 REV 0	-	Activated Carbon Filters	<b><u>Modification:</u></b> The details of internal protection stands replaced as follows: “Glass Flaked Vinyl Ester Lining”
14.	Part 4	Pg 2026 of 7166	Process Datasheet No. B269-475-17-44-DS-1029 REV 0	-	RO-II Skids	<b><u>Modification:</u></b> The Average Flux Rate stands modified as follows: “25 LMH (maximum)”

S. No.	Part No / Vol No	Page No.	Section / Document no.	Clause No / Item No	Subject	Modifications / Additions/Deletion
15.	-	-	Vendor List	-	Supplier List for Environment	<b><u>Addition:</u></b> The latest Vendor List is attached.

**List of Attachments:**

1. Scope of Works/Supply for Operation & Maintenance (Doc. No. B269-472/475/476-17-44-SS-1003 Rev 2, Total pages 17)
2. Design Basis RWTP (Doc. No. B269-472-17-44-DB-1001 Rev 3, Total pages 11)
3. Process Datasheets of RWTP (Total pages 12)
4. Process Flow Diagram RWTP (Total Pages 2)
5. P&I Diagrams RWTP (Total pages 3)
6. Equipment List of RODMP (Doc No. B269-475-17-44-EL-1001 Rev 4, Total pages 16)
7. Process Datasheets of RODMP (Total pages 12)
8. Process Datasheets of CPU P-25 (Total pages 1)
9. Equipment List for CPU (PNCP Complex) (Doc. No. B269-81-17-44-EL-1001, REV 1, Total pages 3)
10. Process Datasheets of CPU (PNCP Complex) (Total pages 1)
11. Vendor List (Total pages 5)
12. Technical Amendment- General Civil (Total No. of pages 4)

## **SCOPE OF WORKS/SUPPLY**

### **OPERATION AND MAINTENANCE**

#### **(PLOT PLAN & WATER DEPARTMENT)**

#### **RAW WATER TREATMENT PLANT, RO BASED DM PLANT, CONDENSATE POLISHING UNIT AND ZERO LIQUID DISCHARGE PLANT**

**PROJECT : PANIPAT REFINERY EXPANSION  
PROJECT (P-25)**

**OWNER : IOCL, PANIPAT**

**PMC : ENGINEERS INDIA LIMITED**

**JOB NO. : B269**

2	06.01.2022	ISSUED FOR AMENDMENT	SC/DD	VS	PKG
1	25.05.2021	REVISED & REISSUED FOR TENDER	SC/DD	VS	PKG
0	18.05.2020	ISSUED FOR TENDER	SC/DD	VS	PKG
Rev. No	Date	Purpose	Prepared by	Reviewed by	Approved by

## **1. SCOPE OF WORK**

Contractor shall operate and maintain the **Raw Water Treatment Plant (RWTP), RO Based DM Plant (RODM), Condensate Polishing Unit (CPU) and Zero Liquid Discharge (ZLD) Plants** during TWO (2) YEARS OPERATION & MAINTENANCE (O&M) CONTRACT duration, which shall start from the date of end of successful commissioning.

The Contractor's scope of work for Two Years O&M Contract of the Raw Water Treatment Plant (RWTP), RO Based DM Plant (RODM), Condensate Polishing Unit (CPU) and Zero Liquid Discharge (ZLD) Plants shall include the following:

➤ **Operation & Maintenance of all the ISBL (inside battery limit) units of Raw Water Treatment Plant (RWTP) for 2 years including the following as a minimum:**

- Pre-treatment section including Flocculation System and Clarification
- Pre-filters (ABFs) and Ultra filtration Section (UF System) and
- Backwash Waste Treatment Section
- Treated Raw Water Storage and Transfer System
- All intermediate storages & pumping, Sludge handling section, Chemicals Handling Section & all other associated works for the RWTP.
- All Instrumentation, Electrical, Mechanical and all other works for RWTP Plant.
- Chemical Loading / Unloading Facilities
- Chemical Storage Facilities
- Chemical Solution Preparation and Dosing facilities
- Control Building including Control Room and Substation and other Buildings in the ISBL of the Plant
- UF Shed Facility
- Solid Storage and Sludge handling Facilities

➤ **Operation & Maintenance of all the ISBL (inside battery limit) units of the RO based DM Plant (RODM) and Condensate Polishing Unit (CPU) for 2 years including the following as a minimum:**

- Pre-treatment section including Clarifier, Dual Media and Activated Carbon Media Filters, ABF etc.
- Ultra-Filtration Section, Reverse Osmosis Section, Degassing Section and Ion-Exchange section (MB exchanger) of RO-DM Plant.
- Reject Recovery Section including Pre-Treatment Clarifier, Media Filters and ABF, Ultra Filtration Section and Reverse Osmosis Section

- Heat exchangers, Oil Removal Section and Ion-Exchange Section (MB exchanger) of the Condensate Polishing Unit (CPU)
  - All intermediate storages & pumping, Sludge handling section, Chemicals Handling Section, Regeneration Section & all other associated works for the RODM Plant and CPU Plants.
  - All Instrumentation, Electrical, Mechanical and all other works for RODM and CPU Plants.
- **Operation & Maintenance of all the ISBL (inside battery limit) units of the Zero Liquid Discharge (ZLD) Plant for 2 years including the following as a minimum:**
- Pre-treatment section including Flocculation System and Clarification
  - Evaporator Section including Condensate Recovery Section
  - Dryer Section including Condensate Recovery Section
  - All intermediate storages & pumping, Sludge handling section, Chemicals Handling Section, Cleaning Systems & all other associated works for the ZLD,
  - All Instrumentation, Electrical, Mechanical and all other works for RWTP Plant.
- **Operation & Maintenance of all the Common Facilities in the RODM & CPU and ZLD Plant for 2 years including the following as a minimum:**
- Chemical Loading / Unloading Facilities
  - Chemical Storage Facilities
  - Chemical Solution Preparation and Dosing facilities
  - PRDS system
  - Control Building including Control Room and Substation and other Buildings in the ISBL of the Plant.
  - UF/RO Shed Facility
  - Solid Storage and Sludge handling Facilities
- **The Contractor shall maintain the following on sustainable basis for RWTP, RODM & CPU and ZLD Plants during the entire O&M contract period of Two Years:**
- *Guaranteed Hydraulic capacity of the RWTP plant (including recoveries) as per Specifications No. B269-472-17-44-SS-1001*
  - *Guaranteed Hydraulic capacity of the RODM & CPU and ZLD plant (including recoveries) as per Specifications No. B269-475-17-44-SS-1001, B269-476-17-44-SS-1001 & B269-475-17-44-SS-1002 respectively.*
  - *Guaranteed Treated Water Quality (including Intermediate Streams) of various streams as per Specifications No. B269-472-17-44-SS-1001*

- *Guaranteed Treated Water Quality (including Intermediate Streams) of various streams as per Specifications No. B269-475-17-44-SS-1001, B269-476-17-44-SS-1001 & B269-475-17-44-SS-1002.*
- *Ensuring trouble free & efficient operation of units individually and plant as a whole.*

**The O&M contract shall be started from the date of end of successful commissioning.**

**Bidders shall quote price for Two (2) years O&M contract duration. The price quoted by the bidders shall be fixed and no escalation is applicable.**

The plants & equipment shall be continuously running all round the year & treated water from the Plants meeting the Quality specifications (including intermediate quality and flow specifications) shall be produced consistently.

The Contractor shall have his own trained, experienced, competent operations and supervisory personnel round the clock responsible to carry out the O&M for the **Raw Water Treatment Plant, RO based DM Plant & Condensate Polishing Unit and Zero Liquid Discharge Plant.**

## **2. MANPOWER REQUIREMENTS**

- The operation and maintenance of **Raw Water Treatment Plant, RO based DM Plant & Condensate Polishing Unit and Zero Liquid Discharge Plants** shall involve round the clock manning of the entire facilities of Raw Water Treatment Plant, RO based DM Plant & Condensate Polishing Unit and Zero Liquid Discharge Plants for providing operation and maintenance, to produce treated water with specific quality and required quantity as per the guaranteed parameters, without any unplanned shut down of the facilities.
- Contractor shall keep adequate number of highly experienced operation and maintenance personnel to cover round the clock operation and maintenance. This shall include experienced staff under a Plant In-charge. Bidders to provide CVs of key personnel who are intended to be deployed for operation of this plant. M/s IOCL shall critically review the experience profile of the operation and maintenance personnel intended to be engaged by the contractor.
- The contractor shall deploy minimum manpower during operation & maintenance of the Raw Water Treatment Plant, RO based DM Plant & Condensate Polishing Unit and Zero Liquid Discharge Plant on round the clock basis during 03 (three) shifts of 08 (eight) hours each as follows and take prior approval from IOCL:

- 2.1. Plant In-Charge: 1 No. (General Shift), for Raw Water Treatment Plant, RO based DM Plant & Condensate Polishing Unit and Zero Liquid Discharge Plants; The Plant in-charge shall be a Degree/Diploma holder in Chemical/Environmental engineering/MSc Chemistry with minimum 10 years of experience in Operations of a UF/RO based water treatment plant and UF/RO based Waste Water Tertiary Treatment plant.

- 2.2. Shift In-Charge: 1 No. (Per Shift), Degree/Diploma holder in Chemical/ Environmental engineering with minimum 5 years of experience in Operations of a UF/RO based water/waste water treatment plant.
- 2.3. Process Engineer: 3 Nos. (Per Shift), One engineer for Raw Water Treatment Plant, One engineer for the RO based DM Plant & Condensate Polishing Unit and one Engineer for the Zero Liquid Discharge Plant each per Shift; Two nos. Process Engineers (per shift), one per shift for RWTP, and one per shift for RODMP & CPU, shall be a Degree/Diploma holder in Chemical/ Environmental engineering having minimum 5 years of experience in operating a UF/RO/Membrane based water/waste water treatment plant. One Process Engineer (per shift) for ZLDP shall be a Degree/Diploma holder in Chemical/ Environmental engineering having a minimum 3 year experience of operating a steam based Evaporator and Dryer/ Crystallizer Unit.
- 2.4. Maintenance In-Charge: 1 No. (General Shift), Degree/Diploma holder in Mechanical/Electrical/Instrumentation engineering with minimum 5 years of experience in overall maintenance (electrical, mechanical, instrumentation, etc.) of a UF/RO based water/waste water treatment plant.
- 2.5. Panel Operators: 3 Nos. (per shift), one per shift for Raw Water Treatment Plant, one per shift for RO based DM Plant & Condensate Polishing Unit and one per shift for Zero Liquid Discharge Plants; operators (all shifts) for Raw Water Treatment Plant, RO based DM Plant & Condensate Polishing Unit shall be Degree/Diploma holder in Chemical/ Environmental engineering having minimum 3 years of experience in DCS & PLC operation of a RO/UF/Membrane based water/waste water treatment plant. One Operator (per shift) for ZLDP shall be a Degree/Diploma holder in Chemical/ Environmental engineering having a minimum 3 year experience of DCS & PLC operation of a steam based Evaporator and Dryer/ Crystallizer Unit.
- 2.6. Field Technician: 5 Nos. (per shift), two nos. per shift for Raw Water Treatment Plant, three nos. per shift RO based DM Plant & Condensate Polishing Unit and Zero Liquid Discharge Plants; shall be Degree/Diploma holder in Chemical/ Environmental engineering having minimum 3 years of experience in operating a RO/UF/Membrane based water/waste water treatment plant.
- 2.7. Maintenance Technician: 3 Nos. (General Shift - electrical, mechanical & instrumentation one each) for Raw Water Treatment Plant and 3 Nos. (General Shift - electrical, mechanical & instrumentation one each) for RO based DM Plant & Condensate Polishing Unit and Zero Liquid Discharge Plants; The Maintenance Technicians shall be Degree/Diploma holder in respective engineering discipline with minimum 5 years of experience in maintenance of a water/waste water treatment plant.
- 2.8. Safety Supervisor: 1 No. (General Shift), Diploma holder in Industrial Safety with minimum 5 years of experience of HSE management in a Refinery or Petrochemical Complex
- 2.9. Fitters: 3 Nos. (General Shift), ITI Diploma holder in electrical/mechanical/instrumentation with minimum 2 years of experience in maintenance of a RO/UF/Membrane based water/waste water treatment plant.

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Labor required for carrying out other sundry activities shall be hired by the contractor on as required & as agreed with IOCL. However, contractor shall augment the above list of manpower as per the instructions of IOCL for carrying out trouble free and successful operation & maintenance of Raw Water Treatment Plant, RO based DM Plant & Condensate Polishing Unit and Zero Liquid Discharge Plant.

Services of the O&M contractor shall also include support from contractor's design & engineering team (as and when required) as well the OEMs and Suppliers for the Units for trouble shooting; preparation of operational procedures, emergency procedures, and contingency action plans in case of influent quality variations, maintenance schedules, etc.

Any additional deployment as required shall be provided by the contractor in case it is established that there is a need for such deployment without any time & cost implication to M/s IOCL. The decision of M/s IOCL shall be final & binding.

Contractor shall train M/s IOCL personnel for plant operation and maintenance during the contract period.

### 3. SPARES AND CONSUMABLES

- (i) All preventive maintenance shall be carried out to avoid shutdown of the plants.
- (ii) All necessary spare parts required and consumed for the smooth Operation and Maintenance of the Plants for the entire O & M contract period shall be in the scope of the Contractor.
- (iii) The spares provided as Mandatory spares for the Plants and handed over to the IOCL, can be utilized by the contractor in the Plant with permission and shall be strictly on replenishment basis. Any spare(s) consumed by the Contractor from the Mandatory spares stock shall be replenished and handed over to the Client at the earliest. However, this shall in no way absolve the Contractor from maintaining the spares as required by him to ensure smooth and trouble-free operation of the Plants during the entire O&M Contract period.
- (iv) Contractor shall maintain adequate quantity of all spares and consumables in stock so that there is no stoppage of the plants.
- (v) Contractor shall keep spares (as specified in **Annexure-I**) in stock as minimum requirement during O&M period. Also, the spares consumed by the contractor out of the spares as listed in Annexure-I shall be replenished by the Contractor from time to time and also at the end of O&M contract duration (before handing over the plant, all these spares as per Annexure-I shall be handed over by contractor to M/s IOCL).

Annexure-I specifies minimum spares to be kept in stock by the Contractor for 2 years Operation & Maintenance contract of the plant and handed over to IOCL at the end of contract period. All other spares (including mandatory spares), as per tender requirements, shall be considered extra and shall also be included in the contractor's scope of supply.



- (vi) Any deficiency in providing services, as pointed out by M/s IOCL, shall be made good in respect of manpower or otherwise within 48 (Forty-Eight) hours of time after having been indicated by M/s IOCL in writing, failing which such deficiencies shall be made good by IOCL at the sole risk and cost of the contractor.
- (vii) Contractor shall maintain all necessary documentation and records such as log sheets, inventory registers, equipment history, monthly reports, chemicals and reagents consumption reports, statutory reports and maintenance records of equipment. These documents shall be approved by M/s IOCL.
- (viii) Relevant important data shall be computerized for easy scrutiny and inventory status along with maintenance records, spares and consumables consumptions to facilitate monitoring of the performance on a monthly basis by first week of every month.
- (ix) Contractor shall maintain accounts for receipt, consumption and inventory of all chemicals, spares and consumables in a Desktop Computer (to be provided by Contractor).
- (x) Arrangement of transportation facilities for Manpower, Chemical, etc. & for Emergency duty shall be in contractor's scope.
- (xi) **Supply of all Chemicals (excluding HCl and NaOH) shall be in the scope of the contractor and adequate inventory of all chemicals shall be maintained at all times for the entire duration of the 2 years O&M contract**
- (xii) **All chemicals stocking; Supply and Replacement of Filter Elements, Top-up and replacement of media & resins for all types of filters/exchangers as required; all spares; all consumables including activated carbon, Filter cartridges, etc. required for the plant operation during O&M period shall be provided by the contractor and adequate stock of the same shall be maintained.**
- (xiii) Contractor shall carry out periodic NDTs, Probe test of the membranes (including autopsy study if required) to check the health of the membranes and shall get the defective membranes replaced by membrane supplier(s) during the O&M period in line with membrane guarantee clauses of contract. In case, contractor does not get these membranes replaced, then such membranes shall get replaced by IOCL through other agencies at cost & expense of contractor.

#### 4. HSE AND SAFETY REGULATIONS

- (i) HSE policies & objectives of M/s IOCL will be applicable for the O&M contractor also and the O&M contractor's personnel shall follow M/s IOCL's HSE policies & objectives.

In addition to IOCL HSE policy: The Contractor must have an own well-defined HS&E policy to realize the highest achievable safety standards of work safety and health and protecting the environment. The policy shall be adaptable to complying all local, state and industry regulations & standards relating to Health, Safety and Environment.

The contractor shall make a comprehensive HSE policy in consultation with IOCL complying local and state regulations for storage, transportation and handling of chemicals, operation and maintenance of the Raw Water Treatment Plant, RO based DM Plant & Condensate

Polishing Unit and Zero Liquid Discharge Plant. The comprehensive HSE policy shall be in place at least one month before the commissioning of the plant.

- (ii) The Contractor shall observe all safety regulations as applicable at site and also the safety regulations in accordance with acceptable practices and applicable Indian Laws. The Contractor shall take all measures reasonably necessary to provide safe working conditions and shall exercise due care and caution in preventing fire, explosion or pollution and ensure safe working environment in the Plants. First aid boxes at adequate locations shall be provided in plant and shall be ensured that these are replenished continuously. Contractor shall conduct such safety drills, Tool box meetings, etc. as may be required by company HSE policy at prescribed intervals.

Documentation, record keeping of all safety practices should be conducted as per international/Indian applicable laws, act, regulations etc., as per standard practice and these records should be made available for inspection at any point of time. The H.S.E policy as well as emergency procedure manual / contingency plans for pollution control should be kept at site. Compliance of these shall be the sole responsibility of the Contractor.

- (iii) Staff deputed by the O&M contractor shall obey the rules and regulations as required and applicable at the site. O&M contractor's personnel shall undergo HSE training, comply to work permit system requirements, wear personal protective equipment (PPE), etc. PPEs and first aid box shall be included in contractor's scope. Contractor to ensure that adequate PPEs are available for carrying out the O&M contract safely.
- (iv) Contractor should ensure that load certification of lifting tools & tackles used is valid during O&M duration. Also, all electrical jobs shall be carried out by authorized competent electricians with valid license.
- (v) Contractor shall follow IOCL existing safety practices like LOTO, JSA, and use of IFR suit during any hot work etc. Contractor shall target to achieve zero injury, zero accident in the Plant.
- (vi) Contractor shall maintain stock of H<sub>2</sub>S responders, multi-gas detector, fire hoses, steam hoses, steam lancer for operational/safety requirement.

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## 5. PLANT OPERATION

- (i) The Contractor shall identify the process variables that need to be adjusted on a day-to-day basis for optimum plant operation based on inlet effluent/water parameters in consultation with M/s IOCL.
- (ii) Contractor shall maintain all necessary documentation and records such as log sheets, charts, performance registers, inventory registers, equipment history, power consumption, laboratory test reports, daily / weekly / monthly performance reports, chemicals and reagents consumption reports, statutory reports and maintenance records of equipment. These documents shall be approved by M/s IOCL. Reports for the individual plant's performance and operating data along with maintenance activities and spares, consumables consumption

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shall be provided to M/s. IOCL to facilitate monitoring of the performance on a monthly basis by first week of every month.

- (iii) All chemicals (except HCl & NaOH), spares and consumables (including cartridges, activated carbon, etc.) required for the Operation and Maintenance of Raw Water Treatment Plant, RO based DM Plant & Condensate Polishing Unit and Zero Liquid Discharge Plant shall be in the scope of supply of the contractor. Also, unloading/handling of all the chemicals, consumables and spares to be done by the contractor. Special chemicals, if any, will have to be clearly defined by the contractor with respect to quality & quantity and shall be under the scope of the Contractor.

Chemical Usage shall be optimized by the contractor. Chemical consumption shall not exceed the design figures. In case the consumption of free issue chemicals exceed the dosing rates/quantities as per the approved BEPs, due to reasons attributed to the contractor, the cost of excess chemical consumed shall be payable by the contractor.

- (iv) In the O&M Manual, Contractor shall provide a list of all reagents as required for trouble free and continuous operation of the plant.
- (v) Sample collection and sending the samples to IOCL lab for analysis of feed water, treated water and reject/wastewater quality from Raw Water Treatment Plant, RO based DM Plant & Condensate Polishing Unit and Zero Liquid Discharge Plant shall be in Contractor's scope. Frequency of sampling and lab analysis (including list of parameters) to be finalized by EIL/IOCL and the contractor before commissioning. Any additional analysis, if so desired by the Contractor for monitoring plant performance & trouble shooting, shall be in Contractor's scope.
- (vi) The performance of the complete Raw Water Treatment Plant, RODM plant, Condensate Polishing Unit and the Zero Liquid Discharge Plant shall be continuously monitored and corrective and control actions required in the Plant Operations shall be done to achieve the desired performance of the Plant at all times.
- (vii) Health of the UF, RO membranes shall also be continuously monitored and cleaning cycle for the systems as required to be undertaken without any loss of production and downtime.
- (viii) All necessary operational and maintenance procedures as per the O & M manual shall be followed for all Plants.
- (ix) Cleaning Cycles for the Zero Liquid Discharge Plant shall be undertaken to avoid scale buildup in the Heat Transfer Equipments and maintain good heat transfer efficiencies in the Plant.
- (x) Bagging of ZLD salts in impervious Jumbo LLDPE/HDPE bags (~1000kg bags) shall be in contractor's scope.
- (xi) Operation and Maintenance of the ClO<sub>2</sub> generation and dosing facilities including the involvement of the OEM as required for the entire O & M period shall be in the Contractor's scope.

- (xii) Contractor shall maintain recommended Lubes and grease stock as per vendor recommendations as required for trouble free and continuous operation of the plant.
- (xiii) MSDS of the chemicals used shall be displayed at site.
- (xiv) Safe Disposal of all the wastes including Spent Consumables, media, empty Cans/ Drums/ Packing etc. generated in the plant, except from chemical sludge and ZLD Salts, outside refinery premises shall be in the contractor's scope.



## 6. MAINTENANCE

- i. Equipment/Items which shall be under Contractor's guarantee shall be rectified/ replaced by the Contractor as per the relevant guarantee clause of the tender for which M/s IOCL shall have no liability.
- ii. Contractor shall carryout all running maintenance / repair jobs required to keep the plant at maximum productivity level. These shall include maintenance of all equipment and other facilities within the Raw Water Treatment Plant, RO based DM Plant & Condensate Polishing Unit and Zero Liquid Discharge Plant as per the maintenance schedule to be provided by contractor in O&M Manual, which shall be reviewed by EIL/IOCL. The contractor shall consider separate maintenance teams with adequate tools and tackles for the Raw Water Treatment Plant and the RODM/CPU/ZLD plant as they are at separate locations.
- iii. The Contractor shall maintain adequate stock of consumables like gaskets, gland packing, O rings, drive belts, indicating lamps, fuses, blades, shims, cleaning agents, cotton waste, adhesives, etc., as required at both the Raw Water Treatment Plant and the RODM/CPU/ZLD Plant locations.
- iv. Contractor shall carry out breakdown maintenance job as and when problems/defects are noticed.
- v. Contractor shall periodically check / calibrate the various instruments/ analyzers and ensure their proper working. Calibration instruments shall be provided by the O&M contractor. Calibration of online analyzers being critical for substantiating compliance to guarantees, calibration of instruments/analyzers shall be carried out in the presence of M/s IOCL personnel, who shall witness and certify the calibration. Certificate of calibration of the calibrating instrument/equipment shall be from NABL accredited laboratories.
- vi. Contractor shall ensure that the maintenance technicians are trained and experienced in maintenance of analyzers. Contractor shall also utilize the services of the OEM for the service and calibration of the online analyzers at least once in 6 months.
- vii. Contractor shall periodically check all equipments, lubrication, alignments etc. to ensure proper performance.
- viii. Contractor shall maintain tool & tackles adequate enough for carrying out all maintenance jobs at both the Plant Locations.



- ix. The housekeeping and keeping the Raw Water Treatment Plant, RO based DM Plant & Condensate Polishing Unit and Zero Liquid Discharge Plant in good condition shall be the responsibility of Contractor.
- x. Contractor shall carry out all trouble shooting, as required, to keep the plant in perfect health as per O & M manuals.
- xi. Compliance to Maintenance Schedule: Contractor shall also provide all services to achieve the overall maintenance schedules.
- xii. Contractor's scope of work also includes inspection & maintenance of all static equipments, All Structures including RCC structures and buildings, Technological Structures, painting, lining, piping (including CPVC/HDPE pipes) and Piping joints, Pipe rack and Sleepers, Internal Roads, etc. All repairs / upkeep of all items, including structural repairs (Civil, Structural), painting, Welding, etc. as required for overall maintenance of the plant. Tender specifications for coating related to new construction and touch up/repair of all metallic surfaces including Technological Structures shall be followed for painting. All painting including touch up as required for all equipment, buildings and structure as per Bid package is in contractor's scope during O&M.
- xiii. Contractor shall ensure zero wastage of utilities like plant air, instrument air, service water, steam. Rectification of leakage shall be carried out by the contractor within 48 (Forty Eight) hours of time after having been identified by the contractor or M/s IOCL, failing which such deficiencies shall be made good by IOCL at the sole risk and cost of the contractor.
- xiv. IOCL Workshop will not be available to the contractor for maintenance jobs of RWTP/RODMP/CPU/ZLDP. Workshop facilities for maintenance and repair of mechanical items shall be arranged by the contractor.
- xv. Contractor shall utilize the services of the OEM for maintenance of mechanical, electrical and instrumentation items as and when required.
- xvi. The maintenance of ZLD Unit shall be in line with the recommendations of the OEM. Contractor shall also utilize the services of the OEM for specialized maintenance of the Evaporator and Crystallizer units.

## 6.1. MECHANICAL

The scope of work includes all works to keep the plant in good operating condition which also includes but not limited to the following:

- Alignment, lubrication, tensioning of all drives and rotating parts as required from time to time as per the details in the instruction manuals.
- Dismantling and assembling of equipment items, components and subassemblies like pumps, motors, agitators, drive heads, center, mechanism, gearboxes as required.
- Cleaning, de-sludging & flushing of various oil & sludge handling units

- Cleaning and flushing of various units, pipelines, tanks, vessels etc.
- Periodic inspection of all installations for checking any deterioration in surface finish/lining etc.
- Cleaning of Filters/ Exchangers element & media and checking for integrity and fouling. Changing Filters/ Exchangers element & media if they are due for replacement, etc.

## **6.2. ELECTRICAL**

The scope of work includes all works to keep the plant in good operating condition which also includes but not limited to the following:

- ✓ Preventive maintenance of MCC/PMCC/PCC/MLDB/LDB panels: All panels shall be maintained in the best manner possible by carrying out the following regularly:
  - Cleaning of the outside/interior of the panel cubicles with vacuum cleaner
  - Cleaning of the switchgear room/panel room including floor rubber mats
  - Checking of tightening of connections at TBs
  - Checking of panel operation
  - Checking of overheating signs (inside cubicles and outgoing cables)
- ✓ Maintenance of transformers (power/lighting):
  - Cleaning
  - Checking overheating & oil level (for oil cooled only)
  - Testing oil (Oil cooled only- for acidity, sludge, water content etc.)
  - Cleaning of breather & checking silica gel
  - Inspection & cleaning of windings (for dry type only)
  - Checking I. R. value including cables
  - Tightening of connections
- ✓ LT/HT Motors: Clean the stator body, fan, etc. Tighten the foundation and coupling bolts. Check IR value of windings. Lubricate with grease the bearing at both ends. Tighten the termination at cable termination box.
- ✓ Cable: Check and tighten the end termination. Check for overheating. Check IR value and continuity.
- ✓ Meters: Check for the tightness of terminals. Check the zero error of the pointer and the take corrective action, if required.

**Electrical Maintenance in the Plant also shall include the following:**

- ✓ Cable Connection and disconnection of all motors/ equipment whenever required.



- 
- ✓ Plant lighting DB maintenance and lamp changing etc.
  - ✓ Maintenance of earth grids / earth pits and recording of resistance value of individual pits periodically once in every six months. These values shall be painted on the individual earth pits with measurement date. These records shall also be kept in a well-maintained register.
  - ✓ Maintenance of Push button stations and all other flameproof/weather proof equipment in the plants.
  - ✓ Testing of RCDs of panels in every month and recording of the same in a well-maintained register.

**Electrical maintenance schedule shall be prepared by the contractor in consultation with M/s. IOCL after taking over of O & M services.**

### 6.3. INSTRUMENTATION

The scope of work includes all works to keep the plant in good operating condition which also includes but not limited to the following:

- Instrument Control Panel: Clean the panel interior & exterior. Check for the tightness of terminals, cable end & earthing terminations. Check fuses, indicating lamps switches, PBS. Check the alarm and annunciator for its proper functioning.
- Panel Instruments: Check the terminals of connectors. Check the function of instruments for zero/span valves. Replace the fused bulbs, Push Buttons, recorder charts, calibrate the instruments.
- Field Instruments: Check the tightness of terminals, cable and termination and earthing studs. Replace the defective components, if observed, calibrate the instruments.
- Calibration of analyzers with standard solutions once in a month or as frequent as required, top up the reagents of analyzers as and when required, clean the probes of the analyzers as and when required, etc.
- Maintenance of the control valves/actuators for the ease of operation of the valves in auto, service of the solenoids and limit switches for the auto operation of the plant, etc.

### 7. EXCLUSIONS

M/s IOCL shall provide the following during O&M contract duration:

- Office (space only) in control room, maintenance-cum-store room in chemical house building (space only), laboratory (space only) and intercom phone facility shall be provided by M/s IOCL to the contractor free of cost
- Give access to the areas of the plant as per functional requirement.
- Necessary work permits as required for the staff and visiting experts.

- Insurance of all the facilities owned by M/s IOCL.
- Gate pass and other permissions required for working in the IOCL nominated premises.
- Power (free of cost) at Incomer board of the Plant in the substation.
- Utilities (free of cost) at Raw Water Treatment Plant and RO based DM Plant & Condensate Polishing Unit and Zero Liquid Discharge Plant battery limit
- Uninterrupted supply of feed effluent / water till the battery limits of the plant for treatment purpose in agreed quality and quantity as per tender.
- HCl and NaOH for Raw Water Treatment Plant, RO based DM Plant & Condensate Polishing Unit and Zero Liquid Discharge Plant shall be free issue supply to the contractor.
- **Arrangement for Conveyance, and Disposal outside RWTP/RODMP/CPU/ZLDP Battery limits of the following shall be done by M/s IOCL:**
  - **Dewatered Chemical Sludge generated in the Raw Water Treatment Plant and RO based DM Plant**
  - **Dried and Bagged Salts generated in Zero Liquid Discharge Plant**



## 8. GUARANTEE PARAMETERS

Contractor shall treat and supply treated water of required specification.

Maintenance schedules shall be mutually worked out stream-wise so as to ensure operation of Raw Water Treatment Plant, RO based DM Plant & Condensate Polishing Unit and Zero Liquid Discharge Plant all-round the Year to produce treated water with specific quality and required quantity as per the guaranteed parameters, without any unplanned shut down of the facilities

Contractor shall be responsible towards operation & maintenance of the system to guarantee the following:

- *Guaranteed Hydraulic capacity of the RWTP plant (including recoveries) as per Specifications No. B269-472-17-44-SS-1001.*
- *Guaranteed Hydraulic capacity of the RODM & CPU and ZLD plant (including recoveries) as per Specifications No. B269-475-17-44-SS-1001, B269-476-17-44-SS-1001 & B269-475-17-44-SS-1002 respectively.*
- *Guaranteed Treated Water Quality (including Intermediate Streams) of various streams as per Specifications No. B269-472-17-44-SS-1001.*
- *Guaranteed Treated Water Quality (including Intermediate Streams) of various streams as per Specifications No. B269-475-17-44-SS-1001 & B269-476-17-44-SS-1001.*



## Annexure-1

Minimum Spares/Consumables List to be considered by Contractor for Operation & Maintenance			
S.No.	Equipment	Unit	Quantity
1.	<b>For Centrifugal Pumps</b>		Quantity for One Set of Pumps
	Shaft	No.	1
	Impeller	No.	1
	Mechanical Seal / Gland Packing	No.	1
	Bearing Isolator	Set	1
	Gaskets	Set	1
	O-Rings	Set	1
	Wear Rings	Set	1
	Coupling Transmission Unit	Set.	1
	Bearing (DE & NDE)	Set	1
2.	<b>For Dosing Pumps</b>		Quantity for One Set of Pumps
	IRV Assembly	No.	1
	Bearing	Set	1
	Oil Seal	Set	1
	Stroke Adjustment Assembly	Set	1
	Gaskets for drive end	Set	1
	O-rings	Set	1
	Circlip	Set	1
	Spring Anti-siphon Valve	No.	1
	Ball	No.	1
	Discharge Valve Assembly	Set	1
	Diaphragm	No.	1
	Suction Valve Assembly	Set	1
	Seat Connecting Rod		
3.	<b>For Air Blowers &amp; Compressors</b>		Quantity for One Set of Blowers & Compressors
	Bearings	Set	1
	Oil seals	Set	1
	Filter	No.	3
4.	<b>For Agitators</b>		Quantity for One Set of Agitators
	Gearbox bearings and oil seals	Set	1
	Agitator bearings and oil seals	Set	1
	Fasteners	Set	1
5.	<b>For Valves</b>	Nos.	10% or Min One of Each Type
6.	<b>For MCC</b>		
	Contractors-each rating 1 no.	Set	1
	O/L Relay – each rating 1 no.		
	HRC fuses – each rating 1 no.		
	Indicating lamp		
	Push buttons		
	Breaker-Necessary fuses		
7.	<b>For Instruments</b>		
	Pressure Gauge		
	Radar Level Transmitter		
	DP Flow Transmitter		
	pH analyser		
	Conductivity analyser		
	ORP analyser		

	DP Transmitter I/P Converter Pressure Transmitter Temperature Transmitter Temperature Gauge with element Solenoid Valve Differential Pressure gauge By pass Rotameters Torque transmitter TOC Analyser (Note-4) Silica Analyser (Note-4) Oil Analyser FRC Analyser Turbidity Analyser ServoType Level indicator Density Indicator Ultrasonic Level transmitter Level/Flow indicator Magnetic flow transmitter PSV Control valve MOV Any other Instrument /Analyser	Nos.	10% or Min One of each type as applicable
8.	Activated Carbon Media, ACF-I (RO-DMP)	Charge	One full charge volume of Activated Carbon for one ACF-I
9.	Activated Carbon Media, ACF-II (RO-DMP)	Charge	One full charge volume of Activated Carbon for one ACF-II
10.	Activated Carbon Media (CPU)	Charge	One full charge volume of Activated Carbon each for one Primary ACF & one Secondary ACF
11.	Media for Vertical Dual Media Filter, DMF-I (RO-DMP)	Volume	15% of the total quantity of Garnet & Anthracite Media in all DMFs (including standby units)
12.	Media for Vertical Dual Media Filter, DMF-II (RO-DMP)	Volume	15% of the total quantity of Garnet & Anthracite Media in all DMFs (including standby units)
13.	Cartridges in Cartridge Filters (RO-DMP)	Set	One full set of Cartridges each for one RO-I Cartridge Filter, one RO-IV Cartridge Filter and one RO Cleaning Cartridge Filter
14.	Degasser Media (RO-DMP)	Volume	15% of Total Quantity of media in all degasser towers (including standby units)
15.	Mixed Bed Exchangers Resin (RO-DMP)	Volume	15% of the total quantity of each resin type in all Mixed bed exchangers (including standby units)
16.	Mixed Bed Exchangers Resin (CPU)	Volume	15% of the total quantity of each resin type in all Mixed bed exchangers (including standby units)
17.	Oil Coalescer Resin (CPU)	Volume	15% of Total Quantity of oil Coalescer resin in all oil Coalescers (including standby units)

18.	Nozzles of strainer plates (RO-DMP & CPU)	Nos.	15% of the total quantity of nozzles in all the filters & MB exchangers (including standby units)
19.	Laterals for Filters & Exchangers (RO-DMP & CPU)	Nos.	One complete set of header & laterals for each type of filter/exchanger
20.	Victaulic Coupling in UF & RO Skids (RWTP & RO-DMP)	Nos.	10% of Total Quantity of Victaulic couplings in all UF & RO skids (including standby skids)
21.	End Cap & Connector O Rings and Seals for UF & RO Skids (RWTP & RO-DMP)	Nos.	10% of Total Quantity in all UF & RO skids (including standby skids)

**NOTES:**

- For all other equipment (including proprietary equipment) not listed above, spares as recommended by the manufacturer/supplier shall be supplied and kept in stock by the Contractor.
- Any other spare as recommended by system supplier/vendor shall be kept in stock by the Contractor.
- Spares recommended by the Evaporator and Dryer Unit System Suppliers / Vendors shall also be provided by the Contractor as part of the Scope and adequate stock of the same shall be maintained during the 2years O&M contract.
- Electrical Measuring instruments such as multi-meter, IR tester, clamp tester, non-contact type voltage detector (multi-range) etc. shall be kept by the Contractor. These shall be of standard reputed make.
- For Silica and TOC analyzers, the spares shall also include the following:
  - All the consumable and reagents required for the maintenance of the analyzers during the O&M period would be in the scope of the contractor. The consumption pattern to be recorded and informed to IOCL for information.
  - For the Silica analyzer – Reagent pump, tubing kit, mirror assembly, optic fiber cable, solenoids are the spares required
  - For the TOC analyzer- UV lamp, seals plug and socket, sensor Probes of all analyzers like pH, turbidity, ORP, etc.

# PROCESS DESIGN BASIS

## FOR

## RAW WATER TREATMENT PLANT

## FOR

## PANIPAT REFINERY EXPANSION (P-25) PROJECT

## PANIPAT, HARYANA, INDIA

IOCL: \_\_\_\_\_

EIL : \_\_\_\_\_

3	23.02.2022	ISSUED AS TECHNICAL AMMENDMENT-01	DD	VS	PKG
2	02.06.2021	REISSUED FOR TENDER	DD	VS	PKG
1	10.05.2020	ISSUED FOR TENDER	DD	VS	PKG
0	07.04.2020	ISSUED FOR INPUTS	DD	VS	PKG
B	15.10.2019	RE-ISSUED AFTER INCORPORATION OF CLIENTS COMMENTS	DD/NP	VS	PKG
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Rev. No	Date	Purpose	Prepared by	Reviewed by	Approved by

## List of Acronyms

AVU	Atmospheric and Vacuum Distillation Unit
ARU	Amine Regeneration Unit
BCW	Bearing Cooling Water
CCRU	Catalytic cracking reformer unit
CDWU	Catalytic Dewaxing Unit
CDU	Crude Distillation Unit
COC	Cycle of Concentration
CPP	Captive Power Plant
CR LPGT	CR LPG Treater
DHDT	Diesel Hydrotreater
EIL	Engineers India Limited
HGU	Hydrogen Generation Unit
IOCL	Indian Oil Corporation Limited
ORP	Oxidation Reduction Potential
NHT	Naphtha Hydrotreater
PRU	Propylene recovery unit
RHCU	Resid Hydrocracker Unit
RO	Reverse Osmosis
RWTP	Raw Water Treatment Plant
SARU	Sulphuric Acid Regeneration Unit
SR LPGT	SR LPG Treater
SRU	Sulphur recovery unit
SWS	Sour water stripper
TDS	Total Dissolved Solids
VDU	Vacuum Distillation Unit
VGO-HDT	Vacuum gasoil Hydrotreater
WWTP	Waste Water Treatment Plant

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## 1.0 INTRODUCTION

Indian Oil Corporation Limited (IOCL) operates 15.0 million metric tons per annum (MMTPA) refinery at Panipat in state of Haryana, India. The refinery is currently implementing facilities to manufacture 100% BS-VI fuel mandated by Auto Fuel Policy.

In order to meet the demand growth of petroleum products and also to increase its profitability and competitiveness in the long run, IOCL intends to enhance the refinery capacity from 15 to 25 MMTPA. The Expansion Project consists of a new Crude / Vacuum Distillation unit (CDU/VDU) of capacity of 10 MMTPA followed by a SR LPG Treater (SR LPGT), MS Block comprising of Naphtha Hydrotreater (NHT), Catalytic cracking reformer unit (CCRU) & Isomerization Unit, an Alkylation/Sulphuric Acid Regeneration Unit (SARU), a Diesel Hydrotreater (DHDT), Vacuum gasoil Hydrotreater (VGO-HDT), Resid Hydrocracker Unit (RHCU), INDMAX including CR LPG Treater (CR LPGT) followed by a Propylene recovery unit (PRU). A new Polypropylene (PP) unit and Catalytic Dewaxing Unit (CDWU) is included as value augmentation unit. Auxiliary facilities i.e., Hydrogen generation unit (HGU), Sour water stripper (SWS)/ Amine regeneration Unit (ARU) and Sulphur recovery unit (SRU) and Utility / Offsite (U&O) facilities for the entire project are included in the facility.

Engineers India Limited has been retained by IOCL as the Engineering and Project Management Consultant (EPCM) for the Upgradation Cum Expansion project and for design of all open art facilities which include AVU, PRU, SWS, ARU and the U&O facilities. Basic Engineering Design Basis (BEDB) for all facilities, containing technical information decided between IOCL and EIL, shall be binding on the process design and engineering of units, utility systems and offsite facilities.

A Raw Water Treatment Plant (RWTP) is envisaged to cater to the treated raw water requirements of the Refinery and Petrochemical Complex. The Raw Water Treatment Plant shall treat incoming raw water to the desired treated raw water specifications.

This Document constitutes the Design Basis for the Raw Water Treatment Plant.

## 2.0 RAW WATER REQUIREMENT

Raw water will be sourced from existing Munak canal. The Raw water for the new refinery complex shall be made available from the existing raw water reservoir (I & II) facility. The raw water from the existing reservoir shall be treated and filtered in a new raw water treatment plant (RWTP).

The raw water shall be pumped from the raw water reservoir to the RWTP battery limit. The treated water would be stored in a separate reservoir from where it will be pumped to

various consumers in the complex to meet its process and other requirements. The raw water treatment and treated raw water reservoir shall have with two compartments with a total storage capacity equivalent to eight hours of Treated Raw Water Requirement for the P-25 Project. The new raw water system will comprise of:

- Pumping facility along with piping from existing reservoir facility to new RWTP
- Filtration/treatment and pumping
- Treated Water Reservoir (Two Compartments)
- Sump for DM water make-up, cooling water make-up and service water
- Dedicated Sump for Drinking Water storage and transfer

Treated raw water shall be used to meet the following requirements:

- Cooling water make-up
- Service water demand of the complex
- DM plant feed
- Fire Water Make Up
- Drinking water, etc.

## 2.1 TREATED RAW WATER REQUIREMENT FOR THE PROJECT

Total treated raw water demand (design) for the entire complex is 2317 m<sup>3</sup>/hr.



## 3.0 DESIGN OF RAW WATER TREATMENT PLANT

Design Capacity and Quality in Raw Water Treatment Plant is mentioned in following sections.

### 3.1 Design Capacity of Raw Water Treatment Plant

An Ultra-filtration membrane based Treatment Plant is envisaged for treating the raw water to the desired treated raw water specifications.

The maximum treated raw water requirement for the complex is 2317 m<sup>3</sup>/hr



The Design Capacity of the Raw Water Treatment Plant shall be 2400 m<sup>3</sup>/hr of Net Treated Raw Water Production.



### 3.2 Design Inlet Raw Water and Treated Raw Water Quality

The Design feed raw water quality and Treated raw water quality to be met at outlet of RWTP shall be as follows:

**Table – 1: Design Inlet Raw Water Feed & Treated Raw Water Quality**

S. No.	Parameters	Unit	Inlet Raw Water Quality	Treated Raw Water Quality
1.	pH	--	7-8.5	7.5-8.0
2.	Temperature	°C	-	-
3.	Turbidity (after 5 min settling)	NTU	20-40 (500 during Monsoon)	<1 #
4.	Silt Density Index (SDI)	-	-	-
5.	Oil and Grease	mg/l	-	-
6.	Total Suspended Solids (TSS)	mg/l	20-40	0.5
7.	Total Dissolved Solids (TDS)	ppmw	100-160	100-160
8.	Conductivity	μS	-	-
9.	MO Alkalinity as CaCO <sub>3</sub>	ppm	80-112	60-90
10.	Calcium Hardness as CaCO <sub>3</sub>	ppm	65-85	65-85
11.	Magnesium Hardness as Mg	mg/l	-	-
12.	Total Hardness as CaCO <sub>3</sub>	ppm	90-125	90-125
13.	Chlorides (as Cl <sup>-</sup> )	ppmw	8-10	13-15
14.	Total Alkalinity (Note-2)	mg/l	-	-
15.	Sulphates (as SO <sub>4</sub> <sup>2-</sup> )	ppmw	15-75	45-55
16.	Nitrates (as NO <sub>3</sub> <sup>-</sup> )	mg/l	-	-
17.	Sodium (as Na <sup>+</sup> )	mg/l	-	-
18.	Potassium (as K <sup>+</sup> )	mg/l	-	-
19.	Total Iron (as Fe)	ppmw	≤ 0.2	≤0.1 #
20.	Chemical Oxygen Demand	mg/l	-	-
21.	Biochemical Oxygen Demand	mg/l	-	-
22.	Residual Free Chlorine	mg/l	-	-

S. No.	Parameters	Unit	Inlet Raw Water Quality	Treated Raw Water Quality
23.	Mineral Oil	mg/l	-	-
24.	ORP Value	mV	245 (HOLD)	-
25.	Total Reactive Silica as SiO <sub>2</sub>	ppmw	8-10	8-10
26.	Colloidal Silica as SiO <sub>2</sub>	mg/l	-	-
27.	Total Silica as SiO <sub>2</sub>	mg/l	-	-
28.	KMnO <sub>4</sub> Value at 100°C	mg/l	-	-
29.	Ammoniacal Nitrogen as NH <sub>4</sub> <sup>+</sup>	mg/l	-	-
30.	Ammonia		Nil	—
31.	Sulphide as S	ppm	Nil	-
32.	Phosphate as PO <sub>4</sub>	mg/l	-	-
33.	Fluoride as F (Note – 6)	mg/l	-	-
34.	Odour	--	-	-
Note : Parameters marked as # in the Treated Raw Water shall be Guaranteed Parameters at the Outlet of RWTP				

#### 4.0 TREATMENT SCHEME FOR THE RAW WATER TREATMENT PLANT

The raw water treatment plant shall be a UF membrane based filtration system.

The Raw water shall be received at the Raw Water Treatment Plant battery limit through a dedicated pressure line @ 2 kg/cm<sup>2</sup>g.

The raw water from the battery limit shall be directly routed to Lamella Clarifier. Online Chlorine dioxide dosing shall also be provided in the raw water inlet line upstream of the Clarifier for Pre-Chlorination of the feed water.

The Clarifier shall be provided with Coagulant (PAC/Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>), Lime and Polyelectrolyte dosing to enhance the coagulation and for effective settling of solids.

The clarified water from the clarifier shall be collected in a UF Feed Tank and then pumped to the Auto backwash filters which are fully automatic self-cleaning filters to retain physical impurities in the clarified water and then processed in UF system for removal of the residual impurities, to produce treated raw water. Net treated water recovery from membrane based filtration system (UF) shall be 90% (minimum).

The treated raw water from UF system shall be collected in a Treated Water Reservoir (covered with twin compartment). For meeting the Drinking water requirement, the treated

water shall be routed to a separate drinking water sump after mixing with NaOCl (Food Grade) for disinfection (Post-Chlorination). The requirement of drinking water for refinery is 25 m<sup>3</sup>/hr.

The backwash waste/ reject water from the UF system shall be routed to Backwash Waste holding sump. The chemical enhanced backwash (CEB) waste/ reject water from the UF system shall also be routed to the Backwash Waste holding sump. The effluent from the backwash waste holding sump shall be pumped to a HRSCC. HRSCC shall be provided with Coagulant (PAC), Lime and Polyelectrolyte dosing to enhance the coagulation and for effective settling of solids. The clarified water from the HRSCC shall be collected in a Clarified Water Tank and then pumped to the inlet of Clarifier with a provision of routing to the raw water reservoir by means of Clarified Water transfer pumps. **Treated water from reject recovery system of DM Plant ZLD units shall also be routed to raw water reservoir.**

The sludge from the Lamella Clarifier bottom and HRSCC bottom shall be routed to the sludge sump with in RWTP battery Limit and then pumped to sludge dewatering unit. The dewatered sludge with a consistency of ~20% solids shall be sent for disposal. Centrate from sludge dewatering unit shall be routed to the Backwash Waste Holding Sump.

Treated water from treated water reservoir shall meet the make-up water requirement of various consumers i.e., RODM plant, service water, cooling water make-up, etc.



#### 4.1 EFFLUENT GENERATION AND HANDLING

The following effluents shall be generated in the Raw Water Treatment Plant and shall be handled / treated as indicated in the Table-2

**Table-2: Effluent Generation and Handling**

S. No.	Effluent	Handling and Treatment
1.	ABF and UF backwash Waste	Sent to HRSCC - Clarified water routed to Raw Water Treatment Plant Inlet for reprocessing along with provision of routing to the raw water reservoir by means of Clarified Water transfer pumps.
2.	Chemical Sludge from Clarifier and HRSCC	Sent to Sludge dewatering unit (dewatered sludge sent for landfill disposal). Supernatant from mechanical dewatering unit routed to Backwash Waste Holding Sump

## 4.2 CHEMICALS HANDLING

Chemical dosing facilities for all chemicals required for dosing in the RWTP shall be provided, including chemical storage facilities, chemical solution preparation and dosing systems.

The following Chemicals are envisaged to be dosed in the Raw Water Treatment Plant:

- Caustic Solution (NaOH) (for use as cleaning chemical for UF CEB)
- Acid Solution (HCl) (for use as cleaning chemical for UF CEB and for ClO<sub>2</sub> production)
- Lime (for increasing pH/ alkalinity in the feed to HRSCC)
- Polyelectrolyte (Coagulant Aid)
- Poly Aluminium Chloride (PAC)/Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> (for coagulation purpose)
- NaOCl (for use as cleaning chemical for UF CEB)
- Dewatering Polyelectrolyte (DWPE) (for the purpose of sludge dewatering)
- Sodium Chlorite (for ClO<sub>2</sub> production)

## 4.3 RWTP CONFIGURATION

Raw Water Treatment Plant Scheme shall have the following Major System/Units (Unit Capacities shall be Finalized as per the Design treated raw water requirements:

**Table-3: RWTP Configuration**

Unit	No. of Units	Design Capacity per Unit / Chain
Lamella Clarifier	2 Working	1350 m <sup>3</sup> /hr Capacity
UF Skid System	6 Working + 1 Standby	400 m <sup>3</sup> /hr net permeate Capacity (90% recovery as UF Permeate)
HRSCC (for UF Backwash Treatment)	1 Working	340 m <sup>3</sup> /hr Capacity
Treated Water Reservoir	1 (Two Compartments)	8 hrs. retention capacity of treated water
Chemical Dosing and Sludge Handling Facilities		



## 5.0 EQUIPMENT DESIGN PHILOSOPHY

On Stream Factor	:	The RWTP shall be able to Operate round the Year at Design Capacity.
Hydraulic Turndown Requirement	:	50%

## 6.0 UTILITIES

The following utilities shall be supplied at the RWTP battery limit:

- Plant Air
- Instrument Air
- Power
- Service Water
- Drinking Water
- Fire Water

**Battery limit conditions shall be as per Scope of Works/Supply Document No. B269-472-17-44-SS-1001 Rev 1.**

## 7.0 CONTROL PHILOSOPHY

The RWTP shall be controlled from the Control Building which shall house the Substation and Control room along with associated facilities for the RWTP. The Control system for RWTP, shall be PLC based. Separate PLC based control systems is envisaged for RWTP.

The control system shall be provided in line with the engineering specifications/ standards/ drawings. The Operation of the UF system shall be automatic and Backwash sequence for the UF shall be incorporated in the PLC based control system, apart from other requirements to be specified in the P&ID's. The Instrumentation and Control Philosophy for the Plant shall be as applicable for smooth, safe & trouble free operation of the plant.

PLC shall be serially interfaced with centralized DCS at Refinery Main Control Room (RMCR) for monitoring purposes and mapped to DCS with dedicated graphics.

## 8.0 UNITS OF MEASUREMENT


All engineering specifications shall be issued in the MKS system of measurement, with the exception of piping/tubing sizes, which shall be reported in inches.

**Table-5: Unit of Measurements**

Parameter	Unit
Temperature	$^{\circ}\text{C}$
Pressure (Gauge)	$\text{Kg/cm}^2.\text{g}$
Mass	Kg
Length	Meters
Relative density (Sp. gravity)	-
Density	$\text{Kg/m}^3$ or $\text{g/l}$
Vacuum	$\text{mmH}_2\text{O}$ or $\text{mmHg}$
Flowing mass	$\text{Kg/hr}$
Flowing liquid	$\text{m}^3/\text{hr}$
Flowing vapour	$\text{Nm}^3/\text{hr}$
Heat rate	$\text{K Cal/hr}$
Viscosity	cP
Kinematic viscosity	cst
Composition	$\text{mg/L}$
Power	KW


## 9.0 REFERENCE DOCUMENTS / DRAWINGS

S. No.	Drawing Name	Drawing No.
1	Schematic Flow Diagram for RWTP	B269-472-17-44-1001 (2 Sheets)

LAMELLA CLARIFIER				
PROJECT: PANIPAT REFINERY EXPANSION (P-25) PROJECT, IOCL, PANIPAT				
JOB NO: B-269		CLIENT: IOCL	ITEM NO: 472-CL-101 A/B (NOTE-1)	
SERVICE: CLARIFICATION OF RAW WATER				
<b>PROCESS DATA &amp; REQUIREMENTS</b>				
<b>INLET CHARACTERISTICS (DESIGN)</b>				
TEMPERATURE (°C)		AMBIENT		
SPECIFIC GRAVITY		~1.0		
SUSPENDED SOLIDS (MAXIMUM) (mg/l)		200 (500 max during monsoon)		
TURBIDITY (NTU), NORMAL (MAXIMUM)		20-40 (500 during monsoon)		
<b>OUTLET CHARACTERISTICS</b>				
TURBIDITY (NTU) (MAXIMUM)		< 20		
<b>FLOW RATE</b>				
INFLUENT FLOW PER UNIT m3/hr		1350		
OVERFLOW PER UNIT m3/hr		*		
WATER LOSSES IN DESLUDGING		*		
UNDERFLOW PER UNIT m3/hr		*		
TYPE		Vertical Upflow with Tube Module/ Inclined Plates		
ADDITION OF CHEMICALS (YES/NO)		YES		
<b>SUSPENDED SOLIDS CONCENTRATION</b>				
OVERFLOW (mg/l)		*		
UNDERFLOW (mg/l)		*		
<b>DESIGN CRITERIA</b>				
SIZE OF SETTLER PLATES/TUBES		*		
ANGLE OF INCLINATION OF SETTLER PLATES/ TUBES		45 - 60 DEGREES *		
<b>UNIT SPECIFICATION</b>				
NO. OF UNITS		2 (NOTE-1)		
VELOCITY IN INLET PIPE (m/s)		1.0 MAXIMUM		
AREA REQUIRED (m2)		*		
INLET PIPE DIA REQUIRED (m)		*		
PROVIDED INLET PIPE DIA (m)		*		
NO. OF COMPARTMENTS PER UNIT		2 (FLOCCULATION & CLARIFICATION COMPARTMENT)		
<b>FLOCCULATION COMPARTMENT</b>				
FLOCCULATOR MECHANISM		PADDLE TYPE/ 4 RPM / DRIVEN BY ELECTRICAL MOTOR		
NO. OF FLOCCULATORS MIXERS		2 IN EACH FLOCCULATION COMPARTMENT		
DIA OF FLOCCULATOR MIXERS (m)		5		
NO. OF PADDLES PER FLOCCULATOR MIXER		12		
DETENTION IN FLOCCULATION ZONE (minutes)		*(MINIMUM 25 MINUTES)		
VOLUME IN FLOCCULATION ZONE (m3)		576		
SWD PROVIDED IN FLOCCULATION ZONE (m)		4		
FREE BOARD PROVIDED (m)		0.5		
<b>SHEET 1 OF 3</b>				
	<b>ENGINEERS INDIA LIMITED</b> NEW DELHI	<b>LAMELLA CLARIFIER</b>	PROCESS DATA SHEET	REV.
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LAMELLA CLARIFIER		
PROJECT : PANIPAT REFINERY EXPANSION (P-25) PROJECT, IOCL, PANIPAT		
JOB NO : B-269	CLIENT: IOCL	ITEM NO : 472-CL-101 A/B (NOTE-1)
AREA OF FLOCCULATION ZONE - REQUIRED(m2)		144
TOTAL AREA OF FLOCCULATION ZONE -PROVIDED (m2)		*
FLOCCULATOR WALL THICKNESS (m)		*
WIDTH x LENGTH OF FLOCCULATION ZONE (m)		18 x 8
OUTER AREA OF FLOCCULATION ZONE (m2)		*
CLARIFICATION ZONE		
DETENTION IN CLARIFICATION ZONE (minutes)		*(MINIMUM 60 MINUTES)
VOLUME IN CLARIFICATION ZONE (m3)		1440
SURFACE LOADING RATE IN CLARIFICATION ZONE		*(MAXIMUM 5 m <sup>3</sup> /hr/m <sup>2</sup> )
AREA OF CLARIFICATION ZONE (m2)		360
SWD PROVIDED IN CLARIFICATION ZONE (m)		4
FREE BOARD PROVIDED (m)		* (0.5 Minimum, actual to be based on common wall height for flocculation and clarification zone)
TOTAL AREA REQUIRED FOR PLATE/ TUBE SETTLER (m2)		*
DIA/ WIDTH x LENGTH PROVIDED FOR PLATE/ TUBE SETTLER (m/ m x m)		*
WIDTH x LENGTH PROVIDED FOR CLARIFICATION ZONE (m)		18 x 20
AREA PROVIDED FOR CLARIFICATION ZONE (m2)		*
SHAPE OF INCLINED PLATES/ TUBES		*(CIRCULAR/ SQUARE/ RECTANGULAR) *
SECTION OF INDIVIDUAL INCLINED PLATE/ TUBE (L x B / DIA)		*(m X m/m)
CROSS SECTION OF PLATES/ TUBE MODULE (m x m)		*
INCLINED PLATES/ TUBE ENTRANCE AREA (m2)		*
NUMBER OF PLATES/ TUBES REQUIRED		*
LENGTH OF PLATES/ TUBE MODULE (m)		*
HEIGHT OF PLATES/ TUBE MODULE (m)		*
THICKNESS OF INDIVIDUAL PLATES/ TUBES		*
SLOPE OF BOTTOM		1 IN 12
SLUDGE REMOVAL MECHANISM		*(BY GRAVITY/ SCREW CONVEYOR/ SLUDGE RAKE)
LAUNDER TYPE		*OUTBOARD/ RADIAL LAUNDER (IN ADDITION TO TOTAL AREA INDICATED ABOVE)
MATERIAL OF CONSTRUCTION		
INCLINED PLATE/ TUBE SETTLER & FLOCCULATOR TANK		RCC
PLATES/ TUBES		FRP
OVER FLOW WEIR - V NOTCH TYPE		MSEP + RUBBER SEALING STRIP
WALKWAY BRIDGE (WIDTH AS PER EIL SPECS.)		MS
SLUDGE REMOVAL MECHANISM (RAKE ARM/ CONVEYOR)		MSEP WITH NEOPRENE SQUEEZERS
FLOCCULATOR MECHANISM (PADDLES, SHAFT ETC )		SS 304


SHEET 2 OF 3


	<b>ENGINEERS INDIA LIMITED</b> NEW DELHI	<b>LAMELLA CLARIFIER</b>	PROCESS DATA SHEET	REV
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UF FEED SUMP					
PROJECT : PANIPAT REFINERY EXPANSION (P-25)		CLIENT : IOCL		JOB NO. : B269	
UNIT : RAW WATER TREATMENT PLANT		UNIT NO.: 472		ITEM NO.: 472-S-101	
SERVICE : TO HOLD AND TRANSFER UF FEED WATER					
PROCESS DATA					
FLUID HANDLED				LAMELLA CLARIFIER OUTLET	
INFLUENT TEMPERATURE (°C)				AMBIENT	
INFLUENT FLOW (m3/hr) (AVERAGE)				2700	
PRESENCE OF CORROSIVE/TOXIC COMPONENTS				YES	
NOMINAL CAPACITY OF SUMP (m3) (OVERALL VOLUME)				DURING DETAIL ENGINEERING	
RESIDENCE TIME (AVERAGE) (MINUTES)				~30	
ANY BAFFLE ARRANGEMENT REQUIRED (YES/NO)				NO	
TYPE OF SUMP (OPEN/COVERED)				OPEN	
UNIT SPECIFICATION					
WET SUMP					
SHAPE				RECTANGULAR	
OVERALL SIZE (LXB) (mXm)				12 X 32	
NO. OF COMPARTMENTS				1 (ONE)	
LIQUID DEPTH (m)				3.5 m SWD	
FREE BOARD (m)				0.5 (MINIMUM)	
TOTAL HEIGHT (m)				4.0	
EFFECTIVE LIQUID STORAGE VOLUME (m3)				1344	
SLOPE FOR SUMP BOTTOM				NOTE-1	
PUMP PIT REQUIRED				NO	
SIZE OF PUMP PIT (mxm)				NA	
SLOPE IN SUCTION CHANNEL				NA	
COVER				NO	
HYDRO INSULATION (YES/NO)				NO	
TYPE OF HYDRO INSULATION				NA	
LEVEL INDICATION REQUIRED (YES / NO)				YES	
LEVEL TRANSMITTER (YES / NO)				YES	
LEVEL SWITCHES (YES / NO)				NO	
LEVEL TRANSMITTER / SWITCH PLATFORM (YES/NO)				YES	
LEVEL ALARM (YES/NO)				YES	
MATERIAL OF CONSTRUCTION					
WET SUMP				RCC	
PAINTING/COATING/LINING				EPOXY PAINTED	
DRY SUMP (BELOW FGL/ABOVE FGL)				N.A.	
STAIRS/HANDRAILS				AS PER EIL SPECS.	
RUNGS				MSEP	
NOTES:					
1	TO BE FURNISHED/CONFIRMED BY THE CONTRACTOR.				
2	TOP OF SUMP SHALL BE RAISED AT LEAST 300 MM ABOVE FINISHED GROUND/ PAVEMENT LEVEL TO AVOID RAIN WATER INGRESS.				
3	TOP WATER LEVEL (TWL) IN THE SUMP SHALL BE ATLEAST 100 MM BELOW THE BOTTOM OF INCOMING PIPE/ DRAIN.				
4	DELETED 				
2	23.02.2022	ISSUED AS TECHNICAL AMMENDMENT-01	DD/SC	VS	PKG
1	21.07.2021	REISSUED FOR TENDER	DD	VS	PKG
0	05.05.2020	ISSUED FOR TENDER	DD	VS	PKG
A	01.04.2020	ISSUED FOR INPUTS/COMMENTS	DD	VS	PKG
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
		ENGINEERS INDIA LIMITED NEW DELHI	UF FEED SUMP	PROCESS DATA SHEET B269-472-17-44-DS-1004	Rev. 2

UF FEED PUMPS					
PROJECT : PANIPAT REFINERY EXPANSION (P-25)		CLIENT : IOCL		JOB NO. : B269	
UNIT : RAW WATER TREATMENT PLANT		UNIT NO.: 472		ITEM NO. : 472-P-101 A/B/C/D	
SERVICE : TO TRANSFER CLARIFIED WATER TO ABF & UF					
TYPE : CENTRIFUGAL, HORIZONTAL					
PROPERTIES OF LIQUID					
LIQUID HANDLED				UF FEED WATER	
PUMPING TEMPERATURE (°C)				AMBIENT	
VISCOSITY AT PUMPING TEMPERATURE (cp)				1.0	
LIQUID DENSITY (kg/m³)				~1000	
PRESENCE OF CORROSIVE / TOXIC COMPONENTS				YES	
SOLIDS IN SUSPENSION (YES / NO)				YES	
SIZE OF SOLID PARTICLES (mm)(MAX)				NOTE-1	
OPERATING CONDITIONS					
FLOW RATE		MAX. (m3/hr)		950 (NOTE-6)	
		NORMAL(m3/hr)		NOTE-1	
		MIN. (m3/hr)		NOTE-1	
SUCTION PRESSURE (kg/cm2.a)				ATM. + LD	
MAXIMUM SUCTION PRESSURE (kg/cm2.g)				NOTE-1	
DISCHARGE PRESSURE (kg/cm2.a)				4.0	
DIFFERENTIAL PRESSURE (kg/cm2.g)				3.0	
DIFFERENTIAL HEAD (m)				30 (NOTE-1)	
NPSH AVAILABLE (m) MIN.				FLOODED SUCTION	
NO. OF PUMPS				4 (3W+1S)	
CAPACITY CONTROL FOR VOLUMETRIC PUMPS					
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC				N.A.	
TYPE				N.A.	
RANGE (%)				N.A.	
PRECISION AT MIN. RATE (%)				N.A.	
MECHANICAL DATA					
DESIGN PRESSURE (kg/cm2.g)				5.5	
DESIGN TEMPERATURE (°C)				65	
MATERIAL CODE		CASING		CS	
		IMPELLER		CS	
SEAL TYPE (MECHANICAL / PACKING)				PACKING	
LINE RATING IN / OUT				150# / 150#	
DRIVER				ELECTRIC MOTOR	
NOTES:					
1	TO BE FURNISHED/ CONFIRMED BY THE CONTRACTOR.				
2	THE PUMP MOTOR SHALL BE DESIGNED FOR OPEN DISCHARGE CONDITION.				
3	THE PUMP SHALL BE CAPABLE OF FREQUENT AUTO START / STOP OPERATION AS PER PROCESS REQUIREMENTS				
4	THE PUMPS SHALL BE ABLE TO MEET REQUIRED PLANT T/D FLOW REQUIREMENTS.				
5	THE PUMPS SHALL BE SELECTED FOR PARALLEL OPERATION.				
6	THE DESIGN FLOW RATE FOR THE UF FEED PUMPS SHALL BE DESIGNED BASED ON THE INSTANTANEOUS FLOW REQUIREMENTS (DESIGN FLOW) OF THE UF AS PER UF SYSTEM SUPPLIER RECOMMENDATIONS				
2	23.02.2022	ISSUED AS TECHNICAL AMMENDMENT-01	DD/SC	VS	PKG
1	21.07.2021	REISSUED FOR TENDER	DD	VS	PKG
0	05.05.2020	ISSUED FOR TENDER	DD	VS	PKG
A	31.03.2020	ISSUED FOR INPUTS/ COMMENTS	DD	VS	PKG
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
		ENGINEERS INDIA LIMITED NEW DELHI	UF FEED PUMPS	PROCESS DATA SHEET B269-472-17-44-DS-1005	REV. 2

ULTRAFILTRATION SKIDS			
PROJECT :PANIPAT REFINERY EXPANSION (P-25)		CLIENT : IOCL	JOB NO. : B269
UNIT : RAW WATER TREATMENT PLANT		UNIT NO.: 472	ITEM NO. : 472-UF-101 A/B/C/D/E/F/G
SERVICE : FILTRATION OF FINE SUSPENDED SOLIDS			
PROCESS DATA			
LIQUID HANDLED		ABF OUTLET WATER/ CLEANING CHEMICALS	
LIQUID DENSITY (Kg/m <sup>3</sup> )		~1000	
VISCOSITY AT STORAGE TEMPERATURE (Cp)		1	
VAPOUR PRESSURE		NOTE-1	
OPERATING/ MECHANICAL DESIGN TEMPERATURE (deg C)		AMBIENT/65	
OPERATING PRESSURE (kg/cm2.g)		3.5-4.0	
DESIGN PRESSURE (kg/cm <sup>2</sup> .g)		5 (MINIMUM) (NOTE-1)	
ULTRA FILTRATION MEMBRANES		<div><div></div><div>2</div></div>	
DESIGN FEED FLOW RATE (m3/hr)		NOTE-1	
UF NET PERMEATE FLOW RATE (m3/hr)		400 PER SKID	
UF GROSS PERMEATE FLOW RATE (m3/hr)		NOTE-1	
WATER REQUIRED FOR BACKWASH / CLEANING (m3/day)		NOTE-1	
NORMAL OPERATING FEED PRESSURE (kg/cm2.g)		3.5	
FLOW REVERSIBILITY REQUIRED (YES/NO)		YES	
BACKWASH FLUX (LMH)		NOTE-1	
BACKWASH FREQUENCY		NOTE-1	
CHEMICAL ENHANCED BACKWASH FREQUENCY		NOTE-1	
CIP FREQUENCY		NOTE-1	
NORMAL BACKWASH PRESSURE		NOTE-1	
MAXIMUM BACKWASH PRESSURE		NOTE-1	
RECOVERY (%)		90%	
NO. OF SKIDS		7 (6W + 1SB) (NOTE-10)	
MODE OF OPERATION		DEAD END/CROSS FLOW	
DIAMETER OF MEMBRANE (inch)		NOTE-1	
LENGTH OF MEMBRANE (inch)		NOTE-1	
FILTRATION AREA PER MEMBRANE (m2)		NOTE-1	
FLOW DIRECTION		INSIDE-OUT/OUTSIDE-IN	
GROSS FLUX (LMH)		50 (MAXIMUM)	
TOTAL MEMBRANE SURFACE FILTRATION AREA (m2) (MINIMUM)		NOTE-1	
TYPE OF MEMBRANE		HOLLOW FIBRE / SINGLE LAYERED	
LUMEN FIBRE INNER DIAMETER		NOTE-1	
DESIGNED TO REMOVE MOLECULAR WEIGHT		< 1,50,000 DALTONS	
GUARANTEED LIFE OF MEMBRANES		5 YEARS	
MAKE OF MEMBRANE SUPPLIERS		AS PER EIL APPROVED VENDOR LIST	
MAKE OF PRESSURE TUBE SUPPLIERS		AS PER EIL APPROVED VENDOR LIST	
MOC OF FLANGE JOINTS AND VICTAULIC CONNECTIONS		NOTE-1	
MOC OF FRAMES		NOTE-1	
GASKETS & ELASTOMERS		EPDM/BUNA	
BOLTS & WASHERS		NOTE-1	
MOC OF PERMEATE PIPING		NOTE-1	
MOC OF MEMBRANES		POLY ETHER SULFONE/PVDF	
MOC OF PRESSURE TUBE		PVC/POLYSULFONE/FRP/ABS	
MOC OF DRAIN & VENT PIPING		PVC SCHEDULE 80 (ASTM-D1784,1785)	
APPLICABLE DESIGN CODE		ASME	
SHEET 1 OF 2			
	ENGINEERS INDIA LIMITED NEW DELHI	ULTRAFILTRATION SKIDS	PROCESS DATA SHEET
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		1	

[illegible]

CENTRIFUGE				
PROJECT : PANIPAT REFINERY EXPANSION (P-25) PROJECT		CLIENT : IOCL	JOB NO. : B269	
UNIT : RAW WATER TREATMENT PLANT		UNIT NO.: 472	ITEM NO. : 472-LZ-101 A/B/C	
SERVICE : DE-WATERING OF SLUDGE				
PROCESS DATA				
FLUID HANDLED		THICKENED SLUDGE		
TYPE & NATURE OF SLUDGE		CHEMICAL		
INFLUENT CHARACTERISTICS				
INFLUENT FLOW RATE (m³/hr)		30		
SOLID CONTENT (% wt.)		2-5 %		
TEMPERATURE(°C)		AMBIENT		
PH		6.5-8.5		
DENSITY (kg/m³)		~1100		
VISCOSITY (Cp)		NOTE-1		
DEWATERED SLUDGE CHARACTERISTICS				
SOLID CONTENT (% wt.) (MIN.)		20		
MOISTURE CONTENT (% wt.)		80		
SOLIDS RECOVERY (% wt.)		NOTE-1		
FLOW RATE (m³/hr)		NOTE-1		
CENTRATE CAHRACTERISTICS				
SOLID CONTENT (mg/l)		NOTE-1		
FLOW RATE (m³/hr)		NOTE-1		
UNIT SPECIFICATION				
NUMBER OF UNITS		3 (2W + 1S) (NOTE-6)		
DUTY (CONTINUOUS/INTERMITTENT)		INTERMITTENT		
OPERATING CYCLE (hrs) PER UNIT		16 HOURS PER DAY		
SEPARATION FORCE (G)(m/s²)		NOTE-1		
SETTLING TIME (sec)		NOTE-1		
BOWL LENGTH (m)		NOTE-1		
BOWL DIAMETER (m)		NOTE-1		
BOWL SPEED (rpm)(MAX/OPERATING)		NOTE-1		
SPEED CONTROL		THROUGH PULLEYS		
CONICAL ANGLE (deg.)		NOTE-1		
CONVEYER SPEED (rpm)		NOTE-1		
POLY-ELECTROLYTE DOSING REQUIRED		YES (DEWATERING POLYELECTROLYTE)		
DOSAGE REQUIREMENT (kg/Ton of Dry Solids)		2.5		
DOSING STRENGTH		0.10%		
MODE OF APPLICATION		BY CENTRIFUGAL PUMP		
POINT OF APPLICATION		INLET OF CENTRIFUGE		
LIFTING ARRANGEMENT REQUIRED		YES		
MATERIAL OF CONSTRUCTION				
BOWL		SS316		
SHAFT/SCROLL		SS316		
LINING		TUNGSTEN CARBIDE		
CASING		SS316		
GEARBOX OVERLOAD PROTECTION MECHANISM (YES/NO)		YES		
Sheet 1 of 2				
	ENGINEERS INDIA LIMITED NEW DELHI	CENTRIFUGE	PROCESS DATA SHEET	REV
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## CENTRIFUGE

**NOTES:**

1	TO BE FURNISHED BY THE CONTRACTOR DURING DETAIL ENGINEERING.
2	SEPARATION FORCE VALUE TO BE FURNISHED BY THE CENTRIFUGE SUPPLIER.
3	DOSING RATE TO BE ESTABLISHED BY THE CENTRIFUGE SUPPLIER.
4	EIL APPROVED VENDOR LIST FOR CENTRIFUGE TO BE FOLLOWED.
5	CENTRATE FROM EACH CENTRIFUGE TO BE ROUTED TO CENTRATE SUMP
6	SYSTEM SHALL BE DESIGNED FOR ALL THREE CENTRIFUGE OPERATING SIMULTANEOUSLY (IF REQUIRED DURING EXCESS SLUDGE GENERATION)

2	23.02.2022	ISSUED AS TECHNICAL AMMENDMENT-01	DD/SC	VS	PKG
1	21.07.2021	REISSUED FOR TENDER	DD	VS	PKG
0	05.05.2020	ISSUED FOR TENDER	DD	VS	PKG
A	01.04.2020	ISSUED FOR INPUTS/ COMMENTS	DD	VS	PKG
<b>NO.</b>	<b>DATE</b>	<b>REVISION</b>	<b>PREPARED</b>	<b>CHECKED</b>	<b>APPROVED</b>


SHEET 2 OF 2

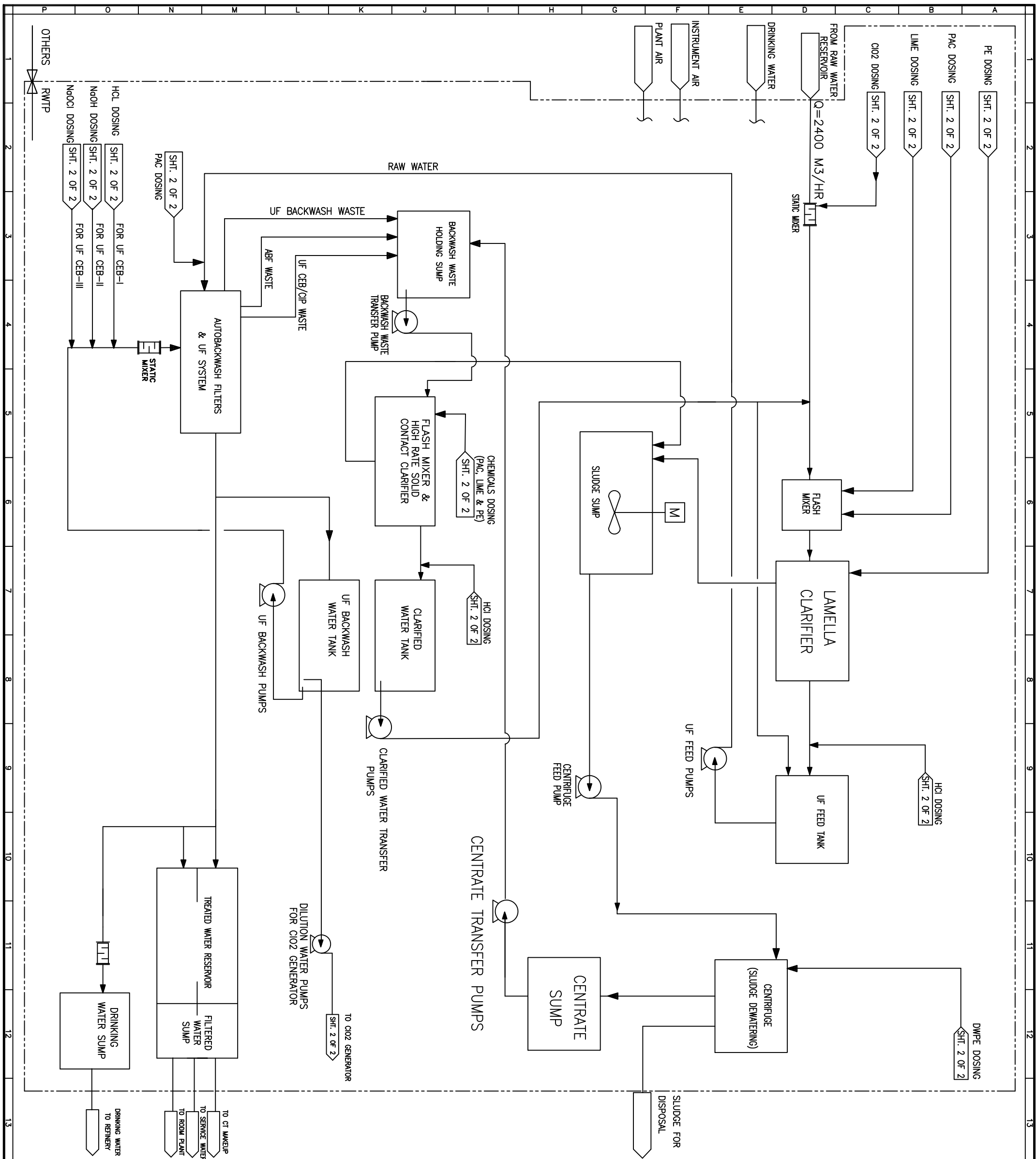
 <b>ENGINEERS INDIA LIMITED</b> <b>NEW DELHI</b>	<b>CENTRIFUGE</b>	<b>PROCESS DATA SHEET</b>	<b>REV.</b>
		<b>B269-472-17-44-DS-1019</b>	<b>2</b>

Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> /PAC SOLUTION DOSING TANKS						
PROJECT : PANIPAT REFINERY EXPANSION (P-25)			CLIENT : IOCL		JOB NO. : B269	
UNIT : RAW WATER TREATMENT PLANT			UNIT NO.: 472		ITEM NO. : 472-T-103 A/B	
SERVICE : PREPARATION OF Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> /PAC SOLUTION						
<b>PROCESS DATA</b>						
LIQUID HANDLED				10 % Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> /PAC SOLN.		
VISCOSITY OF LIQUID (cs)				~1.0		
LIQUID DENSITY (kg/m <sup>3</sup> )				~1000		
OPERATING TEMPERATURE (°C)				AMBIENT		
OPERATING PRESSURE (kg/cm <sup>2</sup> .a)				ATM. + LIQUID COLUMN		
NATURE OF LIQUID (TOXIC/CORROSIVE)				CORROSIVE		
Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> /PAC (100%) REQUIRED AT DESIGN FLOW RATE				(NOTE-1)		
PURITY OF COMMERCIALY AVAILABLE CHEMICAL				NOTE-1		
HOLDING PERIOD OF EACH TANK (hrs) (MIN)				12		
<b>MECHANICAL DATA</b>						
NO. OF TANKS				2		
TYPE				CIRCULAR		
DIAMETER (mxm)				3.3		
LIQUID DEPTH (m)				1.4		
DEAD VOLUME DEPTH (m)				0.2		
FREE BOARD (m)				0.3		
TOTAL HEIGHT (m)				1.9		
EFFECTIVE CAPACITY OF EACH TANK (m <sup>3</sup> )				12		
TOTAL CAPACITY OF EACH TANK (m <sup>3</sup> )				16.3		
LEVEL INDICATOR				YES		
TYPE OF LEVEL INDICATOR				LEVEL TRANSMITTER		
SERVICE WATER CONNECTION				YES		
OVERFLOW CONNECTION				YES		
DRAINING ARRANGEMENT				YES		
WITHDRAWING ARRANGEMENT				THROUGH PUMPS		
AGITATOR REQUIRED				YES (ONE/ TANK)		
BAFFLE ARRANGEMENT				NA		
SIZE OF BAFFLES				NA		
CORROSION ALLOWANCE (mm)				NA		
HEATING COIL				NO		
INSULATION (YES/NO)				NO		
BREATHING VALVE (YES/NO)				NO		
VENT (YES/NO)				NO		
FLAME ARRESTOR (YES/NO)				NO		
CALIBRATION OF TANK (YES/NO)				NO		
<b>MATERIAL OF CONSTRUCTION</b>						
TANK				SS		
COVER				COVERED TANK		
<b>NOTES:</b>						
1	TO BE FURNISHED BY THE CONTRACTOR DURING DETAIL ENGINEERING.					
2	FOR OTHER REQUIREMENTS REFER GENERAL ENGG. SPEC.					
3	ALL INSTRUMENTS ON THE TANKS SHALL BE MOUNTED ON A RCC PLATFORM WITH PROPER APPROACH.					
2	22.02.2022	ISSUED AS TECHNICAL AMMENDMENT-01	DD/SC	VS	PKG	
1	21.07.2021	REISSUED FOR TENDER	DD	VS	PKG	
0	05.05.2020	ISSUED FOR TENDER	DD	VS	PKG	
A	0.1.04.2020	ISSUED FOR INPUTS/COMMENTS	DD	VS	PKG	
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED	
ENGINEERS INDIA LIMITED NEW DELHI			Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> /PAC SOLUTION DOSING TANKS	PROCESS DATA SHEET		REV.
				B269-472-17-44-DS-1020		2



POLYELECTROLYTE SOLUTION DOSING PUMPS					
PROJECT : PANIPAT REFINERY EXPANSION (P-25)		CLIENT : IOCL		JOB NO. : B269	
UNIT : RAW WATER TREATMENT PLANT		UNIT NO.: 472		ITEM NO. : 472-P-109 A/B	
SERVICE : DOSING OF POLYELECTROLYTE SOLUTION TO LAMELLA CLARIFIER AND HRSCC (BACKWASH)					
TYPE : CENTRIFUGAL, HORIZONTAL <span style="float: right;">2</span>					
PROPERTIES OF LIQUID					
LIQUID HANDLED				0.2% POLYELECTROLYTE SOLN.	
PUMPING TEMPERATURE (°C)				AMBIENT	
VISCOSITY AT PUMPING TEMPERATURE (cp)				~1.0	
LIQUID DENSITY (kg/m³)				~1000	
PRESENCE OF CORROSIVE / TOXIC COMPONENTS				YES	
SOLIDS IN SUSPENSION (YES / NO)				NO	
SIZE OF SOLID PARTICLES (mm)(MAX)				NA	
OPERATING CONDITIONS					
FLOW RATE		MAX. (m3/hr)		NOTE-1	
		NORMAL(m3/hr)		3	
		MIN.(m3/hr)		NOTE-1	
SUCTION PRESSURE (kg/cm2.a)				ATM.	
MAXIMUM SUCTION PRESSURE (kg/cm2.g)				NOTE-1	
DISCHARGE PRESSURE (kg/cm2.a)				3.5	
DIFFERENTIAL PRESSURE (kg/cm2.g)				2.5	
DIFFERENTIAL HEAD (m)				25	
NPSH AVAILABLE (m) MIN.				FLOODED SUCTION	
NO. OF PUMPS				2 (1W+1SB)	
CAPACITY CONTROL FOR VOLUMETRIC PUMPS					
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC				MANUAL	
TYPE				STROKE ADJUSTMENT	
RANGE (%)				10-100	
PRECISION AT MIN. RATE (%)				NOTE-1	
MECHANICAL DATA					
DESIGN PRESSURE (kg/cm2.g)				4.5	
DESIGN TEMPERATURE (°C)				65	
MATERIAL CODE		CASING		SS 316 <span style="float: right;">2</span>	
		IMPELLER		SS 316 <span style="float: right;">2</span>	
SEAL TYPE (MECHANICAL / PACKING)				GLANDLESS	
LINE RATING IN / OUT				150# / 150#	
DRIVER				ELECTRIC MOTOR	
NOTES:					
1	TO BE FURNISHED BY THE CONTRACTOR DURING DETAIL ENGINEERING.				
2	PUMP SHALL HAVE EXTERNAL PRESSURE SAFETY RELIEF VALVE (IF NOT PROVIDED INTERNALLY)				
3	PULSATION DAMPNER TO BE PROVIDED ON EACH PUMP DISCHARGE LINE.				
4	PUMP SHALL BE PROVIDED WITH MINIMUM RECIRCULATION LINE AND DETAILED IN THE P&ID <span style="float: right;">2</span>				
2	21.02.2022	ISSUED FOR TECHNICAL AMMENDMENT-01	DD/SC	VS	PKG
1	21.07.2021	REISSUED FOR TENDER	DD	VS	PKG
0	05.05.2020	ISSUED FOR TENDER	DD	VS	PKG
A	01.04.2020	ISSUED FOR INPUTS/COMMENTS	DD	VS	PKG
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
	<b>ENGINEERS INDIA LIMITED</b> NEW DELHI		<b>POLYELECTROLYTE SOLUTION DOSING PUMPS</b>	PROCESS DATA SHEET	REV.
				B269-472-17-44-DS-1029	2

NaClO2 UNLOADING PUMPS						
PROJECT : PANIPAT REFINERY EXPANSION (P-25)			CLIENT : IOCL		JOB NO. : B269	
UNIT : RAW WATER TREATMENT PLANT			UNIT NO.: 472		ITEM NO. : 472-P-115 A/B	
SERVICE : UNLOADING OF NaClO2 SOLUTION						
TYPE : HORIZONTAL CENTRIFUGAL						
PROPERTIES OF LIQUID						
LIQUID HANDLED				25-31% NaClO2 SOLUTION		
PUMPING TEMPERATURE (°C)				AMBIENT		
VISCOSITY AT PUMPING TEMPERATURE (cp)				NOTE-1		
LIQUID DENSITY (kg/m³)				1280 (NOTE-1)		
PRESENCE OF CORROSIVE / TOXIC COMPONENTS				YES		
SOLIDS IN SUSPENSION (YES / NO)				NO		
SIZE OF SOLID PARTICLES (mm)(MAX)				N.A.		
OPERATING CONDITIONS						
FLOW RATE			MAX. (M3/HR)	NOTE-1		
			NORMAL(M3/HR)	10		
			MIN. (M3/HR)	NOTE-1		
SUCTION PRESSURE (kg/cm2.a)				ATM		
MAXIMUM SUCTION PRESSURE (kg/cm2.g)				NOTE-1		
DISCHARGE PRESSURE (kg/cm2.a)				3.0		
DIFFERENTIAL PRESSURE (kg/cm2.g)				2.0		
DIFFERENTIAL HEAD (mLC)				20		
NPSH AVAILABLE (m) MIN.				FLOODED SUCTION		
NO. OF PUMPS				2 (1W+1SB)		
CAPACITY CONTROL FOR VOLUMETRIC PUMPS						
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC				NA		
TYPE				NA		
RANGE (%)				NA		
PRECISION AT MIN. RATE (%)				NA		
MECHANICAL DATA						
DESIGN PRESSURE (kg/cm2.g)				4.0		
DESIGN TEMPERATURE (°C)				65		
MATERIAL CODE			CASING	PP		
			IMPELLER	PP		
SEAL TYPE (MECHANICAL / PACKING)				MECHANICAL		
LINE RATING IN / OUT				150# / 150#		
DRIVER				ELECTRIC MOTOR		
NOTES:						
1	DATA MARKED AS "*" TO BE FURNISHED/CONFIRMED BY THE CONTRACTOR.					
2	THE PUMP MOTOR SHALL BE DESIGNED FOR OPEN DISCHARGE CONDITION.					
3	DELETED					
2	23.02.2022	ISSUED AS TECHNICAL AMMENDMENT-01		DD/SC	VS	PKG
1	21.07.2021	REISSUED FOR TENDER		DD	VS	PKG
0	05.05.2020	ISSUED FOR TENDER		DD	VS	PKG
A	01.04.2020	ISSUED FOR INPUTS/COMMENTS		DD	VS	PKG
NO.	DATE	REVISION		PREPARED	CHECKED	APPROVED
		ENGINEERS INDIA LIMITED NEW DELHI		NaClO2 UNLOADING PUMPS	PROCESS DATA SHEET B269-472-17-44-DS-1040	REV. 2



NOTES :-

1. INTERMEDIATE STORAGE & PUMPING FACILITIES SHALL BE PROVIDED BY CONTRACTOR WHEREVER NECESSARY.
2. BACKWASH FACILITIES AS REQUIRED SHALL BE PROVIDED BY THE VENDOR.
3. SERVICE WATER AND DRINKING WATER REQUIRED FOR THE RAW WATER TREATMENT PLANT SHALL BE TAPPED FROM THE RESPECTIVE PUMP HEADER INSIDE THE RWTP BATTERY LIMIT.
4. THIS IS AN INDICATIVE SFD WHICH SHALL BE FURTHER DEVELOPED BY THE CONTRACTOR AS PER TENDER REQUIREMENT.
5. PROVISION HAS BEEN KEPT TO ROUTE CLARIFIED BACKWASH WASTE TO RAW WATER RESERVOIR IN CASE IT CANNOT BE RECYCLED WITHIN RWTP.

14	15	16
REF. DWG. NO.	REFERENCE DRAWING TITLE	

REV.	DATE	REVISIONS	BY	CHKD	APPR.
1	23.02.22	ISSUED AS TECHNICAL AMENDMENT-01	AJ	DD	VS/PH
0	10.05.20	ISSUED FOR TENDER	GSIC	DD	VS/PH
A	06.09.19	ISSUED FOR COMMENTS	GSIC	AK/DD	PKG/P

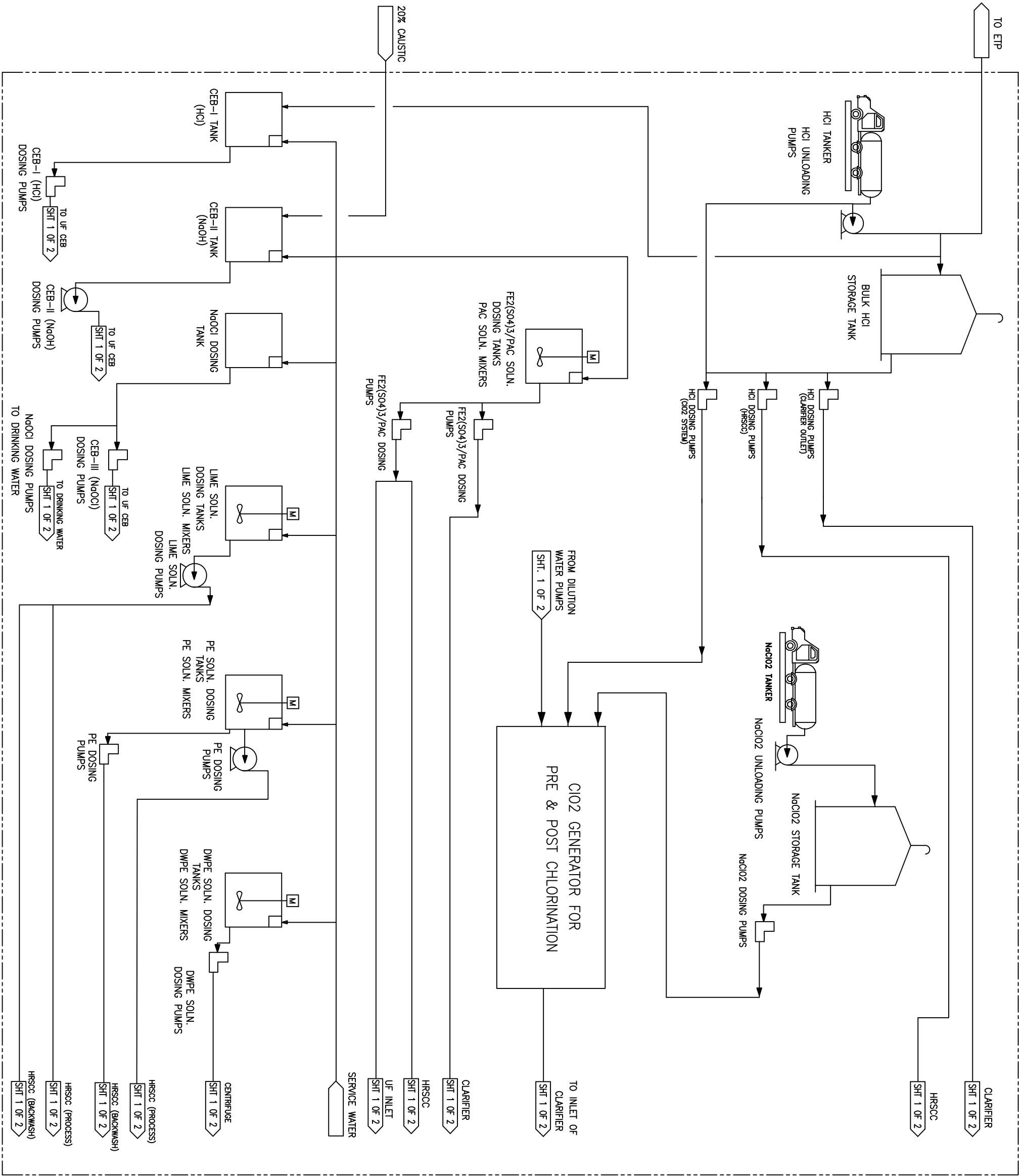
**इंजीनियर्स  
इंडिया लिमिटेड**  
(A Govt. of India Undertaking)

इंडियन ऑयल कॉर्पोरेशन लिमिटेड  
पानीपत रिफाइनरी विस्तार परियोजना  
INDIAN OIL CORPORATION LIMITED  
PANIPAT REFINERY EXPANSION PROJECT

### SCHEMATIC FLOW DIAGRAM (SFD)

RAW WATER TREATMENT PLANT (RWTP) (SHEET 1 OF 2)

P-25 PANIPAT EXPANSION PROJECT																
SCALE	JOB NO.		UNIT	DEPT.	SECT.	DWG. NO.		RE								
NIL	B	2	6	9	4	7	2	1	7	4	4	1	0	0	1	1
14							15						16			



REF. DWG. NO.	REFERENCE DRAWING TITLE
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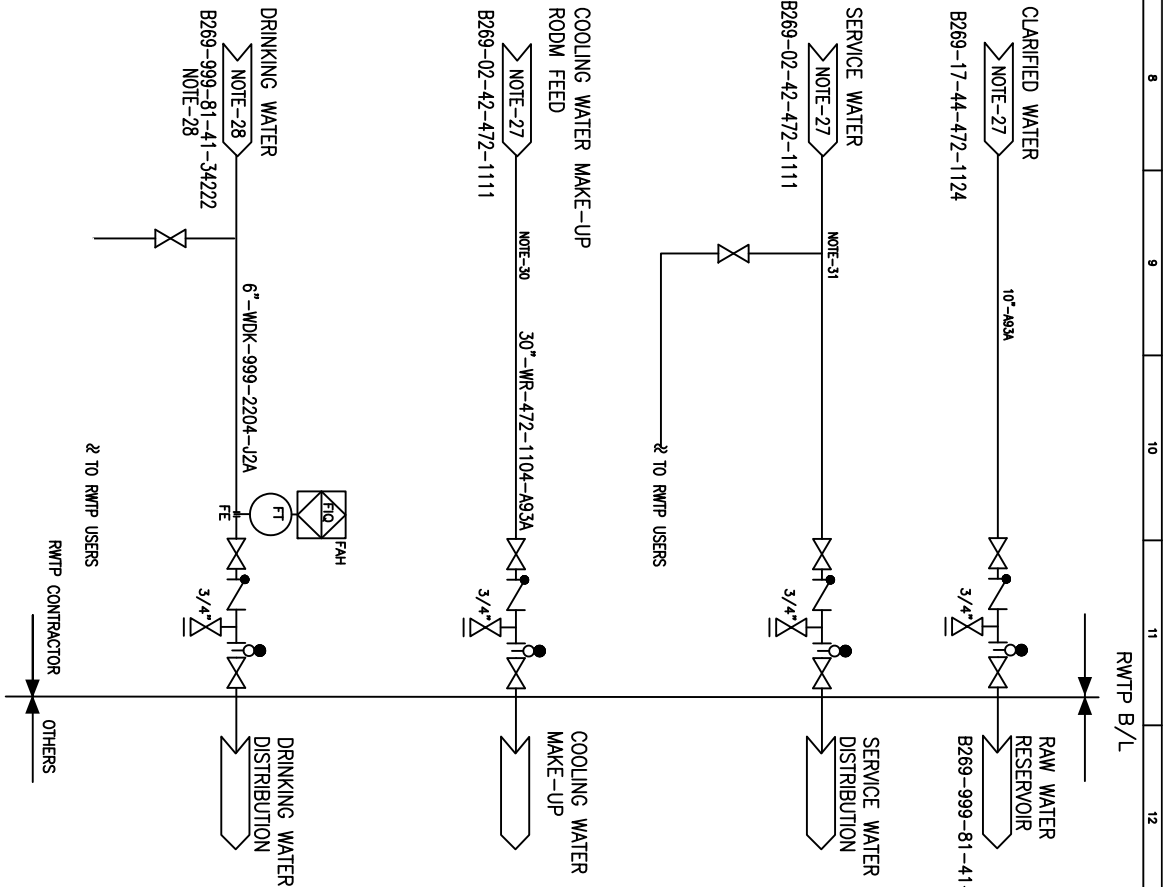
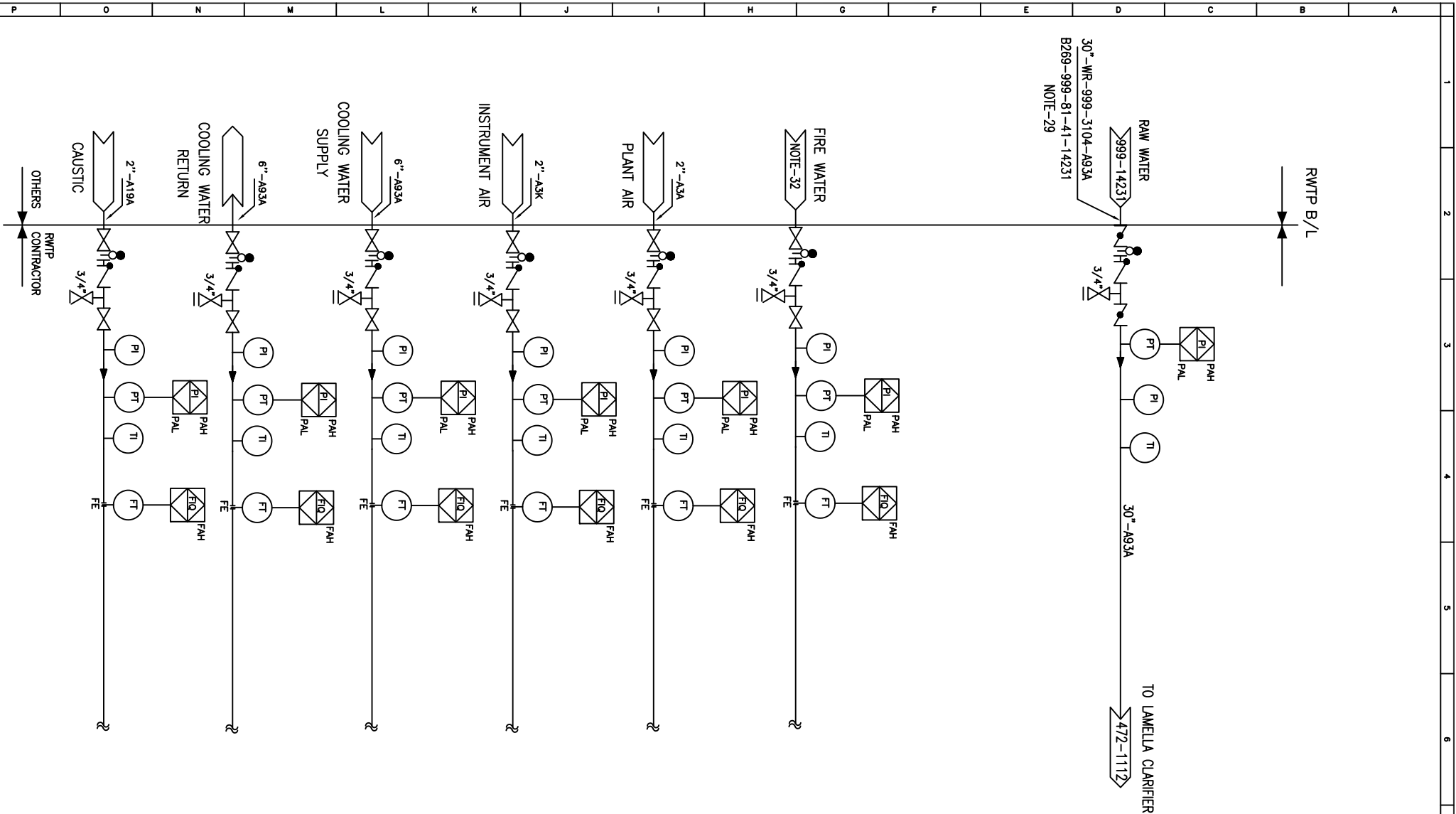
1	23.02.22	ISSUED AS TECHNICAL AMENDMENT-01	AJ	DD	US/PKG
0	10.05.20	ISSUED FOR TENDER	GSC	DD	US/PKG
A	06.09.19	ISSUED FOR COMMENTS	GSC	AK/DD	PKG/VS
REV.	DATE	REVISIONS	BY	CHKD	APPD



पानीपत औद्योगिक विस्तार लिमिटेड  
पानीपत रिफ़ाइनरी विस्तार परियोजना  
INDIAN OIL CORPORATION LIMITED  
**PANIPAT REFINERY EXPANSION PROJECT**

**SCHEMATIC FLOW DIAGRAM (SFD)**  
RAW WATER TREATMENT PLANT (RWTP) (SHEET 2 OF 2)  
P-25 PANIPAT EXPANSION PROJECT

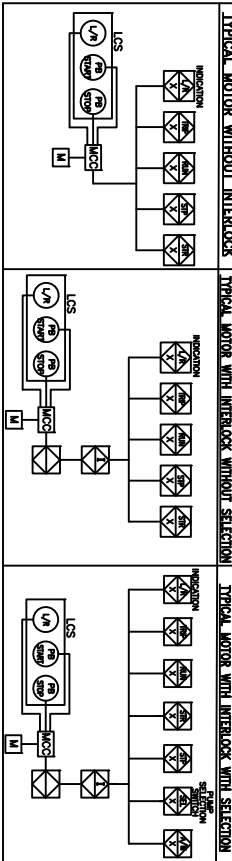
SCALE	JOB NO.	UNIT	DEPT.	SECT.	DWG. NO.	REV.
NIL	B 2	6	9	4	7	2
					1	7
					4	1
					0	1
					1	1



NOTES :-

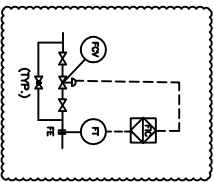
- SUPPLY OF INSTRUMENT AIR & PLANT AIR TILL COMMISSIONING OF RWTP AND FOR THREE MONTHS OPERATION ON THE RWTP AFTER COMMISSIONING SHALL BE IN THE SCOPE OF THE CONTRACTOR.
- AFTER THE COMMISSIONING OF COMPRESSED AIR SYSTEM, INSTRUMENT AIR & PLANT AIR IN RWTP & RO-DMP SHALL BE TAKEN FROM COMPRESSED AIR SYSTEM. ALL NECESSARY PIPING CONNECTIONS FOR THE SAME SHALL BE IN THE CONTRACTORS SCOPE.
- PMS & VMS SHALL BE FOLLOWED FOR ALL LINES & VALVES.
- MINIMUM RECIRCULATION LINE TO BE PROVIDED IN SUMP/TANKS AS PER PROCESS REQUIREMENT.
- LOOP POWERED LOCAL LEVEL INDICATION AT GRADE LEVEL FOR ALL THE TANKS./SUMPS SHALL BE PROVIDED FROM ONE OF THE LT.
- BLEEDER VALVE ARRANGEMENT AT B/L SHALL BE PROVIDED FOR ALL LINES
- ALL AIR BLOWER DISCHARGE LINES TO BE PROVIDED WITH SAFETY INSULATION.
- REFER BEDB PART-B FOR INSULATION DETAILS, ETC.,
- TAPPING FOR SERVICE WATER IN THE RWTP, RODM, CPU & ZLD PLANT SHALL BE TAKEN INTERNALLY FROM THE DISCHARGE HEADER OF THE SERVICE WATER PUMPS IN THE RWTP
- REFER P&ID B269-02-42-472-1111 FOR DETAILS. INSTRUMENTATION AND VALVES TO BE PROVIDED ON THE LINES.
- REFER P&ID B269-999-81-41-34222 FOR DETAILS. INSTRUMENTATION AND VALVES TO BE PROVIDED ON THE LINES.
- REFER P&ID B269-999-81-41-14231 FOR DETAILS. INSTRUMENTATION AND VALVES TO BE PROVIDED ON THE LINES.
- FIRE WATER TAPPING SHALL BE IN SCOPE OF RWTP/RO-DMP/CPU/ZLD CONTRACTOR
- PROCESS DRAIN NETWORK MOC SHALL BE MA WITH 3 LPE COATING.

GENERAL NOTES - MOTOR CONTROL



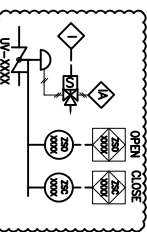
NOTES :-

- THESE ARE INDICATIVE P&IDS. VENDOR TO FURTHER DEVELOP THESE P&IDS IN THE LINE WITH TENDER DOCUMENT REQUIREMENTS. REPRESENTATION OF UNITS/EQUIPMENTS SHOWN ARE INDICATIVE ONLY AND THE SAME SHALL BE AS PER TENDER REQUIREMENTS.
- VELOCITY CRITERIA FOR LINE SIZING SHALL BE AS SPECIFIED IN THE TENDER SPECIFICATIONS. HOWEVER, LINE SIZES AS INDICATED IN THE TENDER DRAWINGS SHALL BE STRICTLY FOLLOWED AS MINIMUM REQUIREMENTS.
- PIPING MATERIAL SPECIFICATIONS (PMS) FOR VARIOUS LINES/ SERVICES SHALL BE AS SPECIFIED IN THE TENDER SPECIFICATIONS. HOWEVER, PIPING MATERIAL AS INDICATED IN THE TENDER DRAWINGS SHALL BE STRICTLY FOLLOWED.
- TYPICAL DETAILS FOR ONE CONTROL VALVE (DETAIL-"A") IS AS FOLLOWS AND SHALL BE FOLLOWED OR ALL CONTROL VALVES.



DETAIL-"A"  
(TYP. FOR CONTROL VALVE)

- SAMPLING VALVES TO BE PROVIDED AT INLET & OUTLET OF VARIOUS UNITS AS PER PROCESS REQUIREMENTS.
- INSTRUMENT & ARRANGEMENTS SHOWN IN ONE CHAIN ARE TYPICAL TO BE PROVIDED IN ALL CHAINS.
- VALVE TYPES INDICATED IN P&IDS & SCOPE OF WORK/SUPPLY TO BE FOLLOWED. WHEREVER TYPES OF VALVES ARE NOT SPECIFIED, EL'S PMS & VMS TO BE FOLLOWED.
- ADEQUATE HEADER RUN LENGTH AFTER WAXER TO BE PROVIDED TO ENSURE MIXING.
- ALL LEVEL TRANSMITTERS SHALL BE NON-CONTACT RADAR TYPE.
- ALL ON/OFF VALVES SHALL BE PROVIDED WITH OPEN/CLOSE FEEDBACK IN THE PLC. REFER DETAIL B



DETAIL-"B"  
(TYPICAL FOR ALL ON/OFF VALVES)

- OVER FLOW AND DRAIN CONNECTION 'D' SHALL BE PROVIDED FOR ALL ABOVE GROUND SUMP & TANKS WITH DRAIN DESTINATION TO BACKWASH. HOLDING SUMP.
- FOR ALL INCOMING LINES, SAME CLASS OF PIPING, AS AVAILABLE AT RWTP B/L, SHALL BE USED UP TO THEIR RESPECTIVE FIRST UNIT.
- ALL BUTTERFLY VALVES SHALL BE TIGHT SHUT-OFF.
- REFER LEGEND P&ID NOS. B269-79-41-00-1191 & 1192 (2 SHEETS)
- ALL CONTROL VALVES SHALL BE PROVIDED WITH SMART POSITIONS.
- FAIL SAFE CONDITION OF EACH ON/OFF VALVE TO BE INDICATED IN P&ID
- SEPARATE UTILITY DISTRIBUTION P&ID'S SHALL BE DEVELOPED & SUBMITTED TO CONTRACTOR TO EL/LOCAL FOR APPROVAL

REV	DATE	REVISIONS	BY	CHKD/APPD
1	23.02.22	ISSUED WITH TECHNICAL AMENDMENT-01	SSC	DD
2	23.05.21	RE-ISSUED FOR TENDER	SSC	DD
3	20.04.20	ISSUED FOR TENDER	SSC	DD

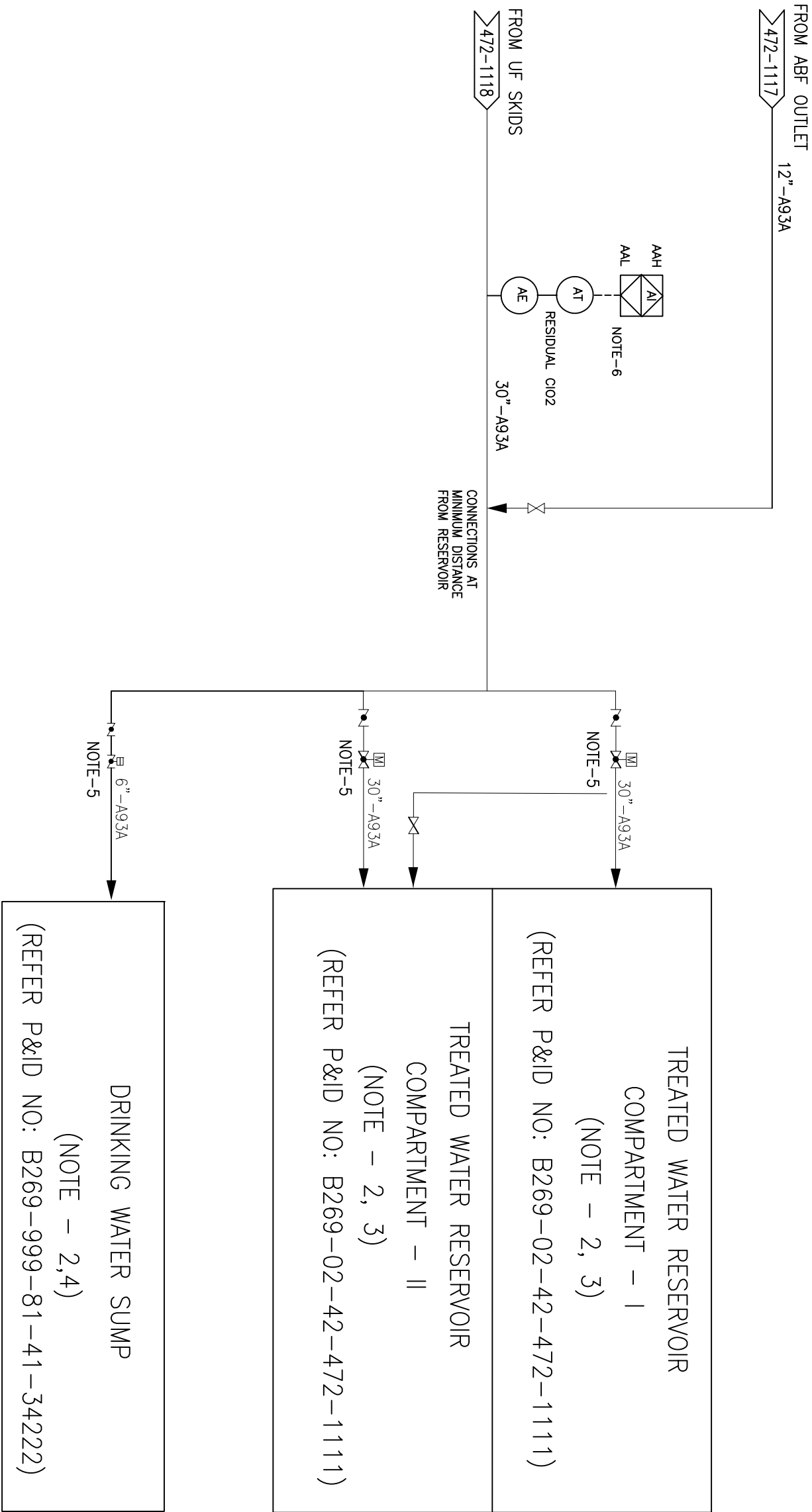
ENGINEERS  
INDIA LIMITED  
(A Unit of India Univalve)

PANIPAT REFINERY EXPANSION (P-25) PROJECT  
PANIPAT, HARYANA

PIPING & INSTRUMENTATION DIAGRAM  
BATTERY LIMITS  
RAW WATER TREATMENT PLANT

SCALE	JOB NO.	DEPT.	SECT.	UNIT	DWG. NO.	REV.
NIL	B12619	17	4	4	472	11112

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NOTES :-

1. REFER GENERAL NOTES IN P&ID NO: B269-17-44-472-1111
2. REFER SCOPE OF WORK (DOC NO: B269-472-17-44-SS-1001) FOR CONTRACTOR'S SCOPE REGARDING CONSTRUCTION OF TREATED WATER RESERVOIR AND DRINKING WATER SLUMP.
3. REFER TREATED WATER DISTRIBUTION P&ID: B269-01-41-472-1111
4. REFER DRINKING WATER P&ID No. B269-999-81-41-34222
5. VALVES SHALL OPEN/CLOSE BASED ON LEVEL IN EACH COMPARTMENT AND DRINKING WATER SLUMP.
6. DOSING OF CLO2 SHALL BE CONTROLLED TO MAINTAIN RESIDUAL CLO2 OF 0.2-0.4 PPM AT THE OUTLET

14	15	16
REF. DWG. NO.	REFERENCE DRAWING TITLE	

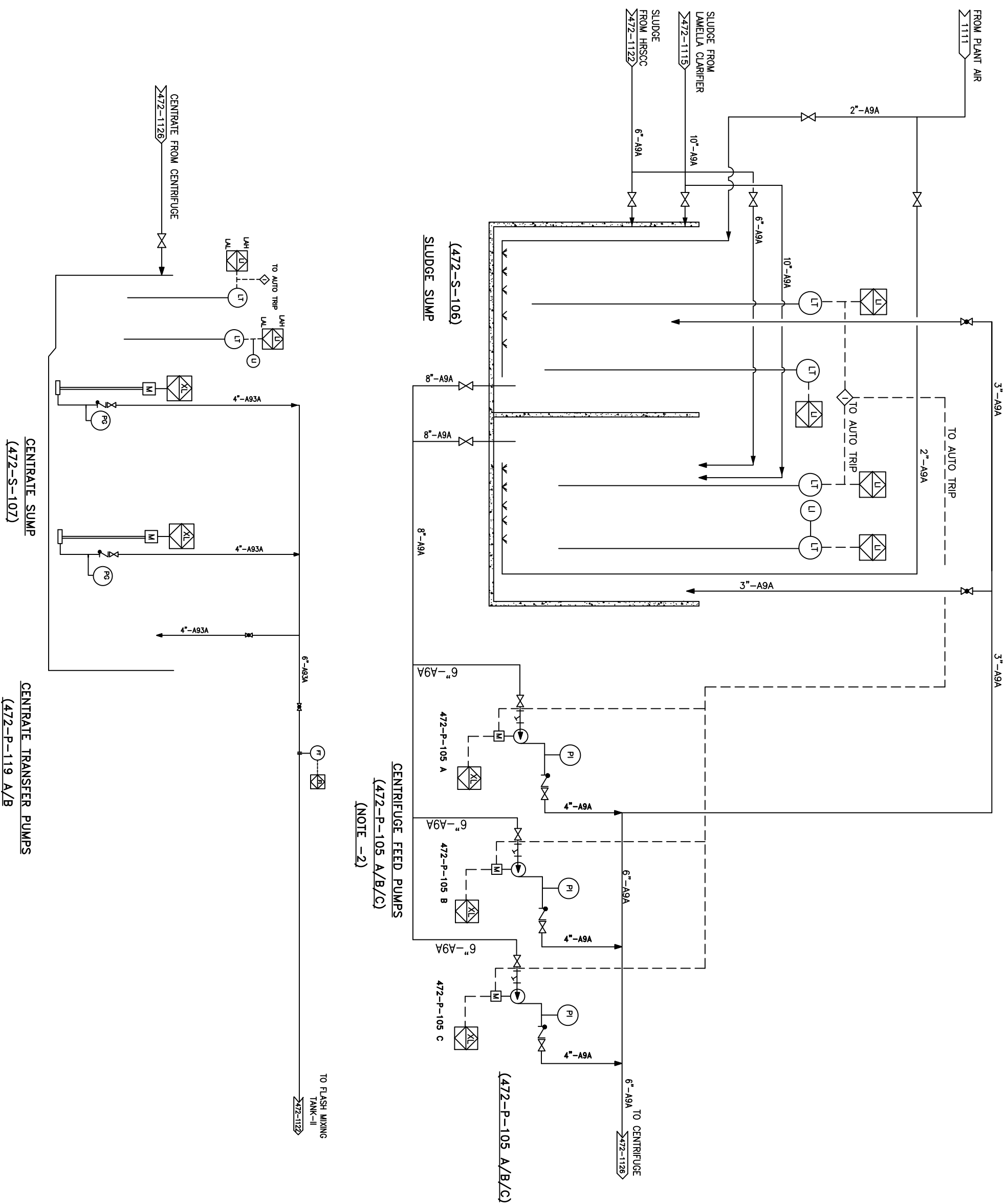
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**PANIPAT REFINERY EXPANSION (P-25) PROJECT**  
**PANIPAT, HARYANA**

ibofix çm bcl VmvesUŞİku Mkt,kzke  
PIPING & INSTRUMENTATION DIAGRAM  
TREATED WATER RESERVOIR &  
DRINKING WATER SUMP  
RAW WATER TREATMENT PLANT

	JOB NO.	DEPT.	SECT.	UNIT	DWG. NO.	REV.
SCALE						
NIL	B 2 6 9 1 7	4 4	4 7 2	1 1 1 9	2	

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NOTES :-

1. REEFER GENERAL NOTES IN P&ID NO B268-17-44-472-1111.
2. SLUDGE TRANSFER PUMPS TO BE PROVIDED IN PUMP HOUSE & 5 M3/HR OF DEWATERING PUMP WITH MCC C-CSS & I: CS & HEAD 20M TO BE PROVIDED IN THE PUMP HOUSE
3. ALL LEVEL TRANSMITTERS SHALL BE NON CONTACT RADAR TYPE

	14	15	16	
REF. DWG. NO.	REFERENCE DRAWING TITLE			
				A

[illegible]

**EQUIPMENT LIST**  
**(PLOT PLAN AND WATER DEPARTMENT)**  
**OF**  
**RO-MB BASED DM PLANT**  
**FOR**  
**PANIPAT REFINERY EXPANSION PROJECT (P-25)**  
**INDIAN OIL CORPORATION LIMITED**

4	23.02.2022	REVISED & ISSUED WITH TA-01	SC	VS	PKG
3	16.06.2021	REVISED & REISSUED FOR TENDER	SC	VS	PKG
2	24.05.2021	REVISED & REISSUED FOR TENDER	SC	VS	PKG
1	01.12.2020	REVISED & REISSUED FOR TENDER	SC	VS	PKG
0	26.05.2020	ISSUED FOR TENDER	SC	VS	PKG
A	15.04.2020	ISSUED FOR INPUTS/ COMMENTS	SC	VS	PKG
<b>Rev. No</b>	<b>Date</b>	<b>Purpose</b>	<b>Prepared by</b>	<b>Reviewed by</b>	<b>Approved by</b>



S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
A.	<b>CTBD TREATMENT SECTION</b>					
1.	B269-475-17-44-DS-1001	2W	475-T-101 A/B	Blow down Collection Tank	Effective Capacity:7475m <sup>3</sup> each Size: 23 m dia x 18 m LD + 1.0 m FB + 1.0 m DVD	CS Epoxy Painted
2.	B269-475-17-44-DS-1002	3 (2W+1S)	475-P-101 A/B/C	HRSCC-I Feed Pumps	Capacity:310 m <sup>3</sup> /h Head: 15 m	C: CS, I:CS
3.	B269-475-17-44-DS-1003	2W	475-T-102 A/B	Flash Mixing Tank-I	Effective Capacity: 22.5 m <sup>3</sup> L x B x H: 3 m x 3 m x 2.5 m SWD + 0.3 m FB	RCC Epoxy Lined
4.	B269-475-17-44-DS-1004	2W	475-MX-101 A/B	Flash Mixer-I	Diameter: 500 mm	I:SS316 L S:SS431
5.	B269-475-17-44-DS-1005	2W	475-CL-101 A/B	High Rate Solid Contact Clarifier –I	Capacity: 370 m <sup>3</sup> /h Size: 17.5m dia x 4 m SWD + 0.5 m FB	RCC Epoxy Lined
6.	B269-475-17-44-DS-1006	1W	475-T-103	Filter Feed Tank-I	Effective Capacity: 300m <sup>3</sup> L x B x H: 16 m X 6.5 m x 3 m SWD + 0.5 m FB + 0.5 DVD	RCC Epoxy Painted
7.	B269-475-17-44-DS-1007	3(2W+1S)	475-P-102 A/B/C	Filter Feed Pumps-I	Capacity:300 m <sup>3</sup> /h Head: 60 m	C: CS, I:CS
8.	B269-475-17-44-DS-1008	5(4W+1S)	475-G-101 A/B/C/D/E	Dual Media Filters (vertical)-I	Capacity: 150 m <sup>3</sup> /h each Dia: 4 m, Height.: 2.6 m (T/T) Garnet & anthracite media: As per design	CS Epoxy Coated

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
9.	B269-475-17-44-DS-1009	5(4W+1S)	475-G-102 A/B/C/D/E	Activated Carbon Filters-I	Capacity: 150 m <sup>3</sup> /h each Dia: 4.0 m, Height.: 3.6 m (T/T)	CS Epoxy Coated
10.	B269-475-17-44-DS-1010	2(1W+1S)	475-P-103 A/B	Filter Backwash Pump –I	Capacity: 230 m <sup>3</sup> /h Head: 25 m	C: CS, I:CS
11.	B269-475-17-44-DS-1011	2(1+1S)	475-K-101 A/B	Filter Air scouring blowers	Capacity: 630 Nm <sup>3</sup> /h Head: 5 m	C: CI Gr. 260 I: CI Gr. 260 S: EN-8
12.	B269-475-17-44-DS-1012	1W	475-S-101	HRSCC-ISludge Sump	Effective Capacity: 120 m <sup>3</sup> Size 10 m L X 6m W x 2 m SWD + 0.5 m FB	RCC Epoxy Coated
13.	B269-475-17-44-DS-1013	2W	475-MX-102 A/B	HRSCC- I Sludge Sump Agitator	Diameter: 1000 mm	Impeller: SS 316L Shaft : SS 431
14.	B269-475-17-44-DS-1014	2(1W+1S)	475-P-104 A/B	HRSCC-I Sludge Transfer Pumps	Capacity: 25 m <sup>3</sup> /h Head: 25 m (16 hrs working)	C: CS, I:SS 304
<b>B.</b>	<b><u>TERTIARY TREATMENT SECTION</u></b>					
15.	B269-475-17-44-DS-1015	1W	475-T-104	UF-I Feed Collection Tank	Effective Capacity:8139m <sup>3</sup> each Size: 24m Dia x 18m LD + 1.0 m DVD + 1.0 m FB	CS Epoxy Coated
16.	B269-475-17-44-DS-1016	4(3W+1S)	475-P-105 A/B/C/D	UF Feed Pumps	Capacity: 352m <sup>3</sup> /h Head: 40 m	C: CS, I:CS

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
17.	B269-475-17-44-DS-1017	4(3W+1S)	475-G-103 A/B/C/D	Auto Backwash Filters-I	Capacity: 352m <sup>3</sup> /h Rating : 200µm	Shell: CS Epoxy Coated; Mesh: SS316
18.	B269-475-17-44-DS-1018	4(3W+1S)	475-UF-101 A/B/C/D	Ultra-Filtration Skids-I (Note-1)	Capacity: 293m <sup>3</sup> /h Net permeate Flow per skid (88% recovery)	Membrane: PVDF/PES
19.	B269-475-17-44-DS-1019	1W	475-S-102	Backwash Waste Holding Sump-I	Effective Capacity: 250 m <sup>3</sup> L x B x D: 10 m x 10 m x 2.5 m SWD + 0.5 m FB	RCC Epoxy Coated
20.	B269-475-17-44-DS-1020	2(1W+1S)	475-P-106 A/B	Backwash Waste Transfer Pump -I	Capacity: 150 m <sup>3</sup> /h Head: 35 m	C: CS, I:CS
21.	B269-475-17-44-DS-1021	1W	475-T-105	RO-I Feed Tank	Effective Capacity: 3052 m <sup>3</sup> Size: 18.0 m dia x 12 m LD + 1.0 m FB + 1.0 m DVD	CS Epoxy Coated
22.	B269-475-17-44-DS-1022	3(2W+1S)	475-P-107 A/B/C	UF Backwash pumps-I	Capacity: 410 m <sup>3</sup> /h Head: 30 m	C: CS, I:CS
23.	B269-475-17-44-DS-1023	3(2W+1S)	475-P-108 A/B/C	RO-I Cartridge Filter Feed Pumps	Capacity: 500 m <sup>3</sup> /h Head: 40 m	C: SS316L, I:SS316L
24.	B269-475-17-44-DS-1024	5(4W+1S)	475-G-104 A/B/C/D/E	RO-I Cartridge Filters	Capacity: 250 m <sup>3</sup> /h Rating : 5µm absolute	Shell: CS Epoxy Coated; Cartridge Membrane: PP
25.	B269-475-17-44-DS-1025	6(4W+1S + 1SS)	475-P-109 A/B/C/D/E/F	RO-I Feed Pumps (VFD Driven)	Capacity: 250 m <sup>3</sup> /h Head: 165 m	C: SS316L, I:SS316L
26.	B269-475-17-44-DS-1026	5(4W+1S)	475-RO-101 A/B/C/D/E	Reverse Osmosis-I (RO) Skid	187.5 m <sup>3</sup> /h permeate flow each skid; 75% Recovery (Minimum)	Membrane-Polyamide / Tube: FRP/GRP (ASME)

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
27.	B269-475-17-44-DS-1027	1W	475-T-106	RO-II Feed Tank	Effective Capacity: 1980 m <sup>3</sup> Size: 14.5 m Dia x 12 m LD + 1.0 m FB + 1.0 m DVD	CS Epoxy Coated
28.	B269-475-17-44-DS-1028	6 (4W+1S + 1SS)	475-P-110 A/B/C/D/E/F	RO-II Feed Pumps (VFD Driven)	Capacity: 241 m <sup>3</sup> /h Head: 160 m	C: SS316L, I:SS316L
29.	B269-475-17-44-DS-1029	5 (4W+1S)	475-RO-102 A/B/C/D/E	Reverse Osmosis-II (RO) Skid	217 m <sup>3</sup> /h permeate flow each skid; 90% Recovery (Minimum)	Membrane-Polyamide / Tube: FRP/GRP (ASME)
30.	B269-475-17-44-DS-1030	1W	475-T-107	RO-III Feed Tank	Effective Capacity: 251 m <sup>3</sup> Size: 8 m Dia x 5.0 m LD + 0.5 m FB + 0.5 m DVD	CS Epoxy Coated
31.	B269-475-17-44-DS-1031	4 (2W+1S + 1SS)	475-P-111 A/B/C/D	RO-III Feed Pumps (VFD Driven)	Capacity: 125 m <sup>3</sup> /h Head: 250 m	C: SDSS, I:SDSS
32.	-	3 (2W+1S)	475-LZ-101 A/B/C	Turbocharger	Capacity: 43 m <sup>3</sup> /h	SDSS
33.	B269-475-17-44-DS-1032	3(2W+1S)	475-RO-103 A/B/C	Reverse Osmosis-III (RO) Skid	82 m <sup>3</sup> /h permeate flow each skid; 65% Recovery (Minimum)	Membrane-Polyamide / Tube: FRP/GRP (ASME)
34.	B269-475-17-44-DS-1033	3(2W+1S)	475-C-101 A/B/C	Degasser Tower	Capacity: 435 m <sup>3</sup> /h Dia: 3.2m, Ht: 4.0 m (T/T) Packing Height: 2 m (minimum)	CS with Glass Flake Vinyl Ester Lining Packing : PP Pall Rings
35.	B269-475-17-44-DS-1034	1W	475-T-108	Degassed Water Tank	Effective Capacity: 665 m <sup>3</sup> Size: 13 m Dia x 5 m LD + 1.0 m FB + 0.5 m DVD	CS with Glass Flake Vinyl Ester Lining

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S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
36.	B269-475-17-44-DS-1035	3(2W+1S)	475-K-102 A/B/C	Degasser Air Blowers	9350 Nm3/h, 100 mm Head (Centrifugal)	C : CS, I : CS, S: EN-8
37.	B269-475-17-44-DS-1036	7(5W+2S)	475-P-112 A/B/C/D/E/F/G	MB Feed Pumps	Capacity:170 m³/h Head: 60 m	C: SS316L , I: SS316L
38.	B269-475-17-44-DS-1037	7(5W+2S)	475-MB-101 A/B/C/D/E/F/G	Mixed Bed Exchanger	170 m3/hFeed water flow; 2.5 m Dia, Ht : 2.7 m (T/T)	CS with Glass Flake Vinyl Ester Lining
39.	B269-475-17-44-DS-1038	2(1W+1S)	475-K-103 A/B	MB Air Scouring Blowers RODM	650 Nm3/h, 5 m Head (Rotary lobe)	C : CS, I : CS, S: EN-8
40.	B269-475-17-44-DS-1039	2(1W+1S)	475-P-113 A/B	MB Regeneration Pumps for RODM	Capacity: 40 m3/h Head: 30 m	C: SS316L, I: SS316L
41.	B269-475-17-44-DS-1040			DELETED		
42.	B269-475-17-44-DS-1041			DELETED		
43.		-	-	DM Water Storage Tank	AS PER PROCESS DATASHEET	
44.		-	-	DM Water Transfer Pumps	AS PER PROCESS DATASHEET	
C.	RO REJECT RECOVERY SECTION					
45.	B269-475-17-44-DS-1042	1W	475-T-109	Flash Mixing Tank – II	Effective Capacity: 6 m³ L x B x H: 2 m x 1.5 m x 2 m SWD + 0.3 m FB	RCC Epoxy Coated
46.	B269-475-17-44-DS-1043	1W	475-MX-103	Flash Mixer – II	Diameter: 400 mm	I:SS316 L S:SS431
47.	B269-475-17-44-DS-1044	1W	475-CL-102	High Rate Solid Contact Clarifier – II	Capacity: 140 m³/h Size: 12 m Dia x 4 m SWD + 0.5 m FB	RCC Epoxy Coated

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S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
48.	B269-475-17-44-DS-1045	1W	475-S-104	HRSCC-II Sludge Sump	Effective Capacity: 80 m <sup>3</sup> Size 8 m L X 5 m W x 2.0 m SWD + 0.5 m FB	RCC Epoxy Coated
49.	B269-475-17-44-DS-1046	1W	475-MX-104 A/B	HRSCC - II Sludge Sump Agitator	Diameter: 800 mm	Impeller: SS 316L Shaft: SS 431
50.	B269-475-17-44-DS-1047	2(1W+1S)	475-P-115 A/B	HRSCC-II Sludge Transfer Pumps	Capacity: 15m <sup>3</sup> /h Head: 25 m	C: CS, I:SS 304
51.	B269-475-17-44-DS-1048	1W	475-T-110	Filter Feed Tank-II	Effective Capacity: 150 m <sup>3</sup> L x B x H: 10 m X 6 m x 2.5 m SWD + 0.5 m FB	RCC Epoxy Coated
52.	B269-475-17-44-DS-1049	2(1W+1S)	475-P-116 A/B	Filter Feed Pumps-II	Capacity:130 m <sup>3</sup> /h Head: 60 m	C:SDSS I:SDSS
53.	B269-475-17-44-DS-1050	2(1W+1S)	475-G-105 A/B	Dual Media Filters (vertical)-II	Capacity: 130 m <sup>3</sup> /h each Dia: 3.8 m, Height.: 2.6 m Garnet & anthracite media: As per design	CS GFVER Coated
54.	B269-475-17-44-DS-1051	2(1W+1S)	475-G-106 A/B	Activated Carbon Filters-II	Capacity: 130 m <sup>3</sup> /h each Dia: 3.8m, Ht.: 3.6 m (T/T)	CS GFVER Coated
55.	B269-475-17-44-DS-1052	2(1W+1S)	475-P-117 A/B	Filter Backwash Pump-II	Capacity:230m <sup>3</sup> /h Head: 25 m	C:SDSS I:SDSS
56.	B269-475-17-44-DS-1053	2(1W+1S)	475-K-104 A/B	Filter Air Scouring blowers -II	Capacity: 560 Nm <sup>3</sup> /h Head: 5 m	C: CI Gr. 260 I: CI Gr. 260 S: EN-8
57.	B269-475-17-44-DS-1054	2(1W+1S)	475-G-107 A/B	Auto Backwash Filters-II	Capacity: 130 m <sup>3</sup> /h Rating : 200µm	Shell: CS GFVER Coated; Mesh: SDSS

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
58.	B269-475-17-44-DS-1055	2(1W+1S)	475-UF-102 A/B	Ultra-Filtration Skids -II (Note-1)	Capacity: 108 m <sup>3</sup> /h Net Permeate Flow per skid (88% recovery)	Membrane: PVDF/PES
59.	B269-475-17-44-DS-1056	1W	475-S-105	Backwash Waste Holding Sump-II	Effective Capacity: 195 m <sup>3</sup> L x B x D: 10 m x 9.5 m x 2.0 m SWD + 0.5 m FB	RCC Epoxy Coated
60.	B269-475-17-44-DS-1057	2(1W+1S)	475-P-118 A/B	Backwash Waste Transfer Pump -II	Capacity: 90 m <sup>3</sup> /h Head: 25 m	C: SDSS I: SDSS
61.	B269-475-17-44-DS-1058	1W	475-T-111	RO-IV Feed Tank	Effective Capacity: 133m <sup>3</sup> Size: 6.5 m dia x 4.0 m LD + 0.5 m FB + 0.5 m DVD	CS Glass Flaked Vinyl Ester Resin Coated
62.	B269-475-17-44-DS-1059	3(2W+1S)	475-P-119 A/B/C	UF Backwash pumps-II	Capacity: 310 m <sup>3</sup> /h Head: 30 m	C: SDSS I: SDSS
63.	B269-475-17-44-DS-1060	2(1W+1S)	475-P-120 A/B	RO-IV Cartridge Filter Feed Pumps	Capacity: 108 m <sup>3</sup> /h Head: 40 m	C: SDSS I: SDSS
64.	B269-475-17-44-DS-1061	2(1W+1S)	475-G-108 A/B	RO-IV Cartridge Filters	Capacity: 108 m <sup>3</sup> /h Rating: 5µm absolute	Shell: CS GFVER Coated; Cartridge Membrane: PP
65.	B269-475-17-44-DS-1062	3(1W+1S+1 SS)	475-P-121 A/B/C	RO-IV Feed Pumps (VFD Driven)	Capacity: 59.5 m <sup>3</sup> /h Head: 500 m	C: SDSS I: SDSS
66.	-	2 (1W+1S)	475-PX-101 A/B	RO-IV Pressure Exchanger	Capacity: 48.5 m <sup>3</sup> /h	As per Mfg. Std

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
67.	B269-475-17-44-DS-1063	3(1W+1S + 1SS)	475-P-122 A/B/C	RO-IV Pressure Exchanger Booster Pump	Capacity: 48.5 m <sup>3</sup> /h Head: DDE	C: SDSS I:SDSS
68.	B269-475-17-44-DS-1064	2(1W+1S)	475-RO-104 A/B	Reverse Osmosis-IV (RO) Skid	59.5 m <sup>3</sup> /h permeate flow each skid; 55% Recovery (Minimum)	Membrane-Polyamide / Tube: FRP/GRP (ASME)
D.	<b>CHEMICAL HANDLING SECTION</b>					
69.	B269-475-17-44-DS-1065	2W	475-T-112 A/B	Antiscalant Solution Dosing Tanks	Effective Capacity: 3.14 m <sup>3</sup> each Size: 2 m dia x 1 m SWD + 0.3 m FB + 0.2 m DVD	Solid FRP
70.	B269-475-17-44-DS-1066	2(1W+1S)	475-MX-105 A/B	Antiscalant Solution Dosing Tanks Agitators	Diameter: 600 mm	Impeller: SS 316L Shaft : SS 431
71.	B269-475-17-44-DS-1067	3(2W+1S)	475-P-123 A/B/C	Antiscalant Solution Dosing Pumps for RO-I& II	Capacity: 50 LPH Head: 45 m	C: PP/PVDF, D:TEFLON
72.	B269-475-17-44-DS-1068	3(2W+1S)	475-P-124 A/B/C	Antiscalant Solution Dosing Pumps for RO-III & IV	Capacity: 100 LPH Head: 45 m	C: PP/PVDF, D:TEFLON
73.	B269-475-17-44-DS-1069	3(2W+1S)	475-P-125 A/B/C	Antiscalant Solution Dosing Pumps for ZLD Evaporator	Capacity: 25 LPH Head: 45 m	C: PP/PVDF, D:TEFLON
74.	B269-475-17-44-DS-1070	2W	475-T-113	Sodium Bisulphite Solution Dosing Tanks	Effective Capacity: 1.2 m <sup>3</sup> each Size: 1.25 m dia x 1 m SWD + 0.3 m FB + 0.2 DVD	Solid FRP



S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
75.	B269-475-17-44-DS-1071	2(1W+1S)	475-MX-106 A/B	Sodium Bisulphite Solution Dosing Tanks Agitators	Diameter: 300 mm	Impeller: SS 316L Shaft : SS 431
76.	B269-475-17-44-DS-1072	2(1W+1S)	475-P-126 A/B	Sodium Bisulphite Solution Dosing Pumps	Capacity: 60 LPH Head: 50 m	C: PP/PVDF, D:TEFLON
77.	B269-475-17-44-DS-1073	2 (1W+1S)	475-T-114 A/B	Acid Dilution/ Measuring Tanks for MB	Effective Capacity: 1.5 m <sup>3</sup> each Size: 1.4 m dia x 1.0 m LD + 0.3 m FB each + 0.2 m DVD	FRP (Vinyl ester lining)
78.	B269-475-17-44-DS-1074	2 (1W+1S)	475-T-115 A/B	Caustic Dilution/ Measuring Tanks for MB	Effective Capacity: 1.5 m <sup>3</sup> each Size: 1.4 m dia x 1.0 m LD + 0.3 m FB each + 0.2 m DVD	KCS (PWHT)
79.	B269-475-17-44-DS-1075	2(1W+1S)	475-P-127 A/B	Caustic Dosing Pump for RO-II	Capacity: 50 LPH Head: 45 m	C: PP/PVDF, D:TEFLON
80.	B269-475-17-44-DS-1076	3(2W+1S)	475-LZ-102 A/B/C	Centrifuge	Capacity: 30 m <sup>3</sup> /h	Bowl: SS316 Shaft/Scroll: SS316
81.	B269-475-17-44-DS-1077	1W	475-T-116	RO Cleaning Tank	Effective Capacity: 10 m <sup>3</sup> Size: 3 m dia x 1.5 m SWD + 0.5 m DVD + 0.5 m FB	Solid FRP
82.	B269-475-17-44-DS-1078	1W	475-MX-107	RO Cleaning Tank Agitator	Diameter: 1000 mm	Impeller: SS 316L Shaft : SS 431
83.	B269-475-17-44-DS-1079	2(1W+1S)	475-P-128 A/B	RO Cleaning Circulation Pumps	Capacity: 150 m <sup>3</sup> /h, 40 m head	C : SS 316L, I : SS 316 L
84.	B269-475-17-44-DS-1080	1	475-G-109	RO Cleaning Cartridge filters	Capacity: 150 m <sup>3</sup> /h Rating : 5 µm (Absolute)	Shell: CSEP, Cartridge Membrane: PP

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
85.	B269-475-17-44-DS-1081			DELETED		
86.	B269-475-17-44-DS-1082			DELETED		
87.	B269-475-17-44-DS-1083	2W	475-T-118 A/B	FeCl <sub>3</sub> Solution Dosing Tank (10%)(COMMON FOR RODM/ZLD)	Effective Capacity: 3.77 m <sup>3</sup> each Size: 2 m dia x 1.2 m SWD + 0.3 m FB + 0.2 m DVD	Solid FRP
88.	B269-475-17-44-DS-1084	2W	475-MX-108 A/B	FeCl <sub>3</sub> Solution Dosing Tank Agitators	Diameter: 600 mm	Impeller: SS 316L Shaft : SS 431
89.	B269-475-17-44-DS-1085	3(2W+1S)	475-P-130 A/B/C	FeCl <sub>3</sub> Solution Dosing Pumps for HRSCC-I & UF-I	Capacity: 120 LPH Head: 15 m	C: PP/PVDF, D:TEFLON
90.	B269-475-17-44-DS-1086	3(2W+1S)	475-P-131 A/B/C	FeCl <sub>3</sub> Solution Dosing Pumps for HRSCC-II & UF-II	Capacity: 30 LPH Head: 15 m	C: PP/PVDF, D:TEFLON
91.	B269-475-17-44-DS-1087	2W	475-T-119 A/B	Lime Solution Dosing Tank	Effective Capacity: 63.5 m <sup>3</sup> each L x B x H: 4.6 m x 4.6 m x 3 m LD + 0.2 m DVD + 0.3 m FB each	RCC with Acid/ Alkali Resistant Proof Tiling
92.	B269-475-17-44-DS-1088	2W	475-MX-109 A/B	Lime Solution Dosing tank Agitator	Diameter: 1500 mm	Impeller: SS 316L Shaft : SS 431
93.	B269-475-17-44-DS-1089	3(2W+1S)	475-P-133 A/B	Lime Solution Dosing Pumps for RODM HRSCC-I& II	Capacity:200 LPH Head: 20 m	C: SS304, I: SS304

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
94.	B269-475-17-44-DS-1090	2W	475-T-120A/B	Polyelectrolyte Solution Dosing Tank (COMMON FOR RODMZLD)	Effective Capacity: 27.47 m <sup>3</sup> each Size: 3.6 m dia x 2.7 m LD + 0.3 m FB each + 0.2 m DVD	Solid FRP
95.	B269-475-17-44-DS-1091	2W	475-MX-110 A/B	Polyelectrolyte Solution Dosing tank Agitator	Diameter: 1200 mm	Impeller: SS 316L Shaft : SS 431
96.	B269-475-17-44-DS-1092	2(1W+1S)	475-P-134 A/B	Polyelectrolyte Solution Dosing Pumps for RODM HRSCC-I	Capacity: 2 m <sup>3</sup> /h Head: 20 m	C: PP/PVDF, D:TEFLON
97.	B269-475-17-44-DS-1093	2(1W+1S)	475-P-135 A/B	Polyelectrolyte Solution Dosing Pumps for RODM HRSCC-II	Capacity: 500 LPH Head: 20 m	C: PP/PVDF, D:TEFLON
98.	B269-475-17-44-DS-1094	2W	475-T-121 A/B	Soda Ash Solution Dosing Tanks(COMMON FOR RODM/ZLD)	Effective Capacity:37.7 m <sup>3</sup> each Size: 4 m dia x 3 m LD + 0.3 m FB + 0.2 m DVD	Solid FRP
99.	B269-475-17-44-DS-1095	2W	475-MX-111 A/B	Soda Ash Solution Dosing Tanks Agitators	Diameter: 1000 mm	Impeller: SS 316L Shaft : SS 431
100.	B269-475-17-44-DS-1096	3(2W+1S)	475-P-136 A/B/C	Soda Ash Solution Dosing Pumps RODM HRSCC-I & II	Capacity: 100 LPH Head:20 m	C: PP/PVDF, D:TEFLON
101.	B269-475-17-44-DS-1097	2(1W+1S)	475-P-137 A/B	HCl Unloading and Transfer Pump	Capacity: 15 m <sup>3</sup> /h Head: 15 m	C: PP, I:PP
102.	B269-475-17-44-DS-1098	2W	475-T-122 A/B	HCL Bulk Storage Tank	Effective Capacity: 78.5 m <sup>3</sup> each Size: 5 m dia x 4 m LD + 0.5 m FB + 0.5 DVD	Solid FRP

EQUIPMENT LIST FOR RODM PLANT  
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103.	B269-475-17-44-DS-1099	2(1W+1S)	475-P-138A/B	HCl Dosing Pumps for RO-I	Capacity: 50 LPH Head: 40 m	C: PP/PVDF, D:TEFLON
104.	B269-475-17-44-DS-1100	3(2W+1S)	475-P-139A/B/C	HCl Dosing Pumps for RO-III & IV	Capacity: 20 LPH Head:40 m	C: PP/PVDF, D:TEFLON
105.	B269-475-17-44-DS-1101	3 (2W+1S)	475-P-140 A/B/C	HCl Dosing Pumps for RODM HRSCC-I and HRSCC-II	Capacity: 30 LPH Head: 20 m	C: PP/PVDF, D:TEFLON
106.	B269-475-17-44-DS-1102	2(1W+1S)	475-P-141 A/B	Caustic Unloading and Transfer Pump	Capacity: 15 m <sup>3</sup> /h Head: 15 m	C : SS 316L, I : SS 316 L
107.	B269-475-17-44-DS-1103	1W	475-T-123	Caustic bulk storage tank (40%)	Effective Capacity: 407 m <sup>3</sup> each Size: 9 m dia x 6.4 m LD + 1.0 m FB + 0.5 DVD	KCS (PWHT)
108.	B269-475-17-44-DS-1104	2W	475-T-124 A/B	Caustic Dilution/ storage tank (20%)	Effective Capacity: 407 m <sup>3</sup> each Size: 9 m dia x 6.4 m LD + 1.0 m FB + 0.5 DVD	KCS (PWHT)
109.	B269-475-17-44-DS-1105	2(1W+1S)	475-P-142 A/B	Caustic Transfer Pumps	Capacity: 20 m <sup>3</sup> /h Head: 60 m	C: SS 316L, I : SS 316 L
110.	B269-475-17-44-DS-1106	2W	475-T-125 A/B	CEB-I (Acid) Dosing Tanks for UF	Effective Capacity: 0.4 m <sup>3</sup> Size: 1 m dia x 0.5 m LD + 0.2 m DVD + 0.3 m FB each	Solid FRP
111.	B269-475-17-44-DS-1107	2(1W+1S)	475-P-143 A/B	CEB-I (HCl) Dosing Pump UF-I	Capacity: 1500 LPH Head: 35 m	C: PP/PVDF, D:TEFLON
112.	B269-475-17-44-DS-1108	2(1W+1S)	475-P-144 A/B	CEB- I (HCl) Dosing Pump UF-II	Capacity: 600 LPH Head: 35 m	C: PP/PVDF, D:TEFLON

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
113.	B269-475-17-44-DS-1109	2W	475-T-126 A/B	CEB-II (Caustic) Dosing Tanks for UF (20%)	Effective Capacity: 0.4 m <sup>3</sup> Size: 1 m dia x 0.5 m LD + 0.2 m DVD + 0.3 m FB each	Solid FRP
114.	B269-475-17-44-DS-1110	2(1W+1S)	475-P-145 A/B	CEB- II (NaOH) Dosing Pump UF-I	Capacity: 4 m <sup>3</sup> /h Head: 35 m	C: PP/PVDF, D:TEFLON
115.	B269-475-17-44-DS-1111	2(1W+1S)	475-P-146 A/B	CEB- II (NaOH) Pump UF-II	Capacity: 150 LPH Head: 35 m	C: PP/PVDF, D:TEFLON
116.	B269-475-17-44-DS-1112	2W	475-T-127 A/B	CEB-III (NaOCl) Dosing Tanks for UF	Effective Capacity: 0.4 m <sup>3</sup> Size: 1 m dia x 0.5 m LD + 0.2 m DVD + 0.3 m FB each	Solid FRP
117.	B269-475-17-44-DS-1113	2(1W+1S)	475-P-147 A/B	CEB-III (NaOCl)Dosing Pump UF-I	Capacity: 1500 LPH Head: 35 m	C: PP/PVDF, D:TEFLON
118.	B269-475-17-44-DS-1114	2(1W+1S)	475-P-148 A/B	CEB-III (NaOCl) Dosing Pump UF-II	Capacity: 500 LPH Head: 35 m	C: PP/PVDF, D:TEFLON
119.	B269-475-17-44-DS-1115	2W	475-T-128 A/B	DWPE (Chemical) Solution Dosing Tanks	Effective Capacity: 37.7 m <sup>3</sup> each Size: 4 m dia, 3 m LD + 0.2 m DVD + 0.3 m FB each	Solid FRP
120.	B269-475-17-44-DS-1116	2W	475-MX-112 A/B	DWPE (Chemical) Solution Dosing Tanks Agitators	Diameter: 1200 mm	Impeller: SS 316L Shaft : SS 431
121.	B269-475-17-44-DS-1117	2(1W+1S)	475-P-149 A/B	DWPE (Chemical) Solution Dosing Pumps	Capacity: 3m <sup>3</sup> /h Head: 20 m	C: SS304 L, I: SS304 L

S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
122.	B269-475-17-44-DS-1118	2W	475-T-129 A/B	Morpholine Dosing Tank RODM & CPU	Effective Capacity: 1 m <sup>3</sup> Size: 1.0 m dia x 1.3 m LD + 0.3 m FB each + 0.2 m DVD	SS 316 L
123.	B269-475-17-44-DS-1119	2(1W+1S)	475-P-150 A/B	Morpholine Dosing Pump RODM	Capacity: 60 LPH Head: 20 m	C: SS304 L, D: PTFE
124.	-	2	475-LZ-103 A/B	Lime Slaker System	Capacity: 25 m <sup>3</sup> /h	DDE
125.	B269-475-17-44-DS-1121	2(1W+1S)	475-P-132 A/B	Lime Slaker Pumps	Capacity: During Detail Engineering Head : 15 m	C:SS316 I:SS316
126.	B269-475-17-44-DS-1122	1	475-S-106	Centrate Sump-I (HRSCC-I)	Effective Capacity: 40 m <sup>3</sup> L x B x D: 4 m x 5 m x 2.0 m SWD + 0.5 m FB	RCC Epoxy Coated
127.	B269-475-17-44-DS-1123	2(1W+1S)	475-P-151 A/B	Centrate Transfer Pump-I (HRSCC-I)	Capacity: 30 m <sup>3</sup> /h Head : 30 m	C: CS I: CS
128.	B269-475-17-44-DS-1124	1	475-S-107	Centrate Sump-II (HRSCC-II)	Effective Capacity: 40 m <sup>3</sup> L x B x D: 4 m x 5 m x 2.0 m SWD + 0.5 m FB	RCC Epoxy Coated
129.	B269-475-17-44-DS-1125	2(1W+1S)	475-P-152 A/B	Centrate Transfer Pump-II (HRSCC-II)	Capacity: 30 m <sup>3</sup> /h Head : 30 m	C:SDSS I:SDSS
130.	B269-475-17-44-DS-1126	1	475-S-108	Centrate Sump-III (Lime Soda Clarifer)	Effective Capacity: 40 m <sup>3</sup> L x B x D: 4 m x 5 m x 2.0 m SWD + 0.5 m FB	RCC Epoxy Coated


S. NO.	DATASHEET NO	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE/SPECIFICATION (EACH UNIT)	MOC
131.	B269-475-17-44-DS-1127	2(1W+1S)	475-P-153 A/B	Centrate Transfer Pump-III (Lime Soda Clarifer)	Capacity: 30 m <sup>3</sup> /h Head : 30 m	C:SDSS I:SDSS
132.		2(1W+1S)	475-T-130 A/B	Chemical Dosing Tank	Effective Capacity: 1 m <sup>3</sup> Size: 1.0 m dia x 1.3 m LD + 0.3 m FB each + 0.2 m DVD	Solid FRP
133.		2(1W+1S)	475-P-154 A/B	Chemical Dosing Pump	Capacity: DDE Head : DDE	C: PP/PVDF, D:TEFLON
<b>E.</b>	<b><u>BUILDINGS</u></b>					
134.	B269-475-17-44-DS-1120	1	475-CH-101	CHEMICAL HOUSE	40.0m [L] x 30.0m [W] x 12.0 m [H] (Minimum)	RCC frame structure + Brick work
135.	-	1	-	UF-RO-MB SHED	50 m W x 100 m L X 6 m Clear Height	Precoated galvalume steel sheet roofing and side cladding
136.	-	1	-	CONTROL BUILDING (FOR RODM/CPU/ZLD)	AS PER ENGINEERING STANDARDS	RCC frame structure + Brick work
137.	-	1	-	CENTRIFUGE BUILDING	10 m [L] x 8 m [W] x 6m [H] (Minimum)	RCC column structure with shed on the first floor
138.	-	1	-	DEGASSER TOWER STRUCTURE	25 m [L] x 15 m [W] x 14.0 m [H] (Minimum)	RCC column structure

**NOTES:**


1. ***Cleaning in Place (CIP) system if recommended by the UF supplier(s), to be included for UF Skids. Facility details of the same shall be confirmed by the Contractor and included in the scope of works. Additional Tank(s) may be provided for each chemical used in chemical cleaning of membrane filtration skids if recommended by system supplier. Same shall be in the scope of the Contractor.***
2. ***All other equipment described elsewhere in the tender document (including technical & process specifications, drawings etc.), and/or as required to make the plant complete from trouble free operation & safety point of view, but not listed above shall also be deemed to have been included in the RWTP Contractor's scope of work.***
3. ***W: Working; SB: Stand by; L: Length; B: Breadth/Width; H: Height; SWD: Side Water Depth; D: Depth; DDE: During Detail Engineering; I: Impeller; S: Shaft; EP: Epoxy Painted; EL: Epoxy Lined; SDSS: Super Duplex Stainless Steel; GFVER: Glass Flaked Vinyl Ester Resin***
4. ***All other works including civil, mechanical, electrical, piping, instrumentation, construction, erection, testing, painting works, etc., shall be as per the tender requirements.***
5. ***The sizes specified in the equipment list are minimum requirements. Vendor to confirm the same during detailed engineering.***
6. ***Equipment list shall be updated during detail engineering based on UF and RO membrane supplier's recommendation.***
7. ***HRSCC – I & II Sludge Transfer Pumps shall be provided in a common underground pump house. The pump house shall be provided with a clear height of 3 m above the finished floor level. Monorail of adequate capacity and a dewatering pit and dewatering pump shall be considered in the pumphouse.***








FILTER FEED PUMPS-I					
PROJECT : PANIPAT REFINERY EXPANSION		CLIENT : IOCL		JOB NO. : B269	
UNIT : RO-MB BASED DM PLANT		UNIT NO.: 475		ITEM NO.: 475-P-102 A/B/C	
SERVICE : TO FEED CLARIFIED WATER TO DMF & ACF					
TYPE : CENTRIFUGAL, HORIZONTAL					
PROPERTIES OF LIQUID					
LIQUID HANDLED			CLARIFIED WATER		
PUMPING TEMPERATURE (°C)			AMBIENT		
VISCOSITY AT PUMPING TEMPERATURE (cp)			1.0		
LIQUID DENSITY (kg/m³)			~1000		
PRESENCE OF CORROSIVE / TOXIC COMPONENTS			YES		
SOLIDS IN SUSPENSION (YES / NO)			YES		
SIZE OF SOLID PARTICLES (mm)(MAX)			NOTE-1		
OPERATING CONDITIONS					
FLOW RATE		RATED (MAX.) (m3/hr)		300 (NOTE-6) <span style="border: 1px solid black; padding: 2px;">3</span>	
		NORMAL(m3/hr)		NOTE-1	
		MIN. (m3/hr)		NOTE-1	
SUCTION PRESSURE (kg/cm2.a)			ATM. + LD		
MAXIMUM SUCTION PRESSURE (kg/cm2.g)			NOTE-1		
DISCHARGE PRESSURE (kg/cm2.a)			5.5		
DIFFERENTIAL PRESSURE (kg/cm2.g)			4.5		
MINIMUM DIFFERENTIAL HEAD (m)			45 (NOTE-6) <span style="border: 1px solid black; padding: 2px;">3</span>		
NPSH AVAILABLE (m) MIN.			FLOODED SUCTION		
NO. OF PUMPS			3 (2W+1S)		
CAPACITY CONTROL FOR VOLUMETRIC PUMPS					
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC			N.A.		
TYPE			N.A.		
RANGE (%)			N.A.		
PRECISION AT MIN. RATE (%)			N.A.		
MECHANICAL DATA					
DESIGN PRESSURE (kg/cm2.g)			7.0		
DESIGN TEMPERATURE (°C)			65		
MATERIAL CODE		CASING		CS	
		IMPELLER		CS	
SEAL TYPE (MECHANICAL / PACKING)			MECHANICAL		
LINE RATING IN / OUT			150# / 150#		
DRIVER			ELECTRIC MOTOR		
NOTES:					
1	TO BE FURNISHED/ CONFIRMED BY THE CONTRACTOR.				
2	THE PUMP MOTOR SHALL BE DESIGNED FOR OPEN DISCHARGE CONDITION.				
3	THE PUMP SHALL BE CAPABLE OF AUTO START / STOP OPERATION.				
4	THE PUMPS SHALL BE ABLE TO MEET REQUIRED PLANT T/D FLOW REQUIREMENTS.				
5	THE PUMPS SHALL BE SELECTED FOR PARALLEL OPERATION.				
6	Rated Capacity and minimum differential head indicated for pump is minimum requirement and can be increased by the Bidder as per requirement during detail engineering. <span style="border: 1px solid black; padding: 2px;">3</span>				
3	10.01.2022	REVISED & ISSUED WITH TA-01	SC	VS	PKG
2	24.05.2021	REISSUED FOR TENDER	SC	VS	PKG
1	23.11.2020	REISSUED FOR TENDER	SC	VS	PKG
0	21.05.2020	ISSUED FOR TENDER	SC	VS	PKG
A	23.04.2020	ISSUED FOR INPUTS/ COMMENTS	SC	VS	PKG
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
		ENGINEERS INDIA LIMITED NEW DELHI	FILTER FEED PUMPS-I	PROCESS DATA SHEET B269-475-17-44-DS-1007	REV. 3


RO-I CARTRIDGE FILTER FEED PUMPS					
PROJECT : PANIPAT REFINERY EXPANSION		CLIENT : IOCL		JOB NO. : B269	
UNIT : RO-MB BASED DM PLANT		UNIT NO.: 475		ITEM NO.: 475-P-108 A/B/C	
SERVICE : TO FEED WATER TO RO-I CARTRIDGE FILTERS					
TYPE : CENTRIFUGAL, HORIZONTAL					
PROPERTIES OF LIQUID					
LIQUID HANDLED			UF PERMEATE WATER		
PUMPING TEMPERATURE ( $^{\circ}$ C)			AMBIENT		
VISCOSITY AT PUMPING TEMPERATURE (cp)			1.0		
LIQUID DENSITY ( $\text{kg/m}^3$ )			~1000		
PRESENCE OF CORROSIVE / TOXIC COMPONENTS			YES		
SOLIDS IN SUSPENSION (YES / NO)			YES		
SIZE OF SOLID PARTICLES (mm)(MAX)			NOTE-1		
OPERATING CONDITIONS					
FLOW RATE		RATED (MAX.) (m3/hr)		500 (NOTE-6) $\triangle 3$	
		NORMAL(m3/hr)		NOTE-1	
		MIN. (m3/hr)		NOTE-1	
SUCTION PRESSURE (kg/cm2.a)			ATM. + LD		
MAXIMUM SUCTION PRESSURE (kg/cm2.g)			NOTE-1		
DISCHARGE PRESSURE (kg/cm2.a)			5		
DIFFERENTIAL PRESSURE (kg/cm2.g)			4		
MINIMUM DIFFERENTIAL HEAD (m)			40 (NOTE-6) $\triangle 3$		
NPSH AVAILABLE (m) MIN.			FLOODED SUCTION		
NO. OF PUMPS			3 (2W+1S)		
CAPACITY CONTROL FOR VOLUMETRIC PUMPS					
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC			N.A.		
TYPE			N.A.		
RANGE (%)			N.A.		
PRECISION AT MIN. RATE (%)			N.A.		
MECHANICAL DATA					
DESIGN PRESSURE (kg/cm2.g)			7.0		
DESIGN TEMPERATURE ( $^{\circ}$ C)			65		
MATERIAL CODE		CASING		SS316L	
		IMPELLER		SS316L	
SEAL TYPE (MECHANICAL / PACKING)			PACKING		
LINE RATING IN / OUT			150# / 150#		
DRIVER			ELECTRIC MOTOR		
NOTES:					
1	TO BE FURNISHED/ CONFIRMED BY THE CONTRACTOR.				
2	THE PUMP MOTOR SHALL BE DESIGNED FOR OPEN DISCHARGE CONDITION.				
3	THE PUMP SHALL BE CAPABLE OF AUTO START / STOP OPERATION.				
4	THE PUMPS SHALL BE ABLE TO MEET REQUIRED PLANT T/D FLOW REQUIREMENTS.				
5	THE PUMPS SHALL BE SELECTED FOR PARALLEL OPERATION.				
6	Rated Capacity and minimum differential head indicated for pump is minimum requirement and can be increased by the Bidder as per requirement during detail engineering. $\triangle 3$				
3	10.01.2022	REVISED & ISSUED WITH TA-01	SC	VS	PKG
2	24.05.2021	REVISED & REISSUED FOR TENDER	SC	VS	PKG
1	01.12.2020	REVISED & REISSUED FOR TENDER	SC	VS	PKG
0	21.05.2020	ISSUED FOR TENDER	SC	VS	PKG
A	23.04.2020	ISSUED FOR INPUTS/ COMMENTS	SC	VS	PKG
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
		ENGINEERS INDIA LIMITED NEW DELHI	RO-I CARTRIDGE FILTER FEED PUMPS	PROCESS DATA SHEET B269-475-17-44-DS-1023	REV. 3

RO-I FEED PUMPS					
PROJECT : PANIPAT REFINERY EXPANSION		CLIENT : IOCL		JOB NO. : B269	
UNIT : RO-MB BASED DM PLANT		UNIT NO.: 475		ITEM NO.: 475-P-109 A/B/C/D/E/F	
SERVICE : TO FEED WATER TO INDIVIDUAL RO-I SKIDS					
TYPE : CENTRIFUGAL, HORIZONTAL					
PROPERTIES OF LIQUID					
LIQUID HANDLED			CARTRIDGE FILTER OUTLET WATER		
PUMPING TEMPERATURE ( $^{\circ}$ C)			AMBIENT		
VISCOSITY AT PUMPING TEMPERATURE (cp)			1.0		
LIQUID DENSITY (kg/m <sup>3</sup> )			~1000		
PRESENCE OF CORROSIVE / TOXIC COMPONENTS			YES		
SOLIDS IN SUSPENSION (YES / NO)			YES		
SIZE OF SOLID PARTICLES (mm)(MAX)			NOTE-1		
OPERATING CONDITIONS					
FLOW RATE		RATED (MAX.) (m3/hr)		250 (NOTE-5) $\triangle 3$	
		NORMAL(m3/hr)		NOTE-1	
		MIN. (m3/hr)		NOTE-1	
SUCTION PRESSURE (kg/cm2.a)		2.0 (NOTE-4) $\triangle 3$			
MAXIMUM SUCTION PRESSURE (kg/cm2.g)		NOTE-1			
DISCHARGE PRESSURE (kg/cm2.a)		18.5 (NOTE-4) (MINIMUM)		$\triangle 3$	
DIFFERENTIAL PRESSURE (kg/cm2.g)		16.5 (NOTE-4) (MINIMUM)		$\triangle 3$	
MINIMUM DIFFERENTIAL HEAD (m)		165 (NOTE-5)			
NPSH AVAILABLE (m) MIN.		FLOODED SUCTION			
NO. OF PUMPS		6 (4W+1S + 1 SS)			
CAPACITY CONTROL FOR VOLUMETRIC PUMPS					
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC		VFD			
TYPE		NOTE-1			
RANGE (%)		NOTE-1			
PRECISION AT MIN. RATE (%)		NOTE-1			
MECHANICAL DATA					
DESIGN PRESSURE (kg/cm2.g)		24.5 (NOTE-1) $\triangle 3$			
DESIGN TEMPERATURE ( $^{\circ}$ C)		65			
MATERIAL CODE		CASING		SS316L	
		IMPELLER		SS316L	
SEAL TYPE (MECHANICAL / PACKING)		MECHANICAL			
LINE RATING IN / OUT		150# / 300# (NOTE-1)			
DRIVER		ELECTRIC MOTOR			
NOTES:					
1	TO BE FURNISHED/ CONFIRMED BY THE CONTRACTOR.				
2	THE PUMPS SHALL BE ABLE TO MEET REQUIRED PLANT T/D FLOW REQUIREMENTS.				
3	PUMPS SHALL BE PROVIDED WITH VARIABLE FREQUENCY DRIVE MOTORS IN ORDER TO MEET VARIABLE PRESSURE REQUIREMENT. THE VFD SHALL BE PROVIDED FOR ALL THE INSTALLED PUMPS.				
4	THE RO-I FEED PUMP MOTOR & HEAD SHALL BE DESIGNED FOR PRESSURE REQUIREMENT OF ATLEAST 2 APPROVED MAKES OF RO-I MEMBRANES AT THE END OF THIRD YEAR AT 15 DEG C DESIGN WATER TEMPERATURE AND 2.0 KG/CM2.G RO-I PERMEATE PRESSURE				
5	Rated Capacity and minimum differential head indicated for pump is minimum requirement and can be increased by the Bidder as per requirement during detail engineering. $\triangle 3$				
3	10.01.2022	REVISED & ISSUED WITH TA-01	SC	VS	PKG
2	24.05.2021	REVISED & REISSUED FOR TENDER	SC	VS	PKG
1	01.12.2020	REISSUED FOR TENDER	SC	VS	PKG
0	21.05.2020	ISSUED FOR TENDER	SC	VS	PKG
A	23.04.2020	ISSUED FOR INPUTS/ COMMENTS	SC	VS	PKG
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
		ENGINEERS INDIA LIMITED NEW DELHI	RO-I FEED PUMPS	PROCESS DATA SHEET B269-475-17-44-DS-1025	REV. 3



RO-II FEED PUMPS					
PROJECT : PANIPAT REFINERY EXPANSION		CLIENT : IOCL		JOB NO. : B269	
UNIT : RO-MB BASED DM PLANT		UNIT NO.: 475		ITEM NO.: 475-P-110 A/B/C/D/E/F	
SERVICE : TO FEED WATER TO INDIVIDUAL RO-II SKIDS					
TYPE : CENTRIFUGAL, HORIZONTAL					
PROPERTIES OF LIQUID					
LIQUID HANDLED				RO PERMEATE	
PUMPING TEMPERATURE ( $^{\circ}$ C)				AMBIENT	
VISCOSITY AT PUMPING TEMPERATURE (cp)				1.0	
LIQUID DENSITY (kg/m <sup>3</sup> )				~1000	
PRESENCE OF CORROSIVE / TOXIC COMPONENTS				YES	
SOLIDS IN SUSPENSION (YES / NO)				YES	
SIZE OF SOLID PARTICLES (mm)(MAX)				NOTE-1	
OPERATING CONDITIONS					
FLOW RATE		RATED (MAX.) (m3/hr)		241 (NOTE-5) $\triangle 3$	
		NORMAL(m3/hr)		NOTE-1	
		MIN. (m3/hr)		NOTE-1	
SUCTION PRESSURE (kg/cm2.a)				ATM + LD	
MAXIMUM SUCTION PRESSURE (kg/cm2.g)				NOTE-1	
DISCHARGE PRESSURE (kg/cm2.a)				17 (NOTE-4) (MINIMUM)	
DIFFERENTIAL PRESSURE (kg/cm2.g)				16(NOTE-4) (MINIMUM) $\triangle 3$	
MINIMUM DIFFERENTIAL HEAD (m)				160 (NOTE-5)	
NPSH AVAILABLE (m) MIN.				FLOODED SUCTION	
NO. OF PUMPS				6 (4W+1S + 1 SS)	
CAPACITY CONTROL FOR VOLUMETRIC PUMPS					
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC				VFD	
TYPE				NOTE-1	
RANGE (%)				NOTE-1	
PRECISION AT MIN. RATE (%)				NOTE-1	
MECHANICAL DATA					
DESIGN PRESSURE (kg/cm2.g)				22.5 (NOTE-1) $\triangle 3$	
DESIGN TEMPERATURE ( $^{\circ}$ C)				65	
MATERIAL CODE		CASING		SS316L	
		IMPELLER		SS316L	
SEAL TYPE (MECHANICAL / PACKING)				MECHANICAL	
LINE RATING IN / OUT				150# / 300# (NOTE-1)	
DRIVER				ELECTRIC MOTOR	
NOTES:					
1	TO BE FURNISHED/ CONFIRMED BY THE CONTRACTOR.				
2	THE PUMPS SHALL BE ABLE TO MEET REQUIRED PLANT T/D FLOW REQUIREMENTS.				
3	PUMPS SHALL BE PROVIDED WITH VARIABLE FREQUENCY DRIVE MOTORS IN ORDER TO MEET VARIABLE PRESSURE REQUIREMENT. THE VFD SHALL BE PROVIDED FOR ALL THE INSTALLED PUMPS.				
4	THE RO-II FEED PUMP MOTOR & HEAD SHALL BE DESIGNED FOR PRESSURE REQUIREMENT OF ATLEAST 2 APPROVED MAKES OF RO-II MEMBRANES AT THE END OF THIRD YEAR AT 15 DEG C DESIGN WATER TEMPERATURE AND 2.0 KG/CM2.G RO-II PERMEATE PRESSURE				
5	Rated Capacity and minimum differential head indicated for pump is minimum requirement and can be increased by the Bidder as per requirement during detail engineering. $\triangle 3$				
3	10.01.2022	REVISED & ISSUED WITH TA-01	SC	VS	PKG
2	24.05.2021	REISSUED FOR TENDER	SC	VS	PKG
1	23.11.2020	REISSUED FOR TENDER	SC	VS	PKG
0	21.05.2020	ISSUED FOR TENDER	SC	VS	PKG
A	23.04.2020	ISSUED FOR INPUTS/ COMMENTS	SC	VS	PKG
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
		ENGINEERS INDIA LIMITED NEW DELHI	RO-II FEED PUMPS	PROCESS DATA SHEET B269-475-17-44-DS-1028	REV. 3

RO-III FEED PUMPS					
PROJECT : PANIPAT REFINERY EXPANSION		CLIENT : IOCL		JOB NO. : B269	
UNIT : RO-MB BASED DM PLANT		UNIT NO.: 475		ITEM NO.: 475-P-111 A/B/C/D	
SERVICE : TO FEED WATER TO INDIVIDUAL RO-III SKIDS					
TYPE : CENTRIFUGAL, HORIZONTAL					
PROPERTIES OF LIQUID					
LIQUID HANDLED				RO REJECT	
PUMPING TEMPERATURE (°C)				AMBIENT	
VISCOSITY AT PUMPING TEMPERATURE (cp)				1.0	
LIQUID DENSITY (kg/m³)				~1000	
PRESENCE OF CORROSIVE / TOXIC COMPONENTS				YES	
SOLIDS IN SUSPENSION (YES / NO)				YES	
SIZE OF SOLID PARTICLES (mm)(MAX)				NOTE-1	
OPERATING CONDITIONS					
FLOW RATE		RATED (MAX.) (m3/hr)		125 (NOTE-5) <span style="border: 1px solid black; padding: 2px;">3</span>	
		NORMAL (m3/hr)		NOTE-1	
		MIN. (m3/hr)		NOTE-1	
SUCTION PRESSURE (kg/cm2.a)				ATM + LD	
MAXIMUM SUCTION PRESSURE (kg/cm2.g)				NOTE-1	
DISCHARGE PRESSURE (kg/cm2.a)				26 (NOTE-4) (MINIMUM)	
DIFFERENTIAL PRESSURE (kg/cm2.g)				25 (NOTE-4) (MINIMUM) <span style="border: 1px solid black; padding: 2px;">3</span>	
MINIMUM DIFFERENTIAL HEAD (m)				250 (NOTE-5)	
NPSH AVAILABLE (m) MIN.				FLOODED SUCTION	
NO. OF PUMPS				4 (2W+1S + 1 SS)	
CAPACITY CONTROL FOR VOLUMETRIC PUMPS					
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC				VFD	
TYPE				NOTE-1	
RANGE (%)				NOTE-1	
PRECISION AT MIN. RATE (%)				NOTE-1	
MECHANICAL DATA					
DESIGN PRESSURE (kg/cm2.g)				34.5 (NOTE-1) <span style="border: 1px solid black; padding: 2px;">3</span>	
DESIGN TEMPERATURE (°C)				65	
MATERIAL CODE		CASING		SDSS	
		IMPELLER		SDSS	
SEAL TYPE (MECHANICAL / PACKING)				MECHANICAL	
LINE RATING IN / OUT				150# / 300# (NOTE-1)	
DRIVER				ELECTRIC MOTOR	
NOTES:					
1	TO BE FURNISHED/ CONFIRMED BY THE CONTRACTOR.				
2	THE PUMPS SHALL BE ABLE TO MEET REQUIRED PLANT T/D FLOW REQUIREMENTS.				
3	PUMPS SHALL BE PROVIDED WITH VARIABLE FREQUENCY DRIVE MOTORS IN ORDER TO MEET VARIABLE PRESSURE REQUIREMENT. THE VFD SHALL BE PROVIDED FOR ALL THE INSTALLED PUMPS.				
4	THE RO-III FEED PUMP MOTOR & HEAD SHALL BE DESIGNED FOR PRESSURE REQUIREMENT OF ATLEAST 2 APPROVED MAKES OF RO-III MEMBRANES AT THE END OF THIRD YEAR AT 15 DEG C DESIGN WATER TEMPERATURE AND 2.0 KG/CM2.G RO-III PERMEATE PRESSURE				
5	Rated Capacity and minimum differential head indicated for pump is minimum requirement and can be increased by the Bidder as per requirement during detail engineering. <span style="border: 1px solid black; padding: 2px;">3</span>				
3	10.01.2022	REVISED & ISSUED WITH TA-01	SC	VS	PKG
2	24.05.2021	REVISED & REISSUED FOR TENDER	SC	VS	PKG
1	01.12.2020	REVISED & REISSUED FOR TENDER	SC	VS	PKG
0	21.05.2020	ISSUED FOR TENDER	SC	VS	PKG
A	23.04.2020	ISSUED FOR INPUTS/ COMMENTS	SC	VS	PKG
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
 <b>ENGINEERS INDIA LIMITED</b> <b>NEW DELHI</b>			<b>RO-III FEED PUMPS</b> <b>PROCESS DATA SHEET</b> <b>B269-475-17-44-DS-1031</b>		
			<b>REV.</b> <b>3</b>		


MB FEED PUMPS						
PROJECT : PANIPAT REFINERY EXPANSION		CLIENT : IOCL		JOB NO. : B269		
UNIT : RO-MB BASED DM PLANT		UNIT NO.: 475		ITEM NO.: 475-P-112 A/B/C/D/E/F/G		
SERVICE : TO FEED WATER TO MB EXCHANGERS						
TYPE : CENTRIFUGAL, HORIZONTAL						
PROPERTIES OF LIQUID						
LIQUID HANDLED			DEGASSED WATER			
PUMPING TEMPERATURE (°C)			AMBIENT			
VISCOSITY AT PUMPING TEMPERATURE (cp)			1.0			
LIQUID DENSITY (kg/m³)			~1000			
PRESENCE OF CORROSIVE / TOXIC COMPONENTS			YES			
SOLIDS IN SUSPENSION (YES / NO)			YES			
SIZE OF SOLID PARTICLES (mm)(MAX)			NOTE-1			
OPERATING CONDITIONS						
FLOW RATE		RATED (MAX.) (m3/hr)	170 (NOTE-6)	3		
		NORMAL(m3/hr)	NOTE-1			
		MIN. (m3/hr)	NOTE-1			
SUCTION PRESSURE (kg/cm2.a)			ATM + LD			
MAXIMUM SUCTION PRESSURE (kg/cm2.g)			NOTE-1			
DISCHARGE PRESSURE (kg/cm2.a)			7 (NOTE-4) (MINIMUM)			
DIFFERENTIAL PRESSURE (kg/cm2.g)			6 (NOTE-4) (MINIMUM)			
MINIMUM DIFFERENTIAL HEAD (m)			60 (NOTE-6)	3		
NPSH AVAILABLE (m) MIN.			FLOODED SUCTION			
NO. OF PUMPS			7 (5W+2S)			
CAPACITY CONTROL FOR VOLUMETRIC PUMPS						
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC			NA			
TYPE						
RANGE (%)						
PRECISION AT MIN. RATE (%)						
MECHANICAL DATA						
DESIGN PRESSURE (kg/cm2.g)			8 (NOTE-1)			
DESIGN TEMPERATURE (°C)			65			
MATERIAL CODE		CASING	SS316L			
		IMPELLER	SS316L			
SEAL TYPE (MECHANICAL / PACKING)			MECHANICAL			
LINE RATING IN / OUT			150# / 300# (NOTE-1)			
DRIVER			ELECTRIC MOTOR			
NOTES:						
1	TO BE FURNISHED/ CONFIRMED BY THE CONTRACTOR.					
2	THE PUMP MOTOR SHALL BE DESIGNED FOR OPEN DISCHARGE CONDITION.					
3	THE PUMP SHALL BE CAPABLE OF AUTO START / STOP OPERATION.					
4	THE PUMPS SHALL BE ABLE TO MEET REQUIRED PLANT T/D FLOW REQUIREMENTS.					
5	THE PUMPS SHALL BE SELECTED FOR PARALLEL OPERATION.					
6	Rated Capacity and minimum differential head indicated for pump is minimum requirement and can be increased by the Bidder as per requirement during detail engineering.					
3	10.01.2022	REVISED & ISSUED WITH TA-01	SC	VS	PKG	
2	24.05.2021	REVISED & REISSUED FOR TENDER	SC	VS	PKG	
1	23.11.2020	REISSUED FOR TENDER	SC	VS	PKG	
0	21.05.2020	ISSUED FOR TENDER	SC	VS	PKG	
A	23.04.2020	ISSUED FOR INPUTS/ COMMENTS	SC	VS	PKG	
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED	
		ENGINEERS INDIA LIMITED NEW DELHI	MB FEED PUMPS	PROCESS DATA SHEET B269-475-17-44-DS-1036	REV. 3	


RO-IV FEED PUMPS						
PROJECT : PANIPAT REFINERY EXPANSION			CLIENT : IOCL		JOB NO. : B269	
UNIT : RO-MB BASED DM PLANT			UNIT NO.: 475		ITEM NO.: 475-P-121 A/B/C	
SERVICE : TO FEED WATER TO INDIVIDUAL RO-IV SKIDS						
TYPE : CENTRIFUGAL, HORIZONTAL						
PROPERTIES OF LIQUID						
LIQUID HANDLED				CARTRIDGE FILTER OUTLET WATER		
PUMPING TEMPERATURE (°C)				AMBIENT		
VISCOSITY AT PUMPING TEMPERATURE (cp)				1.0		
LIQUID DENSITY (kg/m³)				~1000		
PRESENCE OF CORROSIVE / TOXIC COMPONENTS				YES		
SOLIDS IN SUSPENSION (YES / NO)				YES		
SIZE OF SOLID PARTICLES (mm)(MAX)				NOTE-1		
OPERATING CONDITIONS						
FLOW RATE			RATED (MAX.) (m3/hr)		59.5 (NOTE-5) <span style="float: right;">3</span>	
			NORMAL(m3/hr)		NOTE-1	
			MIN. (m3/hr)		NOTE-1	
SUCTION PRESSURE (kg/cm2.a)				ATM + LD		
MAXIMUM SUCTION PRESSURE (kg/cm2.g)				NOTE-1		
DISCHARGE PRESSURE (kg/cm2.a)				51 (NOTE-4) (MINIMUM)		
DIFFERENTIAL PRESSURE (kg/cm2.g)				50 (NOTE-4) (MINIMUM) <span style="float: right;">3</span>		
MINIMUM DIFFERENTIAL HEAD (m)				500 (NOTE-5)		
NPSH AVAILABLE (m) MIN.				FLOODED SUCTION		
NO. OF PUMPS				3 (1W+1S + 1 SS)		
CAPACITY CONTROL FOR VOLUMETRIC PUMPS						
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC				VFD		
TYPE				NOTE-1		
RANGE (%)				NOTE-1		
PRECISION AT MIN. RATE (%)				NOTE-1		
MECHANICAL DATA						
DESIGN PRESSURE (kg/cm2.g)				NOTE-1		
DESIGN TEMPERATURE (°C)				65		
MATERIAL CODE			CASING		SDSS	
			IMPELLER		SDSS	
SEAL TYPE (MECHANICAL / PACKING)				MECHANICAL		
LINE RATING IN / OUT				150# / 300# (NOTE-1)		
DRIVER				ELECTRIC MOTOR		
NOTES:						
1	TO BE FURNISHED/ CONFIRMED BY THE CONTRACTOR.					
2	THE PUMPS SHALL BE ABLE TO MEET REQUIRED PLANT T/D FLOW REQUIREMENTS.					
3	PUMPS SHALL BE PROVIDED WITH VARIABLE FREQUENCY DRIVE MOTORS IN ORDER TO MEET VARIABLE PRESSURE REQUIREMENT. THE VFD SHALL BE PROVIDED FOR ALL THE INSTALLED PUMPS.					
4	THE RO-IV FEED PUMP MOTOR & HEAD SHALL BE DESIGNED FOR PRESSURE REQUIREMENT OF ATLEAST 2 APPROVED MAKES OF RO-IV MEMBRANES AT THE END OF THIRD YEAR AT 15 DEG C DESIGN WATER TEMPERATURE AND 2.0 KG/CM2.G RO-IV PERMEATE PRESSURE					
5	Rated Capacity and minimum differential head indicated for pump is minimum requirement and can be increased by the Bidder as per requirement during detail engineering. <span style="float: right;">3</span>					
3	10.01.2022	REVISED & ISSUED WITH TA-01	SC	VS	PKG	
2	24.05.2021	REISSUED FOR TENDER	SC	VS	PKG	
1	23.11.2020	REISSUED FOR TENDER	SC	VS	PKG	
0	21.05.2020	ISSUED FOR TENDER	SC	VS	PKG	
A	23.04.2020	ISSUED FOR INPUTS/ COMMENTS	SC	VS	PKG	
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED	
 <b>ENGINEERS INDIA LIMITED</b> <b>NEW DELHI</b>			<b>RO-IV FEED PUMPS</b>		<b>PROCESS DATA SHEET</b> <b>B269-475-17-44-DS-1062</b>	
					<b>REV.</b> <b>3</b>	





CEB-I (HCl) TANK					
PROJECT : PANIPAT REFINERY EXPANSION		CLIENT : IOCL		JOB NO. : B269	
UNIT : RO-MB BASED DM PLANT		UNIT NO.: 475		ITEM NO.: 475-T-125 A/B	
SERVICE : STORAGE OF HCl SOLUTION					
PROCESS DATA					
LIQUID HANDLED			30% HCl		
NOMINAL CAPACITY OF EACH TANK (m <sup>3</sup> )			0.785		
EFFECTIVE LIQUID HOLD UP OF EACH TANK (m <sup>3</sup> )			0.4		
NATURE OF LIQUID (TOXIC/CORROSIVE)			CORROSIVE		
STORAGE TEMPERATURE (°C)			AMBIENT TO 45		
DESIGN TEMPERATURE (°C)			65		
STORAGE PRESSURE (kg/cm <sup>2</sup> abs.)			ATM.+ LIQUID COULMN		
DESIGN POSITIVE PRESSURE (kg/cm <sup>2</sup> abs.)			ATM.+ FULL OF LIQUID		
DESIGN VACUUM PRESSURE			NA		
PURITY OF COMMERCIALY AVAILABLE CHEMICAL			NOTE 1		
HOLDING PERIOD OF EACH TANK (hrs) (MIN)			NOTE-2		
UNIT SPECIFICATION					
NO. OF TANKS			2		
TYPE			CIRCULAR WITH REMOVABLE LIDS		
DIAMETER (m) / DIMENSIONS (m x m)			1		
EFFECTIVE LIQUID DEPTH (m)			0.5		
FREE BOARD (m) +DVD (m) (minimum)			0.3 + 0.2		
TOTAL HEIGHT (m)			1		
SLOPE FOR TANK BOTTOM			AS PER ENGG. SPECS.		
BOTTOM DRAIN (YES / NO)			YES		
OVERFLOW CONNECTION			YES		
SERVICE WATER / TREATED EFFLUENT CONNECTION			YES		
DOSING ARRANGEMENT			THROUGH METERING PUMPS		
AGITATOR REQUIRED			NO		
BAFFLE ARRANGEMENT			NO		
SIZE OF BAFFLES			NA 		
HEATING COIL (YES / NO)			NO		
INSULATION (YES/NO)			NO		
VENT			YES		
FUME ABSROBER/ CO2 ABSORBER/ BREATHER VALVE/ FLAME ARRESTOR			NO		
GAUGING AND SAMPLING HATCH (YES/NO)			NO		
LEVEL INDICATOR (YES / NO)			YES		
LEVEL TRANSMITTER (YES / NO)			YES		
LEVEL TRANSMITTER PLATFORM (YES / NO)			YES		
CALIBRATION OF TANK (YES/NO)			NOTE-1		
MATERIAL OF CONSTRUCTION					
TANK			SOLID FRP		
INTERNAL LINING			NIL		
CORROSION ALLOWANCE (mm)			NONE		
STAIRS / HANDRAILINGS / OPERATING PLATFORM			AS PER ENGG. SPECS.		
NOTES:					
1	To be furnished/ confirmed by the Contractor.				
2	Tank sizes indicated are minimum requirements. Higher tank sizes (equivalent to UF CEB requirement in RODM PLANT) to be provided if required.				
2	23.02.2022	REVISED & ISSUED WITH TA-01	SC	VS	PKG
1	24.05.2021	REVISED & REISSUED FOR TENDER	SC	VS	PKG
0	21.05.2020	ISSUED FOR TENDER	SC	VS	PKG
A	23.04.2020	ISSUED FOR INPUT / COMMENTS	SC	VS	PKG
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
		ENGINEERS INDIA LIMITED NEW DELHI	CEB-I (HCl) TANK		PROCESS DATA SHEET B269-475-17-44-DS-1106
					REV. 2




CEB-II (NaOH) TANK						
PROJECT : PANIPAT REFINERY EXPANSION		CLIENT : IOCL		JOB NO. : B269		
UNIT : RO-MB BASED DM PLANT		UNIT NO.: 475		ITEM NO.: 475-T-126 A/B		
SERVICE : STORAGE OF NaOH SOLUTION						
PROCESS DATA						
LIQUID HANDLED				20% NaOH		
NOMINAL CAPACITY OF EACH TANK (m <sup>3</sup> )				0.785		
EFFECTIVE LIQUID HOLD UP OF EACH TANK (m <sup>3</sup> )				0.4		
NATURE OF LIQUID (TOXIC/CORROSIVE)				CORROSIVE		
STORAGE TEMPERATURE (°C)				AMBIENT TO 45		
DESIGN TEMPERATURE (°C)				65		
STORAGE PRESSURE (kg/cm <sup>2</sup> abs.)				ATM.+ LIQUID COULMN		
DESIGN POSITIVE PRESSURE (kg/cm <sup>2</sup> abs.)				ATM.+ FULL OF LIQUID		
DESIGN VACUUM PRESSURE				NA		
PURITY OF COMMERCIALY AVAILABLE CHEMICAL				NOTE 1		
HOLDING PERIOD OF EACH TANK (hrs) (MIN)				NOTE-2		
UNIT SPECIFICATION						
NO. OF TANKS				2		
TYPE				CIRCULAR WITH REMOVABLE LIDS		
DIAMETER (m) / DIMENSIONS (m x m)				1		
EFFECTIVE LIQUID DEPTH (m)				0.5		
FREE BOARD (m) +DVD (m) (minimum)				0.3 + 0.2		
TOTAL HEIGHT (m)				1		
SLOPE FOR TANK BOTTOM				AS PER ENGG. SPECS.		
BOTTOM DRAIN (YES / NO)				YES		
OVERFLOW CONNECTION				YES		
SERVICE WATER / TREATED EFFLUENT CONNECTION				YES		
DOSING ARRANGEMENT				THROUGH METERING PUMPS		
AGITATOR REQUIRED				NO		
BAFFLE ARRANGEMENT				NO		
SIZE OF BAFFLES				NA 		
HEATING COIL (YES / NO)				NO		
INSULATION (YES/NO)				NO		
VENT				YES		
FUME ABSROBER/ CO2 ABSORBER/ BREATHER VALVE/ FLAME ARRESTOR				NO		
GAUGING AND SAMPLING HATCH (YES/NO)				NO		
LEVEL INDICATOR (YES / NO)				YES		
LEVEL TRANSMITTER (YES / NO)				YES		
LEVEL TRANSMITTER PLATFORM (YES / NO)				YES		
CALIBRATION OF TANK (YES/NO)				NOTE-1		
MATERIAL OF CONSTRUCTION						
TANK				SOLID FRP		
INTERNAL LINING				NIL		
CORROSION ALLOWANCE (mm)				NONE		
STAIRS / HANDRAILINGS / OPERATING PLATFORM				AS PER ENGG. SPECS.		
NOTES:						
1	To be furnished/ confirmed by the Contractor.					
2	Tank sizes indicated are minimum requirements. Higher tank sizes (equivalent to UF CEB requirement in RODM PLANT) to be provided if required.					
2	23.02.2022	REVISED & ISSUED WITH TA-01	SC	VS	PKG	
1	24.05.2021	REVISED & REISSUED FOR TENDER	SC	VS	PKG	
0	21.05.2020	ISSUED FOR TENDER	SC	VS	PKG	
A	23.04.2020	ISSUED FOR INPUT / COMMENTS	SC	VS	PKG	
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED	
	ENGINEERS INDIA LIMITED NEW DELHI		CEB-II (NaOH) TANK		PROCESS DATA SHEET B269-475-17-44-DS-1109	REV. 2

CEB-III (NaOCl) TANK						
<b>PROJECT : PANIPAT REFINERY EXPANSION</b>		<b>CLIENT : IOCL</b>		<b>JOB NO. : B269</b>		
<b>UNIT : RO-MB BASED DM PLANT</b>		<b>UNIT NO.: 475</b>		<b>ITEM NO.: 475-T-127 A/B</b>		
<b>SERVICE : STORAGE OF NaOH SOLUTION</b>						
<b>PROCESS DATA</b>						
LIQUID HANDLED				12% NaOCl		
NOMINAL CAPACITY OF EACH TANK (m <sup>3</sup> )				0.785		
EFFECTIVE LIQUID HOLD UP OF EACH TANK (m <sup>3</sup> )				0.4		
NATURE OF LIQUID (TOXIC/CORROSIVE)				CORROSIVE		
STORAGE TEMPERATURE (°C)				AMBIENT TO 45		
DESIGN TEMPERATURE (°C)				65		
STORAGE PRESSURE (kg/cm <sup>2</sup> abs.)				ATM.+ LIQUID COULMN		
DESIGN POSITIVE PRESSURE (kg/cm <sup>2</sup> abs.)				ATM.+ FULL OF LIQUID		
DESIGN VACUUM PRESSURE				NA		
PURITY OF COMMERCIALY AVAILABLE CHEMICAL				NOTE 1		
HOLDING PERIOD OF EACH TANK (hrs) (MIN)				NOTE-2		
<b>UNIT SPECIFICATION</b>						
NO. OF TANKS				2		
TYPE				CIRCULAR WITH REMOVABLE LIDS		
DIAMETER (m) / DIMENSIONS (m x m)				1		
EFFECTIVE LIQUID DEPTH (m)				0.5		
FREE BOARD (m) +DVD (m) (minimum)				0.3 + 0.2		
TOTAL HEIGHT (m)				1		
SLOPE FOR TANK BOTTOM				AS PER ENGG. SPECS.		
BOTTOM DRAIN (YES / NO)				YES		
OVERFLOW CONNECTION				YES		
SERVICE WATER / TREATED EFFLUENT CONNECTION				YES		
DOSING ARRANGEMENT				THROUGH METERING PUMPS		
AGITATOR REQUIRED				NO		
BAFFLE ARRANGEMENT				NO		
SIZE OF BAFFLES				NA		
HEATING COIL (YES / NO)				NO		
INSULATION (YES/NO)				NO		
VENT				YES		
FUME ABSROBER/ CO2 ABSORBER/ BREATHER VALVE/ FLAME ARRESTOR				NO		
GAUGING AND SAMPLING HATCH (YES/NO)				NO		
LEVEL INDICATOR (YES / NO)				YES		
LEVEL TRANSMITTER (YES / NO)				YES		
LEVEL TRANSMITTER PLATFORM (YES / NO)				YES		
CALIBRATION OF TANK (YES/NO)				NOTE-1		
<b>MATERIAL OF CONSTRUCTION</b>						
TANK				SOLID FRP		
INTERNAL LINING				NIL		
CORROSION ALLOWANCE (mm)				NONE		
STAIRS / HANDRAILINGS / OPERATING PLATFORM				AS PER ENGG. SPECS.		
<b>NOTES:</b>						
1		To be furnished/ confirmed by the Contractor.				
2		Tank sizes indicated are minimum requirements. Higher tank sizes (equivalent to UF CEB requirement in RODM/RWTP PLANT) to be provided if required.				
2	23.02.2022	REVISED & ISSUED WITH TA-01	SC	VS	PKG	
1	24.05.2021	REVISED & REISSUED FOR TENDER	SC	VS	PKG	
0	21.05.2020	ISSUED FOR TENDER	SC	VS	PKG	
A	23.04.2020	ISSUED FOR INPUT / COMMENTS	SC	VS	PKG	
<b>NO.</b>	<b>DATE</b>	<b>REVISION</b>	<b>PREPARED</b>	<b>CHECKED</b>	<b>APPROVED</b>	
 <b>ENGINEERS INDIA LIMITED</b> <b>NEW DELHI</b>		<b>CEB-III (NaOCl) TANK</b>		<b>PROCESS DATA SHEET</b>		<b>REV.</b>
				<b>B269-475-17-44-DS-1112</b>		<b>2</b>

HIGH RATE SOLID CONTACT CLARIFIER-II				
PROJECT : PANIPAT REFINERY EXPANSION		CLIENT : IOCL	JOB NO. : B269	
UNIT : RO BASED DM PLANT		UNIT NO.: 475	ITEM NO.:475-CL-102	
SERVICE : CLARIFICATION OF RO REJECT & MB WASTE WATER				
INFLUENT CHARACTERISTICS				
TEMPERATURE (°C)		AMBIENT		
SPECIFIC GRAVITY		~1.0		
SUSPENDED SOLIDS (NORMAL/ MAXIMUM) (mg/l)		NOTE-1		
TURBIDITY (NORMAL/ MAXIMUM) (NTU)		NOTE-1		
FLOW RATE				
INFLUENT FLOW PER UNIT (m³/hr)		140		
OVERFLOW PER UNIT (m³/hr)		NOTE-1		
UNDERFLOW PER UNIT (PEAK) (m³/hr)		NOTE-1		
OUTLET CHARACTERISTICS				
SUSPENDED SOLIDS (mg/l)		< 25		
DESIGN CRITERIA				
SURFACE LOADING CLARIFIER (m³/m²/day)		60 (MAXIMUM)		
FLOCCULATION (minutes)		20 (MINIMUM)		
SOLIDS LOADING (Kg/m²/hr)		NOTE-1		
WEIR LOADING (m³/m/day) (MAX/NOR)		300 (MAXIMUM)		
TOTAL DETENTION TIME (minutes)		150 (MINIMUM)		
UNIT SPECIFICATION				
NO. OF UNITS		1W		
MODE OF FEED		BOTTOM TO TOP THROUGH A BLANKET (NOTE-1)		
DIA. OF CLARIFIER (m)		12.0		
HEIGHT (S.W.D + F.B) (m)		4.0 + 0.5		
HOLD UP VOLUME (m³)		452		
BOTTOM SLOPE		1 : 12 (NOTE-1)		
TYPE OF INLET ARRANGEMENT		SUBMERGED, SIDE ENTRY		
FEED WELL DIAMETER (m)		NOTE-1		
FEED WELL DEPTH (m)		NOTE-1		
TYPE OF OVER FLOW ARRANGEMENT		NOTE-1		
SIZE OF OVER FLOW WEIR		NOTE-1		
OVER FLOW LAUNDER FREE BOARD		NOTE-1		
SIZE OF EFFLUENT LAUNDER (mxm)		NOTE-1		
SLOPE OF EFFLUENT LAUNDER		1 : 5000		
SLUDGE SCRAPPING MECHANISMTYPE/RPH		CENTRALLY DRIVEN TRUSSED RAKE/0.75-1.5 (NOTE-1)		
SHEET 1 OF 2				
	ENGINEERS INDIA LIMITED NEW DELHI	HIGH RATE SOLID CONTACT CLARIFIER-II	PROCESS DATA SHEET	REV.
			B269-475-17-44-DS-1044	1

HIGH RATE SOLID CONTACT CLARIFIER-II					
TYPE OF BRIDGE & WALKWAY			FULL DIA. FIXED BRIDGE / WALK WAY UP TO CENTER		
APPROACH TO BRIDGE			BY STAIRS		
WIDTH OF WALKWAY			1.0 m		
SLUDGE WITHDRAWAL ARRANGEMENT			OUTLET PIPE FROM BOTTOM		
SLUDGE HOPPER VOLUME (m3) (MIN.)			NOTE-1		
SCUM REMOVAL ARRANGEMENT (YES/ NO)			NO		
<b>DRIVE UNIT FOR SLUDGE SCRAPPING MECHANISM</b>					
TYPE			ELECTRIC MOTOR		
MOUNTING			CENTRAL		
NO. OF MOTORS			TWO		
DRIVE HP/RPM (REACTOR/SCRAPPER) TURBINE			NOTE-1		
SPEED REDUCTION GEAR BOX			YES		
REDUCTION RATIO			NOTE-1		
<b>MATERIAL OF CONSTRUCTION</b>					
TANK			RCC EPOXY COATED		
FEED WELL			MSFRP		
RAKE ARM			MSFRP		
OVER FLOW WEIR			MSFRP		
PEDESTAL			RCC		
SCRAPPER RAKE			MSFRP		
SQUEEZERS			NEOPRENE		
DESLUDGING VALVE & PIPE			AS PER ENGG. SPECS.		
SCUM BAFFLE			AS PER ENGG. SPECS.		
SCUM TROUGH			AS PER ENGG. SPECS.		
WALKWAY BRIDGE			MS		
HANDRAILINGS			AS PER ENGG. SPECS.		
ACCESS STAIR			AS PER ENGG. SPECS.		
PAINTING/ COATING			AS PER ENGG. SPECS.		
INTERNAL SURFACE			AS PER ENGG. SPECS.		
EXTERNAL SURFACE			AS PER ENGG. SPECS.		
<b>NOTES:</b>					
1	DATA TO BE FURNISHED/CONFIRMED BY THE CONTRACTOR				
2	ACCESS SHALL BE PROVIDED FROM ONE SIDE TO ATTEND TO CENTRALLY LOCATED SCRAPPING / CLARIFYING MECHANISM MOTOR.				
3	TOP LEVEL OF ORIFICE SHALL BE MINIMUM 40 MM BELOW TWL.				
4	AN MS/RCC PLATFORM SHALL BE PROVIDED ACROSS THE DIAMETER OF THE CLARIFIER UP TO CENTRE.				
1	23.02.2022	REVISED & ISSUED WITH TA-01	SC	VS	PKG
0	21.05.2020	ISSUED FOR TENDER	SC	VS	PKG
A	23.04.2020	ISSUED FOR INPUTS/ COMMENTS	SC	VS	PKG
<b>SHEET 2 OF 2</b>					
		ENGINEERS INDIA LIMITED NEW DELHI	HIGH RATE SOLID CONTACT CLARIFIER-II	PROCESS DATA SHEET B269-475-17-44-DS-1044	REV. 1

CPU FEED PUMPS						
PROJECT : PANIPAT REFINERY EXPANSION		CLIENT : IOCL		JOB NO. : B269		
UNIT : CONDENSATE POLISHING UNIT		UNIT NO.: 476		ITEM NO.: 476-P-101 A/B		
SERVICE : TO FEED UNPOLISHED CONDENSATE TO CPU TREATMENT SYSTEM						
TYPE : CENTRIFUGAL, HORIZONTAL						
PROPERTIES OF LIQUID						
LIQUID HANDLED				UNPOLISHED CONDENSATE		
PUMPING TEMPERATURE ( <sup>0</sup> C)				AMBIENT		
VISCOSITY AT PUMPING TEMPERATURE (cp)				~1		
LIQUID DENSITY (kg/m <sup>3</sup> )				~1000		
PRESENCE OF CORROSIVE / TOXIC COMPONENTS				YES		
SOLIDS IN SUSPENSION (YES / NO)				NO		
SIZE OF SOLID PARTICLES (mm)(MAX)				NO		
OPERATING CONDITIONS						
FLOW RATE		NORMAL(m3/hr)		140		
		MAX. (m3/hr)		NOTE-1		
		MIN. (m3/hr)		NOTE 1		
SUCTION PRESSURE (kg/cm2.a)				ATM+ LD		
MAXIMUM SUCTION PRESSURE (kg/cm2.g)				NOTE-1		
DISCHARGE PRESSURE (kg/cm2.a)				7.0(NOTE-6)		
DIFFERENTIAL PRESSURE (kg/cm2.g)				6.0(NOTE-6)		
DIFFERENTIAL HEAD (m)				60 (NOTE-6)		
NPSH AVAILABLE (m) MIN.				FLOODED SUCTION		
NO. OF PUMPS				2 (1 W+ 1 SB)		
CAPACITY CONTROL FOR VOLUMETRIC PUMPS						
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC				N.A.		
TYPE				N.A.		
RANGE (%)				N.A.		
PRECISION AT MIN. RATE (%)				N.A.		
MECHANICAL DATA						
DESIGN PRESSURE (kg/cm2.g)				8.0 (NOTE-6)		
DESIGN TEMPERATURE ( <sup>0</sup> C)				65		
MATERIAL CODE		CASING		SS304L		
		IMPELLER		SS304L		
SEAL TYPE (MECHANICAL / PACKING)				MECHANICAL		
LINE RATING IN / OUT				150# / 150#		
DRIVER				ELECTRIC MOTOR		
NOTES:						
1	To be furnished/confirmed by the contractor.					
2	The pump motor shall be designed for open discharge condition.					
3	The pump shall be capable of auto start/stop operation.					
4	The pump shall be selected for parallel operation.					
5	The pumps shall be able to meet required plant turndown flow requirements.					
6	To be firmed up during detailed engineering.					
2	23.02.2022	REVISED & ISSUED WITH TA-01	SC	VS	PKG	
1	23.11.2020	REISSUED FOR TENDER	SC	VS	PKG	
0	11.05.2020	ISSUED FOR TENDER	SC	VS	PKG	
A	10.04.2020	ISSUED FOR INPUT / COMMENTS	SC	VS	PKG	
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED	
		ENGINEERS INDIA LIMITED NEW DELHI	CPU FEED PUMPS	PROCESS DATA SHEET B269-476-17-44-DS-1002		REV. 2

**EQUIPMENT LIST**  
**(PLOT PLAN AND WATERDEPARTMENT)**  
**FOR**  
**CONDENSATE POLISHING UNIT (PNCP COMPLEX)**  
**OF**  
**IOCL – PANIPAT REFINERY EXPANSION PROJECT**  
**PANIPAT, HARYANA**

1	23.02.2022	REVISED & ISSUED WITH TA-01	SC	VS	PKG
0	01.07.2021	ISSUED FOR TENDER	SC	VS	PKG
A	09.04.2021	ISSUED FOR INPUTS/ COMMENTS	SC	VS	PKG
Rev. No	Date	Purpose	Prepared by	Reviewed by	Approved by

S. NO.	DATASHEET NO.	NOS.	EQUIPMENT TAG NO.	EQUIPMENT DESCRIPTION	SIZE (EACH UNIT)	MOC
1.	-	-	-	Feed Polished Condensate Exchanger	AS PER PROCESS DATASHEET	
2.	-	-	-	Trim Cooler	AS PER PROCESS DATASHEET	
3.	B269-81-17-44-DS-1001	3(2W+1S)	81-P-101 A/B/C	Unpolished Condensate Feed Pumps	Capacity:50 m <sup>3</sup> /h Head: 55 m	C: SS304L, I:SS304L
4.	B269-81-17-44-DS-1002	4W	81-G-101 A/B/C/D	Primary & Secondary Activated Carbon Filter (ACF)	Capacity: 50 m <sup>3</sup> /h (each) Dia: 2.3 m, Ht.: 3.7 m (T/T)	Shell: CS with Glass Flake Vinyl Ester Lining
5.	B269-81-17-44-DS-1003	2W	81-MB-101 A/B	Mixed Bed Exchanger	50 m <sup>3</sup> /h net feed water flow; Dia: 1.4 m, Ht.: 3.5 m (T/T)	Shell: CS with Glass Flake Vinyl Ester Lining
6.	B269-81-17-44-DS-1004	3(2W+1S)	81-P-102 A/B/C	Polished Condensate Transfer Pump	Capacity:50 m <sup>3</sup> /h Head: 90 m	C: SS304L, I:SS304L
7.	B269-81-17-44-DS-1005	2(1W+1S)	81-P-103 A/B	Morpholine Solution Dosing Pump	Capacity:50 LPH Head: 20 m	C: SS304L D: PTFE


**Note:**

- The following equipment of existing PNCP RODMP & CPU shall be utilized for the new CPU:

S. No.	Equipment	Tag No.
i.	Polished Condensate Tank	51-T-001 A/B
ii.	Unpolished Condensate Feed Tank	51-T-002 A/B
iii.	Acid Measuring Tank-CPU	51-T-003 A/B
iv.	Alkali Measuring Tank-CPU	51-T-004 A/B
v.	ACF Backwash Tank	51-T-005

S. No.	Equipment	Tag No.
vi.	ACF Backwash Pumps	51-P-003 A/B
vii.	MB Air Scour Blower	51-K-001 A/B
viii.	DM Water Regeneration Pumps	51-P-004 A/B
ix.	Morpholine Dosing Tank	46-T-022 A/B



UNPOLISHED CONDENSATE FEED PUMPS					
PROJECT : PANIPAT REFINERY EXPANSION		CLIENT : IOCL		JOB NO. : B269	
UNIT : CPU (PNCP COMPLEX)		UNIT NO.: 81		ITEM NO.: 81-P-101 A/B/C	
SERVICE : TO FEED UNPOLISHED CONDENSATE TO CPU TREATMENT SYSTEM					
TYPE : CENTRIFUGAL, HORIZONTAL					
PROPERTIES OF LIQUID					
LIQUID HANDLED				UNPOLISHED CONDENSATE	
PUMPING TEMPERATURE ( $^{\circ}$ C)				AMBIENT	
VISCOSITY AT PUMPING TEMPERATURE (cp)				~1	
LIQUID DENSITY ( $\text{kg/m}^3$ )				~1000	
PRESENCE OF CORROSIVE / TOXIC COMPONENTS				YES	
SOLIDS IN SUSPENSION (YES / NO)				NO	
SIZE OF SOLID PARTICLES (mm)(MAX)				NO	
OPERATING CONDITIONS					
FLOW RATE		NORMAL( $\text{m}^3/\text{hr}$ )		50	
		MAX. ( $\text{m}^3/\text{hr}$ )		NOTE-1	
		MIN. ( $\text{m}^3/\text{hr}$ )		NOTE 1	
SUCTION PRESSURE ( $\text{kg/cm}^2.\text{a}$ )				ATM+ LD	
MAXIMUM SUCTION PRESSURE ( $\text{kg/cm}^2.\text{g}$ )				NOTE-1	
DISCHARGE PRESSURE ( $\text{kg/cm}^2.\text{a}$ )				6.5(NOTE-6)	
DIFFERENTIAL PRESSURE ( $\text{kg/cm}^2.\text{g}$ )				5.5(NOTE-6)	
DIFFERENTIAL HEAD (m)				55 (NOTE-6)	
NPSH AVAILABLE (m) MIN.				FLOODED SUCTION	
NO. OF PUMPS				3 (2 W+ 1 SB)	
CAPACITY CONTROL FOR VOLUMETRIC PUMPS					
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC				N.A.	
TYPE				N.A.	
RANGE (%)				N.A.	
PRECISION AT MIN. RATE (%)				N.A.	
MECHANICAL DATA					
DESIGN PRESSURE ( $\text{kg/cm}^2.\text{g}$ )				8.0 (NOTE-6)	
DESIGN TEMPERATURE ( $^{\circ}$ C)				65	
MATERIAL CODE		CASING		SS304L	
		IMPELLER		SS304L 1	
SEAL TYPE (MECHANICAL / PACKING)				MECHANICAL	
LINE RATING IN / OUT				150# / 150#	
DRIVER				ELECTRIC MOTOR	
NOTES:					
1	To be furnished/confirmed by the contractor.				
2	The pump motor shall be designed for open discharge condition.				
3	The pump shall be capable of auto start/stop operation.				
4	The pump shall be selected for parallel operation.				
5	The pumps shall be able to meet required plant turndown flow requirements.				
6	To be firmed up during detailed engineering.				
1	23.02.2022	REVISED & ISSUED WITH TA-01	SC	VS	PKG
0	01.07.2021	ISSUED FOR TENDER	SC	VS	PKG
A	09.04.2021	ISSUED FOR INPUT / COMMENTS	SC	VS	PKG
NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
		ENGINEERS INDIA LIMITED NEW DELHI	UNPOLISHED CONDENSATE FEED PUMPS	PROCESS DATA SHEET B269-81-17-44-DS-1001	
				REV.	1

Sr No	Supplier Name	City	Phone	E-Mail	Remarks
<b>Department : ENVIRONMENT</b>					
<b>Area of Experience:</b> Other					
<b>Item : AUTO BACKWASH FILTERS</b>					
1	AMIAD	MUMBAI	+91 22 2778 7813/14, ,	info-india@amiad.com	
2	AZUD	SPAIN	+34 968808402, ,	info@azud.com	
3	HYDAC	MUMBAI	+9122411188 88/12/79, +91 22 2778 1180,	info@hydacindia.com	
4	SHARPLEX FILTERS (INDIA) PVT LTD	NAVI MUMBAI	+91 22 6940 9850-65, ,	sales@sharplexfilters.com	
5	STF FILTROS	SPAIN	+34 974401933, ,	info@stf-filtros.com	
6	YAMIT FILTRATION	ISRAEL	+972 4 622006, ,	info@yamit-f.com	
<b>Item : ACTIVATED CARBON</b>					
1	ACTIVE CHAR PRODUCTS PVT. LTD.	ERNAKULUM	+91 484 658 6362, +91 484 255 6518,	marketing@activechar.com	
2	CABOT (NORIT)	MUMBAI	+91 22 6179 1115, ,	NA	
3	CALGON CARBON	SINGAPORE	+65 6221 3500/3554, ,	singapore.sales@calgoncarbon.com	
4	DONAU CARBON	FRANKFURT	+49 (69) 40 11 650, ,		
5	GLOBAL ADSORBENTS PVT. LTD.	KOLKATA	+91 33 2283 2266, ,	info@globaladsorbents.com	
6	JACOBI	SINGAPORE	+65 9387 2155, 55055	infoasia@jacobi.net	
7	KALIMATI CARBON (P) LIMITED	KOLKATA	9830520805, ,	sneha@kalimaticarbon.com	
<b>Item : DISSOLVED AIR FLOTATION UNIT</b>					
1	DEGREMONT (SUEZ)	GURGAON	+91 8004366942, +91 8067021228,	NA	
2	K-PACK SYSTEMS PVT. LTD.	BANGALORE	+91 80 22351122, +91 80 2238 1122,	sales@kpack.in	
3	KROFTA ENGINEERING LTD.	NEW DELHI	+91 11 4724 2500, ,	krofta@kroftaengineering.com	
4	OVIVO	SHANGHAI	+86 21 5080 4558, ,	NA	
5	PARAMOUNT LTD.	VADODARA, NEW DELHI	+91 265 2397111, +91 112618 6525/6369,	sales@paramountlimited.com, delhi@paramountlimited.com	
6	VOLTAS	MUMBAI	+91 22 66656666, ,	NA	
7	WORLD WATER WORKS	USA	+1 800 607 7873, ,	NA	
<b>Item : BELT FILTER PRESS</b>					
1	ANDRITZ	NEW DELHI	+91 11 4937 2900, ,	contact-hydro.in@andritz.com	
2	AURIC TECHNOSERVICES PVT. LTD	PUNE	+91 20 2729 2485, +9172760 08168/94216,	auric@vsnl.com, info@auricnet.com	
3	DEWA	ESTONIA	+372 631 1186, +372 503 9239,	dewa@dewa.ee	
4	EMO	FRANCE, HONGKONG	+33 (0)2 99860203, ,	info@emochinacn.com	

Sr No	Supplier Name	City	Phone	E-Mail	Remarks
5	KROFTA ENGINEERING LTD.	NEW DELHI	+91 11 4724 2500 ,	krofta@kroftaengineering.com	
6	TRIVENI ENGINEERING & INDUSTRIES LTD	NOIDA	+91 120 474 8000 ,	wbg@projects.trivenigroup.com	
<b>Item : CENTRIFUGE</b>					
1	ALFA LAVAL	PUNE	+9120 6734 1100/1101, ,	india.info@alfalaval.com	
2	MBE COAL & MINERAL TECHNOLOGY INDIA PVT. LTD.	KOLKATA	+91 33 6628 1111, +91 33 3014 1111,	sales.mbehumboldt@mbecl.co.in	
3	PENNWALT	MUMBAI	+91 22 6516 6633, +91 22 6147 1600,	info@pennwalt.com	
<b>Item : CHLORINE DIOXIDE GENERATOR</b>					
1	CAPCO WATER SOLUTIONS PRIVATE LIMITED	MUMBAI, NEW DELHI	+91 22 4091 0000, +91 11 4161 9305,	info@capwater.com, cwsdelhi@capwater.com	
2	CHEMBOND WATER TECHNOLOGIES LTD	MUMBAI	+91 22 6264 3000, ,	info@chembondindia.com	
3	EVOQUA (WALLACE & TIERNAN)	SINGAPORE	+65 6559 2600, ,	sales.sg@evoqua.com, info.sg@evoqua.com	
4	PROMINENT	BANGALORE	+9180235788 72/73/74, ,	prominent@hpfclindia.com	
5	PURITA WATER SOLUTIONS PVT LTD	VASAI, MAHARASHTRA	+250 609 0001-08, ,	info@puritawater.com	
6	VASU CHEMICALS	MUMBAI	+91-22-61449500, ,	info@vasuchemicals.com	
<b>Item : CLARIFIER/THICKENER/SOLID CONTACT CLARIFIER MECHANISM</b>					
1	DEGREMONT (SUEZ)	GURGAON	+91 8004366942, +91 8067021228,	NA	
2	EIMCO KCP	CHENNAI	+91 44 2855 5171, ,	ekcp@vsnl.com, info@ekcp.com	
3	HINDUSTAN DORR OLIVER	NOIDA	+91 120 300 6143/50, ,	hdodelhi@hdo.in	
4	NAVBHARAT ENVIROTECH	CHENNAI	, ,	NA	
5	PARAMOUNT LTD.	VADODARA, NEW DELHI	+91 265 2397111, +91 112618 6525/6369,	sales@paramountlimited.com, delhi@paramountlimited.com	
6	TRIVENI ENGINEERING & INDUSTRIES LTD	NOIDA	+91 120 474 8000, ,	wbg@projects.trivenigroup.com	
7	VOLTAS	MUMBAI	9769767148,02266656666, ,	talatmehmood@voltas.com	
<b>Item : DIFFUSERS</b>					
1	EDI	SINGAPORE	+65 6521 4536, ,	sales@wastewater.sg	
2	OTT	GERMANY	+49 (0) 511786310, ,	info@ott-group.com	
3	OVIVO	SHANGHAI	+86 21 5080 4558, ,	NA	
4	TITAN	NA	, ,		
<b>Item : EDI</b>					
1	AQUATECH	PUNE	+91 20 6654 7000, ,	asa@aquatech.com	

## Departmental List

Date :08/02/2022 14:10:54

Page 3 of 5

Sr No	Supplier Name	City	Phone	E-Mail	Remarks
2	ELECTRO CELL	DENMARK	+45 9737 4499, ,	ec@electrocell.com	
3	GE (SUEZ)	GURGAON	+91 8004366942, +91 8067021228,	NA	
4	SIEMENS	GURGAON, GERMANY	+91 124 383 6000, +49 (9131) 7-44544,	rainer.schulze@siemens.com	
<b>Item : FILTER CARTRIDGE/OIL REMOVAL CARTRIDGE</b>					
1	3M/CUNO	BANGALORE	+91 8066595600, ,	NA	
2	AMIAD	MUMBAI	+91 22 2778 7813/14, ,	info-india@amiad.com	
3	MILLIPURE	MUMBAI	+91 9820672232, +91 8042754103,	millipure@gmail.com	
4	MYCLEX CORPORATION	USA	+1 888 306 3843, ,	NA	
5	PALL CORPORATION	PUNE	+91 20 6675 1200, ,	NA	
6	PARKER	HYDERABAD	+91 8455248700, ,	NA	
7	PENTAIR	GOA	+91 8322883300, ,	NA	
<b>Item : MEMBRANE BIOREACTOR</b>					
1	GE (SUEZ)	GURGAON	+91 8004366942, +91 8067021228,	NA	
2	HYDRANAUTICS	MUMBAI	+91 22 4003 0500,	NA	
3	KUBOTA	TOKYO	+81 3 3245 3933, ,	NA	
4	MEMSTAR PTE LTD	SINGAPORE	+65 6775 2512, ,		
5	PENTAIR	GOA	+91 8322883300, ,	NA	
6	SIEMENS	GURGAON, GERMANY	+91 124 383 6000, +49 (9131) 7-44544,	rainer.schulze@siemens.com	
<b>Item : MICRO/ULTRA-FILTRATION MEMBRANES</b>					
1	ASAHI KASEI CORPORATION	TOKYO	+81 3 6699 3227, ,	NA	For Asahi KASEI Microza Membrane
2	GE (SUEZ)	GURGAON	+91 8004366942, +91 8067021228,	NA	
3	HYDRANAUTICS	MUMBAI	+91 22 4003 0500, ,	NA	
4	HYFLUX	CHENNAI	+91 44 4286 7101, ,	NA	
5	INGE	MUMBAI	+91 22 6712 7777, +91 22 6172 7600,	NA	
6	KOCH MEMBRANE SYSTEMS	NEW DELHI	+91 11 4506 9466, ,	NA	
7	MANN & HUMMEL	REWARI	+91 128 426 300, ,	office.india@mann-hummel.com	
8	MEMBRANE HITEC (Division of TITANIUM EQUIPMENT & ANODE MANUFACTURING COMPANY PRIVATE LIMITED)	CHENNAI	, ,	info@draaholdings.com	
9	MEMSTAR PTE LTD	SINGAPORE	+65 6775 2512, ,		

Sr No	Supplier Name	City	Phone	E-Mail	Remarks
10	PALL CORPORATION	PUNE	+91 20 6675 1200, ,	NA	
11	PENTAIR	GOA	+91 8322883300, ,	NA	
12	TORAY	GURGAON	+91 124 412 8450, ,	NA	
<b>Item : PLATES INTERCEPTOR (TPI/CPI)</b>					
1	K-PACK SYSTEMS PVT. LTD.	BANGALORE	080 22 351122/381122, ,	sales@kpack.in	
2	KROFTA ENGINEERING LTD.	NEW DELHI	+91 11 4724 2500, ,	krofta@kroftaengineering.com	
3	PARAMOUNT LTD.	VADODARA, NEW DELHI	+91 265 2397111, +91 112618 6525/6369, ,	sales@paramountlimited.com, delhi@paramountlimited.com	
4	VOLTAS	MUMBAI	+91 22 66656666, ,	NA	
<b>Item : PRESSURE TUBES</b>					
1	ADVANCED COMPOSITES PVT LTD	GOA	+91 832 236 22 50/65, ,	NA	
2	BEL	CYPRUS	, ,	info@bel-g.com	
3	KANOPPE		, ,		
4	ORLITE INDUSTRIES LTD	ISRAEL	, ,	NA	
5	PENTAIR (CODELINE)	GOA	+91 8322883300, ,	NA	
6	PHOENIX	UK	+40 (0) 1452 311673, ,	NA	
7	PROTEC ARISAWA	USA	+1 760 599 4800, ,	NA	
8	WAVE CYBER	SHANGHAI	+86 216975 8588/8333, +86 216975 8333, ,	info@wave-cyber.com	
<b>Item : ION EXCHANGE RESINS</b>					
1	BAYER (LANXESS)	THANE	+91 22 2587 1000, ,	NA	
2	DOW	MUMBAI	+91 22 6674 1500, +91 22 6182 0423, ,	NA	
3	ION EXCHANGE (INDIA) LTD	NEW DELHI, MUBAI	+91 11/22 3989 0909, ,	delcro@ionexchange.co.in, ieil@ionexchange.co.in	
4	PUROLITE	PUNE	+91 7887842255, ,	sales.india@purolite.com	
5	ROHM & HASS		, ,		
6	THERMAX	PUNE	+91 20 6605 1200, +91 20 2554 2122, ,	enquiry@thermaxglobal.com	
<b>Item : REVERSE OSMOSIS MEMBRANES</b>					
1	DOW	MUMBAI	+91 22 6674 1500, +91 22 6182 0423, ,	NA	
2	EVOQUA (MEMCOR)	SINGAPORE	+65 65592600, ,	sales.sg@evoqua.com, info.sg@evoqua.com	
3	GE (SUEZ)	GURGAON	+91 8004366942, +91 8067021228, ,	NA	
4	HYDRANAUTICS	MUMBAI	+91 22 4003 0500, ,	NA	

Sr No	Supplier Name	City	Phone	E-Mail	Remarks
5	ION EXCHANGE (INDIA) LTD	NEW DELHI, MUBAI	+91 11/22 3989 0909, ,	delcro@ionexchange.co.in, ieil@ionexchange.co.in	MAKE: HYDRAMEM
6	KOCH MEMBRANE SYSTEMS	NEW DELHI	+91 11 4506 9466, ,	NA	
7	PALL CORPORATION	PUNE	+91 20 6675 1200, ,	NA	
8	ROCHEM	MUMBAI	+91 22 6704 9000, ,	sales@rochemindia.net	
9	TORAY	GURGAON	+91 124 412 8450, ,	NA	
<b>Item : SEQUENCING BATCH REACTOR</b>					
1	AQUA AEROBIC SYSTEM INC	USA	+91 9958711944, ,	VSingh@aqua-aerobic.com	
2	EVOQUA	SINGAPORE	+65 6559 2600, ,	sales.sg@evoqua.com, info.sg@evoqua.com	
3	SFC	MUMBAI	+91 22 2783 2646/47, ,	info@ctechsbr.com	
<b>Item : TURBOCHARGER &amp; PRESSURE EXCHANGER</b>					
1	ERI	USA	+1 510 483 7370, ,	desalsales@energyrecovery.com	
2	FEDCO	USA, INDIA	+1 734 241 3935, +91 251 231 9130,	sales@fedco-usa.com, sparanjpe@fedco-usa.com	
<b>Item : UPVC/CPVC PIPING</b>					
1	ALIAxis UTILITIES & INDUSTRY PVT LTD	BELGIUM, SINGAPORE	+32 2775 5050, +65 6266 6698,	NA	MAKE: FIP, DIN/ISO/ASTM
2	ASTRAL PIPES	AHMEDABAD, NEW DELHI	+91 7966212000, +91 112616 8156/9461,	info@astralpipes.com, delhi@astralpipes.com	MAKE: ASTM STANDARDS
3	GEORG FISCHER PIPING SYSTEMS PVT LTD	MUMBAI	+91 22 4007 2000, ,	branchoffice@georgfischer.com	MAKE: DIN STANDARDS
<b>Item : WALNUT SHELL FILTER/ MEDIA</b>					
1	ARABIAN INDUSTRIES	OMAN	+968 2205 6000, ,	sales@arabian-industries.net, info@arabian-industries.net	
2	CAMERON (SCHLUMBERGER)	GURGAON	+91 124 335 5667, ,	NA	
3	ECO-TEC SOLUTIONS PVT.LTD	CANADA	+1 905 427 0077, ,	sales@eco-tec.com	
4	ENHYDRA LTD	UK	+44 (0) 1454 262 600, ,	sales@enhydra.co.uk	
5	MANN & HUMMEL	REWARI	+91 128 426 300, ,	office.india@mann-hummel.com	
6	PEERLESS EUROPE LTD	SINGAPORE	+65 6472 0020, ,	NA	
7	SIEMENS	GURGAON, GERMANY	+91 124 383 6000, +49 (9131) 7-44544,	rainer-schulze@siemens.com	

## TECHNICAL AMENDMENT NO: 01

**ITEM DESCRIPTION :** RO/DM/RWTP/CPU/ZLD FOR P-25  
**BIDDING DOCUMENT NO. :** B269-475-17-44-PA-T-8701  
**DISCIPLINE :** GENERAL CIVIL DEPT.

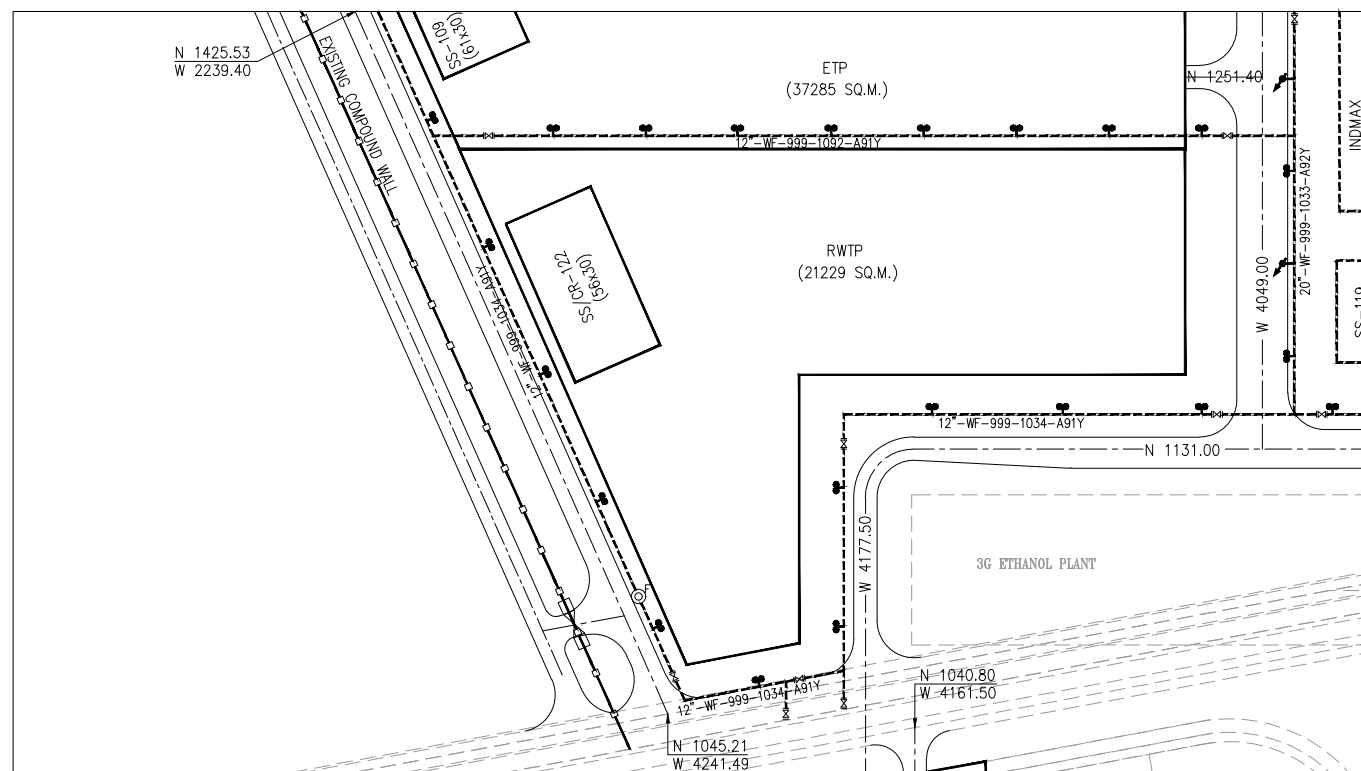
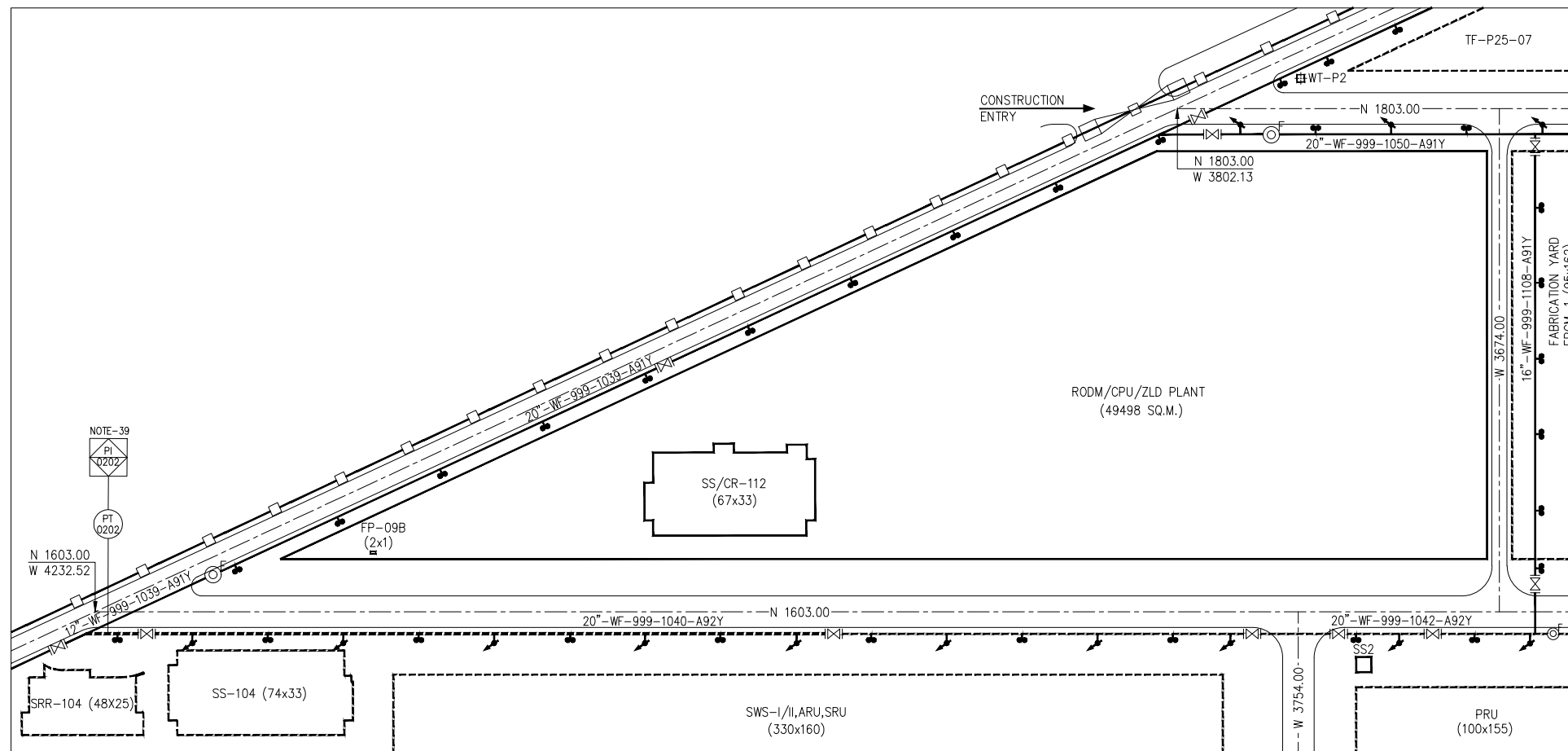
0	16.02.2021	ISSUED AS TECHNICAL AMENDMENT	AP	BP	CD				
Rev. No	Date	Purpose	Prepared by	Checked by	Approved by				



The terms, conditions and specifications of Bidding Document stand modified to the extent indicated under column "MODIFICATIONS/ADDITION/DELETION". All other terms & conditions, stipulations and specifications of bidding document shall remain unaltered.

S No	Part No / Vol No	Page No.	Section / Document no.	Clause No / Item No	Subject	Modifications / Additions/Deletion
1.	-	-	Doc.NoB269-000-17-44-00002 Rev F	-	Overall plot plan	<u>Modification:</u> The document B269-999-81-45-00001 Rev 6 is attached which shall supersede the previous revision doc no.. No.B269-000-17-44-00002 Rev F
2.	-	-	Drg no:B269-475-17-44-3-0101 Rev.B	-	Firewater P&ID for RO/DM/CPU/ZLD/TWTP	<u>Deletion:</u> This document shall be deletion
3.	-	-	Drgno:B269-475-81-45-3-0101 Rev.A	-	Firewater P&ID for RO/DM/CPU/ZLD/TWTP	<u>Additions:</u> This document shall be Additions





REF. DWG. NO.	REFERENCE DRAWING TITLE																
B269-999-81-45-00001	OVERALL PLAN PLAN																
<p><b>NOTES :-</b></p> <ol style="list-style-type: none"> <li>1. FIRE WATER PIPING SHALL BE AS PER PMS.</li> <li>2. FW HEADER WITHIN RCC PAVED AREA SHALL BE LAID DIRECTLY BURIED WITHOUT RCC TRENCHES WITH PRECAST RCC SLABS/ HEAVY DUTY PAYER BLOCKS ON TOP. IN CRANE MOVEMENT AREAS, FW PIPES SHOULD BE PROTECTED WITH CONCRETE/STEEL ENCASEMENT.</li> <li>3. ABOVE GROUND FIRE WATER LINES SHALL BE SUPPORTED ON RCC SLEEPERS AND PAINTED WITH FIRE RED AS PER PAINTING SPECIFICATION.</li> <li>4. ISOLATION VALVES IN THE FIRE WATER NETWORK SHALL BE GATE VALVE TYPE.</li> <li>5. HOSE CABINETS (TYPE-II) ALONG WITH TWO HOSE PIPE AND NECESSARY ACCESSORIES AS PER SPECIFICATION FOR EACH HYDRANT AND LANDING VALVE.</li> <li>6. HOSE REEL NEAR LANDING VALVES SHALL BE PROVIDED FOR TECH STRUCTURE, AND SUB STATIONS.</li> <li>7. HYDRANTS AND MONITOR SHOWN FOR UNIT ARE INDICATIVE AND SHALL BE FINALIZED BY EPCC CONTRACTOR.</li> <li>8. LANDING VALVES ALONG WITH HOSE CABINETS SHALL BE PROVIDED FOR TECH STRUCTURE AND SUB STATIONS BY PACKAGE CONTRACTOR.</li> <li>9. NOS. AND SIZE OF TAPPING FOR WATER SPRAY SYSTEM SHALL BE PROVIDED BY RESPECTIVE PACKAGE CONTRACTOR DURING DETAIL ENGINEERING.</li> <li>10.INTERNAL HYDRANT LINE SHALL BE PROVIDED BY RESPECTIVE PACKAGE CONTRACTOR DURING DETAIL ENGINEERING.</li> <li>11.LOCATION FOR HVLRM WITHIN UNIT ARE NOT SHOWN IN THE LAYOUT. THE SAME SHALL BE PROVIDED BY PACKAGE CONTRACTOR AS PER DETAIL ENGINEERING.</li> <li>12.DESIGN OF OFFSITE FIRE WATER NETWORK AND FIRE WATER PUMPING SYSTEM NOT IN SCOPE OF PACKAGE CONTRACTOR.</li> <li>13.MIN PRESSURE 7.0 TO 10.0kg. Sqcm (G) AT TIE POINTS OF FIRE WATER HEADER AROUND RODM/CPU/ZLD PLANT UNIT AND RWTP IS ENSURED AT THE BATTERY LIMIT.</li> <li>14.IF HIGH PRESSURE FWL IS REQUIRED PACKAGE CONTRACTOR SHALL BE PROVIDED THE BOOSTER PUMP.</li> <li>15.PACKAGE CONTRACTOR TO PROVIDED FIRE HYDRANT/MONITOR INCLUDING TAPPING AND PIPING FROM FIRE WATER LINE AROUND UNIT FOR ENTIRE COVERAGE OF UNIT IN CASE ENTIRE COVERAGE FOR UNIT IS NOT MEETING EVEN AFTER CONSIDERING FIRE THE HYDRANT/MONITOR ON FIRE WATER MAIN HEADER PROVIDED BY PACKAGE AROUND UNIT.</li> </ol>																	
<p><b>LEGEND</b></p> <table border="0"> <tr> <td>FIRE WATER LINE (BY OTHER)</td> <td></td> </tr> <tr> <td>GATE VALVE</td> <td></td> </tr> <tr> <td>VALVE PIT</td> <td></td> </tr> <tr> <td>DOUBLE HEADED HYDRANT</td> <td></td> </tr> <tr> <td>HYDRANT CUM WATER CUM FOAM MONITOR (500-1000 GPM)</td> <td></td> </tr> <tr> <td>FLUSHING CONNECTION</td> <td></td> </tr> <tr> <td>PRESSURE GAUGE</td> <td></td> </tr> <tr> <td>HYDRANT CUM MONITOR ASSEMBLY</td> <td></td> </tr> </table>		FIRE WATER LINE (BY OTHER)		GATE VALVE		VALVE PIT		DOUBLE HEADED HYDRANT		HYDRANT CUM WATER CUM FOAM MONITOR (500-1000 GPM)		FLUSHING CONNECTION		PRESSURE GAUGE		HYDRANT CUM MONITOR ASSEMBLY	
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A92Y	UNDER GROUND PIPING																
A91Y	ABOVE GROUND PIPING																







**TECHNICAL AMENDMENT NO.; B269-475-17-44-PC-T-8701/T-01**

**TO**

**TENDER NO.; B269-475-17-44-PC-T-8701**

**FOR**

**RWTP, RO-DMP, CPU & ZLD PLANT**

**(PROJECT: PANIPAT REFINERY EXPANSION PROJECT (P-25))**

24.02.2022	Issued as amendment to RFQ	AS	RK	AA
Date	Purpose	Prepared By	Reviewed By	Approved By

**SUBJECT : TECHNICAL AMENDMENT FOR RWTP, RO-DMP, CPU & ZLD PLANT**  
**TENDER NO. : B269-475-17-44-PC-T-8701**  
**SERVICE : RWTP, RO-DMP, CPU & ZLD PLANT**

The terms & conditions of **Bid document No. # B269-475-17-44-PC-T-8701** stand modified to the extent indicated under column "MODIFICATIONS/ ADDITIONS/ DELETIONS". All other terms & conditions etc. of Material Requisition issued earlier shall remain unaltered.

Sl. No.	Section no. of MR	Document no.	Page No.	Clause / Item No.	Modifications/Additions/Deletions
1.	Job Specification (Instrumentation)	B269-475-16-51-SP-8701, Rev F	4 of 42	2.4 Scope of procurement, supply and installation	<b><u>Modification</u></b> Clause no. 2.4 modified as below:  UCR-100 shall be read as UCR-105.
2.	EDB (Instrumentation)	B269-999-16-51-EDB-1001		Rev.3	<b><u>Modification</u></b> "EDB (Instrumentation)" document updated to Rev.3 and the same is enclosed herewith.
3.	Job Specification (Instrumentation)	B269-475-16-51-SP-8701, Rev F	5 of 42	2.4.5 PLC SOE (Sequence Of Events) requirement	<b><u>Modification</u></b> Clause no. 2.4.5 modified as below:  "SOE capability..... Dedicated SER PC is required."
4.	Job Specification (Instrumentation)	B269-475-16-51-SP-8701, Rev F	30 of 42	7.1/ Instrument impulse lines	<b><u>Modification</u></b> Clause no. 7.1 modified as below :  "...Impulse line shall be Piping with Tubing at instrument end for Hydrocarbon for line rating above 600 class, Hydrogen service & steam and where pre-fabricated hook-up is not used..... break flanges shall be used."
5.	Job Specification (Instrumentation)	B269-475-16-51-SP-8701, Rev F	31 of 42	7.3/ Instrument Air	<b><u>Modification</u></b> Clause no. 7.3 modified as below :  "...size shall be 1/2" OD with 0.049" wall thickness."

Sl. No.	Section no. of MR	Document no.	Page No.	Clause / Item No.	Modifications/Additions/Deletions
6.	Instrument Duct/Trench Layout	B269-000-16-51-008000		Rev.G	<b>Modification</b> "Overall Duct/Trench Layout" document updated to Rev.G and the same is enclosed herewith.
7.	Standard Specification for Electromagnetic Flowmeter (Instrumentation)	6-52-0002, Rev.4	-	-	<b>Modification</b> Standard Specification for Electromagnetic Flowmeter updated to Rev.5 and the same is enclosed herewith.
8.	Standard Specification for restriction orifice plate (Instrumentation)	6-52-0006, Rev.4	-	-	<b>Modification</b> Standard Specification for restriction orifice plate updated to Rev.5 and the same is enclosed herewith.
9.	Standard Specification for Control Valves (Instrumentation)	6-52-0031, Rev.4	-	-	<b>Modification</b> Standard Specification for Control Valves updated to Rev.5 and the same is enclosed herewith.
10.	Standard Specification for Control Valves (Instrumentation)	6-52-0037, Rev.2	-	-	<b>Modification</b> Standard Specification for On-Off Valves updated to Rev.3 and the same is enclosed herewith.
11.	Standard for Orifice plates and flanges dimensional details RTJ flanges (Instrumentation)	7-52-0042, Rev.0	-	-	<b>Modification</b> Standard for Orifice plates and flanges dimensional details RTJ flanges updated to Rev.1 and the same is enclosed herewith.
12.	Standard for Perforated tray supports & cables clamping details(Instrumentation)	7-52-0107, Rev.3	-	-	<b>Modification</b> Standard for Perforated tray supports & cables clamping details updated to Rev.4 and the same is enclosed herewith.
13.	Standard for FRP	7-52-0255,	-	-	<b>Addition</b>

Sl. No.	Section no. of MR	Document no.	Page No.	Clause / Item No.	Modifications/Additions/Deletions
	duct fabrication - bolted construction detail	Rev.0			Standard for FRP duct fabrication - bolted construction detail Rev.0 enclosed herewith.

**Enclosures:**

1. EDB (Instrumentation)/ B269-999-16-51-EDB-1001, Rev.3.
2. Overall Duct/Trench Layout, Rev.G
3. Standard Specification for Electromagnetic Flow meter,6-52-0002, Rev.4
4. Standard Specification for restriction orifice plate,6-52-0006, Rev.5
5. Standard Specification for Control Valves,6-52-0031, Rev.5
6. Standard Specification for On-Off Valves,6-52-0037, Rev.3
7. Standard for Orifice plates and flanges dimensional details RTJ flanges ,7-52-0042,Rev. 1
8. Standard for Perforated tray supports & cables clamping details,7-52-0107,Rev. 4
9. Standard for FRP duct fabrication - bolted construction detail,7-52-0255,Rev.0

# ENGINEERING DESIGN BASIS INSTRUMENTATION

JOB NO: B269  
PROJECT: PANIPAT REFINERY EXPANSION (P-25) PROJECT  
CLIENT: INDIAN OIL CORPORATION LIMITED (IOCL)

EIL SIGNATURE:



CLIENT SIGNATURE:



3	02/Sep/2021	Revised and Reissued for Implementation	RAKESH ROSHAN SAHOO	RAJIV KONWAR	ANU ACHARYA
2	25/Aug/2020	Revised and Reissued for Implementation	ARPAN SAMANTA	HASHIM XAVIER	ANU ACHARYA
Rev. No.	Date	Purpose	Prepared by	Reviewed by	Approved by

Legend: ***Bold italic*** text denotes change with respect to previous revision.

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## 1.0 SCOPE

This Specification covers the design criteria for the purpose of carrying out Engineering for Procurement of various instruments and control systems required for the project including spare philosophy.

## 2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

### 2.1 ABBREVIATIONS

Code	Description
AWG	American Wire Gauge
BEDB	Basic Engineering Design Basis
BIS	Bureau of Indian Standards
CCE	Chief Controller of Explosives
CCTV	Closed Circuit Television
DCS	Distributed Control System
DGMS	Director General of Mines Safety
DPDT	Double Pole Double Throw
FF	Foundation Fieldbus
FRP	Fibre Reinforced Polymer
GRP	Glass Reinforced Polymer
HART	Hi-way Addressable Remote Transducers
HC	Hydrocarbon
HVAC	Heating Ventilation and Air Conditioning
IBR	Indian Boiler Regulations
IP	Ingress Protection
IR	Infrared
IS	Intrinsically Safe
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MCC	Motor Control Center
NACE	National Association of Corrosion Engineers
NB	Nominal Bore
NEC	National Electric code
NEMA	National Electrical Manufacturer's Association
NPT	National Pipe Threads
OSHA	Occupational Safety and Health Authority
PESO	Petroleum and Explosives Safety Organisation
PLC	Programmable Logic Controller
PWAMC	Post Warranty Annual Maintenance Contract
RTD	Resistance Temperature Detector
SAMA	Scientific Apparatus Maker's Association
SPDT	Single Pole Double Throw
TFMS	Tank Farm Management System
<b>BOO</b>	<b>Built, Own, Operate</b>
<b>BOOT</b>	<b>Built, Own, Operate, Transfer</b>

### 2.2 CODES & STANDARDS / PUBLICATIONS

Design and terminology shall comply, as a minimum, with the latest edition prior to the date of purchaser's enquiry with following codes, standard practices and publications:-

S.No.	Description	Standards / Codes
1	AGA-American Gas Association	
1.1	Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids- Part 1: General Equations and Uncertainty Guidelines	AGA Report No-3 Part-1
1.2	Measurement of Gas by Multipath Ultrasonic Meters	AGA Report No-9
2	ASME- American Society of Mechanical Engineers	
2.1	Pipe Threads General Purpose (Inch)	B 1.20.1
2.2	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/ Inch Standard	B 16.5
2.3	Metallic Gaskets for pipe Flanges- Ring Joint, Spiral- wound and Jacketed	B 16.20
2.4	Valves-Flanged, Threaded and Welding End	ASME B 16.34
2.5	ASME Boiler and Pressure Vessel Code (BPVC), Section VIII, Division 1: Rules for Construction of Pressure Vessels	ASME BPVC-VIII-1
2.6	Boiler and Pressure Vessel Code (BPVC), Section I: Rules for Construction of Power Boilers	ASME BPVC-I
2.7	Orifice Flanges	ASME B.16.36
2.8	Thermowells Performance Test Codes	PTC 19.3 TW :2010 & ERTA 2012
3	ANSI/FCI-American National Standards Institute/Fluid Control Institute	
3.1	Control Valve Seat Leakage	FCI 70-2
4	API-American Petroleum Institute	
4.1	Part-I Sizing and Selection	API STD 520
	Part-II Installation	API RP 520
4.2	Guide for Pressure Relieving and Depressurising Systems- Petroleum Petrochemical and natural gas industries-Pressure relieving and Depressurising Systems	API STD 521
4.3	Flanged Steel Pressure Relief Valves	API STD 526
4.4	Seat Tightness of Pressure Relief Valves	API STD 527
4.5	Manual of Petroleum Measurement Standards	API MPMS
	Vocabulary	API MPMS 1-Vocabulary
	Proving Systems	API MPMS 4 Chapter-4
	Metering	API MPMS 5 Chapter-5
4.6	Process Measurement Instrumentation- Part I - Process Control and Instrumentation	API RP 551
4.7	Transmission Systems	API RP 552
4.8	Venting Atmosphere and Low Pressure Storage Tanks	API 2000
4.9	Valve Inspection & Tests	API 598
5	BS-British Standards	
5.1	Multi-Element Metallic Cables Used in Analogue and Digital Communication and Control- Part 7: Sectional Specification for Instrumentation and Control Cables	BS EN 50288-7
6	EN-European Standards	
6.1	Metallic materials- Types of inspection documents	BS EN 10204:2004
7	IEC-International Electrotechnical Commission	
7.1	Explosive Atmosphere-Part 0: Equipment- General Requirements	IEC 60079-0 ED.6.0 2011

S.No.	Description	Standards / Codes
7.2	Electrical Insulation - Thermal Evaluation and Designation	IEC 60085
7.3	Tests on Electric and Optical Fiber Cables under Fire Conditions - Part 1-1: Test for Vertical Flame Propagation for a Single Insulated Wire or Cable-Apparatus	IEC 60332-1-1
7.4	Degree of protection provided by enclosures.(IP code)	IEC 60529 ED.2.1 B
7.5	Industrial Process Control Valves - Part 2-1: Flow Capacity - Sizing Equations for Fluid Flow Under Installed Conditions	IEC 60534-2-1
7.6	Industrial Process Control Valves- Part 2: Flow Capacity - Section Three - Test Procedures	IEC 60534-2-3
7.7	Industrial Process Control Valves - Part 2-4: Flow Capacity - Inherent Flow Characteristics and Rangeability	IEC 60534-2-4
7.8	Industrial Process Control Valves - Part 2-5: Flow Capacity - Sizing Equations for Fluid Flow Through Multistage Control Valve with Interstage Recovery	IEC 60534-2-5
7.9	Testing of Fire Resistant Cables	IEC 60331
7.10	Thermocouple Tolerances	IEC 60584-2
7.11	Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors	IEC 60751
7.12	Electromagnetic Compatibility (EMC) - Part 4: Testing and Measurement Techniques Set (Contains 30 sections)	IEC 61000-4 SET
7.13	Industrial Communication Networks - Fieldbus Specifications - Part 1: Overview and Guidance for the IEC 61158 and IEC 61784 series	IEC/TR 61158-1 Ed 3.0
7.14	Industrial Communication Networks - Fieldbus Specifications - Part 2: Physical Layer Specification and Service Definition	IEC 61158-2 Ed 5.0
7.15	Functional Safety of Electrical / Electronic / Programmable Electronic Safety-related Systems.	IEC 61508
7.16	Functional Safety – Safety Instrumented Systems for the Process Industry Sector	IEC 61511
8	IS-Indian Standard	
8.1	Specification of Thermal Evaluation and Classification of Electrical Insulation	IS-1271
8.2	PVC insulated (heavy duty) electric cables working Part I -voltage up to and including 1100V	IS-1554
8.3	Specification for pressure and vacuum gauges	IS-3624
8.4	PVC insulation and sheath of electric cables.	IS-5831
8.5	Specifications for Thermocouples	IS-7358
8.6	Thermocouple compensating cables.	IS-8784
9	ISA-International Society of Automation.	
9.1	Binary logic diagrams for process operations	ISA 5.2 (1976) (R1992)
9.2	ISA 7.0.01 Quality Standard for Instrument Air	ISA 7.0.01
9.3	Standards related to control valves	S-75.xx
9.4	Instrumentation Symbols & Identification	ISA 5.1
9.5	Instrumentation Loop Diagrams	ISA 5.4
9.6	Annunciator Sequence & Specifications	ISA S18.1

S.No.	Description	Standards / Codes
9.7	Environmental conditions for Process measurement & control systems - Temperature & Humidity	ISA-S71.01
9.8	Environmental conditions for Process measurement & control systems - Airborne Contaminants	ISA-S71.04
9.9	Hardware Testing of Digital Process Computers (Codes of Practice for Testing Computer Based Systems)	ISA-RP-55.1/BS-588
10	ISO - International Organisation for Standardization	
10.1	Measurement of Fluid Flow by Means of Pressure Differential Devices - Part 1: Orifice Plates, Nozzles and Venturi Tubes Inserted in Circular Cross-Section Conduits Running Full	ISO 5167-1
10.2	Measurement of Fluid Flow in Circular Cross-Section Conduits Running Full Using Pressure Differential Devices - Part 2: Orifice Plates	ISO 5167-2
10.3	Measurement of Fluid Flow in Circular Cross-Section Conduits Running Full Using Pressure Differential Devices - Part 3: Nozzles and Venturi Nozzles	ISO 5167-3
10.4	Measurement of Fluid Flow in Circular Cross-Section Conduits Running Full Using Pressure Differential Devices - Part 4: Venturitube	ISO 5167-4
11	Enclosures for Industrial control and systems.	ICS-6
12	NFPA-National Fire Protection Association	
12.1	Purged and pressurized enclosures for electrical equipment.	NFPA-496
13	Military Handbook - Reliability Prediction of Electronic Equipment	MIL-STD-217E

### 3.0 GENERAL / DESIGN CONSIDERATIONS

S.No.	Description
1	All instruments and equipments shall be suitable for use for specified site climatic conditions and industrial environment in which corrosive gases and/or chemicals may be present. As a minimum, all instruments and enclosures in field shall be dust proof and weatherproof to IP-65 as per IEC-60529 or equivalent NEMA 4X enclosure rating or better and secure against the ingress of fumes, dampness, insects and vermin. All external surfaces shall be suitably treated to provide protection against corrosive plant atmosphere
2	In case of contradiction between licensor specification and this Design basis, licensor specification shall prevail unless waiver to that specific requirement has been identified in the job specification. In case, job specification categorically identifies requirement, which is in contradiction to this, job specification will prevail.
3	The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC 61000-4 "Electromagnetic compatibility for Industrial Process measurement and Control equipment".
4	All electrical/electronic instruments used in hazardous area shall have statutory certification from the country of origin. Additionally these instruments shall be certified by CCE/PESO/DGMS as applicable, whenever installed in India. Also indigenous flameproof equipment shall comply with BIS requirement.



S.No.	Description
5	<i>Process switches, shall be realised through field transmitters. If for some packages, process switches (pressure, level etc.) are unavoidable same shall be provided with sealed micro switch contacts rated for the specified application. Contacts shall be 1 no. DPDT preferably. Otherwise 2 nos. SPDT can be considered. All switch contacts except those used in intrinsically safe circuits shall be silver plated. Contacts used in intrinsically safe circuits shall be suitable for the applications. Switches shall be hermetically sealed type. Switches shall be connected through interposing relays. Pressure Switches if used shall be with local display indicating the real time pressure.</i>
6	<p><b>Redundancy Philosophy for DCS:</b></p> <p>a) <b>Controller: Redundant (1:1 redundancy).</b></p> <p>b) <b>Data Acquisition (I/O cards): Redundant for all i.e. Control/ Interlock/ Sequence/Open Loop application (1:1 redundancy). (AI card limited to maximum 16 channels and DI cards limited to maximum 32 channels).</b></p> <p>c) <b>Power supply subsystem: Redundant (1:1 redundancy). Redundancy shall be provided to ensure availability of the system at single point failure.</b></p> <p>d) <b>Communication subsystem: Redundant (1:1 redundancy).</b></p> <p>e) <b>FF H1 cards: Redundant (1:1 redundancy)</b></p> <p>f) <b>FF power supply: Redundant (1:1 redundancy)</b></p> <p>g) <b>History: Redundant (1:1 redundancy).</b></p> <p>h) <b>System server (for server based DCS): Redundant (1:1 redundancy)</b></p> <p>i) <b>Modbus / serial interface cards: Redundant (1:1 redundancy)</b></p> <p>j) <b>OPC server: OPC server shall have RAID-5 / RAID 10 configuration. Separate (shall not be combined with DCS system server) redundant OPC servers shall be considered with independent DMZ and double firewall. One shall be for Plant LAN/RTDBMS/MCMS and other as gateway for APC (group wise).</b></p> <p><b>Unit wise Controller, IO and BPS segregation shall be provided for all units.</b></p> <p><b>System shall be Fault tolerant. Redundancy of the system should not be compromised on a single component failure. No single point failure should exist in the DCS &amp; PLC hardware configuration. If a Processor fails, corresponding IO modules should not become offline and vice versa. Redundancy should only be lost at Controller level whereas IOs continue to be redundant and vice versa.</b></p>
7	The instrument item like control valve, pressure relief valve, orifice flanges, level instrument, thermowell etc., coming on pipe and vessel under IBR services shall be certified by IBR or IBR authorised representative, even for SS metallurgy.
8	<p>Smart transmitters when specified shall be used in analog mode with an accuracy of <math>\pm 0.05\%</math> of span (for direct mounted transmitters) with a rangeability of 10:1 unless specified otherwise. Also fieldbus transmitters shall have an accuracy of <math>\pm 0.05\%</math> of span (for direct mounted transmitters) with a rangeability of 10:1 unless specified otherwise.</p> <p>Universal type Hand held communicator suitable for both smart as well as Fieldbus transmitters shall be supplied for smart transmitters and fieldbus transmitters. Minimum 3 Nos. Universal type Hand held communicator shall be considered for each unit.</p>
9	Field transmitter supports should be properly clamped to the pipe for pre-fabricated wherever required and closed couple installation. No air gap shall be kept between support clamp and pipe.
10	Threaded end connections shall be to NPT as per ASME B 1.20.1. Flanged end connections shall be as per ASME B 16.5. Orifice flanges shall be as per ASME B 16.36

S.No.	Description
11	Drain/ vent valves used in remote installation shall be Gate Valve to facilitate rodding.
12	<b><i>Solenoid valves shall be in TMR configuration for critical applications as per P&amp;ID where SIL-3 certified solenoid valve will be used. SOV in single configuration shall be a PFD value with SIL-3. SOV configuration in 2oo2 configuration shall not be used. However, different configurations like 2002, etc., if mandated by Licensor, the same shall be discussed with IOCL. Pilot operated SOVs shall not be considered.</i></b>
13	<b><i>All online process analysers and gas detectors shall be supplied complete with proper calibration apparatus / calibration gas cylinders etc. Auto calibration facility need to be provided for the analysers and gas chromatographs. Wherever auto calibration features are not available for any analysers from the approved manufacturers, manual calibration shall be considered. Gas detectors shall have local indication. Valid CCOE certificate must be provided along with carrier gas (H2 and N2) cylinders. CCOE certificates for both basic gas and mixture gas must be provided for calibration gas cylinder and the certificates should be in the name of IOCL. Analysers Operation shall be "Reagent free". Reagents (if any) required for operation of Analysers the same shall be supplied along with Analysers for a period of 12 months.</i></b>
14	<b><i>For instrumentation electrical interface, input and output contacts shall be in separate multicables. Electrical interface signals for DCS and PLC shall be segregated.</i></b>
15	All instruments in sour service shall meet NACE requirement wherever required as per licensor specification/ piping material specification.
16	Canopy shall be Prefabricated type. Canopy for transmitters shall cover TOP and all 4 SIDES with transparent door on the front; canopy for JB shall cover 3 SIDES. SS canopy instead of FRP, if offered by package vendor, shall also be acceptable. No separate canopy shall be required for instruments located under shed like compressor shed etc.
17	<b><i>Wherever dual power supplies are used, anyone power supply failure shall generate an alarm in DCS graphics. BPS should have status monitoring with current output (4-20 mA) and contact output for power failure, power supply should have voltage balancing facilities and redundant MOSFET based with no common electronics.</i></b>

### 3.1 CONTROL PHILOSOPHY

#### 3.1.1 TYPE OF PLANT

S.No.	Description	EIL Choice	Remarks
1	Grassroot		
2	Expansion	YES	Expansion to 25 MMTPA
3	Other		

#### 3.1.2 MODE OF PLANT OPERATION

S.No.	Description	EIL Choice	Remarks
1	Centralised		Main Control Room (MCR-100)



S.No.	Description	EIL Choice	Remarks
1.1	For all process units	YES	<b>RHCU,INDMAX,Propylene Recovery Unit (PRU),Atmospheric Vacuum Distillation (AVU),SR LPG Treater Unit,VGO Hydro treater Unit,Naphtha Hydro Treater Unit,Catalytic Cracking Unit (CCRU),Isomerisation Unit (ISOM),CDW Unit/LOBS, Diesel Hydro treater Unit,Sulphur Recovery Unit (SRU),Sour Water Stripper Unit,Amine Recovery Unit,Utility Boiler,Flare, Cooling water, FG System, MUG.</b>
2	Dedicated		
2.1	For new Polypropylene Unit	YES	Existing MCR in PNCP
2.2	<b>For new Instrument Air / Plant Air/N2 (BOO)</b>	YES	CR-110
2.3	<b>For RWTP</b>	YES	<b>CR-122</b>
2.4	<b>For new Utility Boiler, Cooling Tower:CT-01,CT-02, OWS,CRWS,SS</b>	YES	UCR-105
2.5	<b>For new Tank Farms / Mounded Vessels &amp; Product blending automation system (BOOT)</b>	YES	OMSCR-113
2.6	For new ETP	YES	<b>CR-109</b>
2.7	<b>For Hydrogen Generation Unit (BOO)</b>	YES	<b>CR/SRR-114</b>
2.8	<b>For RO-DM/CPU &amp; ZLD</b>	YES	<b>CR-112</b>
2.9	<b>Existing PR area new facilities</b>	YES	<b>Existing OC # 2,OC # 3, LBT CR</b>
2.10	<b>New CPU (PNCP Area)</b>	YES	<b>Existing DMRO Control Room</b>
2.11	<b>RWTP facility in existing PR area</b>	YES	<b>Existing RWTP CR</b>
2.12	<b>Cooling tower CT-2A in PNCP area</b>	YES	<b>Existing CT CR in PNCP area</b>

1. SI No. 2.4 :- DCS Operator Consoles with Connectivity to MCR-100 will be considered in UCR-105.
2. SI No. 2.5 :- Blending and TFMS consoles will be located in OMSCR-113 integrated with DCS.
3. Operator console shall be provided for Fire Water operation at Fire Water Pump House, Existing Main Fire Station.

### 3.1.3 CONTROL ROOM/SATELLITE RACK ROOM REQUIREMENT

S.No.	Control Room/ SRR	Process/ Utility Units	Floor Location	Remarks

S.No.	Control Room/ SRR	Process/ Utility Units	Floor Location	Remarks
1.1	SRR-118	Naphtha Hydro Treater Unit, Catalytic Cracking Unit (CCRU), Isomerisation Unit (ISOM) & SR LPG Unit	Ground	Safe Area
1.2	SRR-101	Atmospheric Vacuum Distillation (AVU)	Ground	Safe Area
1.3	SRR-115	Diesel Hydro treater Unit	Ground	Safe Area
1.4	<b>CR/SRR-114</b>	Hydrogen Generation Unit	Ground	Safe Area
1.5	SRR-119	INDMAX Unit & Flare	Ground	Safe Area
1.6	SRR-102	<b>FG System &amp; MUG</b>	Ground	Safe Area
1.7	SRR-116	VGO Hydro treater Unit	Ground	Safe Area
1.8	SRR-103	Propylene Recovery Unit (PRU)	Ground	Safe Area
1.9	SRR-117	RHCU	Ground	Safe Area
1.10	SRR-104	Sulphur Recovery Unit (SRU), Sour Water Stripper & Amine Recovery Unit	Ground	Safe Area
1.11	SRR-120	CDW Unit/LOBS	Ground	Safe Area
1.12	SRR-121	Alkylation Unit (including n- Butane isomerisation Unit) & Sulphuric Acid Regeneration Unit.	<b>Deferred</b>	
1.13	<b>CR-122</b>	<b>RWTP</b>	Second Floor	Safe Area
1.14	CR-110	Instrument Air / Plant Air & Nitrogen	Ground	Safe Area
1.15	UCR-105	<b>Utility Boiler, Cooling Tower:CT-01,CT-02,OWS, CRWS,SS</b>	Ground	Safe Area
1.16	OMSCR-113	Tank Farms / Mounded Vessels & Product Blending	Ground	Safe Area
1.17	SRR-31(In PNCP)	<b>Polypropylene Unit (PPU)/ CT2A(PNCP)</b>	Ground	Safe Area
1.18	<b>CR-109</b>	ETP	<b>Ground</b>	Safe Area
1.19	<b>CR-112</b>	<b>RO-DM/CPU &amp; ZLD</b>	<b>Second Floor</b>	<b>Safe Area</b>
1.20	<b>Existing DCU CR</b>	<b>New facilities in existing PR area</b>	<b>Ground</b>	<b>Safe Area</b>
1.21	<b>Existing LBT CR</b>	<b>New facilities in existing PR area</b>	<b>Ground</b>	<b>Safe Area</b>
1.22	<b>Existing Old SRU CR</b>	<b>New facilities in existing PR area</b>	<b>Ground</b>	<b>Safe Area</b>
1.23	<b>Existing DMRO CR</b>	<b>New CPU (PNCP)</b>	<b>Ground</b>	<b>Safe Area</b>
1.24	<b>Existing RWTP CR</b>	<b>RWTP facility in existing PR area</b>	<b>Ground</b>	<b>Safe Area</b>

1) IO's of Fire water pump house and CT-01 will be terminated in MCR-100.

### 3.1.4 FLOORING REQUIREMENT IN INSTRUMENT ROOMS

S.No.	Rooms of SRR/ Control Room	Flooring Type (shall be as per Architecture)	Cable Routing inside C/R	Remarks
1	Rack Room of SRR.	False Floor	Covered Tray for all system and special cables. Cables from field up to marshalling cabinet and power cables shall be routed generally through open trays (perforated / ladder) below the false floor in rack room.	Cable entry shall be through MCT below false floor.
2	Rack Room in Control Rooms.	False Flooring	Covered Tray for all system and special cables. Cables from field up to marshalling cabinet and power cables shall be routed generally through open trays (perforated / ladder) below the false floor in rack room.	Cable entry shall be through MCT below false floor.
3	Engineering Room	Solid Floor	Trench	All the cables shall be laid through trays inside the trenches.
4	Console Room	Solid floor	Trench	All the cables shall be laid through trays inside the trenches.

### 3.1.5 TYPE OF CONTROL AND MONITORING

S.No.	Description	Units	Remarks
1	Centralised		
1.1	Distributed Control System	<i>RHCU,INDMAX,Propylene Recovery Unit (PRU),Atmospheric Vacuum Distillation (AVU),SR LPG Treater Unit,VGO Hydro treater Unit,Naphtha Hydro Treater Unit,Catalytic Cracking Unit (CCRU),Isomerisation Unit (ISOM),CDW Unit/LOBS,Diesel Hydro treater Unit,Sulphur Recovery Unit (SRU),Sour Water Stripper Unit,Amine Recovery Unit,Utility Boiler,Flare,Cooling water, Cooling Tower, FG System, MUG.</i>	

S.No.	Description	Units	Remarks
2	Dedicated		
2.1	Distributed Control System	Polypropylene Unit (PPU)	<b>DCS/ESD system of new PPU shall be seamlessly integrated with existing DCS/ESD system by EPCM-3. Hence DCS shall be of Yokogawa Centum CS 3000 and ESD shall be Schneider Triconex only.</b>
2.2	Programmable Logic Controller	Packages like Instrument Air / Plant Air / Nitrogen, RO-DM & CPU, ETP, RWTP, PSA,SRU Palletising, bagging machines, extruder, pneumatic conveying, dryer regeneration etc.	
2.5	<b>Distributed Control System</b>	<b>Hydrogen Generation Unit</b>	
2.4	<b>Distributed Control System</b>	<b>Tanks &amp; Mounted Bullets, Product Blending</b>	
3	Local Panel Control System		
3.1	Microprocessor based/PLC	<b>For LP Air Compressor, Air Dryer, Slides Valves/ Catalyst Loader etc.</b>	<b>Manufacturer's standard control system shall be considered with repeat indications to main control system. All package PLCs except heater soot blower PLC, LP Air Compressor, Air Dryer shall be located in respective SRRs/CRs.</b>
3.2	Pneumatic	NO	
3.3	Hydraulic	NO	

For revamp units, expansion of existing Control System will be carried out.

### 3.1.6 INTERLOCK AND SHUT-DOWN SYSTEM

S.No.	Description	EIL Choice	Remarks
1	Logic Representation		
1.1	As per ISA	YES	
1.2	As per actual electronics	NO	
1.3	Other	NO	
2	Interlock Execution		

S.No.	Description	EIL Choice	Remarks
2.1	Independent of Shutdown System		
2.1.1	With DCS	NO	
2.1.2	Dedicated	NO	
2.2	With Shutdown system	YES	
3	Shutdown System		
3.1	Dedicated unit wise	YES	
3.2	Common for all units	NO	
3.3	Type of hardware		
3.3.1	PLC	YES	Non-FF
3.3.2	Relay	NO	
4	PLC Configuration for shutdown		PLC configuration for process units shall be TMR or Quad, SIL-3 certified as per IEC 61508 and IEC 61511
4.1	Triple Modular Redundant	YES	
4.2	Quad	YES	
4.3	Dual Modular Redundant	NO	
5	SIL3 Classification	YES	
6	Other	YES	Licensors' specific requirement, if any, shall be considered.
7	Process bypass switch		
7.1	Software	NO	
7.2	Hardwired with Indication Lamp (as per approved P&IDs)	YES	All interlock bypass, startup bypass shall be as per licensors/equipment manufacturer requirement. Self-illuminated hardwired only and with key-lock.
8	ESD switch	YES	<b><i>Push Type with protective cover and with three independent contacts (3 separate micro switches with separate actuation mechanism). All three contacts shall be wired to ESD in 2oo3 configuration.</i></b>
8.1	Local panel	YES	As per P&IDs
8.2	Control Room	YES	As per P&IDs
8.3	Field	YES	As per P&IDs
9	Maintenance Bypass switches	YES	In PLC Operator HMI enabled through Master MOS in HWC

ESD PB"s in field shall be provided with cover.

### 3.1.7 LOCAL PANEL REQUIREMENT

S.No.	Description	EIL Choice	Remarks
1	Location		
1.1	Hazardous Area	YES	As per area classification
1.2	Non Hazardous Area	YES	As per area classification
2	Type		

S.No.	Description	EIL Choice	Remarks
2.1	Weatherproof	YES	For local panel in hazardous area, local display unit (HMI) , Alarm annunciators including and other components like lamps, switches, push buttons etc shall be intrinsically safe.
2.2	Flame-proof	YES	Wherever Applicable
2.3	Purged	YES	Shall be considered for analyser cabinets if flame proof enclosure is not available as standard.
3	Instruments Type		
3.1	Pneumatic	NO	
3.2	Electronic	YES	

**a. All cable entries in the local panels shall be from bottom. All local panels shall be provided with canopy.**

**b. IS display unit shall be installed with required driver software and configured as MODBUS SLAVE instead of MODBUS MASTER. Since the DCS always acts as MODBUS MASTER, configuring the IS display unit as MODBUS slave only will ensure proper serial communication between DCS and IS display unit.**

**c. Cable entry to analyser shelter shall be through MCT and for Local Control Panel shall preferably be through MCT.**

**d. Dedicated local display shall be provided for MMS which shall be separate to process display.**

## 3.2 PACKAGE UNITS PHILOSOPHY

### 3.2.1 OPERATING PHILOSOPHY

S.No.	Package Description	Control & Monitoring-Centralized DCS	Control & Monitoring-Dedicated PLC in CR	Control & Monitoring-Dedicated PLC in Local Panel	Interlock & Shutdown-Centralised PLC	Interlock & Shutdown-Dedicated PLC in CR	Interlock & Shutdown-Dedicated PLC in Local Panel	Remarks
1	Compressor Packages	Yes	-	-	Yes	-	-	See note below
2	Sulphur Forming And Handling System	-	YES	-		YES	-	PLC will be located in Pelletizer control room.
3	PSA	-	YES	-		<b>YES</b>	-	Package Vendor supplied operator console will be located in MCR-100 along with Units operator console.
4	Instrument Air / Plant Air, N2		YES	<b>YES (For LP Air Compressor and Dryer)</b>		<b>YES</b>	<b>YES (For LP Air Compressor and Dryer)</b>	System will be operated using Package Vendor supplied operator console located in CR-110.

S.No.	Package Description	Control & Monitoring-Centralized DCS	Control & Monitoring-Dedicated PLC in CR	Control & Monitoring-Dedicated PLC in Local Panel	Interlock & Shutdown-Centralised PLC	Interlock & Shutdown-Dedicated PLC in CR	Interlock & Shutdown-Dedicated PLC in Local Panel	Remarks
5	ETP, RWTP, RO-DM/CPU & ZLD		YES	-		YES	-	<i>System will be operated using Package Vendor supplied operator console located in respective Control Rooms CR-109, CR-112 and CR-122.</i>
7	Extruder Package of PPU	-	YES	-		YES	-	System will be operated using the package Vendor supplied operator console located in extruder control room.



S.No.	Package Description	Control & Monitoring-Centralized DCS	Control & Monitoring-Dedicated PLC in CR	Control & Monitoring-Dedicated PLC in Local Panel	Interlock & Shutdown-Centralised PLC	Interlock & Shutdown-Dedicated PLC in CR	Interlock & Shutdown-Dedicated PLC in Local Panel	Remarks
8	Pneumatic conveying system of PPU	-	YES	-		YES	-	Package Vendor supplied operator console will be located in existing MCR of PNCP along with Units operator console.
9	<b>UB-BMS and BOP</b>	-	-	-	-	YES	-	<b>Package Vendor supplied operator console will be located in UCR-105 along with Units operator console.</b>
10	<b>ASRS (PNCP Area)</b>	-	YES	-	-	YES	-	<b>Package Vendor supplied operator console will be located in Local Control Room.</b>

S.No.	Package Description	Control & Monitoring-Centralized DCS	Control & Monitoring-Dedicated PLC in CR	Control & Monitoring-Dedicated PLC in Local Panel	Interlock & Shutdown-Centralised PLC	Interlock & Shutdown-Dedicated PLC in CR	Interlock & Shutdown-Dedicated PLC in Local Panel	Remarks
11	<b>Bagging &amp; Pelletizing Package (PNCP Area)</b>	-	YES	-	-	YES	-	<b>Package Vendor supplied operator console will be located in Local Control Room.</b>

- a. Logic implementation for package units shall be through Plant PLC. However for proprietary items like LP Air compressor/ Air Dryer, Soot Blower, ClO2 dosing, Slides Valves, Catalyst Loader etc. or licensors specific requirements, Package vendor's PLC / Control System shall be used.
- b. Wherever dedicated PLC is considered for packages, all signals shall be mapped to DCS with dedicated graphics.

### 3.2.2 PLC CONFIGURATION (FOR PACKAGE VENDOR SUPPLIED PLC)

S.No.	Description	EIL Choice	Remarks
1	Dual Processor, single I/O	NO	
2	Redundant Processor, redundant I/O & Redundant Power Supply, Redundant Communication	YES	For utilities/package PLCs like Instrument Air / Plant Air / Nitrogen, RO-DM & CPU, ZLD, ETP, RWTP, SRU Palletising & bagging machines SIL certification is not required. SIL certified PLC shall be considered for extruder package and for other packages SIL requirement shall be as per Licensor requirement.
3	Vendor's standard	YES	For proprietary items like LP Air Compressor, Air Dryer, Slides Valves/ Catalyst Loader etc
4	Others	YES	As per licensor specific requirements.

**1. Bagging & Pelletizing Package PLC (PNCP Area) shall be in Non-redundant configuration.**

### 3.2.3 ANTI SURGE CONTROLLER

S.No.	Description	EIL Choice	Remarks
1	Type		
1.1	Conventional Single loop Controller	NO	
1.2	DCS	NO	
1.3	Dedicated Special Controller	YES	CCC make with Duplex configuration having scan time of 40 msec and with redundant serial interface to DCS. Independent antisurge controller shall be considered with redundant serial link to DCS and real time data recording facility in DCS.
1.4	PLC	NO	
2	Location		
2.1	HMI in Control Room	YES	
2.2	SRR	YES	

**a. Anti surge controller hardware shall be located in rack room of SRR with operator interface system (HMI) located in console room of the control room. The HMI shall be console mounted type with 21" TFT screen and keyboard.**

**b. License software of Antisurge controller shall be considered with laptop from machine vendor.**

**c. Controller diagnostics shall be provided as part of HMI.**

### 3.2.4 MACHINE MONITORING SYSTEM

S.No.	Description	EIL Choice	Remarks
1	Type		

S.No.	Description	EIL Choice	Remarks
1.1	Machine Monitoring System with Machine Asset Management and Analysis System	YES	With hard-wired connection to PLC for interlocks. Dual Serial link to DCS. DO from MMS shall be realized through three relay modules configured with same logic and independently hardwired to ESD. These contacts in ESD shall be configured in 2oo3 configuration for tripping the machines. Also all the signals from MMS shall be repeated to DCS as 4~20mA.
1.2	Machine Monitoring System without Machine Asset Management and Analysis System	NO	
2	Machine Monitoring System Monitors Location		
2.1	SRR	YES	
2.2	Field Local Panel	<b>NO</b>	
3	MMS Display Unit Location		
3.1	Local Panel	YES	

- 1) **SI No. 1.1 :- Machine Asset Management and Analysis System of each make of Machine monitoring system as supplied by equipment vendor will be considered. Moreover a Client PC of the Machine Asset Management software shall be extended to the Mechanical maintenance room through IOCL Plant LAN. Separate MCMS shall be provided for EPCM 2, EPCM 3, BOOT & BOO.**
- 2) **Axis wise separate monitors shall be considered for Radial & Axial Vibrations.**

### 3.2.5 LOCATION OF SPEED GOVERNOR

S.No.	Description	EIL Choice	Remarks
1	Control room	YES	
2	SRR	YES	

1. Speed governor hardware shall be located in Rack room of SRR with redundant serial interface to DCS having following location of HMI

1a. For special purpose Turbine, Speed Governor shall be in TMR configuration with its operator interface system (HMI) located in console room of the Main Control room. The HMI shall be console mounted type with 21" TFT screen and keyboard.

1b. For General purpose Turbine, Speed Governor operator interface system (HMI) located in console room of the Main Control room. The HMI shall be console mounted type with 21" TFT screen and keyboard.

### 3.2.6 TYPE OF LOCAL PANEL

S.No.	Description	EIL Choice	Remarks
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S.No.	Description	EIL Choice	Remarks
1	Weather proof to IP55	YES	
2	Purged, type-Z As per NFPA 496	NO	
3	Purged, type-X As per NFPA 496	YES	Only for Panels like Analyser panels etc. where components suitable for hazardous area are not available.
4	Intrinsically safe Push Buttons, Lamps, Selector Switches	YES	
5	Intrinsically Safe Alarm Annunciator	YES	
6	IS PCs for Display of loop powered indicators.	YES	IS PC shall be used if no. of signals in LCP is more than 5 nos.

a. Signals to Alarm Annunciators shall be from DCS. Same shall be configured accordingly in detail engineering.

### 3.3 DCS REQUIREMENTS

#### 3.3.1 OPERATOR CONSOLES

S.No.	Control Room	Units	Number of Operator Consoles	Number of display screens/ console
1.1	Main Control Room (MCR-100)			
1.1.1		RHCU	4 (DCS) + 1 (PLC)	2
1.1.2		<b>INDMAX, Flare &amp; Propylene Recovery Unit (PRU)</b>	<b>4 (DCS) + 2(PLC)</b>	2
1.1.3		<b>Atmospheric Vacuum Distillation (AVU) &amp; SR LPG</b>	<b>4 (DCS) + 1 (PLC)</b>	2
1.1.4		VGO Hydro treater Unit	3 (DCS) + 1 (PLC)	2
1.1.5		<b>Naphtha Hydro Treater Unit, Catalytic Cracking Unit (CCRU) &amp; Isomerisation Unit (ISOM)</b>	4(DCS) + 1 (PLC)	2
1.1.6		CDW Unit/LOBS	3 (DCS) + 1 (PLC)	2
1.1.7		Alkylation Unit (including n- Butane isomerisation Unit) & Sulphuric Acid Regeneration Unit	<b>Deferred</b>	
1.1.8		Hydrogen Generation Unit	<b>1 (DCS)-View Only-Part of BOO</b>	
1.1.9		<b>Diesel Hydro treater Unit, MUG &amp; FG</b>	<b>4 (DCS) + 1 (PLC)</b>	2

S.No.	Control Room	Units	Number of Operator Consoles	Number of display screens/ console
1.1.10		Sulphur Recovery Unit (SRU, Sour Water Stripper Unit & Amine Recovery Unit	3 (DCS) + 1 (PLC)	2
1.1.11		<b>UB, OWS, CRWS, SS, CT-01, CT-02</b>	<b>1 (DCS)- View Only</b>	<b>1</b>
1.1.12		TFMS & Product blending system	1 (DCS)-View Only	2
1.2		OMSCR-113		
1.2.1		Tank Farms & Mounded Vessels	<b>3(DCS) + 1 (PLC)- Part of BOOT</b>	2
1.2.2		Product Blending System	<b>2 (Blending DCS)- Part of BOOT</b>	2
1.3		<b>CR-122</b>		
1.3.1		<b>RWTP</b>	<b>1 Operator Console + 1 Operator cum Engineering Console</b>	1
1.4		<b>CR-109</b>		
1.4.1		ETP	<b>2 Operator Console</b>	1
1.5		CR-110		
1.5.1		Instrument Air / Plant Air/N <sub>2</sub>	<b>2 Consoles- Part of BOO</b>	1
1.6		Existing MCR in PNCP		
1.6.1		Polypropylene Unit (PPU)	3 (DCS) + 1 (PLC)	2
1.7		UCR-105		
1.7.1		Utility boiler & Cooling towers	<b>4 (DCS)+ 1 (PLC)</b>	2
1.8		<b>CR-112</b>		
1.8.1		<b>RO-DM/CPU &amp; ZLD</b>	<b>2 Operator Console</b>	<b>1</b>
1.9		<b>CR/SRR-114</b>		
1.9.1		<b>Hydrogen Generation Unit (HGU)</b>	<b>3(DCS)+ 1(PLC)- Part of BOO</b>	<b>2</b>
1.10		<b>Existing OC#2, OC#3, LBT CR</b>		
1.10.1		<b>New facilities in existing PR Area</b>	<b>1 (DCS) each</b>	<b>1</b>
1.11		<b>Existing DMRO Control Room</b>		
1.11.1		<b>New CPU (PNCP Area)</b>	<b>1(PLC)</b>	<b>1</b>
1.12		<b>Existing Cooling tower Control room(PNCP Area).</b>		
1.12.1		<b>Cooling Tower CT-2A in PNCP area</b>	<b>1(DCS)</b>	<b>1</b>

**a. Each Display screen shall be Dual Tier type with common electronics (i.e. CPU,**

keyboard mouse).

b. Exact numbers will be finalised before system configuration conceptualisation.

c. Consoles in CR-110, CR-109, CR-112 & CR-122 are operator consoles supplied by Package Vendor.

d. Blending simulation PC will be located in OMSCR-113.

e. Operator console in shift in charge room for each group in SRR & MCR shall be considered.

f. View Only Operator console in operator room in SRR/UCR shall be considered.

### 3.3.2 CONSOLE CONFIGURATION

S.No.	Description	EIL Choice	Remarks
1	Console configuration		
1.1	Single	YES	<b>For package Consoles in CR-110, CR-109, CR-112, CR-122, extruder control room, sulphur pelletizer control room supplied by Package Vendor.</b>
1.2	Stacked (Dual)	YES	
2	Type of monitor		
2.1	LED (TFT LCD with backlit LED)	YES	
2.2	LCD	NA	
3	Engineering functions from operator console	NO	
4	Open system connectivity	YES	Through dedicated OPC server
5	Historic Trending on each console	YES	For all tags

1. DCS Group wise Long term historian server (UHN) shall be considered.

### 3.3.3 ENGINEERING CONSOLES

Number of consoles for each Control Room and SRR:

S.No.	Control	Unit	Number of Engineering Consoles	Remarks
1.1	Main Control Room (MCR-100)			
1.1.1		RHCU	1+1	Separate for DCS and PLC
1.1.2		<b>INDMAX Unit + PRU</b>	1+1	Separate for DCS and PLC
1.1.3		<b>Atmospheric Vacuum Distillation (AVU)+ SR LPG</b>	1+1	Separate for DCS and PLC
1.1.4		VGO Hydro treater Unit	1+1	Separate for DCS and PLC

S.No.	Control	Unit	Number of Engineering Consoles	Remarks
1.1.5		<b>Naphtha Hydro Treater Unit, Catalytic Cracking Unit (CCRU), Isomerisation Unit (ISOM)</b>	1+1	Separate for DCS and PLC
1.1.6		CDW Unit/LOBS	1+1	Separate for DCS and PLC
1.1.7		Alkylation Unit (including n- Butane isomerisation Unit) & Sulphuric Acid Regeneration Unit	<b>Deferred</b>	
1.1.8		<b>Deleted</b>		
1.1.9		<b>Diesel Hydro treater Unit, FG System &amp; MUG</b>	1+1	Separate for DCS and PLC
1.1.10		Sulphur Recovery Unit (SRU), Sour Water Stripper Unit & Amine Recovery Unit	1+1	Separate for DCS and PLC
1.1.11		<b>Deleted</b>		
1.1.12		<b>Cooling Tower:CT-01, Fire Water Pump House</b>	1+1	Separate for DCS and PLC
1.2	OMSCR-113			
1.2.1		Tank Farms & Mounded Vessels and Product Blending Control System	<b>1+1 - Part of BOOT</b>	Separate for DCS and PLC. Also dedicated engineering consoles for blending and TFMS shall be considered.
1.3	Existing MCR of PNCP			
1.3.1		Polypropylene Unit (PPU)	<b>1+1 -Part of EPCM 3</b>	Separate for DCS and PLC
1.4	SRR-117	RHCU	1+1	Separate for DCS and PLC
1.5	SRR-119	<b>INDMAX Unit, Flare</b>	1+1	Separate for DCS and PLC
1.6	SRR-101	Atmospheric Vacuum Distillation (AVU)	1+1	Separate for DCS and PLC
1.7	SRR-116	VGO Hydro treater Unit	1+1	Separate for DCS and PLC



S.No.	Control	Unit	Number of Engineering Consoles	Remarks
1.8	SRR-118	<b>Naphtha Hydro Treater, Catalytic Cracking Unit (CCRU) &amp; Isomerisation Unit (ISOM)</b>	1+1	Separate for DCS and PLC
1.9	SRR-120	CDW Unit/LOBS	1+1	Separate for DCS and PLC
1.10	SRR-121	Alkylation Unit (including n- Butane isomerisation Unit) & Sulphuric Acid Regeneration Unit	<b>Deferred</b>	
1.11	<b>CR/SRR-114</b>	Hydrogen Generation Unit	<b>1+1 - Part of BOO</b>	Separate for DCS and PLC
1.12	SRR-115	Diesel Hydro treater Unit	1+1	Separate for DCS and PLC
1.13	SRR-104	Sulphur Recovery Unit (SRU), Sour Water Stripper Unit & Amine Recovery Unit	1+1	Separate for DCS and PLC
1.14	SRR-31	Polypropylene Unit (PPU)	1+1	Separate for DCS and PLC
1.15	SRR-103	Propylene Recovery Unit (PRU)	1+1	Separate for DCS and PLC
1.16	SRR-102	<b>FG System &amp; MUG</b>	1+1	Separate for DCS and PLC
1.17	UCR-105	Utility Boiler & Cooling Tower:CT-02	1+1	Separate for DCS and PLC
<b>1.18</b>	<b>SRR-118</b>	<b>SR LPG</b>	<b>1+1</b>	<b>Separate for DCS and PLC</b>

The DCS Engineering Console in the SRRs shall be Operator cum Engineering Console.

### 3.3.4 ENGINEERING & OPERATIONAL DATABASE

S.No.	Description	EIL Choice	Remarks
1	Historical Database		
1.1	Unitwise	YES	
1.2	Combined	YES	Note-a
2	Type of Reports Required		
2.1	Hourly	YES	
2.2	Shiftwise	YES	
2.3	Daily	YES	
2.4	Alarm History	YES	
2.5	Alarm Summary	YES	
2.6	Shutdown Report	YES	
2.7	MIS Report	YES	
3	Plant History		

S.No.	Description	EIL Choice	Remarks
3.1	Required	YES	

**a. Only for the following groups:**

- (i) Sulphur Block Units (Sulphur Recovery Unit (SRU), Amine Recovery Unit & Sour Water Stripper Unit
- (ii) Naphtha Hydro Treater Unit, Catalytic Cracking Unit (CCRU), Isomerisation Unit (ISOM).
- (iii) AVU & SR LPG Treater Unit.
- (iv) DHD, MUG, FG System.
- (v) Utility Boiler & Cooling Tower:CT-01 & CT-02), Fire water pump house, OWS, CRWS, SS.
- (vi) INDMAX & PRU.

### 3.3.5 ALARM INFORMATION MANAGEMENT SYSTEM

S.No.	Description	EIL Choice	Remarks
1	Required	YES	<i>AIMS shall be considered in MCR-100 group wise. For new PP Unit existing AIMS in existing MCR of PNCP will be utilised.</i>

1. For package PLC's of Instrument Air / Plant Air / Nitrogen, RO-DM & CPU, ETP, RWTP, BOO, BOOT dedicated AIMS from the respective package vendor shall be considered in the respective control room.

### 3.3.6 GIANT SCREEN REQUIREMENT

S.No.	Description	EIL Choice	Remarks
1	Giant Screen Required		<b>Laser type with 4K resolution</b>
1.1	No. of Screens	10 (Ten) numbers Giant Screens each with 3 x 3 cubes in console area of MCR. The ten nos. Giant screens shall be mounted seamlessly together in the video wall area of the Console room of the MCR maintaining the curvature and the aesthetics of the video wall area and proper mounting/installation supports shall be provided.	
1.2	Size	65"-70"	
1.3	Location	Main Control Room (MCR-100)	

### 3.3.7 SEQUENCE OF EVENT RECORDING

S.No.	Description	EIL Choice	Remarks
1	SER Functionality	Yes	In PLC
2	Resolution	Same as PLC scan time.	

S.No.	Description	EIL Choice	Remarks
2.1	PLC Scan Time	250 mSec for SIL3 PLC	
3	Dedicated SER PC	YES	Along with PLC operator console in MCR-100, PLC engineering station in MCR and other CR. Separate SER PC in respective SRR also.

### 3.3.8 ADVANCED CONTROL FUNCTION REQUIREMENT

S.No.	Description	EIL Choice	Remarks
1	Advanced Process Control Functions.		
1.1	Through DCS	NO	
1.2	Through Dedicated System	NO	

Advance process control platform is not part of project scope. However, OPC shall be considered in DCS system architecture for future connectivity with APC.

### 3.3.9 ASSET MANAGEMENT SYSTEM

S.No.	Description	EIL Choice	Remarks
1	Required	YES	
1.1	Integrated with DCS and PLC	YES	
1.2	Dedicated through multiplexer	NO	
2	Dedicated Asset Management system PC	YES	

Dedicated station loaded with Instrument Asset Management System software is required on DCS network, through HART/FF pass through DCS and PLC cards. For package PLCs, interfaced through MUX and dual input barriers in PLC.

### 3.3.10 DOCUMENTATION NODE

S.No.	Description	EIL Choice	Remarks
1	Required	YES	

Documentation Node (DON) shall be considered with DCS system. Software license shall be provided for the documentation software.

### 3.3.11 TRAINING KIT

S.No.	Description	EIL Choice	Remarks
1	Required	NO	
1.1	For DCS		
1.2	For PLC		

### 3.3.12 TRAINING SIMULATOR

S.No.	Description	EIL Choice	Remarks
1	Required	NO	

### 3.3.13 LOADING PHILOSOPHY

S.No.	Description	%	Remarks
1	Control Processor	50%	
2	Communication Processor / Bus	50%	
3	Maximum number of Nodes in the network	50% of the maximum capacity	
4	Bulk Power Supply (BPS)		<i>Each BPS in redundant configuration shall be sized for 70% of its rated load considering failure of other redundant BPS unit. Each BPS to have its own individual Diode / MOSFET OR-ing module (cross connected). Mosfet based O-ring modules shall be provided at the BPS output in conjunction with Diode-O-ring modules for balanced load sharing between two BPS in redundant configuration. Redundant Mosfet based O-ring modules to be considered (One each for individual power supply). Each Mosfet based O-ring should have 2 inputs from separate power supply (cross connected with each of redundant BPS).</i>

### 3.4 INSTRUMENTATION ON CONTROL ROOM PANEL / HARD-WIRED CONSOLE

S.No.	Type	Description	Remarks
1	Alarm Annunciator		<i>As per P&amp;ID. Annunciator window shall be provided for Common Gas Detector alarm, Common Bulk Power Supply Failure alarm, Common MOSFET Failure.</i>
1.1	On panel/ Hanging Type/ On console	On HWC	
1.2	First out sequence Required	YES	
2	Multi-point Temperature Indicator Required	NO	
3	Auto Manual Station		

S.No.	Type	Description	Remarks
3.1	On HWC/On Operator Console	On HWC/On Operator Console	As per P&ID
4	Manual Loading Station		
4.1	On HWC/On Operator Console	On HWC/On Operator Console	As per P&ID
5	Selector Switch		
5.1	On HWC/On Operator Console	On HWC/On Operator Console	As per P&ID
6	Start/Stop, Push Button		
6.1	On HWC/On Operator Console	On HWC	As per P&ID
7	Emergency Push Button location		
7.1	On HWC/On Operator Console	On HWC	
7.2	Type		
	Push Type With protective cover	<b>YES</b>	<b>Push Type with protective cover and with three independent contacts. All three contacts shall be wired to ESD in 2oo3 configuration.</b>
	Pull Type With mushroom head	<b>NO</b>	
8	Process Bypass Switch/ Indication		
8.1	On HWC/On Operator Console	On HWC	As per P&ID

**a. In case of contradiction, Location as per P&ID shall govern.**

**b. The Hardware Console shall be of mosaic finish design for ease of adding/ deleting any hardware on the console. It shall be possible to add or remove any item from console front by removing or adding mosaic tiles.**

**c. To ensure prevention of any unintentional operation of HWC PB, Two nos. of common desk release type push buttons shall be considered in each HWC which shall be permissive to allow other PBs on HWCs to be operated. Any HWC PB shall be active if and only if pressed alongwith any of the above two desk release buttons. The logic for the same shall be configured in PLC.**

**d. Terminals of various Switches on HWC shall be with prewired modular type fixed with TB.**

**e. Annunciation for BPS and MOSFET not to be clubbed.**

### 3.5 GENERAL

#### 3.5.1 TYPE OF POWER SUPPLY

S.No.	Type	Tolerance for Instruments	Back up time for UPS	Emergency Power Supply Requirement
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S.No.	Type	Tolerance for Instruments	Back up time for UPS	Emergency Power Supply Requirement
1	110V AC UPS	$\pm 10\%, \pm 3\text{Hz}$	As per Electrical Design Basis Section 5.6.11	

a. Applicable for new UPS.

b. UPS Voltage indication & current will be repeated in DCS from each DCS 110 VAC PDB. For diagnostic data a serial link shall be considered from UPS to DCS. Also UPS1 & UPS 2 failure alarm to be hardwired to DCS and annunciated in HWC.

### 3.5.2 POWER SUPPLY REQUIREMENT

For each of the items below, user shall select the power supply type from the choices available.

S.No.	Description	110V AC 50Hz UPS	110V DC	24V DC	110V AC Non UPS	240V AC 50Hz (UPS)	240V AC 50Hz (Non UPS)	415 V AC-3 phase	Remarks
1	Distributed Control system	YES					YES		Non UPS for Lighting & Fan
2	Package Units	YES					YES		Non UPS for Lighting & Fan
3	Alarm Annunciator	YES							
4	PLC	YES					YES		Non UPS for Lighting & Fan
5	Solenoid Valves			YES					
6	Smart/ FF Positioners, I/P, Transmitters			YES					
7	I/P Interrogation Voltage			YES					
8	Gas Detectors			YES					
9	Analyzers and Analyzer System	YES							
10	Chromatographs	YES							
11	Training Kit for DCS/PLC								
12	Training Simulator for DCS								
13	Level Gauge Illumination						YES		If applicable
14	Cabinets Fan						YES		
15	Cabinets Lighting						YES		
15.1	Control Room						YES		
15.2	Local Panel						YES		

S.No.	Description	110V AC 50Hz UPS	110V DC	24V DC	110V AC Non UPS	240V AC 50Hz (UPS)	240V AC 50Hz (Non UPS)	415 V AC-3 phase	Remarks
16	CCTV	YES							With Step-Up transformer (if required)
17	Analyzer Cabinet Air Conditioning						YES		
18	Analyzer Shelter HVAC							YES	

- A. 24 V DC power supply will be derived from UPS using redundant bulk power supply.  
B. All Non-DCS loads shall be through isolation transformer only.

### 3.5.3 POWER SUPPLY DISTRIBUTION

S.No.	Description	EIL Choice	Remarks
1	Less than or equal to 1.5 kVA	PDB in Rack Room	
2	Greater than 1.5kVA	UPS ACDB in UPS Room	

### 3.5.4 CABLE ENTRY

S.No.	Description	EIL Choice	Remarks
1	Control Room	MCT Block	
2	Analysers Rooms / Shelter	MCT Block	

### 3.5.5 AIR SUPPLY AT BATTERY LIMIT

As per Process BEDB Part B Section 6

### 3.5.6 SIZE OF INSTRUMENT NOZZLES

As per Process BEDB Part B Section 9

### 3.5.7 INSTALLATION / TUBING HOOK-UPS

S.No.	Description	EIL Choice	Remarks
1	Instrument Installation		

S.No.	Description	EIL Choice	Remarks
1.1	Pre-fabricated Hook Ups	YES	For Non-congealing Hydrocarbon services (Upto 600 class and maximum operating temp. upto 325 Deg C.) as well as utility services (except steam & hydrogen Service), standard bought out Pre-fabricated (with 5 valve manifold for flow and 2 valve manifold for PT) & pretested hook-up for all flow (dP) transmitters, Pressure transmitters shall be used. These hook-ups shall be basically close coupled instrument hookup integral type complete with instrument root valve, equalizing valves, oval flange adaptors, vent, drain pre-tested and pre-engineered ready for installation.
1.2	Close coupled	YES	For hydrogen service.
1.3	Remote	YES	(i) For DP Type Level and PDT. (ii) For DP Type FT & PT above 600 class and maximum operating temp. above 325 Deg C. , steam & Hydrogen. (iii) For DP type FT pertaining to venturi, Flow Nozzle, D- D/2 Tapping, Meter Run. (iv) For Congealing services v) For corrosive services diaphragm seal shall be used as per P&ID.
2	Instrument impulse lines		
2.1	Piping Impulse Lines	<b>NO</b>	
2.1.1	Instrument manifolds- Pre fabricated		
2.1.1.1	For PT & PG	NO	
2.1.1.2	For Flow DP transmitter	<b>NO</b>	
2.1.2	Impulse Line Valves		
2.1.2.1	Isolation valves		
2.1.2.2	Vent/drain valves		
2.2	Piping with Tubing at instrument end	<b>YES</b>	<b>For Hydrocarbon for line rating above 600 class, Hydrogen service &amp; steam and where pre-fabricated hook-up is not used.</b>
2.2.1	Instrument manifolds- Pre fabricated		
2.2.1.1	For PT & PG	NO	<b>Manifold shall be site fabricated as part of instrument hook-up.</b>
2.2.1.2	For Flow DP transmitter	<b>YES</b>	<b>3 Valve Manifold</b>
2.2.2	Impulse Line Valves		
2.2.2.1	Isolation valves	<b>Gate</b>	<b>Equalisation valve shall be Globe type.</b>
2.2.2.2	Vent/drain valves	<b>Gate</b>	



S.No.	Description	EIL Choice	Remarks
2.3	Prefabricated hook ups	YES	Standard bought out Pre-fabricated (with 5 valve manifold for flow and 2 valve manifold for PT) & pretested hook-up for all flow (dP) transmitters, Pressure transmitters shall be used. These hook-ups shall be basically close coupled instrument hookup integral type complete with instrument root valve, equalizing valves, oval flange adaptors, vent, drain valves, pre-tested and pre-engineered ready for installation.
2.3.1	For Flow DP, PT	YES	As defined in Sl.no. 1.1 above.
2.3.2	Impulse Line valves		
2.3.2.1	Isolation valves	Ball	<b>First isolation valve shall be Quarter turn full bore ball valve (Globe as per Licensor requirement) with metal seated /soft seated as per process pressure/ temperature conditions.</b>
2.3.2.2	Vent/drain valves	Yes	Part of valve manifolds in the hook-ups
2.4	Others	No	
2.5	Tubing Impulse lines	No	
3	Air Supply Tubing		
3.1	Material		
3.1.1	SS	NO	
3.1.2	Copper	NO	
3.1.3	SS 316L	YES	However, Fitting shall be SS316.
3.1.4	Others		
3.2	Tube size		
3.2.1	1/4" OD with 1mm wall thickness	NO	
3.2.2	<b>1/2" OD with 0.049" wall thickness</b>	YES	
3.2.3	Others	NO	
4	Steam Tracing Tubing	YES	Note-B
4.1	Material		
4.1.1	Bare Copper	Yes	
4.1.2	SS 316	NO	
4.1.3	Others	NO	
4.2	Tube size		
4.2.1	1/4" OD with 0.04" wall thickness	YES	Only for Gauge glasses.
4.2.2	3/8" OD with 0.049" wall thickness	YES	
4.2.3	Others	NO	
5	Impulse tubing		
5.1	Material		
5.1.1	SS	Yes	Tubing shall be SS316L and fitting shall be SS316
5.2	Tube size		
5.2.1	1/2" OD with 0.049" Wall Thickness	NO	
5.2.2	12mm OD with 1.2 mm wall thickness	YES	<b>For &lt;= 600#, 1.2 mm thickness shall be used. For &gt; 600#, 1.65 mm thickness shall be used.</b>

S.No.	Description	EIL Choice	Remarks
6	Seal pot requirement for Steam/ Condensing Vapour Instruments	NO	

**A. After the Instrument Air main header, the Instrument Air branch header shall be of SS316 material and Instrument air manifold shall be used for distribution to individual consumers in each branch.**

**B. Electrical heat tracing shall be provided only where accurate temperature maintenance is called for as per Licensor or equipment manufacturer recommendation or main process line is electrically traced. For other tracing requirements, steam tracing shall be used.**

**C. Double isolation, double vent / drain valve shall be used wherever required as per P&ID/PMS. No unions shall be used. Only break flanges shall be used.**

**D. Apart from root valve dedicated isolation valves are to be considered for isolation of the instrument during maintenance for Non Dia Seal instruments and DP Flow Dia Seal instruments.**

**E. Steam Trap bypass facility is to be provided with proper isolation Gate valves.**

**F. Minimum 1/2" tubing including AFR, SOV shall be considered for on-off valve. For control valve upto AFR, it shall be 1/2".**

### 3.5.8 FIELD TRANSMITTER TYPE

S.No.	Description	Conventional	Smart	Fieldbus	Wireless	Remarks
1	Open loops		YES	YES		Fieldbus type shall be used in general. SMART shall only be used where Fieldbus is not available for any specific instrument.
2	Close loops		YES			
3	For anti-surge loops		YES			As per vendor's standard requirement
4	For interlock/ shut-down loops/ Safety system loops		YES			For shutdown, smart transmitters' configuration facility shall be kept inhibited by default.

S.No.	Description	Conventional	Smart	Fieldbus	Wireless	Remarks
5	Pump seal Instruments				YES	For pump seal plan instruments wireless transmitters shall be used to the extent possible wherever it is available for the type of instruments applicable for pump seal. Type of level transmitters shall be either guided wave radar type or dP type.

1. Fieldbus shall not be used for Motor Operated Valves (MOV) status indication and command.
2. All SMART transmitters shall be SIL-2 certified.
3. The transmitters shall be offered with resolution & turndown ratio as per specifications without retro-fitting / upgrading or piggy backing of lower model transmitters (with non-standard electronics). Transmitters with inherent features from the standard models meeting the required specifications shall be provided. (No Make to meet the specification of transmitters from lower models shall be acceptable).

### 3.5.9 FIELD POSITIONER TYPE

S.No.	Description	EIL Choice	Remarks
1	Electro pneumatic, Smart	YES	<b>For Close/Open loops. Positioners shall be Linkless / contact less type.</b>
2	Electro pneumatic, Fieldbus	NO	
3	Pneumatic	NO	

### 3.5.10 PROCESS INSTRUMENT TYPE FOR SHUT-DOWN

As per Process BEDB Part B Section 9.

### 3.5.11 HAZARDOUS AREA PROTECTION

S.No.	Description	Intrinsically Safe	Flame proof	Remarks
1	Field transmitters	YES		
2	Field switches	YES	YES only for limit switches pertaining to MOVs	

S.No.	Description	Intrinsically Safe	Flame proof	Remarks
3	I/P converters	YES(Wherever applicable)		<b>I/P Converter: Review / Approval from Owner / PMC on case to case basis</b>
4	Solenoid valves	YES		
5	<b>SMART Positioners</b>	YES	YES	Dual Certified.
6	Special instruments/ Analyzers etc.	YES	YES	
7	FieldBus Instrument			
7.1	IS(Entity Concept) with High Power Trunk	YES		Refer note 2 below
7.2	FISCO			
7.3	FISCOIC/FNIICO			
8	Gas Detector		YES	

1. If intrinsically safe item is not available for any instruments, then it must be Flame proof. MCC I/Os shall be non-intrinsically safe.
2. High Power Trunk Field barrier concept to be followed for Fieldbus loops.

### 3.5.12 JUNCTION BOXES AND ACCESSORIES

S.No.	Description	Weather proof	Flame proof + Weather proof	Remarks
1	For IS Instruments		YES	
2	For flame proof instruments		YES	
3	FF Junction Boxes	YES		Increased safety (Ex'e'')

- a. JB's shall have bottom entry for Spur/single pair as well as Trunk/multipair Cables.
- b. All cable glands, irrespective of instrument type and area classification, shall be Exd only.
- c. Non FF JB's shall be of Bolted design with SS bolts.
- d. Junction Box Terminals shall be 'push-fit clamp on type' with side cable termination.
- e. All signal JB's shall be with hinged type cover.
- f. No power distribution JB in field shall be considered. However for TFMS level instruments separate PDB for distribution to tanks within dyke area shall be considered for primary & secondary level instruments. Separate PDB shall be considered for Primary and Secondary level instruments.

### 3.5.13 BARRIERS

S.No.	Description	EIL Choice	Remarks
1	Intrinsic Safety Barriers, with 3-port Isolating type	YES	Active isolating type with 3 ports

Barriers shall be 1 in 1 out type, in general. Dual output barriers shall be used only for cases where field signal required both in DCS and PLC as per Licensor requirement or for package PLC interface to IAMS.

### 3.5.14 STACK ANALYZERS

S.No.	Description	EIL Choice	Remarks
1	Stack Monitoring System Required	YES	
1.1	Separate for each stack	YES	CDSU pertaining to stack analyser shall have provision for connecting to CPCB and State Pollution Control Board for remote data monitoring & calibration as per statutory guidelines. CDSU shall have the facility for dynamic emission limit calculation facility also.
1.2	Common for all stacks	NO	
2	Sample Extraction		
2.1	Hot Extraction	NO	
2.2	Dilution Type	YES	For SOx/NOx/CO
2.3	Types of Analyzer		
2.3.1	CO -NDIR	YES	
2.3.2	SOx - UV Fluorescence	YES	
2.3.3	NOx - Chemiluminescence	YES	
2.3.4	SPM - Opacity /Back Scattering	YES	
2.3.5	Oxygen Analyser	YES	Tunable diode laser
3	Analyser Shelter		
3.1	Required	YES	
4	Shelter/Analyser Panel Location		As per Equipment Layout and Electrical Area Classification
4.1	Hazardous area	YES	Only if safe area location not available
4.2	Safe area	YES	

(I) Hot wet extraction for SRU stack for CO/SOx/NOx parameters.

(II) Separate CDSU shall be provided for EPCM-2, EPCM-3 and BOO.

### 3.5.15 EARTHING SYSTEM

S.No.	Description	Earth Pit	Remarks
1	Panel Earth for Panels, racks, cabinets, consoles, shelters etc. with power $\geq 110$ V	Plant Electrical Earth pit	DCS/ PLC console/ panel earthing as per DCS vendor recommendation.
2	Signal Earth	Separate signal earth pit	

1. MMS Panel in field (if applicable) & Analyser Shelters will be interfaced with Instrument earth ( $<1$  ohm).

### 3.5.16 TYPE OF CABLES

S.No.	Description	EIL Choice	Remarks
1	Flame retardant		
2	Flame retardant and low smoke	YES	

S.No.	Description	EIL Choice	Remarks
3	Flame retardant and Fire resistant	YES	Both single pair and multipair cables for all ESD signals and gas detectors.
4	others		

All Cables shall have XLPE as primary insulation.  
Blue cable shall be used for IS and Black cable shall be used for Non-IS signals.

### 3.5.17 UNITS OF MEASUREMENT

As per Process BEDB Part B Section 2.5

## 4.0 SPECIFIC DESIGN CONSIDERATIONS

### 4.1 TEMPERATURE INSTRUMENTS

#### 4.1.1 TEMPERATURE MEASUREMENT

S.No.	Description	EIL Choice	Remarks
1	Temperature gauges		
1.1	Bimetallic	YES	Refer Section 4.1.4 of this document.
1.2	Filled system	NO	Refer Section 4.1.4 of this document.
2	Thermowell flange rating		From BDEP Section 9.0
2.1	Vessel Nozzle rating	YES	Rating greater than ASME Class 300.
2.2	Minimum 300# rating	YES	Licensors specific requirement given in PDP shall be adhered.
3	Thermocouple		
3.1	Type		
3.1.1	All K Types	YES	
3.1.2	K/E/T/S (as per range)	YES	For high temperature S & R shall be used.
3.2	Element		
3.2.1	Simplex	NO	
3.2.2	Duplex	YES	
3.3	Grounded	YES	For Skin thermocouple
3.4	Un-grounded	YES	Others
4	RTD (Pt-100) 3 wire element	YES	RTD shall be used for motor bearing & winding temperatures and any other application as per Licensors requirement.
4.1	Simplex	YES	Shall be accepted only in case of space constraint.
4.2	Duplex	YES	
5	Temperature Transmitter		

S.No.	Description	EIL Choice	Remarks
5.1	Required	YES	<i>Temperature transmitters for both open and close loops unless specified otherwise by licensors or in special cases. Dual input capability with automatic transfer to back-up sensor shall be considered for all temperature transmitters. Accordingly, both the elements shall be wired to transmitters. Burnout protection (selectable Up Scale / Down Scale) must be provided for temperature transmitters.</i>
5.2	Location		
5.2.1	Head-mounted	NO	
5.2.2	Remote-mounted	YES	On yoke
6	Multi input Temperature Transmitter	NO	

For temperature elements / temperature gauges in pits, the long nozzle shall be extended above ground.

#### 4.1.2 THERMOWELLS

S.No.	Project Philosophy
1	Thermowells and their flanges shall be minimum of 316 SS or better material to suit the service conditions. Pressure rating of flanges shall be minimum 300 ASME class rating (including heater / reformer body and duct).
2	These shall be fabricated from bar-stock.
3	Immersion length of thermowells for different line sizes shall be as follows:- Line Size Immersion length (U) 4" to 6" 280 mm 8" to 12" 320 mm Above 14" 400 to 500 mm depending on line ID. Vessels 400 mm Immersion length is based on 200 mm length between flange face and outer wall of pipe. For vessels, 200mm projection shall be from Vessel ID. In vessels, where fouling with vessel internals is expected, the immersion length shall be suitably modified.
4	Built-up thermowells may be considered in low pressure and low velocity services like in fired heaters and also where longer thermowell immersion lengths are required (for greater than 500 mm). Single Barstock shall be limited up to 500 mm.
5	Design, manufacture and testing of Thermowell shall comply with PTC 19.3(Latest edition)
6	Above design temperature 600 Deg C, Inconel alloy 625 Thermowell shall be used.
7	Vendor to carryout vibration analysis of Thermowell wake frequency and it shall not exceed 80% of natural frequency.
8	The base of the thermowells shall be chosen to fit the instrument without air gap for minimizing measurement lag.

#### 4.1.3 THERMOCOUPLES/RTD

S.No.	Project Philosophy
1	Thermocouples elements shall be 18 AWG for simplex & 20 AWG for duplex.



S.No.	Project Philosophy
2	Skin thermocouples for heater shall be extraction type with sheath material of Inconel Alloy 625. All extraction type skin thermocouples shall be provided with Heat shield assembly.
3	Temperature transmitters shall be provided for all temperature elements and shall be remote field mounted type. Dual compartment type transmitters shall be used.
4	RTDs shall be with Class A accuracy.
5	Thermocouple heads shall be fitted with screw covers with retaining chain.
6	Thermocouple wire & extension wire colour coding must be as per IEC 60584-3 standard.
7	<b><i>Sheath diameter shall be minimum 6 mm and shall be SS316 as minimum.</i></b>

#### 4.1.4 TEMPERATURE GAUGES

S.No.	Project Philosophy
1	All temperature gauges are to be bimetallic type. Filled type temperatures gauges are envisaged only for specific applications like sump temperature. Filled system if used shall be gas filled type with full compensation as per SAMA Class IIIA. Mercury filled temperature gauge shall not be used. Dial size shall be 150mm for main plant, background Fluorescent White for Clear Display in Low illumination.

#### 4.2 PRESSURE INSTRUMENTS

S.No.	Project Philosophy
1	All pressure gauges in toxic service or with ranges more than 0 - 60 kg/cm <sup>2</sup> g shall have safety type, solid front case. Dial size for gauges shall be 150 mm. End connection shall be ½" NPT. Pressure gauges shall have over range protection up to 1.3 times maximum pressure scale with out any calibration drift. Instruments which can be exposed to vacuum shall have under range protection. Case material for pressure gauges shall be SS 304.
2	All transmitters shall have an integral output meter with LCD/LED display. Remote mounted meters may be provided for specific applications.
3	Diaphragm seal element with capillary shall be used for corrosive, congealing and highly viscous services as per P&ID. Diaphragm / flange material shall be as per process requirement, but SS316 is to be considered as minimum. On pulsating services like reciprocating pump discharge, pulsation dampners / snubbers & glycerine filled gauges shall be considered.
4	Remote surface mounting pressure gauges shall be considered for services of higher operating temperature ≥ 120 Deg C and pulsating services like reciprocating pump discharge.
5	All field transmitters, in contact with hydrogen service must be SS 316L Gold plated.

#### 4.3 LEVEL INSTRUMENTS

##### 4.3.1 LEVEL MEASUREMENT

S.No.	Description	EIL Choice	Remarks
1	Level Stand-pipe philosophy		
1.1	As per EIL standard	YES	
1.2	Licenser Requirement		For Licenser unit

S.No.	Description	EIL Choice	Remarks
2	Tank Level Gauging		<i>Wherever redundant / two level gauges are considered in a tank, the measurement principle shall be as per process requirements.</i>
2.1	Servo	YES	
2.2	Mechanical Float or DP type	NO	
2.3	Hydrostatic	NO	
2.4	Radar	YES	
3	Tank Farm Management System(TFMS)		
3.1	Dedicated Tank Farm Management (with Serial Communication to DCS)	<b>YES</b>	<i>TFMS system will have an engineering PC located in the engineering room of OMSCR-113 for calibration of tank level instruments. Temperature compensation and compliance to OISD-144.</i>  <i>Located in OMSCR-113</i>
3.2	With DCS	<b>NO</b>	
3.3	Redundancy		
3.4	No. of display screens (HMI) for TFMS (dedicated)		Part of DCS operating console.
3.4.1	Two		
3.5	TFMS HMI Display Location		
3.5.1	Control room	Offites CR	
3.5.2	Shift-in-charge (Product Despatch)		
3.6	Special Level Instruments	As per P&ID and Process requirements.	

**1. For tank overfill protection tuning fork type level switches shall be used.**

#### 4.3.2 LEVEL GAUGES

S.No.	Project Philosophy
1	Magnetic type shall only be used as a default until unless any other type specified by Licensor. Gauge glasses in case used shall generally be steel armoured reflex or transparent type. All level gauges shall be provided with vent / drain valves with plug.
2	Protective shields shall be used on gauge glasses depending on service e.g. in steam condensate and caustic services. Frost shields shall be used if the operating temperature is below 0°C. For all level gauges, automatic shutoff arrangement like ball check valve etc to be used such that the level gauge is automatically isolated in case gauge glass breaks.

### 4.3.3 LEVEL TRANSMITTER

S.No.	Project Philosophy
1	<p>Guided Wave Radar (GWR) type instruments shall be used for level measurement depending upon application to 2400 mm and for interface level measurement.</p> <p>For interface level measurement, GWR shall only be used. Displacer type level transmitters shall only be used for interface level measurements in case measurement by GWR type is not possible. Displacer type level instruments in case used shall be of standard lengths 356mm(14"inch), 813mm(32 inch) and 1236mm(48 inch) shall be used suitable for covering the C-C lengths. Differential pressure transmitter shall be used for level measurement above 2400 mm, for interface level application where GWR or standard displacer (above 48") cannot be used, for services requiring purge &amp; where GWR cannot be used due to dielectric constant. All Differential pressure level transmitters shall be of remote seal capillary type only. Electronic remote seal shall be used for Differential pressure level transmitters with C to C above 7 mtrs. Internal displacer type of level transmitters shall be avoided unless application necessitates its use.</p>
2	Deleted.
3	Non-Contact Radar type level shall be used on corrosive, congealing, slurry services where diaphragm seal type transmitter cannot be used. Dip tube can be used in above services where radar cannot be used.
4	For sump levels, Guided wave radar upto 3m and connected with DCS and non-contact type radar level instrument for interlock or range greater than 3m shall be used within accuracy $\pm 3\text{mm}$ . In general, co axial shall be preferred, Single Rod design shall be provided only when co axial is not suitable in services like congealing / sticky service (high viscosity).
5	For servo gauges where used, calibration chamber with access for removing the displacer for maintenance purpose shall be provided.

### 4.3.4 LEVEL STANDPIPE PHILOSOPHY

S.No.	Project Philosophy
1	The usage of standpipe shall be considered for clean, non-viscous and non-crystallizing services. The size of standpipe shall be 2" NB minimum. However the size of standpipe shall be 3" NB minimum for the installation of remote seal capillary type differential pressure level transmitters.
2	Standpipe shall be used if there are more than 4 nozzles required for level instruments. All instruments shall be provided with separate isolation valve.
3	Maximum number of nozzles on the standpipe shall be limited to 6 nos. Not more than two level transmitters shall be considered in one standpipe.
4	Standpipe shall not have instruments other than for level.
5	Standpipe accommodating level gauge / transmitter shall be separate from vessel tappings for transmitters used in interlocks.
6	Multiple level gauges shall be used for visible lengths more than 1470 mm for gauge glass (reflex/transparent type in case used). For magnetic level gauges multiple level gauges shall be used for visible lengths above 2500mm.
7	Separate standpipe shall be used for boot interface level measurement in addition to standpipe for the horizontal vessel. Standpipe shall not be from the bottom of the vessel / column.

### 4.3.5 LEVEL SWITCHES

Where ever applicable

S.No.	Project Philosophy
1	Level transmitter shall be used instead of level switches.

## 4.4 FLOW INSTRUMENTS

### 4.4.1 FLOW MEASUREMENT

As per Process BEDB Part B, Section 9

### 4.4.2 TYPES OF TAPS FOR ORIFICE

S.No.	Description	EIL Choice	Remarks
1	Flange	YES	
2	D-D/2 (for rating upto 300#:D-D/2 to be used for size $\geq 16"$ )	YES	
3	D-D/2 (for rating upto 600#:D-D/2 to be used for size $> 18"$ )	YES	
4	D-D/2 (for rating upto 900#:D-D/2 to be used for size $\geq 14"$ )	YES	
5	D-D/2 (for rating 1500# & above):D-D/2 to be used for size $> 22"$ )	YES	
6	2 1/2 - 8D	NO	
7	Integral Orifice	YES	

Unless otherwise recommended by process licensors

### 4.4.3 PRIMARY DEVICES

S.No.	Project Philosophy
1	Orifice, Flow nozzles and Venturi shall be designed in accordance with ISO 5167 latest edition. The ratio of the orifice bore to inside pipe diameter ( $B=d/D$ ) shall be between the limits as laid down by ISO 5167.
2	The orifice plate primary element shall generally be thin plate, square-edge concentric orifices plate mounted between a pair of weld-neck type orifice flanges with flange taps. The minimum pressure rating of flanges shall be 300 ASME class. Process tapping shall be flange tapping as per ISO 5167. For orifice Plates where D-D/2 taps are required and for all restriction orifices, the ratings of the orifice flanges shall be as per piping specification and the flanges shall be procured by Piping.
3	Eccentric / Segmental type of orifice plates shall be used for specific applications.
4	Quadrant edge or conical entrance orifice plates shall be used for services with low Reynolds number.

## 4.5 CONTROL VALVES

### 4.5.1 GENERAL

S.No.	Project Philosophy
1	Control valves shall normally be Globe type single seated. For clean services, guiding shall be top and bottom/cage type. For highly viscous services, cage guiding shall be avoided.

S.No.	Project Philosophy
2	Characteristic Ball valves shall be considered for services where solids in suspension, high rangeability, low pressure drops are required.
3	Butterfly valves shall be considered for services where solids in suspension, low pressure drops and high capacities are required.
4	Angle valves shall be considered for services where flashing, coking, solids in suspension or very large pressure drops are encountered.
5	For control valve, on-off valve and self actuated pressure control valves, pressure rating of body and flanges shall be minimum 300 ASME class or as per respective piping specification whichever is higher.
6	Fugitive emission compliant as per Class A of ISO 15848-1 shall be considered for H <sub>2</sub> S and H <sub>2</sub> services. For all other cases valves shall be compliant to fugitive emission as per Class C of ISO 15848-1. This is applicable for On-Off valves also. For steam service valves double packing shall be provided.
7	For high temperature application control valves, suitable precautions shall be taken in datasheet for gland packing and materials. Double packing shall be used for valves in vacuum service.
8	Deleted.
9	Actuators
9.1	Actuator shall be sized for Inst Air pressure of 4 Kg/cm <sup>2</sup> g. For larger dP shut offs, higher spring range/higher areas shall be considered. Actuator housing material shall be steel or anodised aluminium.
9.2	Piston actuators can be considered for severe pressure drop services.
10	Flexible fire-proof jacket shall be considered for valve actuators and its accessories for fire safe valve.
11	Control Valve Positioners shall be side-mounted on control valves and shall have corrosion resistant Stainless steel linkages and rugged brackets. All control valve positioners shall have metallic casing.
12	All the control/ On-Off valves shall have availability of necessary rain protection for diaphragm vent ports. If not available, the same to be provided (1/4 inch SS tube formed to inverted U shape with necessary fitting can be used).

## 4.5.2 CONTROL VALVE RATING

As per Process BEDB Part B Section 9

## 4.5.3 TRIM DESIGNS

S.No.	Project Philosophy
1	Material used for Trim shall be minimum 316 SS, with guide bushing of hardened stainless steel like 440 C, 17-4 PH all up to a pressure drop of 10 kg/cm <sup>2</sup> . For higher pressure drops or erosive and slurry services and in general for all steam services, hard-surfacing of plug, seal rings and sealing area of inner valve with stellite shall be used.
2	Special cases may require 17-4 PH seat ring and 440 C solid plugs or other materials like Hastelloy, Monel etc.
3	Multi-stage trims shall be used for where large differentials (> 40 kg/sq.cm) are encountered on case to case basis.
4	For valves in services encountering particulate carry over along with high pressure drop, axial flow path trim design shall be used with angle body for continuous applications and globe body for intermittent applications.

## 4.5.4 ON-OFF VALVE

S.No.	Description	EIL Choice	Remarks
1	Type	Ball	In general ball type valves shall be used for shutdown unless any other type specifically required for the application. For line sizes 20" and above triple offset butterfly valves with double flange design shall be used.

- Partial stroke checking of "Fail Close" shutdown valves used in SIL 2 & 3 loops shall be considered from IAMS and AO card in DCS.
- Volume bottle for valves with double acting piston actuators and Fire safe shall be considered as per Process requirements.

#### 4.5.5 SOLENOID VALVES

S.No.	Project Philosophy
1	Solenoid valves body material shall be SS 316.
2	Solenoid valves insulation class shall be H.
3	Solenoid valves shall be in TMR configuration for critical applications as per P&ID where SIL-3 certified solenoid valve will be used. SOV in single configuration shall be a PFD value with SIL-3. SOV configuration in 2oo2 configuration shall not be used.

- All solenoid valves shall be auto-reset type. For Solenoid valves requiring Field manual reset as per P&ID, separate electrical push button station shall be considered in the field wired to ESD for this purpose.
- Solenoid valves shall be in TMR configuration for critical applications as per P&ID. SOV configuration in 2oo2 configuration shall not be used.
- Vent port of all solenoid valves shall be provided with SS/ Brass bug screens, to prevent blockage of port because of bugs and to save the port from dust.
- Trip SOV for turbine shall be in 2oo3 configuration.
- Governor or E/H shall be dual coil.

#### 4.5.6 LIMIT SWITCHES

S.No.	Project Philosophy
1	<b><i>Limit switches shall be generally intrinsically safe hermitically sealed proximity type as per NAMUR (DIN 19234) except for MOVs.</i></b>

#### 4.6 PRESSURE RELIEF DEVICES

S.No.	Project Philosophy
1	Generally spring operated pressure relief valves may be used. Pilot operated relief valves may be used for special services and where set pressure is closer to the operating pressure by less than 10% or back pressure is above 50% of set pressure or as indicated by licensor. Spring loaded PSV's vents connected to flare/pressure shall be provided with balanced bellows depending on the process condition. For NACE services Inconel bellows / springs shall be used. PSV's shall be manufactured in accordance with ASME Boiler and pressure vessel code section VIII.

#### 4.7 ELECTRICAL FIELD WIRING



S.No.	Project Philosophy
1	Instrument electronic signal & alarm cables, single pair shall be 1.5 mm <sup>2</sup> (min.) and multipair shall be 1.5 mm <sup>2</sup> (min.) twisted in pair individually and overall shielded with aluminium Mylar tape with drain wire and armoured.
2	For Control wiring for solenoid valves of the interlock and shutdown system, single pair shall be 2.5 mm <sup>2</sup> (min.) and multipair shall be 2.5 mm <sup>2</sup> (min.) twisted in pair individually and overall shielded with aluminium Mylar tape with drain wire and armoured. However Cable voltage drop shall be calculated for IS solenoid valves and Cable thickness to be decided accordingly.
3	Multicore extension cables for Thermocouples, wherever applicable, shall be 20 AWG single conductor twisted pairs, armoured, individual pair and overall aluminium mylar shielded with over all drain wire. Triad shall be 1.5 mm <sup>2</sup> (min.) armoured. Single pair extension cables shall be armoured cable with 16 AWG single conductor wire.
4	Power supply cables to field instruments and SOV shall be minimum 2.5 mm <sup>2</sup> armoured.
5	All cable glands shall be of nickel-plated brass and they shall be of double compression type suitable for armoured cables. Slipper type PVC sleeves (cable shrouds) shall be used over cable glands for all cable entries in junction boxes & instrument side. All cable glands shall be Exd (both JB and Instrument side) irrespective of the area classification.
6	For longer distances conductor sizes shall be selected based on voltage drop.
7	Cables used for Foundation Fieldbus shall be type A, 0.82 mm <sup>2</sup> (18AWG) for spur/ 1.31 mm <sup>2</sup> (16 AWG) for trunk and armoured. Spur cable shall be orange with blue longitudinal stripes and trunk cable orange with black longitudinal stripes.
8	Ferrules used shall be single sleeve with source destination type. Cross ferruling philosophy shall be followed for wiring including MCC interface cabling to DCS / PLC systems.
9	All cables including spare pair / core shall be terminated inside control room and no loose cables shall be allowed. All cables shall be glanded in control room.
10	For tankages, power distribution box with isolation switches for a group of tanks shall be located outside the dyke wall and power switch supplied by level instrument vendor shall be located along with the tank side indicator.
11	Cable glands shall be all NPT type for all single pair gland requirements and plastic glands shall not be considered.
12	The cables at the control room ends should also be glanded at the panel end. Any spare holes to be closed to prevent any rodent entry to the panel
13	Ultrasonic type pest repellents requirements for the Control room shall be included in the scope of the DCS vendor
14	Copper cable shall be used for power cables from DCS PDB to field.

#### 4.8 CABLE TRAYS AND CABLE DUCTS

S.No.	Project Philosophy
1	<b><i>Instrument cable duct shall be primarily used wherever piperack/slipper is available and all cables on the main pipe rack shall be laid in cable duct fabricated out of GI and bolts and nuts of SS. However for Sulphuric Acid Regeneration Unit, DM, SRU block, CT and Acid &amp; Caustic dosing area cable duct and trays shall be FRP. RCC cable trenches shall be used for instrument cable routing wherever pipe rack is not available. No duct shall be used inside RCC trenches.</i></b>



S.No.	Project Philosophy
2	<b>All branch cables shall be run on cable trays. These cable trays shall be made of Anodised Perforated Aluminium with standard sizes of 60mm, 150mm and 300mm width. Thickness of anodizing shall be 10 microns. However for Sulphuric Acid Regeneration Unit the tray material shall be FRP. All cable trays in field shall be with cover. Tray thickness shall be minimum 2.5 mm. Minimum Tray height shall be 40 mm.</b>
3	Each individual cable routed through trays must be clamped or tied using SS wires. The overall clamping shall be with aluminium clamp instead of tying with cable armour. Nuts/Bolts for cable tray fixing shall be SS. All multipair cables shall have identification tag with JB no. at every 10 meter interval even in duct / trench.
4	<b>All Instrument cable ducts on pipe rack and trays carrying multi-cables shall be fire-proofed on all sides. Type test of fire as per UL1709/ASTM E 1529 for hydrocarbon fire.</b>
5	Main cable duct routing should avoid proximity to pump house, heat exchangers. RCC cable trench should be designed in a way so as to prevent accumulation of surface / rain water inside the trench and slope shall be away from control room. RCC trenches should be away from underground process lines of CBD/ ABD/ OWS etc

#### 4.9 AIR FILTER REGULATOR

S.No.	Description	EIL Choice	Remarks
1	Filter Size	5 microns Max.	

#### 4.10 CANOPY

S.No.	Description	EIL Choice	Remarks
1	Material		
1.1	FRP	YES	<b>1. SS Canopy is also acceptable if offered by vendor. 2. Canopy thickness shall be 3mm minimum.</b>
1.2	GRP		
1.3	MS		
2	Canopy to be provided for :-		Tag number shall be printed on the canopy
2.1	Transmitter	YES	
2.2	JBs	YES	Canopy for Junction Boxes shall cover from 3 sides.
2.3	Temperature Elements	YES	
2.4	Local Panels	YES	
2.5	Positioner	NO	
2.6	Gas Detector	YES	Heat and Rain protection. Supply in scope of Gas Detector vendor.

#### 4.11 DESUPERHEATER

As per Process requirement and vendor's recommendation

## 4.12 TEST /LAB EQUIPMENT

S.No.	Description	EIL Choice	Remarks
1	Required	NO	

## 4.13 CCTV SYSTEM

S.No.	Description	EIL Choice	Remarks
1	CCTV System		CCTV camera system shall be with IP address based network.
1.1	For Process units	YES	
1.2	Flare	YES	
1.3	Plant surveillance	YES	
	Other		
2	Monitor		
2.1	Location	Control room	
2.2	Number	No. of cameras and monitors shall be decided during detail engineering	
2.3	Type		
3	Recording facility Required		
3.1	All cameras	YES	<b><i>NVR for CCTV shall be considered for 60 days video recording and LAN connectivity shall be provided. Cameras shall be PTZ, Explosion Proof type provided with wiper and wash water connection.</i></b>
3.2	Selective Number of points		

***a. CCTV cameras shall be high resolution type.***

***b. For Polypropylene Unit (PPU), consider new CCTV system (part of EPCM-3) for PP line-3 with following specification:***

***i. IP based CCTV system.***

***ii. CCTV system shall consist of PTZ camera (explosion proof), server (main & standby), display and its accessories.***

***iii. CCTV camera should be equipped with video analytics to detect abnormalities like sudden vapour cloud/fire and generate alarm at control room.***

***iv. CCTV system should be OnVIF (open protocol) so that it can will be integrated with upgraded CCTV system (existing).***

***v. CCTV system should have capacity for future addition of cameras (25%).***

## 4.14 FIRE AND GAS DETECTION (F & G) SYSTEM

S.No.	Description	EIL Choice	Remarks
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S.No.	Description	EIL Choice	Remarks
1	Integrated F&G System	YES	Only for Field Fire and Gas detectors. Building Fire detection System shall be separate (refer Electrical Design Basis)
1.1	Gas detector Required	YES	SIL-2 certified gas detectors sensors and transmitters shall be provided.
1.1.1	HC Detectors (Point IR Type)	YES	
1.1.2	Open Path Type	YES	As per Process requirement.
1.1.3	H2 Detectors(Catalytic diffusion)	YES	
1.2	H2S Detectors		
1.2.1	Electrochemical	YES	
1.2.2	Semiconductor		
1.3	Output		
1.3.1	4~20 mA+ HART signal directly connected to PLC.	YES	
1.3.2	Vendor Standard	No	
2	Fire detection system		
2.1	Automatic fire detection Required		
2.2	Plant Fire detection Required	YES	Wherever required as per Process Operations
2.3	Plant /Non Plant building	Refer Electrical Design Basis	
3	Separate F & G LAN Required	NO	
4	Separate F&G PLC (SIL-3)	Yes	F&G PLC shall be dedicated for each Process unit.
4.1	F&G PLC/Monitor	Yes	For actuation of fire water deluge valves/other fire actuation systems, PLC with line monitoring facility shall be used and the SOV's shall be normally de-energized (so that failure of the SOV would not actuate sprinkler system but give an alarm with the help of line monitoring facility).
4.2	Plant PLC	NO	
4.3	Plant DCS	NO	
5	Integration with DGFAP	Yes	

#### 4.15 BOILER DRUM INSTRUMENTATION

S.No.	Description	EIL Choice	Remarks
1	Type of level instrument		
1.1	Conductivity	Yes	For ASME Sec-1 Drum.
1.2	DP	Yes	As per P&ID alongwith constant head chamber

S.No.	Description	EIL Choice	Remarks
1.3	Bicolour level Gauges	Yes	For ASME Sec-1 Drum. Hydra step (Red-Green) type local indication as well as 4-20mA signal to DCS.
1.4	Level Instrumentation 2 out of 3	As per P&ID.	
1.5	<b>EWLI</b>	<b>Yes</b>	<b>EWLI indicator shall be provided at MCR/UCR.</b>
2	Safety valves		
2.1	Section I	Yes	
2.2	IBR	Yes	

#### 4.16 AMBIENT AIR QUALITY MONITORING SYSTEM

S.No.	Description	EIL Choice	Remarks
1	Required		
1.1	No. of fixed stations		
1.2	No. of mobile stations		
2	Mobile van Required		
3	Meteorological Sensors		

Shall be decided during detail engineering.

#### 4.17 SAFETY VALVE TESTING AT SITE

S.No.	Description	EIL Choice	Remarks
1	Required		
1.1	By Contractor	YES	
1.2	By Purchaser	NO	
1.3	Test jig Required	YES	

#### 5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS

#### 6.0 POST WARRANTY ANNUAL MAINTENANCE CONTRACT

S.No.	Description	EIL Choice	Remarks
1	PWAMC		After expiry of warranty
1.1	Comprehensive	YES	DCS, PLC, CCTV and Analyser systems (including consumables).
1.2	Non-comprehensive	NO	

To be considered for 5 years for main plant DCS, PLC, Analysers (except density, moisture, PH/conductivity) and CCTV & except local panel mounted package PLCs also.

#### 7.0 SPARE PHILOSOPHY

S.No.	Type	Description	Remarks
1	Mandatory Spares	20% or minimum 2 nos. (whichever is higher) of each type or as specifically specified elsewhere	<p>a.Range, type &amp; material of construction, excluding control valve, self actuated pressure control valve, safety valve, flame arrester, breather valve, level gauge, analyzer, desuperheater, flow meter, radar type level instrument(GWR), tank level instrument.</p> <p>b.Soft parts like gasket, O-ring, seal-ring, packing material shall be considered as mandatory spares for control valve, safety valves, self actuated control valves [diaphragm also], breather valves etc. and it shall be min 50% or min 2 nos. For control valves with flashing, low noise and anti-cavitation trim, 20% or min. 2 nos. shall be considered for each type.</p> <p>c. For Temperature instruments, spare is to be considered for the temperature elements including skin thermocouples and gauges. Above is applicable for main unit as well as packages. For item like pumps with seal plan, dosing skid, filters, mandatory spares shall not be procured separately as part of package vendor.</p>
2	For Startup and Commissioning	As Required	As per vendor recommendation.
3	Consumable spares for one year operation	Required	Consumable spares shall be applicable for systems like DCS/PLC, analysers / Chromatographs, Machine Monitoring systems, Local / Main Control Panels.
4	DCS, PLC, Machine Monitoring Spare Philosophy		
4.1	System Spares (Control Room/ SRR wise)	Bus Capacity- 50% Number of nodes- 50%	

S.No.	Type	Description	Remarks
4.2	Installed Spares	a. I/O Level- 20% Marshalling Level- 20% b. Additional Power Feeder with Switch Fuse Assembly - 20% c. Additional Spare Windows in Alarm Annunciators - 30% d. All types of marshalling hardware i.e. terminals etc. - Min. 20% e. Free Space for hardware with installed DIN Rail, Base plate, back plane - Min. 20% f. Spare MCB - Min. 20% g. FF Segment pre-wired spare capacity for device per segment - 20% h. Electronic System spare channels shall be 20%	
4.3	Spare Space	I/O Level- 10% Marshalling Rack- 10%	
4.4	Mandatory Spares	5% or minimum one (whichever is higher) of each type of module including processor modules	
4.5	<b>Mandatory Spares</b>	<b>10% or minimum two (whichever is higher) of each type of BPS &amp; Diode O-ring modules, Barriers, Fans, RTDs, Volt Meter, Amp Meters + Transducer, Cabinet Lights, Louvers Filters, Door Switches, Cable Glands, MCBs, Network Cable of each type, Printer Cartridges, Consumables, Storage Devices, Drive, Media, Push Buttons, LEDs, Switches, Mouse, Key Boards</b>	
5	For two years operation as per vendor recommendation	Required	

a. Spares related to DCS are only applicable for Control Room items. For DCS related item in the field like FF JB's, spares FF JB's along with its all component like terminator , barrier etc shall be limited to a maximum quantity of 10% or min 2 nos.

b. For Fibre Optic Cable 100% spare cores shall be considered.

## 8.0 ADDITIONAL NOTES

S.No.	Notes
1	Fan location and cooling methodology shall be as per Manufacturer's standard design with fan failure monitoring at DCS console.
2	For smart remote output meters looping either through 3 ways JB or via transmitter test terminals for open loops. In case of closed loops and interlocks, remote output meter signal shall be provided from AO card of the control system. FF type remote output meters are connected as spur on FF segment.
3	Air Fin Coolers (AFC) / Cooling Tower Fans shall be provided with vibration transmitter (instead of vibration switch) which shall be connected to ESD system and DO contact from ESD to MCC shall be used for tripping of AFC fans.
4	Local / Remote switch shall be considered in Local Control Station (LCS) which shall be directly wired to MCC. Auto/ Manual switch wherever applicable as per P&ID shall be considered in Control room (HWC or DCS Console) and wired to PLC
5	All parameters like panel temperature (4-20 mA signal) of system cabinet to be programmed in DCS graphics. Pre alarm to be provided. Operator should get pre alarm well in advance to take corrective action. Voltage indication shall be repeated in DCS from each DCS 110 V AC PDB.
6	<b>MCC interface with Control room for command signals and feedback signals used in interlocks shall be through hardwired I/O's of PLC panels located in respective SRR/CR. Other feedback signals for monitoring shall be through redundant serial link to DCS. No remote I/O is used in substation. For DCS, dual redundant serial link shall be considered for motor &amp; VFD status. Outputs from DCS to VFD shall be through Hardwired only.</b>
7	Licenser special requirements if any in their process design package (PDP), shall be followed.
8	Transparent front shall be provided for all DCS & PLC system cabinets.
9	<b>DCS/PLC hardware (except consoles) shall be suitable for use in G3 environment. The conformal coating should be from the manufacturing facility.</b>
10	For UPS AC redundant power supply incomer in the rack room PDBs, Automatic Transfer Switch (ATS) shall be considered for NON DCS loads. Power supply for all subsystems, where facility is available for accepting redundant supplies, shall be from redundant power source and not from ATS including for the following systems: a. Machine Monitoring System b. Antisurge, Governor Control System. c. TMR Over-speed trip system (e.g. woodward protect system). d. Where Over-speed trip is generated by using any other method ( Like using Frequency to current converter & fed to PLC as AI or through trip amplifier) –Ensure that power supply is not common. e. Package Vendor supplied PLCs.  All DCS non redundant components like consoles shall be through ATS. Also separate UPS feeders shall be considered for DCS and ESD. ATS shall have serial communication for status and diagnostics reporting in DCS.
11	<b>All communication from DCS to PLC including Manual Pump Start / Stop and Manual Valve Open / Close Command through Soft PB on DCS operator HMI shall be hardwired to PLC.</b>
12	For TMR PLC, in general ""Hot Slots"" shall not be populated. However, one installed spare I/O card of each type shall be kept in the Hot slot"" in each PLC sub-system.
13	The suggested technology for tank level gauging is FMCW/TF (Time of Flight).



S.No.	Notes
14	All inputs and outputs of PLC shall be configured in SOE with comprehensive description.
15	<b>Separate marshalling cabinet shall be considered for IS and Non-IS signals. Also separate marshalling cabinets shall be considered for Analogue, DI and DO signals.</b>
16	For revamp / modification of existing units any modification required in the existing system shall be carried out through existing system OEM.
17	<b>2003 signals, 2002 signals or 1002 signals shall be wired in separate junction boxes and connected to separate cards in PLC. For 2002/TMR SOV, line fault detection for each SOV from barrier shall be provided in DCS. 2002 shall be used only if insisted by Licensor.</b>
18	All contacts of DCS/ESD to and from field shall be through intrinsically safe barrier only.
19	In case of DIN rail mounted barriers are used, number of barriers in a single DIN rail with a pair of power feed module shall be restricted to 50 Nos.
20	Generally two separate inputs shall be considered in Governor Control Systems for measuring speed.
21	<b>Time synchronization from single GPS in redundant configuration needs to be considered in Main control room. NTP port shall be provided at each SRR for time synchronization of Non DCS systems.</b>
22	Junction Box terminals shall be Push fit clamp on type with side cable entry.
23	<b>For Special thermocouples / thermo-wells (Like Reactor bed thermocouples etc.) M&amp;I guideline to be followed.</b>
24	<b>All System Cabinets and Server Cabinets shall be with Glass Door and shall have Access Control through Electronic Finger Print Readers &amp; Magnetic Locks. Server cabinets shall be with perforated door at the rear.</b>
25	<b>For SIL PLC (as applicable), PLC vendor to have team which have 2 to 3 SIL certified engineers for certifying the system design.</b>
26	<b>For package being monitored from DCS console, the graphics for the package used in DCS is to be developed by the package vender for DCS vendor to implement.</b>
27	<b>All unused USB Ports other than those required for the system like hardware dongle should be disabled. If enabled, it should require user authentication and USB port should be hard locked.</b>



# इलेक्ट्रोमैग्नेटिक फ्लोमीटरों के लिए मानक विनिर्देश

## STANDARD SPECIFICATION FOR ELECTROMAGNETIC FLOWMETERS

5	16.07.21	Revised and Reissued as Standard Specification	PK	AJS/KS	MN	SM
4	04.04.16	Revised and Reissued as Standard Specification	JJ	MN	RG	RN
3	29.11.10	Revised and Reissued as Standard Specification	RK	RG	TGM/JMS	ND
2	02.05.05	Revised and Reissued as Standard Specification	RSD	TGM	PM	VJN
1	15.01.97	Revised and Reissued as Standard Specification	RK	BRS	RB	AS
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

## **Abbreviations**

<b>AARH</b>	<b>:</b>	<b>Arithmetic Average Roughness Height</b>
<b>FISCO</b>	<b>:</b>	<b>Fieldbus Intrinsic Safe Concept</b>
<b>HART</b>	<b>:</b>	<b>Highway Addressable Remote Transducer</b>
<b>LCD</b>	<b>:</b>	<b>Liquid Crystal Display</b>
<b>NPT</b>	<b>:</b>	<b>National Pipe Threads</b>
<b>PA</b>	<b>:</b>	<b>Process Automation</b>
<b>PID</b>	<b>:</b>	<b>Proportional, Integral and Derivative</b>
<b>PTFE</b>	<b>:</b>	<b>Poly Tetra Fluoro Ethylene</b>

## **Instrumentation Standards Committee**

**Convener:** Mr. Mainak Nandi

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

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## 1.0 GENERAL

### 1.1 Scope

1.1.1 This specification, together with the data sheets describes the requirements for the design, materials, nameplate marking, inspection, testing and shipping of electromagnetic flow meter and its accessories.

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

ASME	American Society of Mechanical Engineers.
B 1.20.1	Pipe Threads General Purpose (Inch)
B 16.5	Pipe Flanges and Flanged Fittings
B 16.20	Metallic Gaskets for Pipe Flanges
EN	European Standards
10204	Inspection Documents for Metallic Products.
IS/IEC	Indian Standards/International Electrotechnical Commission
IS/IEC-60079	Electrical Apparatus for Explosive Gas Atmosphere.
IEC 60085	Electrical Insulation - Thermal Evaluation and Designation
IS/IEC-60529	Degree of Protection Provided by Enclosures (IP code).
IEC-61000-4	Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment.
IEC-61158-1	Industrial Communication Networks - Fieldbus Specifications - Part 1: Overview and Guidance for the IEC 61158 and IEC 61784 series.
IEC-61158-2	Industrial Communication Networks - Fieldbus Specifications - Part 2: Physical Layer Specification and Service Definition.
IEC-61508	Functional Safety of Electrical / Electronic / Programmable Electronic safety related system.
IS	Indian Standards
1271	Electrical Insulation-Thermal Evaluation and Designation.
ISO	International Organisation for Standardisation
20456	Measurement of fluid flow in closed Conduit – Guidance for the use of Electromagnetic Flowmeters for conductive liquids.

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

- Statutory Regulations
- Job Specification/ Data Sheets
- Standard Specification
- Codes and Standards

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

- Purchaser's data sheets specify the material for the metering tube, tube liner, electrodes etc. of the magnetic flow meter. Alternate superior material of construction shall also be acceptable provided vendor assumes complete

responsibility for the selected materials for compatibility with the specified fluid and its operating conditions.

- b) Selection of magnetic flow meter of the proper size suitable for the indicated flow rate and turndown.

## 1.2 Bids

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

1.2.2 Vendor's quotation shall include the following;

- a) Detailed specification sheet for each item which shall provide the information regarding material of construction, flow range, performance specifications, end connection details etc. The material of specification and the units of measurement, for various parts in vendor's specification sheets shall be to the same standards as those indicated in purchaser's data sheets.
- b) Sizing calculation indicating the velocity at which the meter has been sized for each tag number. Sizing calculation shall include accuracy at all the specified flow conditions viz. minimum, normal and maximum as per datasheets.
- c) Minimum and maximum fluid velocity permitted through the offered flow meter.
- d) Cable specifications and the maximum permissible cable length between the flow meter and associated receiver instruments.
- e) Recommended grounding techniques.
- f) Upstream and downstream straight length requirements for installation.
- g) Proven references for each offered model in line with clause 1.2.3 of this specification.
- h) A copy of approval for installation of electromagnetic flow meter in electrically hazardous area, from local statutory authority as applicable such as Petroleum and Explosives Safety Organisation (PESO), Nagpur, India, along with;
  - i) Test certificate from recognised house Central Institute of Mining and fuel Research (CIMFR) / Electromechanical Regional Testing Laboratory (ERTL) etc for the specified hazardous protection class as per relevant standard for all Indian manufactured equipments
  - ii) Certificate of conformity from agencies like Laboratoire Central Des Industries Electriques (LCIE), British Approval Service for Electrical Equipment in Flammable Atmospheres (Baseefa), Factory Mutual (FM), Physikalisch-Technische Bundesanstalt (PTB), Canadian Standards Association (CSA), and Underwriter's Laboratory (UL) for compliance to ATEX or other recognised standards for all equipments manufactured outside India.
- i) Deviation on technical requirements shall not be generally entertained. In case vendor has some valid technical reason for not complying with the specific requirements due to superior alternatives and materials, tag wise deviation list must be provided along with the technical justification.
- j) Catalogues giving detailed technical specifications, model decoding details and other related information for Electromagnetic flow meters covered in the bid.
- k) Two years operational spares for each electromagnetic flow meter and its accessories covered in the bid, which shall include electrode, electronic card set, gasket/o-ring set etc. as a minimum.
- l) Any special tools needed for maintenance work on the flow meter and its accessories. In case no special tools are necessary for the offered electromagnetic flow meters, vendor must certify in their offer



- 1.2.3 All items, as offered, shall be field proven and should have completed operation for a period of minimum 6 months on the bid due date in the similar application with process conditions similar to those as specified in the purchaser's data sheet. Items with proto-type design or items not meeting provenness criteria specified above shall not be offered.
- 1.2.4 Whenever specified, vendor must furnish tested values of failure rates, Probability of Failure on Demand (PFD) and test intervals for the Safety Integrity Level (SIL) analysis.
- 1.2.5 All documentation submitted by the vendor including their quotation, catalogue, drawings, installation manual, operation and maintenance manuals etc., shall be in English language only.

### **1.3 Drawings and Data**

- 1.3.1 Detailed drawings, data, catalogues and manuals required from the vendor are indicated by the purchaser in vendor data requirement sheets of Requisition.
- 1.3.2 Final documentation consisting of design data, installation manual, operation and maintenance manual submitted by the vendor after placement of purchase order as per vendor data requirement which shall include the following, as a minimum;
- a) Certified drawing for each flow meter which shall provide;
    - i) Dimensional details in mm.
    - ii) Weight of flow meter in kilograms
    - iii) Material of construction
    - iv) Installation requirements
    - v) Detailed wiring drawing for the whole system including recommended grounding techniques for the offered meters.
  - b) Clearance required for maintenance work.
  - c) Installation procedures for electromagnetic flow meter
  - d) Calibration and maintenance procedure for electromagnetic flow meters including replacement of internal parts, as applicable.

## **2.0 DESIGN AND CONSTRUCTION**

### **2.1 Flow Meter**

- 2.1.1 Unless otherwise specified, flow meter shall be of in-line mounting design. Insertion type of magnetic flow meter shall not be offered.
- 2.1.2 Flow direction should be clearly marked on the magnetic tube to ensure correct installation of the flow meter.
- 2.1.3 Vendor to note that the location and orientation of installation of electromagnetic flow meter in the line shall not affect the calibration, accuracy and performance of the meter.
- 2.1.4 **End Connection**
- 2.1.4.1 Flow meter shall be of flanged body construction with material of construction as specified in the purchaser's data sheet. In case of welded end connection design, the weld joint shall be of radiography quality.
- 2.1.4.2 Unless otherwise mentioned, end connection details shall be as below: -
- a) Threaded end connections shall be to NPT as per ASME B 1.20.1
  - b) Flanged end connections shall be as per ASME B 16.5.
  - c) Grooves of ring-type joint flanges shall be octagonal as per ASME B16.20.

- d) Flange face finish shall be as per ASME B 16.5. The face finish as specified in the data sheets, shall be as follows:
- |          |   |                           |
|----------|---|---------------------------|
| 125 AARH | : | 125 to 250 microinch AARH |
| 63 AARH  | : | 32 to 63 microinch AARH   |
- 2.1.5 Unless specified otherwise, the flow meter tube shall have PTFE liner. The liner shall hold tightly and rigidly against the flow meter tube without any air gap.
- 2.1.6 **Magnetic Coils**
- 2.1.6.1 The field coils shall operate on an alternating supply voltage as indicated in the purchaser's data sheets. The performance of the flow meter shall not be affected by the following variations in the supply voltage;
- a) Voltage variation of  $\pm 10\%$  of nominal value.
- b) Frequency variation of  $\pm 3\text{Hz}$  of nominal value.
- 2.1.6.2 Coil insulation should be class F suitable as per IEC 60085/IS 1271.
- 2.1.6.3 Unless otherwise specified, the coil housing shall be of carbon steel construction fully welded to the meter body to avoid ingress of moisture, dust and corrosive gases.
- 2.1.6.4 Coil excitation technique shall be pulsed DC type or dual frequency type. In case of slurry applications, the meters shall have high coil current and high frequency excitation. In case of slurry applications, grounding ring shall act as lining protector.
- 2.1.7 **Electrodes**
- 2.1.7.1 Electrodes shall have good corrosion resistance and shall be welded to meter body. Field replaceable electrode construction shall be offered only when specifically indicated in the purchaser's data sheet.
- 2.1.7.2 Vendor shall offer on line removable electrodes where cleaning of electrodes, is necessary due to coating characteristics of the process fluid.
- 2.1.7.3 The vendor shall ensure that for potential equalisation between sensor and liquid, the flow meter shall be provided with two nos. measurement electrodes along with integral earthing reference electrode when installed in non-lined pipe and an earthing plate / ring when installed in lined pipe. Vendor's scope of supply shall also include earthing cables and cable accessories like earthing lugs for interconnection with meter electronics. Unless specifically indicated, earthing electrode shall not be acceptable in place of earthing ring.
- 2.1.7.4 The electrodes including earthing ring shall be connected in the intrinsically safe circuit for flow meter handling electrically hazardous fluids.
- 2.1.8 **Sizing Considerations**
- 2.1.8.1 Meter shall be capable of measuring process fluid of conductivity 5 micromhos / microsiemens per centimetre unless specified otherwise in the data sheet.
- 2.1.8.2 Following velocity limits shall be considered for meter sizing, unless otherwise specified.
- a) Minimum velocity: 0.5 m/s.  
Maximum velocity: 3 m/s.
- b) Velocity limits for the various flows in the data sheet shall be typically in the above range complying with the accuracy as per clause 2.3 below. Velocity beyond these limits shall not be considered for sizing.

## **2.1.9 Terminal Housing**

2.1.9.1 Following shall apply for both integral as well as for remote meter electronics:

- a) All connections shall be terminated on the terminals brought out in the terminal housing located on the flow meter body. Flying leads shall not be provided.
- b) All intrinsically safe terminals shall be properly identified and shall be separate from the non-intrinsically safe terminals.
- c) Separate cable entry shall be provided in the terminal housing for power and intrinsically safe signals.
- d) The flow meter enclosure, housing the electrical parts shall be suitable for the area classification indicated in the purchaser's data sheets. Unless otherwise specified, the enclosure shall conform to the following standards:

Weatherproof housing - IP 65 to IS/IEC-60529.

Flameproof housing - Flame proof / Ex (d) as per IS/IEC-60079.

Flameproof housing shall also be made weatherproof.

2.1.9.2 Proper terminal blocks shall be provided in the transmitter unit for the termination of purchaser's cables. Separate terminal blocks shall be provided for power and signal connections. Power TBs shall be suitable for cable sizes upto 6 mm<sup>2</sup> core diameter.

## **2.2 Meter Electronics**

2.2.1 Meter electronics includes all the associated electronics like pre-amplifiers, transmitter / converters etc. Where the vendor is supplying the complete meter electronics, vendor shall ensure that the input/output signals and performance characteristics of individual item are compatible with each other.

2.2.2 When meter electronics is specified for installation in electrically classified area, the transmitter shall be flameproof with intrinsically safe sensor. Safety barrier as required for the sensor shall be provided by the vendor and shall be part of transmitter enclosure.

2.2.3 The electronic transmitter shall be two (2) wire micro-process based and shall be capable of providing 4 to 20mA analog output superimposed with diagnostic data in digital mode (i.e. HART output). When specified, flow meter shall provide field-bus output conforming to the standard specified in the purchaser's specification sheets.

2.2.4 For smart transmitters with HART output or for field bus based transmitter the following features must be ensured;

- a) It shall allow multi-master (primary and secondary) for configuration, calibration, diagnosis and maintenance. The primary could be the control system or host computer, and the secondary could be the hand held communicator.
- b) It should be capable of implementing universal commands.

2.2.5 In addition to the requirements specified above, Fieldbus based transmitter shall meet the following requirements;

- a) All instruments must satisfy the requirements of the Fieldbus registration laboratory with applicable checkmark like Foundation Fieldbus, Profibus PA, or as specified in the purchaser's data sheets.
- b) All instruments shall have two analog input blocks, as a minimum. In addition, when specified the transmitter shall also have PID controller block.
- c) All instruments must be interoperable and shall have valid interoperability test clearance for Foundation Fieldbus or equivalent for PA, as applicable.
- d) The Fieldbus instruments shall support peer-to-peer communication.

- e) Fieldbus instruments as offered shall not be polarity sensitive.

The Fieldbus instruments in hazardous area shall be certified as per Intrinsic Safe (entity concept) or shall be FISCO approved as per the requirements specified in the purchaser's specification.

- 2.2.6 Field mounted converters/transmitters shall have an integral output LCD meter. Local indication of the output meter shall be digital with engineering units. When the transmitter detects an empty pipe condition, the display shall be set to zero flow value.
- 2.2.7 The span of the transmitter shall be field adjustable. In case separate device is required, to make such a change, the same shall be included.
- 2.2.8 The configurational data for the instrument shall be stored in a non-volatile memory or in a battery backed RAM such that the data remains unchanged because of power fluctuations or power off condition. In case, vendor standard instrument has battery backed RAM vendor to ensure that battery drain alarm is available and shall be provided as maintenance alarm.
- 2.2.9 When the purchaser's data sheets indicate the presence of permeable solids in the stream (e.g. slurries containing magnetic materials like iron) vendor shall offer a flow meter system whose circuitry compensates for signal changes induced by the presence of permeable solids.
- 2.2.10 When specified, the meter electronics shall be protected against transients induced by lighting and power supply surges. Transient protection electronics shall preferably be provided in the terminal block.
- 2.2.11 Where remote mounted converter/ transmitter is offered a minimum of 10 metre of interconnecting cable shall be included for measuring electrode and earthing electrode / plate, unless specified otherwise. The remote mounted transmitter shall be suitable for mounting on 2" NB pipe. Vendor shall provide mounting accessories for the same.
- 2.2.12 Purchaser shall provide one number of feeder for power supply at the meter electronics i.e. converter / transmitter. Further distribution if any shall be taken care of by vendor. Accessories like cable gland, conduit and junction box as required to interconnect sensor, transmitter signal cable, power supply cables etc., shall be supplied by the vendor.

### **2.3 Performance Requirements**

Unless otherwise specified, the magnetic flow meter shall meet the following performance specifications;

- a) Magnetic flow meter accuracy inclusive of linearity, repeatability and hysteresis shall be better than  $\pm 0.5\%$  of flow rate.
- b) Repeatability of the magnetic flow meter shall be better than  $\pm 0.1\%$  of flow rate.

### **3.0 NAMEPLATE**

Each electromagnetic flow meter and its accessories shall have a stainless steel nameplate attached firmly to it at a visible place, furnishing the following information:

- a) Tag number as per purchaser's data sheet.
- b) Manufacturers serial number and model number.
- c) Manufacturer's name/ trademark.
- d) Nominal end connection size and rating in pounds.
- e) Tube, tube liner and electrode materials.
- f) Calibrated range of flow.
- g) Area classification for which the equipment is certified for installation.

- h) Hazardous area certification number and marking
- i) Operating power supply voltage and frequency.
- j) Specified range and units of measurement for flow.

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



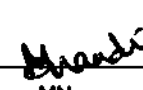

Purchaser reserves the right to inspect and witness testing at vendor's works as per Inspection Test Plan. All these tests shall be completed by the vendor and test reports shall be submitted to Purchaser for scrutiny.

#### **5.0 SHIPPING**

- 5.1** All threaded and flanged openings shall be suitably protected to prevent entry of foreign material. The flow transmitter shall be suitably protected to prevent any damage to its liner during shipment or storage at site.
- 5.2** The flow transmitter and accessories shall be packed separately.

# अवरोधक ऑरिफिस प्लेटों के लिए मानक विनिर्देश

## STANDARD SPECIFICATION FOR RESTRICTION ORIFICE PLATES

5	08.01.21	Revised and Reissued as Standard Specification	 DK	 JJ	 MN	 SM
4	09.11.15	Revised and Reissued as Standard Specification	RS	RKG	RG	SC
3	29.11.10	Revised and Reissued as Standard Specification	RS	RG	TGM/JMS	ND
2	02.05.05	Revised and Reissued as Standard Specification	AR	TGM	PM	VJN
1	10.06.97	Revised and Reissued as Standard Specification	RK	BRS	RB	AS
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

**Abbreviations:**

NIL

**Instrumentation Standards Committee**

**Convener:** Mr. Mainak Nandi

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



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## **1.0 GENERAL**

### **1.1 Scope**

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

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

ASME	American Society of Mechanical Engineers
B 16.5	Pipe Flanges and Flanged Fittings
B16.34	Valves Flanged, Threaded and Welding End
B 36.10	Welded and Seamless Wrought Steel Pipe.
EN	European Standards
10204	Inspection Documents for Metallic Products
ISO	International Organisation For Standardisation
5167	Measurement of fluid flow by means of orifice plates, nozzles and venturi tubes inserted in circular cross-section conduits running full.

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

- Statutory Regulations
- Job Specifications / Data Sheets
- Standard specification
- Codes and standards

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

- Purchaser's data sheets specify the material for restriction orifice plates. Unless specifically indicated otherwise, alternate superior material of construction shall also be acceptable provided vendor assumes complete responsibility for the selected materials for their compatibility with the specified fluid and its operating conditions.
- Purchaser's data sheets indicate the thickness of the restriction orifice plate. If found necessary, vendor may provide higher thickness of the restriction orifice plate considering process conditions, specified in the purchaser's datasheets.
- Sizing of the multistage restriction orifice plate assembly and the number of stages to meet the process conditions specified in purchaser's data sheet.

### **1.2 Bids**

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

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

### **1.3 Drawings and Data**

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

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

## **2.0 DESIGN AND CONSTRUCTION**

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

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

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

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

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

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

- 2.6 Restriction orifice plate with thickness greater than 12 mm, Vendors scope shall include long stud bolts for bolting in between Purchaser's flanges. Minimum bore dia for the restriction orifice plate shall be 1.6 mm.

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

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

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

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

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

## **3.0 NAMEPLATE**

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

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

- b) Nominal pipe size in inches and rating in pounds.
- c) Orifice plate and assembly material of construction
- d) Bore diameter

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

- a) Tag number as per purchaser's datasheet
- b) Manufacturer's name / trade mark
- c) Nominal end connection size and rating
- d) Orifice plate and assembly material of construction
- e) Number of orifice plate stages

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

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

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

#### **5.0 SHIPPING**

- 5.1** Each restriction orifice plate shall be packed inside thick polythene bags with suitable protective packing outside.
- 5.2** Each plate shall be packed separately.
- 5.3** All restriction orifice plates in oxygen and chlorine service shall be separately packed along with a certificate indicating 'SUITABLE FOR OXYGEN/CHLORINE SERVICE', as applicable.

# कन्ट्रोल वाल्वों के लिए मानक विनिर्देशन

## STANDARD SPECIFICATION FOR CONTROL VALVES

5	11.11.21	Revised and Reissued as Standard Specification	HMX/AJS	AR	MN	SM
4	27.03.17	Revised and Reissued as Standard Specification	AM	ADB	RG	DM
3	11.04.11	Revised and Reissued as Standard Specification	MN	RG	RP/JMS	DM
2	15.02.07	Revised and Reissued as Standard Specification	SM	TGM	HCJ	VC
1	01.11.96	Revised and Reissued as Standard Specification	RK	BRS	RB	AS
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

**Abbreviations:**

AARH	:	Arithmetic Average Roughness Height
CIMFR	:	Central Institute of Mining and Fuel Research
EDDL	:	Electronic Device Description Language
ERTL	:	Electronics Regional Testing Laboratory
FCRI	:	Fluid Control Research Institute
FDT/DTM	:	Field Device Tool/Device Type Manager
FF	:	Fieldbus Foundation
FISCO	:	Fieldbus Intrinsic Safety Concept
HART	:	Highway Addressable Remote Transducer
HHT	:	Hand Held Terminal
NACE	:	National Association of Corrosion Engineers
NPS	:	Nominal Pipe Size
NPT	:	National Pipe Thread
PID	:	Proportional, Integral and Derivative
PTFE	:	Poly Tetra Fluoro Ethylene
SS	:	Stainless Steel
TSO	:	Tight Shutoff

**Instrumentation Standards Committee**

**Convenor:** Mr. Mainak Nandi

**Members:** Mr. Arupjyoti Saikia  
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Mr. Jerry Johnson  
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Mr. R.K. Gupta (Proj.)

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### **ANNEXURES:**

**ANNEXURE – 1: STUD-BOLT AND NUT MATERIAL REQUIREMENT**

**ANNEXURE – 2: GASKET MATERIAL REQUIREMENT**



## **1.0 GENERAL**

### **1.1 Scope**

1.1.1 This specification, together with the data sheets describes the requirements for the design, materials, fabrication, documentation, nameplate marking, inspection, testing and shipping of control valves.

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

**ASME** American Society of Mechanical Engineer.

B 1.20.1 Pipe Threads, General Purpose (Inch)  
B 16.5 Pipe Flanges and Flanged Fittings  
B 16.20 Metallic Gaskets for Pipe Flanges  
B 16.34 Valves – flanged, Threaded and Welding End.  
B 16.47 Large Diameter Steel Flanges: NPS 26 through NPS 60  
Metric/Inch Standard

**ANSI/FCI** American National Standard Institute/Fluid Control Institute  
FCI 70-2 Control Valve Seat Leakage

**API** American Petroleum Institute

6 D Specification for Pipeline and Piping Valves  
598 Inspection Requirements  
609 Lug and wafer type, Butterfly valves.  
624 Type Testing of Rising Stem Valves Equipped with  
Graphite Packing for Fugitive Emissions

**AWWA** American Water Works Association  
C207 CL.D Steel Pipe Flanges for Water Works Services

**BS** British Standards

6364 Valves in cryogenic service

**EN** European Standards

10204 Inspection Documents For Metallic Products.

**IBR** Indian Boiler Regulation.

**IS/IEC** Indian Standards/International Electro-Technical Commission

IS/IEC 60079 Electrical Apparatus for Explosive Gas Atmosphere.  
IS/IEC 60529 Degree of Protection Provided by Enclosures (IP Code).  
IEC 60534-3-2 Face to Face dimension of rotary valves except butterfly valves.  
IEC 60534-4 Inspection & Routine Testing  
IEC 60534-8-3 Industrial process control valves, noise consideration, control valve aerodynamic noise prediction method  
IEC 60534-8-4 Industrial process control valves, noise consideration, prediction of noise generated by hydrodynamic flow  
IEC-61158 Fieldbus Standard for use in Industrial Control System  
IEC-61158-2 Physical layer specification and Service definition for Fieldbus

	FF 890	Function Block Application Process Part 1
	FF 891	Function Block Application Process Part 2
	FF 892	Function Block Application Process Part 3
	FF 893	Function Block Application Process Part 4
	FF 894	Function Block Application Process Part 5
	IEC 61508	Functional Safety of Electrical/Electronic/Programmable Electronic Safety related Systems.
	IEC-61511	Functional safety instrumented system for the process industry sector
	IEC-61804	Function Blocks (FB) for Process Control: Electronic Device Description
ISA	International Society of Automation	
	75.01.01	Flow equation for sizing control valves.
	75.02	Control valve capacity test procedure.
	TR75.04	Control Valve positioner stability
	75.05.01	Control Valve terminology
	75.07	Laboratory measurement of aerodynamic noise generated by control valves
	75.08.01	Face to face dimensions for integral flanged Globe-style control valve bodies (ASME Class 125,150,300 and 600)
	75.08.02	Face to face dimensions for flangeless control valve (ASME Class 150,300 and 600)
	75.08.04	Face to face dimensions for Butt-weld-end globe style control valve (ASME Class 4500)
	75.08.05	Face to face dimensions for Butt-weld-end globe style control valve (ASME Class 150,300, 600, 900, 1500 and 2500)
	75.08.06	Face to face dimensions for flanged Globe-style control valve bodies (ASME Class 900, 1500 and 2500)
	75.11.01	Inherent flow characteristic and Rangeability of control valves.
	75.19.01	Hydrostatic testing of control valves.
	75.22	Face to centre-line dimensions for flanged Globe-style Angle control valve bodies (ASME Class 150,300 and 600)
	75.25.01	Test Procedure for Control valve response measurement for step inputs
	TR 75.25.02	Control valve response measurement for step inputs
	75.13	Method of evaluating the performance of positioners with analog input signals and pneumatic output.
	75.17	Control valve aerodynamic noise prediction.
	RP75.23	Considerations for evaluating control valve cavitation
ISO	International Organization for Standardization	
	15848-1	Industrial valves — Measurement, test and qualification procedures for fugitive emissions
ITK	Interoperability Test Kit (latest version)	
MSS	Manufacturer's Standardisation Society	
	SP25	Standard Markings System for Valves, Fittings, Flanges and Unions

NACE      National Association of Corrosion Engineers

MR0103      Materials Resistant to Sulphide stress cracking in Corrosive  
Petroleum Refinery Environments

OSHA      Occupational Safety and Health Authority

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

- a)      Statutory regulations
- b)      Job Specifications/Data Sheets
- c)      Standard specification
- d)      Codes and standards

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

- a)      Purchaser's data sheets specify the minimum acceptable materials for the control valve body and trim. Alternate superior materials of construction shall also be acceptable with consent of purchaser provided vendor assumes complete responsibility for proper selection of material for these parts for their compatibility with the process fluid and its operating conditions.
- b)      Purchaser's data sheets specify the control valve size, flow coefficient (Cv) and required flow rangeability. Vendor shall be responsible for selecting their standard valve flow coefficient suitable for the specified service and process conditions specified in the purchaser's data sheets.
- c)      Selection of actuator to meet the shut off differential pressure indicated in the purchaser's data sheets.
- d)      Checking for cavitation, flashing and noise generated and provide suitable trim and treatment to limit these within appropriate limits.

## 1.2      Bids

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

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

- i)      Compliance to the specifications.
- ii)      Whenever specifically indicated, a detailed specification sheet for each control valve which shall provide information regarding type, material of construction, capacity sizing code, inlet and outlet type, size and rating, etc. of the control valve and its valve accessories. The material specifications and units of measurement indicated in the specification sheet shall be to the same standards as those in purchaser's data sheet.

- iii) Whenever the requirement of sizing calculation is specifically indicated in the materials requisition, vendor shall furnish sizing calculation for each tag number clearly highlighting the standard used for calculation, noise level, cavitation or flashing, Cv selected, percentage opening at minimum, normal and maximum flow, inlet and outlet velocity etc.
- iv) Proven references in line with clause no. 1.2.3 of this specification specifically for valves with ASME Class 600 and above, temperature more than 250°C and below-29°C, pressure drop greater than 50 kg/cm<sup>2</sup> and special application like hydrogen, NACE, Cryogenic etc.
- v) A copy of approval for items such as limit switches, solenoid valves, electro-pneumatic converters, electro-pneumatic positioners, smart positioners, Fieldbus positioners from local statutory authority, as applicable, such as Petroleum and Explosives Safety Organization (PESO) in India, along with:
  - i) Test certificate from recognised test house like Central Institute of Mining and Fuel Research (CIMFR) / Electronics Regional Testing Laboratory (ERTL) etc. for flameproof enclosure and/ or intrinsic safety, as specified in the data sheets as per relevant Indian Standard for all Indian manufactured equipments.
  - ii) Certificate of conformity from agencies like Laboratoire Central Des Industries Electriques (LCIE), British Approval Service for Electrical Equipment in Flammable Atmospheres (Baseefa), Factory Mutual (FM), Physikalisch-Technische Bundesanstalt (PTB), Canadian Standards Association (CSA), Underwriters Laboratories (UL) etc., for compliance to ATEX directives or equivalent recognised standards for all equipments manufactured outside India.
- vi) Limitation, if any, in changing actuator orientation at site.
- vii) Deviations on technical requirements shall not be entertained. In case vendor has any valid technical reason, they must include a list of deviations tag number wise, summing up all the deviations from the purchaser's data sheets and other technical specification along with the technical reasons for each of these deviations.
- viii) Published catalogues giving detailed technical specifications (i.e. available sizes, ratings, sizing codes, approvals & certifications, MOC, etc), model decoding details and other information for each type of control valve and accessories covered in the bid. For fieldbus positioners, information shall include, but not limited to, product certification, power supply, current drawn, Standard/Advanced/Enhanced function blocks available and the execution time for each block, device type, number of link objects, Virtual Communication Relationships, Basic and advanced diagnostic features, failure mode etc. In case catalogues do not provide all such technical details, vendor shall submit supplementary technical literature.

**1.2.3 For valves in cryogenic service, vendor shall meet the following acceptance criteria:**

- a) Vendor shall furnish, along with the offer, type test certificate, duly witnessed by Third Party Inspection agency like M/S LRIS, DNV BV, TUV, CEIL etc. of having successfully conducted the cryogenic test as per BS 6364 on the offered valves (same model, size, rating and material) in cryogenic service. Further vendor to note the following:

- i) Test temperature shall be -45°C for LTCS and -196°C for all grades of austenitic Stainless Steel.
  - ii) Test carried out on a particular size of one type of valve, pressure rating and material shall qualify all sizes equal to and below the test valve size for the same type, pressure rating and material. In case of austenitic Stainless Steel any one grade would qualify for other grades of austenitic Stainless Steel.
- b) In case vendor does not have cryogenic type test certificate for the offered valves as mentioned above, vendor shall confirm to conduct the cryogenic test on the offered valves and furnish cryogenic test report meeting requirements specified in Clause 1.2.3 a) above with the following as a minimum:-
- i) Vendor must have proven references as per clause 1.2.4 of this specification for each of the offered valves (same model, size, rating and material) in cryogenic service. The references with details shall be furnished with the offer.
  - ii) Cryogenic test shall be conducted at maximum operating pressure specified in Purchaser's datasheets.
  - iii) In case the vendor fails to conduct cryogenic test(s) within 12 weeks or failure in the test(s) conducted after receipt of order, the purchaser reserves the right to invoke any of the provisions of the purchase order including cancellation of the Purchase Order at the risk and cost of vendor.
- 1.2.4 All items, as offered, shall be field proven and should have been operating individually for a period of minimum six (6) months on the bid due date in the process conditions similar to those as specified in the purchaser's data sheets. Items with proto-type design or items not meeting provenness criteria specified above shall not be offered.
- 1.2.5 Whenever specified, vendor must furnish certified values of failure rates, probability of failure on demand (PFD) and test intervals for the safety integrity level (SIL) analysis.
- 1.2.6 All documentation submitted by the vendor including their quotation, catalogues, drawings, installation, operation and maintenance manuals etc., shall be in English language only.
- 1.2.7 Vendor shall specifically note that the quote for control valves shall include the following:
- a) One extra set of packing and bonnet gasket with each tag.
  - b) One extra set of stem seal O-ring for each actuator and piston O-ring additionally for each piston actuated valve.
  - c) Line bolting (set of studs and nuts) and set of gasket, in case of flangeless valves as per material given in Annexure-1 and Annexure-2 with each such tag number.
- 1.2.8 Vendor shall separately quote for the following:
- a) Control valve diagnostic package for seat ring, gland packing and actuator diagnostic with smart positioner.
  - b) Two years' operational spares for offered control valve and its accessories, which shall include plug, seat ring, gasket set, packing set, diaphragm/o-ring set etc. as a minimum.

- c) Any special tools needed for maintenance work. Vendor must certify in their offer in case no special tools are necessary for the offered control valves and their accessories.
- d) Required software for operation and diagnosis of the control valve shall be provided separately in the physical device such as CD/DVD.

### **1.3 Drawing and Data**

1.3.1 Detailed drawings, data, catalogues and manuals required shall be submitted by the vendor as per Vendor Data Requirements (VDR) attached with the requisition.

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

- a) Specification sheet for each control valve, positioner and other accessories and sizing calculation.
- b) Certified drawings and technical catalogues for each control valve and its accessories, which shall provide dimensional details (face-to-face and height of completely assembled valve). Dimensions of clearance space for maintenance work, weight of completely assembled valve, internal constructional details, materials of construction of actuator, wiring diagram, installation procedure for control valves and their accessories, orientation with respect to flow direction marked on the body, sizing codes, approvals & certifications.
- c) Copy of the type test certificates and the test certificates for all tests indicated in Inspection Test Plan.
- d) Calibration, configuration and maintenance procedures including replacement of its parts/ internals wherever applicable.
- e) Control valve operating signatures whenever smart positioners or Fieldbus based positioners are specified.
- f) Device Descriptor (DD) Files for configuring Smart positioner /Fieldbus parameters
- g) Common File Formats (CFF) for integrating the Fieldbus positioner into the control system.

## **2.0 DESIGN AND CONSTRUCTION**

### **2.1 Body**

2.1.1 Control valves shall have flanged end connections integral to the valve body. Split body type valve design shall not be offered unless specifically indicated in the purchaser's data sheets. Whenever flangeless control valve body design is specified in the purchaser's data sheet, following shall apply:

- a) Wafer type or lug type body design for control valves body size up to 6 inches.
- b) Lug type body design for butterfly type of control valve body size more than 6 inches.

- 2.1.2 The minimum control valve body size shall be 1 inch. Control valve body size of less than 1 inch shall be offered only when specifically indicated in the purchaser's data sheet. The control valve body size shall be adhered to the size mentioned in the data sheet, if due to process condition and other parameters the same size is not suitable than higher size can be offered with reason. Only after acceptance of offered higher size by client/EIL, vendor shall proceed. In general, Control Valve size shall neither be more than the inlet line size nor be less than half the inlet line size unless specified otherwise in datasheets.
- 2.1.3 The valve body rating shall be equal to or higher than the flange rating specified in the data sheets. As a minimum, control valve body shall be rated for ASME Class 300. However, end connection shall be as specified in purchaser's data sheet.
- 2.1.4 The control valves shall be suitable for installation in horizontal as well as in vertical lines.
- 2.1.5 For all applications, where full port valves are specified in on-off service, following shall apply:
- Port size shall be equal to line size for rating up to ASME Class 1500.
  - Port size shall not be smaller than one size lower than that of the line size for body rating ASME Class 2500 and above.
- 2.1.6 Vendor to note that there shall not be any price or time implications in case the valve port size need to be changed to accommodate minor process changes while keeping the valve size and other specifications same during detailed engineering.
- 2.1.7 Flow Direction
- 2.1.7.1 In general, flow direction shall be as below:
- Flow tending to open for single seated unbalanced valve design.
  - Flow entering between the seats for double seated valves.
  - Flow entering at the side and leaving at the bottom for angle valves.
- For valves design other than those specified above, flow direction shall be as per manufacturer standard.
- 2.1.7.2 Flow direction shall be clearly marked on the control valve body.
- 2.1.7.3 For 3-way control valves, service like mixing or diverting, shall be clearly identified with inlet and outlet end connection clearly marked on the control valve body.

## 2.1.8 End Connections

### 2.1.8.1 Unless otherwise specified, the following shall govern:

- Threaded end connections shall be to NPT as per ASME B1.20.1.
- Flanged end connections shall be as per ASME B 16.5/ B 16.47B/ AWWA C207 CL.D.
- Flange face finish shall be as per ASME B16.5. The face finish shall be as follows:

125 AARH : 125 to 250 micro inch AARH

63 AARH : 32 to 63 micro inch AARH

- d) Grooves of ring type joint flanges shall be octagonal as per ASME B 16.20
- 2.1.8.2 Face-to-face dimensions of globe type control valves shall be in accordance with ISA 75.08.
- 2.1.8.3 Where provided, control valve bottom drains shall be blind flanged. Flange dimensions and rating shall correspond to ASME B16.5.
- 2.1.9 Material of Construction
- 2.1.9.1 The material of construction of control valves body shall be as specified in the data sheet. No material shall be substituted by vendor without specific written approval from purchaser.
- 2.1.9.2 Control valve body, bonnet, bottom flange, line flanges and other pressure containing assemblies shall be of the same material of construction as specified for valve body in the purchaser's data sheets.
- 2.1.9.3 The bonnet flange and bottom flange shall have metallic spiral wound gaskets suitable for the specified service. The gaskets with asbestos bearing fillers shall not be used.
- 2.1.9.4 Vendor shall be responsible for selecting proper material for the internal parts of control valve. All such materials shall have the same or better specification than specified in the purchaser's data sheets.
- 2.1.9.5 The material of construction of silencers, diffuser plates, diffuser plate assembly etc shall be as per the body material specified in the purchaser's data sheets, as a minimum.
- 2.2 Trim**
- 2.2.1 The term 'trim' covers those parts of valve assembly (excluding the body, bonnet and bottom flange) which are exposed to and are in contact with the line medium consisting of but not limited to the seat ring, valve stem, valve plug, valve plug guide, guide bushing and cage.
- In case of rotary type of control valves like butterfly, ball, segmental ball, rotary plug, eccentric disc and rotary disc, the term trim covers disc/ball, seat ring, shaft and bearing.
- 2.2.2 Guiding
- 2.2.2.1 Single seated globe and angle type control valves shall have heavy top plug guiding or cage guided design as per data sheets. The cage shall provide a continuous plug guiding
- 2.2.2.2 Double seated valves shall have top and bottom or cage guiding and shall be of the pressure balanced type.
- 2.2.2.3 Whenever cage type control valves are specified, top guided or top and bottom guided control valves can be offered provided it meets all other process and functional requirements. But whenever top or top and bottom type of guiding is specified, cage type control valves shall not be offered. However, if the service requires the anti-cavitation trim or low noise trim then in place of top or top and bottom guiding the cage type control valve can be accepted only after reviewing the control valve sizing.
- 2.2.2.4 Rotary control valves like butterfly, segmental ball, eccentric rotary plug etc shall have blowout proof shaft guiding design.
- 2.2.3 Trim Design



2.2.3.1 Control valve manufacturer/vendor shall be responsible for trim selection and trim design of the control valve. However it must meet the following minimum requirements:

- a) Control valve trim design shall suit the type of guiding specified in the data sheet.
- b) The trim design and material of construction shall be selected to minimize the risk of galling particularly in case of cage guided valves. Vendor shall select proper material pairs, surface finish, hardness and clearances wherever possibility of galling exist.
- c) Under extreme temperature conditions, vendor shall consider increased clearances at room temperature and seal welding of threaded seat rings etc. Hard facing of trim shall be used in high temperatures. For very low temperature application, material used shall have adequate cold impact strength.
- d) For globe/angle/3-way type of control valves, stem and plug shall be detachable and shall be attached together by suitable threaded design secured with a pin to avoid plug rotation during operation.
- e) For top and bottom guided control valves with sizes above 8", post and guide bushing design shall be used to prevent rotation of plug and stem.
- f) Whenever cavitation conditions are expected, vendor shall select a special anti-cavitation trim design and shall use trim material of sufficiently high hardness.
- g) Whenever the possibility of aerodynamic noise in a control valve exists under any operating condition specified in purchaser's data sheet, vendor shall select a special low noise trim for that application.
- h) For control valves with anti-cavitation or low noise trim, the no. of stages shall be decided by vendor ensuring that the selected number of stages can sufficiently withstand the dynamic fluid forces to avoid vibration of stem and plug during normal continuous operation. Vendor shall ensure trim design to account for worst case dynamic force / power generated by the process fluid under maximum operating conditions with a 10% safety margin.

2.2.3.2 The plug inherent characteristics shall be as indicated in the purchaser's data sheet. However, following shall be followed unless otherwise specified:

- a) Control valves with low noise and anti-cavitation trim design shall have modified equal percentage or linear characteristics.
- b) Rotary type control valves shall have modified equal percentage or equal percentage characteristics.
- c) Control valves with flow co-efficient less than 0.4 shall have equal percentage or linear characteristics.
- d) All other control valves shall have equal percentage characteristics, unless linear characteristic is specified in Purchaser's data sheets or required to meet the valve percentage opening limits within the process operating conditions.

Whenever linear or modified equal percentage characteristics are specified, equal percentage characteristics shall also be acceptable. Characterized positioner cam design to meet specified inherent control valve characteristics shall not be offered.

#### 2.2.3.3 Trim Material

2.2.3.3.1 Whenever stellite or hardened trim is specified in the data sheets following material of construction for the trim parts shall be acceptable.

- |    |               |  |
|----|---------------|--|
| a) | Plug and seat | Stellite sheathing/hard alloy coating or solid stellite              |
| b) | Cage          | Nitrided or stellite sheathing/hard alloy coating or solid stellite. |
| c) | Guide bushing | Stellite coating/sheathing or solid stellite                         |
| d) | Valve stem    | Hardened SS /Inconel X-760   |

In case of steam, water, air and other non-hydrocarbon utility services 17-4 PH SS or 440C is also acceptable.

Special material requirements, if specified in the datasheets, shall supersede the above mentioned requirements.

2.2.3.3.2 Minimum acceptable hardness in case of stellite or hardened trim shall be of the order of RC 38 (BHN 352) to RC 45 (BHN 429).

2.2.3.4 Leakage class

- a) Leakage class as per ANSI FCI 70.2 shall be specified in the purchaser's data sheet for each control valve. Where no leakage class is specified, the same shall be considered as Class III for Top-bottom Guided valves and Class IV for all other type of valves. Higher leakage class shall be provided wherever indicated in purchaser's data sheet.
- b) For control valves specified with Class VI leakage class, vendor shall select the soft seat (elastomer) material suitable for the process conditions i.e., shut off pressure, maximum temperature and process fluid.

2.2.3.5 Control valve experiencing cavitation, flashing and noise are generally identified in the purchaser's data sheet. Same must be offered without exception. In case in any valve, vendor's calculation show occurrence of cavitation, flashing or noise under any of the specified process condition, vendor shall select proper type of valve trim to suit such process conditions even if the same is not explicitly specified in the Purchaser's data sheets.

2.2.3.6 Minimum acceptable materials of construction to be considered by vendor for valve components are specified in Purchaser's datasheets.  
However, alternate superior materials may be provided if they meet all process conditions (operating, design, fluid properties, corrosion, etc), testing (ASME, API, radiography, etc) and statutory requirements (ASME, API, IBR, NACE, etc) specified by purchaser. Accordingly, the following alternate materials can be accepted: Body & bonnet: ASTM A105, ASTM A 216 gr. WCB / WCC in place of carbon steel.

## 2.3 Sizing

2.3.1 The control valve capacities in terms of flow coefficient (Cv) shown in the purchaser's data sheets have been calculated based on the formulae given in the standard ISA 75.01 "Control valve sizing equations".

All factors used while arriving at the sizing are also as per ISA 75.01. Vendor must resize the control valves considering various factors specific to the offered valves.

2.3.2 Purchaser's data sheet indicates calculated flow co-efficient values at minimum, normal and maximum operating conditions. Vendor shall calculate this co-efficient as per the offered control valve and select the size considering valve openings as under:

- |                 |   |                    |
|-----------------|---|--------------------|
| At maximum flow | - | less than 90% open |
| At normal flow  | - | typically 75% open |
| At minimum flow | - | more than 10% open |

2.3.3 Rangeability of globe type of valves shall be 30:1, as a minimum. Vendor shall ensure that the actual rangeability of offered valves shall meet these requirements. For other types of offered control valves, vendor to specify that the available rangeability of the offered valves meet the requirements specified in the purchaser's data sheets.

2.3.4. Wherever butterfly valves are specified, these shall be high performance type with maximum valve opening of 90°.

2.3.5. Vendor shall offer valves with standard Cv as per their catalogue. However in case it is unavoidable due to percentage opening or any other technical sizing criteria to offer valve Cvs which are not indicated in standard product catalogue, vendor shall ensure that capacity test certificate is made available for the valves from independent test laboratory like FCRI, etc. clearly indicating the capacity in terms of Cv values (as per ISA 75-01) and valves shall be provided accordingly.

2.3.6 Vendor to note that wherever more than one case is specified in data sheet, vendor to size the control valves for all cases and select the valve based on the governing case.

## **2.4 Noise**

2.4.1 Vendor shall examine each control valve for noise generation possibilities. The noise level shall be calculated as per ISA 75.17 or any other equivalent standard.

2.4.2 Noise generated by control valve during operation shall be limited to OSHA specified levels i.e. the maximum allowable noise shall be less than 85 dBA, when measured at a distance governed by ISA 75.17.

2.4.3 If the predicted noise level is found to exceed 85 dBA SPL, control valve shall be treated for noise. Source treatment for noise shall be resorted to. When source treatment for noise is not sufficient to reduce the noise level below 85 dBA, vendor shall provide path treatment like diffuser plate (silencer) etc in addition to source treatment so as to reduce the level below 85dBA. Whenever additional path treatment is recommended, the maximum differential pressure across the diffuser plate shall not exceed 40% of the specified differential pressure. Where path treatment is required for noise, suitable baffle / diffuser plates shall be provided installed within expander assembly with flanged ends.

2.4.4 Vendor shall also furnish noise calculations with and without the use of these devices and the noise abatement achieved in individual components.

2.4.5 Whenever Diffuser plate is provided by the vendor as part of path treatment of noise, Diffuser plate shall be inserted between control valve body and pipe flanges. Vendor shall supply long studs and nuts along with a pair of gaskets on the downstream side with material as per Annexure-1 and Annexure-2 attached with this specification.

In cases where the diffuser plate size is higher than the valve body size or there is a need of multiple diffuser plates, vendor shall supply the complete diffuser assembly with eccentric

expander and flanged end connections for mating with the upstream control valve flange and downstream line size, unless otherwise specified in the Requisition.

## **2.5 Packing Box, Bonnet and Stem**

### **2.5.1 Packing Box**

2.5.1.1 The packing box shall be flanged bolted to the bonnet and shall meet the requirements specified in purchaser's data sheet.

2.5.1.2 Generally low friction type packing like braided PTFE will be used wherever operating conditions permit. For high temperature application (with design temperature above 200°C), Grafoil or equivalent gasket suitable for the specified service shall be selected. Asbestos based packing material shall not be used.

2.5.1.3 Where specifically indicated, control valve shall have its packing box drilled and tapped to 1/4" NPT (F) for connecting external lubricator. When external lubricator is not provided, this hole shall be plugged.

2.5.1.4 An isolating valve shall be provided with all valves having external lubrication provision. Vendor shall specify the lubricator stick material used in each case.

### **2.5.1.5 Fugitive Emission Requirements**

a) Unless otherwise specified, all Control valves shall comply with the following performance class requirement as per ISO-15848-1:

Service	Tightness Class	Endurance Class	Temperature Class
H <sub>2</sub> , H <sub>2</sub> S and Benzene	AH / AM	CC1	≤200 °C
All other services	CH / CM	CC1	≤200 °C

b) Type test certificates shall be provided by vendor with the offer clearly indicating the extension of qualification to untested valves. All valves supplied by vendor shall fall within this extended qualification criteria.

c) In case any valve supplied by vendor is not covered under the extended qualification criteria of type test certificates, vendor shall test the valve as per ISO-15848-1, prove compliance to performance class requirement as per clause 2.5.1.5 a), furnish the test reports for purchaser's review as part of vendor document submission before inspection and only then proceed for dispatching the valve to site.

d) Alternatively, Control valves with type test qualification as per API 624 are also acceptable in place of Class CH / CM of ISO-15848-1.

2.5.1.6 For application in vacuum service, vendor to provide inverted packing design suitable for vacuum service. For pressure-cum-vacuum service, the control valve shall have dual packing design suitable for the application and Fugitive emission requirement is not mandatory for such application.

### **2.5.2 Bonnet**

2.5.2.1 The bonnet shall be flanged bolted to the body. Threaded bonnets are not permitted.

2.5.2.2 Wherever the operating temperature of the fluid is above 200°C, extension or radiation finned bonnet shall be provided. Vendor standard bonnet design shall also be acceptable if these are suitable for higher temperatures.

2.5.2.3 For the operating temperature below 0°C, vendor shall provide extended bonnet design. Vendor standard bonnet design shall also be acceptable if these are suitable for lower temperatures. For valves in cryogenic application bonnet extension shall be as per BS-6364 as a minimum.

2.5.2.4 For valves with Bellow seal type bonnet, Vendor's standard proven design considering extra gland packing with equivalent sealing characteristics for minimizing the leakage to the external environment from the valve bonnet is also acceptable.

## 2.5.3 Stem

2.5.3.1 The stem surface finish shall be fine. Extra fine surface finish shall be provided wherever the packing material is PTFE.

2.5.3.2 The stem/shaft shall be designed for the maximum thrust of the actuator without any measurable deflection.

2.5.3.3 The valve stem/shaft shall be connected to the actuator stem/shaft by suitable arrangement to avoid backlash problem.

## 2.6 Actuator

### 2.6.1 Pneumatic Actuator

2.6.1.1 Actuator shall be sized for the shut-off differential pressure indicated in purchaser's data sheets. However, for 3-way type control valve, the actuator shall be sized for maximum differential pressure, unless specifically indicated otherwise.

2.6.1.2 The actuator shall be designed to move the valve to the failure position specified in the purchaser's data sheet. For failure position specified as 'fail-locked' (with Drift close or Drift open), vendor shall provide fail-lock relays to meet the requirement.

2.6.1.3 Actuator casing shall be made of pressed steel or anodised aluminium. Non-metallic actuator casings shall not be offered.

2.6.1.4 Springs shall be corrosion-resistant and shall be cadmium or nickel-plated. Alternately vendor standard coating shall also be acceptable. These shall be of the enclosed type. The compression of the springs shall be adjustable.

2.6.1.5 In general, an actuator operating range of 0.2-to 1.0 kg/cm<sup>2</sup>g is preferred. However when vendor standard actuator model is not able to meet the specified shutoff pressure, higher actuator operating range may be offered.

2.6.1.6 In general, spring opposed diaphragms type actuators shall be used. Only when this type of actuator becomes extremely unwieldy, based on the data specified in the purchaser's datasheet, should a piston and cylinder type of actuator be considered.

2.6.1.7 Whenever piston and cylinder actuator is considered, single acting spring return type shall be used.

2.6.1.8 Whenever double acting springless type of actuator is specified in Purchaser's valve data sheet or offered by the vendor, all accessories like pilot valves, booster relays, non-return valve, pressure gauge, volume tank etc. shall be provided to ensure desired action on air

failure. Volume tank is not required when failure position in Purchaser's data sheet is specified as 'Fail lock' only.

2.6.1.9 Volume Tanks (Volume bottles / Air reservoirs), required for double acting springless type actuator or where ever specified in Purchaser's valve data sheet shall be provided by vendor with all required accessories including PG, PSV, NRV, etc. in 316 Stainless steel construction as a minimum. The volume tank shall be sized at the minimum air supply pressure for a minimum of three full strokes. Volume tanks shall be painted with same colour as that of the corresponding actuator. The volume tanks when provided shall be free standing equipment and not mounted on valve actuator. Volume tanks shall be of SS304 construction and shall be designed as per ASME Sec VIII Div. I with a design pressure of 10.5 Kg/cm<sup>2</sup>g with a minimum thickness of 6mm. Unless otherwise specified, vendor shall supply minimum 10 m of interconnecting tubing between the Volume Bottles / Volume tanks and actuator assembly. Volume bottle shall be tagged with the associated control valve tag number by the vendor

2.6.1.10 For actuator casing design, vendor shall consider at least any one of the following:-

- Actuator casing shall be suitable for 1.5 times the maximum pneumatic operating pressure
- Actuator provided with upstream safety valve set at "Actuator Casing suitable pressure less 0.2 kg/sq.cm.g"
- Actuator provided with Positioner having Overpressure Limit feature and set for the "Actuator Casing suitable pressure less 0.2 kg/sq.cm.g"

2.6.1.11 Valve stem position indicator shall be provided for every control valve. The position indicator scale shall be marked from 0 to 100% in steps of 10%.

2.6.1.12 In general, side-mounted hand-wheel shall be provided whenever specified in Purchaser's data sheet. Hand-wheel shall provide manual control in both opening and closing directions independent of spring action. Hand-wheels shall be of non-rising type suitable for accurate valve positioning. The hand-wheel actuator shall be sized to provide the required thrust for valve positioning with 178N force applied to the hand-wheel.

2.6.1.13 Actuator orientation shall be as per purchaser's requirements, in general. When, no requirements are indicated by purchaser, vendor shall provide recommended actuator orientation. It shall be possible to change this orientation at site for the offered valve-actuator combination in case it is found necessary.

2.6.1.14 The failure position of valves shall be indicated in the data sheet, vendor to note that change in failure position if intimated by Purchaser during review of engineering drawings in the order execution phase shall not have any implication.

2.6.1.15 All the control valves shall be provided with rain protection for diaphragm vent ports. 1/4 inch SS tube formed to inverted U shape with necessary fitting shall be provided for this purpose.

## 2.6.2 Actuator Sizing

2.6.2.1 Vendor shall be fully responsible for the sizing and selection of the correct actuator for the specified control valve. Any change in actuator model number necessary to meet requisition requirements after placement of order shall be taken care of by vendor without any price or time implication. While sizing the actuator, vendor shall ensure that the actuator is able to develop sufficient thrust to properly seat the control valve plug/disc at a pressure which is at least 0.5 units less than the minimum air supply pressure specified in purchaser's datasheet and the specified shut-off conditions.

2.6.2.2 While sizing the actuator, vendor must ensure that the sizing factors indicated below are fully complied. Higher sizing factor may be considered if found necessary by vendor.

- a) For control valves with leakage class IV and below, the actuator shall be sized considering actuator thrust at least 1.3 times the total force induced by shut-off conditions specified in the data sheet and the force required to overcome packing friction. Vendor shall utilize this factor as 1.5 in case the control valve is operating between 80% to 90% or 10% to 20% in any of the specified conditions.
- b) For control valves with leakage class V and above, the actuator shall be sized considering actual thrust at least 1.5 times the total force induced by specified shut-off conditions in the purchaser's data sheet and the force required to overcome packing friction.

2.6.2.3 Vendor shall indicate the recommended actuator orientation. In addition other allowable orientations shall also be provided along with the offer. The orientation of the actuator may be changed after order during detail engineering. The vendor shall do the same without any price or time implication.

## **2.7 Accessories**

### **2.7.1 Positioners**

2.7.1.1 Positioners shall be of force-balance type or smart digital type or fieldbus type as specified in the purchaser's datasheet. They shall be direct acting, with an adjustable gain unless otherwise specified.

2.7.1.2 The pneumatic positioner shall be provided with an integral by-pass switch whenever the operating range of the actuator is the same as that of the control signal.

2.7.1.3 Every positioner shall have two pressure gauges mounted on it, one each for air supply and for positioner output to actuator. In addition, pneumatic positioner shall have a third pressure gauge for control signal.

2.7.1.4 Pneumatic connections shall be ¼" NPT (F) / ½" NPT (F) as per vendor's requirement and cable entry shall be ½" NPTF. If connection for cable entry is different than that specified, suitable adapters shall be provided.

2.7.1.5 Positioners shall be side-mounted on control valves and shall be Linkage-less / contact less type. Alternatively positioners with SS linkages is also acceptable. Any applicable links shall be of corrosion resistant Stainless steel linkages and with rugged brackets. All control valve positioners shall have metallic casing.

2.7.1.6 All positioners in Electrical Gas Group IIC area as specified in Purchaser's datasheet shall be dual certified. i.e certified intrinsically safe Ex'i' and Flameproof Ex'd'.

2.7.1.7 Valve position shall be available through HART/FF signal as a default. Additionally, Positioners shall be provided with 4-20mA hardwired output signal for position transmission if specifically indicated in Purchaser's data sheet.

2.7.1.8 The Software necessary for advance control valve diagnostics like seat ring condition, gland packing condition, actuator leakage, device checks, maintenance etc. shall be supplied by vendor. Any such diagnostic software related to Smart or fieldbus positioner shall be of "plug-in" type and the software shall be easily integrated with Asset Management System Platform of purchaser. These advance diagnostic software shall be of latest release or version with advanced features

2.7.1.9 Vendor shall also ensure that all electric & pneumatic entries to be suitably plugged before dispatch to site and metallic plug shall be provided.

2.7.2 Smart type and fieldbus type positioners

2.7.2.1 Digital smart positioners or fieldbus type of positioners with diagnostic capabilities shall be supplied whenever specified in the purchaser's data sheets. These shall meet the following minimum requirements:

- a) The positioner sensor and sensing mechanism shall be rugged and shall not be affected by the line/valve vibration. The performance of the positioners shall be immune to above vibration.
- b) The positioner's output and input range shall be field adjustable without any hardware modification. The output from the positioners shall be available for both single acting as well as double acting actuator.
- c) Each positioner shall be operable, configurable and accessible through HART compatible hand held configurator/fieldbus configurator as applicable.
- d) The positioner shall be a two-wire device, which shall operate on two-way digital communication mode. All engineering, configuration, diagnostic and maintenance related data shall be provided by the positioner.
- e) The smart positioner shall provide HART protocol of latest version and shall be capable of implementing commands from Instrument Asset Management System / hand-held HART configurator.
- f) Positioners with fieldbus output shall meet the following requirements:
  - i) All positioners must satisfy the requirements of the fieldbus registration laboratory with applicable checkmark like FieldBus Foundation, Profibus Nutzerorganisation e.v (PNO) or as specified in the purchaser's data sheets.
  - ii) All positioners shall have analog output (AO) and controller blocks (PID).
  - iii) All positioners must be interoperable and shall have valid interoperability test clearance like ITK latest version for foundation fieldbus or equivalent for profibus PA, as applicable.
  - iv) The fieldbus positioners shall support peer-to-peer communication with two wire communicator and bus powered supply.
  - v) Fieldbus positioners as offered shall not be polarity sensitive.
  - vi) The fieldbus positioners in hazardous area shall be certified as per entity concept or shall be FISCO approved as per the requirements specified in the purchaser's specification.
  - vii) Internal software shall be configured by the vendor including the following information:

-Serial Number

-Device tag (Tag No.)

-Process Description/service



- viii) Positioners shall be capable of supporting incremental Device Description (DD) for extra functionality and/or software revisions in Device memory.
  - g) The positioners shall be suitable to operate with commercially available asset management software and shall support the following features, as a minimum:
    - i) It shall allow multi-master for configuration, calibration, diagnosis and maintenance. The primary could be a host computer and secondary could be a hand held communicator.
    - ii) It shall be capable of implementing universal commands. It shall be possible to communicate all commands of commercially available asset management system to/ from smart positioner.
  - h) The offered positioners shall meet the following performance characteristics: -
    - i) Overall control accuracy shall be better than  $\pm 0.5\%$  of span.
    - ii) Repeatability shall be less than  $\pm 0.25\%$  of span.
    - iii) Hysteresis shall be less than  $\pm 0.5\%$  of span.
    - iv) Vendor shall supply the valve's operating signatures in the form of hard copy and soft copy for each control valve supplied with smart positioners. The necessary software for advanced control valve diagnostics like seat ring condition, gland packing condition, actuator leakage etc. shall also be included.
  - i) All positioners shall have metallic casing and cover either of stainless steel or of anodized aluminium.
  - j) Fieldbus positioners shall support EDDL requirements as per IEC 61804/FDT/DTM requirements, as specified in job specifications.
  - k) Acceptance criteria for Performance/Calibration of Valves with Smart / FF Positioners shall be 1% of span.
- 2.7.3 Electro-Pneumatic Converter**
- 2.7.3.1** Electro-pneumatic converter shall be of electronic feedback type unless specified otherwise and shall be yoke mounted.
- 2.7.3.2** It shall have an integral terminal housing. Electro pneumatic converter with flying leads shall not be acceptable.
- 2.7.3.3** Unless otherwise mentioned, it shall be intrinsically safe.
- 2.7.3.4** Pneumatic connections shall be  $\frac{1}{4}$ " NPT (F) /  $\frac{1}{2}$ " NPT (F) as per vendor requirement. The electrical connections shall be  $\frac{1}{2}$ " NPT (F). If they are different, suitable adapters shall be provided.
- 2.7.3.5** The overall accuracy of the electro-pneumatic converter shall be better than  $\pm 0.3\%$ .
- 2.7.3.6** Acceptance criteria for Performance/Calibration of Valves shall be 1.5% of span.
- 2.7.4 Air Filter Regulator**

- 2.7.4.1 Vendor shall supply air filter regulator with each positioner complete with an integral output gauge.
- 2.7.4.2 Air filter regulator shall be sized considering the air supply pressure and flow required to meet requirements specified in the purchaser's data sheets.
- 2.7.4.3 Filter material shall be sintered bronze. Filter size shall be maximum 5 microns. However, lower filter mesh size shall be considered to suit the electro pneumatic converter vendor's requirement.
- 2.7.5 Valve Jacketing
- 2.7.5.1 The jacketed valves shall have steam inlet/outlet connections as flanged.
- 2.7.5.2 The valve end connections shall be one size higher than the normal valve connections for jacketed valve.
- 2.7.6 Hand held configurator for Smart Instruments
- Hand Held configurator shall be universal type and shall be able to communicate with all make and models of smart instruments with HART output like transmitters, smart positioners etc., and shall be capable of carrying out all engineering functions like calibration, configuration and diagnostics. The hand held configurator shall be certified intrinsically safe when used in hazardous area. Carrying case shall be supplied with each configurator.
- 2.7.7 Fieldbus configuration :
- The fieldbus configuration, whenever specified in datasheet, shall be provided with hardware and software for configuration and maintenance of fieldbus devices and also to perform diagnostics and troubleshooting of the fieldbus segments.
- 2.7.8 Battery charger
- Both Fieldbus and HART configurations shall be supplied with battery charger for battery charging. Unless otherwise specified, battery charger shall operate at 230V 50Hz supply.
- 2.7.9 Wherever solenoid valves have been asked for control valves in modulating service, the control valves are for modulating cum shutdown application. For all such cases, solenoid valve shall be installed between positioner output and actuator. The de-energisation of solenoid valve shall bring the control valve to failure position by venting the actuator
- 2.8 Control valve accessories like Air Filter Regulators (AFR), Smart Positioners, Foundation Fieldbus Positioners , Solenoid valves, Limit switches, handwheel, Pneumatic lock relay etc. (Wherever applicable) shall be supplied in fully assembled conditions with minimum of ¼" / 6.0mm or 8.0mm OD with 0.04" / 1 mm wall thickness SS316L air tubing. Material for mounting part/bracket shall be SS as minimum. Tube fittings shall be of flareless compression type of SS316 material. The fitting/ ferrule hardness shall be in the range of RB 85-90 so as to ensure a minimum difference of RB 5 to 10 between tube and fitting. The ferrule shall also be made of stainless steel (SS 316). Tubing of higher size like ½" / 12.0mm OD or higher, min 0.049" / 1.2mm thick (if required) for proper actuation of actuator / control valve shall be provided by vendor. Accessories like AFR shall be selected to match the air tubing requirements.

## 2.9 Special Service Valves

All control valves in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or carbon tetra-chloride. End connections shall be blinded / plugged after this degreasing process in order to avoid entrance of grease and oil particles.

## 2.10 Finish

### 2.10.1 The body shall be painted as below:

Carbon steel body	-	Light grey (RAL -7035)
Alloy steel body	-	Canary yellow (RAL-1003)
Stainless steel body	-	Natural
Above 150°C Operating Temp.	-	Aluminium white (RAL – 9006)

Items like silencers, diffuser plate assemblies etc., shall be painted as per respective control valve body requirements.

### 2.10.2 The actuator shall be painted as below:

Direct action (open on air failure including fail lock drift open) valves	-	Green (RAL-6024)
Reverse acting (close on air failure including fail lock drift close) valve	-	Red (RAL-3001)
Fail Lock / Fail Last (Stay-put on air failure) valve	-	Yellow (RAL-1004)

Items like air volume tanks etc., supplied as an accessory along with the actuators, shall be painted as per corresponding actuator.

### 2.10.3 Valve Body, Actuator and accessory Paint colours complying to equivalent BIS Standard IS-5 in place of specified RAL Codes mentioned above are also acceptable.

## 3.0 NAMEPLATE

Each control valve shall have a stainless steel nameplate attached firmly to it at a visible place, furnishing the following information:

- Tag number as per purchaser's data sheet.
- Body and port sizes in inches.
- Valve flow coefficient ( $C_v$ ).
- Stem travel in millimetres.
- Action on air failure.
- Spring range.
- Air supply pressure.
- Manufacturer's model number for the valve body, actuator and positioner.

## 4.0 INSPECTION AND TESTING

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

**5.0 SHIPPING**

- 5.1 The control valve and its accessories shall be supplied pre-assembled and pre-tubed.
- 5.2 All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.
- 5.3 Valves with external lubricators shall be lubricated prior to shipment.
- 5.4 Valves in oxygen and chlorine service shall be packed separately along with a certificate indicating 'CERTIFIED FOR OXYGEN / CHLORINE SERVICE', as applicable.

Sr. No.	Piping Classes	Nut and Bolt Material
1	A1A, A2A, A5A, A6A, A7A, A8A, A9A, A10A, A11A, A13A, A14A, A15A, A19A, A20A, A32A, A33A, A1K, A6K, A1M, A1N, B1A, B2A, B5A, B6A, B9A, B13A, B18A, B19A, B32A, B1K, B6K, B18K, B1M, B3M, B5M, B1N, B6N, D1A, D2A, D5A, D18A, D1K, D18K, D18P, E1A, E2A, E5A, E5E, F5A	A-193 Gr. B7 A-194 Gr. 2H
2	A16A, B16A	A-193 Gr. B7M A-194 Gr. 2HM
3	A1B, A1D, A4F, A4G, B1B, B1D, B5D, B1E, B3F, B4F, B4G, D1B, D2B, D1D, D2D, D5D, D5E, F2D	A1-193 Gr. B16 A-194 GR. 4
4	A2K, B2K, D2K	A-320 Gr. B8 CL.2 A-194 Gr. 8
5	A4A, A1H, B4A, B1H, D4A, D1H	A-320 Gr. L7 A-194 Gr. 4
6	A3Y	A-307 Gr. B A-563 Gr. B
7	A3A, A3K, A3Y, A4Y, J3A	A-307 Gr. B A-563 Gr. B
8	A1Z, A4Z, A5Y, A5Z, J2A, J5A	A-307 Gr. B (Galv) A-563 Gr. B (Galv)
9	B4K, B5K	A-193 Gr. B8 M C11 A-194 Gr. 8 MA
10	A32Y	A-193 Gr. B (Galv) A-194 Gr. 2H (Galv)
11	B3M, B4K, B5K, B5M	A-453 Gr. 660 CL.A A-453 Gr. 660 CL.A

Note : Bolts & Nuts material mentioned above is applicable for loose supply of nuts/bolts.

<b>Sr. No.</b>	<b>Piping Classes</b>	<b>Gasket Material</b>
1	A1A, A6A, A9A, A10A, A11A, A13A, A14A, , A19A, A1B, A1D, A1H, A1K, A1M, A4A, A4F, A4G, B1A, B1H, B2A, B4A, B6A, B9A, B13A, B18A, B19A, B32A, B18K, D1A, D2A, D1H, D1K, D4A, D18A, D18K, D18P	SP.WND SS316+GRAFIL+ I Ring
2	B5M	SP WND SS316H+ GRAFIL + I RING
3	A2K, B2K, D2K	SP WND SS 316+GRAFIL+SS 316 I/O RING
4	B1N	SP WND SS 316L+GRAFIL + I RING
5	B6N	SP WND SS 316L + GRAFIL
6	A1Z, A3Y, A4Y, A4Z, J2A	BUTYL RUBBER
7	E1A, E2A, E5A, F5A	SOFT IRON
8	E5E, F2D	5% CR, 0.5% MO
9	B4K, B5K	SS 316H+GRAFIL+I RING SS 316 O RING
10	A5Z	BS 7531 GR X (PTFE JACKETED)
11	A5Y, A8A, A15A, A32Y, A33Y	IS 2712 Gr. A/I
12	B3M	SP WND SS 321+GRAFIL+I RING
13	A1N, A6K, A16A, B16A	SP.WND SS316L+GRAFIL+ I Ring
14	A3A, A3K, A33A, J3A, J5A, A32A, A20A	NON ASBESTOS BS 7531 GR X
15	A2A	SP.WND SS316L+GRAFIL+ I Ring
16	B5A, D5A	SP.WND SS316L+GRAFIL+ I Ring
17	A7A, B1B, B1D, B1E, B1K, B3F, B4F, B4G,B5D, D1B, D1K, D2B, D1D, D2D, D5D, D5E	SP WND SS 316 + GRAFIL + I RING
18	B6K, B1M	SS 316 + GRAFIL

1. The gaskets material shall be applicable for loose supply of gaskets.

# ऑन-ऑफ वाल्वों के लिए मानक विनिर्देशन

## STANDARD SPECIFICATION FOR ON-OFF VALVES

3	11.11.21	Revised and Reissued as Standard Specification	RM/SM	SD/SB	MN	SM
2	27.03.17	Revised and Reissued as Standard Specification	RM	AR	RG	RN
1	11.04.11	Revised and Reissued as Standard Specification	SM	RG	RP/ JMS	DM
0	15.05.07	Issued as Standard Specification	SM	TGM	HCJ	VC
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	

**Abbreviations:**

AARH	:	Arithmetic Average Roughness Height
AFR	:	Air Filter Regulator
CIMFR	:	Central Institute of Mining and Fuel Research
DD	:	Device Description
DPDT	:	Double Pole Double Throw
ERTL	:	Electronics Regional Testing Laboratory
FLDC	:	Fail Lock Drift Close
FLDO	:	Fail Lock Drift Open
HART	:	Highway Addressable Remote Transducer
MVT	:	Manual Valve Testing
NPS	:	Nominal Pipe Size
NPT	:	National Pipe Thread
PE	:	Plain End
PID	:	Proportional, Integral and Derivative
PFD	:	Probability of Failure on Demand
PST	:	Partial Stroke Testing
PTFE	:	Poly Tetra Fluoro Ethylene
SS	:	Stainless Steel
TSO	:	Tight Shutoff

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**ANNEXURES:**

**ANNEXURE – 1 : STUD - BOLTS AND NUTS MATERIAL REQUIREMENT**

**ANNEXURE – 2 : GASKET MATERIAL REQUIREMENT**

## 1.0 GENERAL

### 1.1 Scope

1.1.1 This specification, together with the data sheets attached herewith describes the requirement for the design, materials, nameplate marking, inspection, testing and shipping of on-off valves.

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

ASME American Society of Mechanical Engineers

- B 1.20.1 Pipe Threads, General Purpose (Inch)
- B 16.5 Pipe Flanges and Flanged Fittings NPS½ through NPS24  
Metric/Inch Standard
- B 16.10 Face-to-face and End-to-End Dimensions of Valves
- B 16.20 Metallic Gaskets for Pipe Flanges
- B 16.34 Valves – Flanged, Threaded and Welding End
- B 16.47 Large diameter Steel Flanges: NPS 26 through NPS 60  
Metric/Inch Standard

ANSI American National Standards Institute

FCI 70-2 Control Valve Seat Leakage

API American Petroleum Institute

- API 6D Specification for Pipeline and Piping Valves
- API 6 FA Specification for Fire Test of Valves
- API 598 Valve Inspection & Testing
- API 607 Fire Test for Quarter-Turn Valves and Valves Equipped with  
Non-Metallic seats
- API 608 Metal Ball Valves – Flanged, Threaded and Welding Ends
- API 609 Butterfly Valves: Double-Flanged, Lug- and Wafer-type
- API 641 Type testing of Quarter-turn Valves for Fugitive Emissions

AWWA American Water Works Association

C207 CL.D Steel Pipe Flanges for Water Works Services

BS British Standards

6364 Specification for Valves for Cryogenic Service

EN European Standard

- 10204 Metallic Products – Types of Inspection Documents
- 12266-1 Industrial valves. Testing of metallic valves Pressure tests,  
test procedures and acceptance criteria. Mandatory  
requirements

EPA United States Environment Protection Agency

Method 21 Volatile Organic Compound Leaks

IBR Indian Boiler Regulation

IS/IEC Indian Standards/International Electro Technical Commission

IEC 60079	Electrical Apparatus for Explosive Gas Atmospheres
IS/IEC 60529	Degrees of Protection Provided by Enclosures (IP Code).
IEC-60534-4	Inspection & Routine Testing
IEC-61508	Functional Safety of Electrical/ Electronic/ Programmable Electronic Safety-related systems
IEC-60534-3-2	Face-to-face Dimension for Rotary Control Valves Except Butterfly Valves
IEC-61511	Functional Safety - Safety Instrumented Systems for the Process Industry Sector

## ISA

### International Society of Automation

75.01.01	Industrial – Process Control Valves – Part 2-1: Flow Capacity – Sizing Equations for Fluid Flow under Installed Conditions
75.02.01	Control Valve Capacity Test Procedures
TR75.04	Control Valve Position Stability
75.05.01	Control Valve Terminology
75.08.01	Face-to-Face Dimensions for Integral Flanged Globe-style Control Valve Bodies (Classes 125,150,250,300 and 600)
75.08.02	Face-to-Face Dimensions for Flanged and Flangeless Rotary Control Valves (Classes 150,300 and 600)
75.08.04	Face-to-Face Dimensions for Butt-weld-end Globe-style Control Valves (Class 4500)
75.08.05	Face-to-Face Dimensions for Butt-weld-end Globe-style Control Valves (Classes 150,300,600,900,1500 and 2500)
75.08.06	Face-to-Face Dimensions for Flanged Globe-style Control Valve Bodies (Classes 900,1500 and 2500)
75.11.01	Inherent Flow Characteristic and Rangeability of Control Valves.
75.19.01	Hydrostatic Testing of Control Valves
75.08.08	Face-to-centreline Dimensions for Flanged Globe-style Angle Control Valve Bodies (Classes 150,300 and 600)
75.25.01	Test Procedure for Control from Step Inputs
TR 75.25.02	Control Valve Response Measurement from Step Inputs
75.13.01	Method of Evaluating the Performance of Positioners with Analog Input Signals and Pneumatic Output

## ISO

### International Organization for Standardization

10497	Testing of valves — Fire type-testing requirements
15848-1	Industrial valves — Measurement, test and qualification procedures for fugitive emissions
5208	Industrial valves — Pressure Testing of Metallic Valves
17292	Metal ball valves for petroleum, petrochemical and allied industries

## MSS

### Manufacturers Standardization Society

SP 25	Standard Marking System for Valves, Fittings, Flanges and Unions
SP 61	Pressure Testing of Valves
SP 67	Butterfly Valves

## NACE

### National Association of Corrosion Engineers

MR0103 Petroleum, Petrochemical and Natural Gas Industries –  
Metallic Materials Resistant to Sulphide stress Cracking in  
Corrosive Petroleum Refining Environments.

OSHA Occupational Safety and Health Authority

UL Underwriter Laboratories

1709 Standard for Rapid Rise Fire Tests of Protection Materials  
for Structural Steel

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

- a) Statutory regulations
- b) Job specification/data sheets
- c) Standard specification
- d) Codes and standards

1.1.4 In addition to meeting purchaser's specifications in totality, vendor's extent of responsibility shall also include the following:

- a) Purchaser's data sheets specify the minimum acceptable materials for the on-off valve body and trim. Alternate superior materials of construction shall also be acceptable, with the consent of purchaser, provided vendor assumes complete responsibility for proper selection of material for these parts for their compatibility with the process fluid and its operating conditions
- b) Purchaser's data sheets specify the on-off valve size and open / close operation time. Vendor shall be responsible for selecting their standard valve suitable for the specified service and process conditions and operation time specified in the purchaser's data sheets.
- c) Purchaser's datasheet specify the shut-off differential pressure and fire safe requirements. Vendor shall be responsible for correct selection of Actuator for the offered valves.

## 1.2 Bids

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

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

- a) Compliance to the specifications. Deviations on technical requirements shall not be entertained. In case vendor has any valid technical reason, they must include a list of deviations tag number wise, summing up all the deviations from the purchaser's data sheets and other technical specification along with the technical reasons for each of these deviations.
- b) Whenever the requirements of a detailed specification sheet for each on-off valve is specifically indicated, the specification sheet shall provide information regarding type, material of construction, capacity, open/close operation time etc. of the on-off valve and its accessories. The material specifications and units of measurement

indicated in the specification sheet shall be to the same standards as those in purchaser's data sheet.

- c) Proven references for each offered model, in line with clause no. 1.2.4 of this specification, specifically for valves with ANSI rating 600# and above, temperature more than 250°C and below -29°C, special applications like hydrogen, NACE, cryogenic, fire safe and metal seated valves with leakage rate as per API 598 or Rate A of ISO 5208.
- d) A copy of approval for items such as limit switches, solenoid valves, PST positioner, whenever specified from local statutory authority, as applicable, such as Petroleum & Explosives Safety Organisation (PESO) in India, along with:
  - i) Test certificate from recognised test house like Central Institute of Mining and Fuel Research (CIMFR) / Electronics Regional Testing Laboratory (ERTL) etc. for flameproof enclosure and/ or intrinsic safety, as specified in the data sheet, as per relevant Indian Standard for all Indian manufactured equipments.
  - ii) Certificate of conformity from agencies like Laboratoire Central Des Industries Electriques (LCIE), British Approval Service for Electrical Equipment in Flammable Atmospheres (Baseefa), Factory Mutual (FM), Physikalisch-Technische Bundesanstalt (PTB), Canadian Standards Association (CSA), Underwriters Laboratories (UL) etc. for compliance to ATEX directives or equivalent recognised standards for all equipments manufactured outside India.
- e) Type test certificate for fire safety and fugitive emissions for on-off valve, wherever applicable.
- f) Limitation, if any, in changing actuator orientation at site.
- g) Catalogues giving detailed technical specifications, model decoding details and other technical information for each type of on-off valve and accessories covered in the bid.

**1.2.3 For valves in cryogenic service, vendor shall meet the following acceptance criteria:**

- a) Vendor shall furnish, along with the offer, type test certificate, duly witnessed and certified by any one of Third Party Inspection agency like M/S Lloyds Register, DNV, BV, TUV or CEIL of having successfully conducted the cryogenic test as per BS 6364, subject to below mentioned conditions, on the offered valves (same model, size, rating and material) in cryogenic service.
  - i) Test temperature, unless otherwise specified, shall be -45°C for LTCS and -196°C for all grades of austenitic stainless steel.
  - ii) Test pressure, unless otherwise specified, shall be the maximum operating pressure.
  - iii) Seat pressure tests shall be conducted for the normal flow direction, unless the valves are specifically indicated as Bi-directional in Purchaser's datasheets.
  - iv) For valves requiring Tight Shut-off as per Purchaser's datasheets, acceptable leakage rate shall be as per class VI of ANSI FCI 70-2.

- b) Tests carried out on a particular size of one type of valve, pressure rating and material shall qualify all sizes equal to and below the test valve size for the same type, pressure rating and material. In case of austenitic SS any one grade would qualify for all other grades of austenitic SS.
- c) In case vendor does not have cryogenic type test certificate for the offered valves as mentioned above, vendor shall meet one of the following requirements:
  - i) Vendor shall successfully carry out the cryogenic type testing as per BS 6364 on the same series (model) of the valves and type test certificate duly witnessed by any one of Third Party Inspection agency as per cl no. 1.2.3 a) for same shall be furnished for purchaser's review as part of vendor document submission after order.
  - ii) Vendor has proven references as per clause 1.2.4 of this specification for each of the offered valves (the same model, size, rating and material) in cryogenic service.
- 1.2.4 All items, as offered, shall be field proven and should have been operating individually for a period of minimum 6 months on the bid due date in the process conditions similar to those as specified in the purchaser's data sheets. Items with proto-type design or items not meeting provenness criteria specified above shall not be offered.
- 1.2.5 Whenever specified, vendor must furnish certified values of failure rates, probability of failure on demand (PFD) and test intervals for valve and its accessories for the safety integrity level analysis.
- 1.2.6 All documentation submitted by the vendor including their quotation, catalogues, drawings, installation, operation and maintenance manuals etc., shall be in English language only.
- 1.2.7 Vendor's quote shall include the following:
  - a) Partial Stroke Testing positioner with license software for loading in purchaser's IAMS, when specified.
  - b) Two years' operational spares for each on-off valve and its accessories, which shall include plug, seat ring, gasket set, packing set, diaphragm, o-ring set etc. as a minimum.
- 1.2.7.1 Each valve quoted shall include the following:
  - a) One extra set of packing and bonnet gasket with each tag.
  - b) One extra set of stem seal o-rings for each actuator and piston o-rings additionally for each piston actuator.
  - c) Seat insert (soft part) for each ball valve.
  - d) Line bolting (set of long studs and nuts) and set of gasket, in case of flangeless valves as per material given in Annexure-1 and Annexure-2 with each such tag number
  - e) Line bolting ( set of studs and nuts) with suitable spares in case of valves with tapped holes

### **1.3 Drawing and Data**

- 1.3.1 Detailed drawings, data, catalogues and manuals required shall be submitted by the vendor as per vendor data requirements attached with the requisition.
- 1.3.2 Final documentation consisting of design data, installation manual/procedure, operation and maintenance manual/calibration procedure etc., submitted by the vendor after placement of purchase order shall include the following, as a minimum:
- a) Specification sheet for each on-off valve and its accessories.
  - b) Certified drawings for each on-off valve and its accessories, which shall provide dimensional details (face-to-face and height of completely assembled valve), hook-up and wiring details, dimensions of clearance space for maintenance work, weight of completely assembled valve, internal constructional details, materials of construction, fire box/jacket dimensions and actuator orientation with respect to flow direction marked on the body.
  - c) Copy of the type test certificates.
  - d) Copy of the test certificates for all tests indicated in Inspection Test Plan.
  - e) Device Description (DD) Files for configuring PST positioner parameters.

## **2.0 DESIGN AND CONSTRUCTION**

### **2.1 Body**

- 2.1.1 On-off valves shall have flanged end connections integral to the valve body. Whenever flangeless on-off valve body design is specified in the purchaser's data sheet, following shall apply:
- a) Wafer type or lug type body design for on-off valves body size up to 6 inches.
  - b) Lug type body design for butterfly type of on-off valve body size more than 6 inches.
- However, for on-off valves with fire safe design, flanged body construction shall only be acceptable.
- 2.1.2 Top entry valve design shall not be offered unless specifically indicated in the purchaser's data sheets. However, for valves with butt-weld ends required as per purchaser's datasheets, top entry design shall be provided to facilitate maintenance without cutting the valve out of the pipe.
- 2.1.3 Unless specifically indicated otherwise, the minimum on-off valve body size shall be 1 inch.
- 2.1.4 The valve body rating shall be equal to or higher than the flange rating specified in the data sheets.
- 2.1.5 Whenever flanged body is mentioned in the purchaser's datasheet, the same shall be double-flanged and suitable for connecting to Purchaser's flanges on both sides through standard length stud bolts & nuts.
- 2.1.6 Unless otherwise specified, the on-off valves shall be suitable for horizontal pipe installation. When vertical pipe installation is found necessary at site, it shall be possible to suitably modify the valve assembly at site for vertical mounting. The weight of actuators and supporting of actuator should be considered in the vendor design.

2.1.7 Unless otherwise specified, the on-off valves shall be of full-port design and the following shall apply:

- a) Port size shall be equal to line size for rating up to ASME Class 1500.
- b) Port size shall not be less than one size than the line size for rating ASME Class 2500 and above.

2.1.8 For steam jacketed valves, the body size and jacket line size shall be as per individual valve datasheets.

2.1.9 Flow Direction

2.1.9.1 Flow direction shall be clearly marked on the on-off valve body, preferably either stamped or cast on the valve body for uni-direction valves and 3-way valves. For Bi-directional valves, marking of flow direction on the valve is not required.

2.1.9.2 3-way on-off valves shall be clearly identified with inlet and outlet end connection.

2.1.10 End Connections

2.1.10.1 Unless otherwise specified, the following shall govern:

- a) Threaded end connections shall be to NPT as per ASME B1.20.1.
- b) Flanged end connections shall be as per ASME B 16.5 for sizes up to 24". For sizes 26" and above AWWA-C207 CL.D shall be followed for water applications & ASME B-16.47B for all other applications.
- c) Flange face finish shall be as per ASME B16.5. The face finish shall be as follows:  
  
125 AARH : 125 to 250 micro inch AARH  
  
63 AARH : 32 to 63 micro inch AARH
- d) Grooves of ring type joint flanges shall be octagonal as per ASME B 16.20

2.1.10.2 Face-to-face dimensions of on-off valves shall be in accordance with the relevant standard indicated in clause 1.1.2 of this standard specification.

2.1.10.3 Where provided, on-off valve bottom drains shall be blind flanged only with dimensions and rating corresponding to ASME B 16.5. Material of blind flanges shall be same as valve body material.

2.1.11 Material of Construction

2.1.11.1 The material of construction of on-off valves shall be as specified in the data sheet. Alternate superior materials of construction shall also be acceptable, with the consent of purchaser, provided vendor assumes complete responsibility for proper selection of material for the internal parts of on-off valve and compatible with the process fluid and conditions specified in the purchaser's data sheets.

2.1.11.2 On-off valve body, bonnet, bottom flange, line flanges and other pressure containing assemblies shall be of the same material of construction as specified for valve body in the purchaser's data sheets.



2.1.11.3 The bonnet flange and bottom flange shall have metallic spiral wound gaskets suitable for the specified service. The gaskets with asbestos bearing fillers shall not be used.

## 2.2 Trim

2.2.1 The term 'trim' covers those parts of valve assembly (excluding the body, bonnet and bottom flange) which are exposed to and are in contact with the line medium consisting of but not limited to the seat ring, valve stem, valve plug/disc/ball, valve plug guide, cage guide bushing etc.

2.2.2 In case of ball-type of on-off valves;

- a) The valve design shall ensure valve seat and body protection against thermal expansion of the entrapped fluid when the on-off valve is fully close.
- b) Ball valves shall be of floating ball/trunnion mounted type as per following:

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

## 2.2.3 Guiding

2.2.3.1 Single seated globe (unbalanced) and angle type on-off valves shall have heavy top plug guiding. Stem guided on-off valve design shall not be acceptable.

2.2.3.2 Rotary type on-off valves like Ball valves, butterfly valves etc. shall have blow out proof shaft guiding design.

2.2.3.3 Guide bushing shall be of a sufficiently hard material to resist side thrust on the plug or shaft.

## 2.2.4 Trim Design

2.2.4.1 Vendor shall be responsible for trim design and selection of the on-off valve. However, it must meet the following minimum requirements:

- a) On-off valve trim design shall suit the type of guiding specified in the data sheet.
- b) Unless specifically indicated otherwise in purchaser's data sheets, the valve characteristics shall be quick-opening (on-off) type.
- c) Vendor shall select proper material pairs, surface finish, hardness and clearances to avoid galling.
- d) For on-off valves operating under extreme temperature conditions, vendor shall consider increased clearances at room temperature and seal welding of threaded seat rings etc whenever required. Hard facing of trim including guide bushing shall be considered for all on-off valves operating at high temperatures (i.e. temperature more than 200°C). For very low temperature application, material used shall have adequate cold impact strength.

- e) For all on-off valves including 3-way type of valves, stem and plug shall be detachable and shall be attached together by suitable threaded design secured with a pin to avoid plug rotation during operation.
- 2.2.4.2 For valves in bi-directional service as per purchaser's datasheets, the valve seat design shall provide tight shut off for flow in either directions meeting the leakage requirement as per clause 2.2.5.4.
- 2.2.5 Trim Material
- 2.2.5.1 Whenever stellited trim is specified in the data sheets following material of construction for the trim parts shall also be acceptable.
- |    |                         |   |
|----|-------------------------|---|
| a) | Ball/Disc/Plug and seat | Stellite sheathing/Chromium Carbide/Tungsten Carbide/Alloy 6 coating or solid stellite          |
| b) | Guide                   | Stellite sheathing/Chromium Carbide/Tungsten Carbide/Alloy 6 coating, solid stellite or SS 440C |
| c) | Stem/Shaft              | 17-4 PHSS, Hastelloy  |
- 2.2.5.2 Minimum acceptable hardness in case of stellited or hardened trim shall be of the order of RC38 (BHN 352) to RC45 (BHN 429).
- 2.2.5.3 In case of rotary valves, vendor shall select the stem bearing type and material as per the process conditions. Material of construction shall be as per the wetted part material specified in the purchaser's data sheet, as a minimum.
- 2.2.5.4 Unless otherwise specified in Purchaser's datasheet, Leakage rate of non-cryogenic on-off valves shall be as per API 598 or Rate A of ISO 5208.
- 2.2.5.5. For on-off valves specified with leakage rate as per API 598, the valves should have undergone both low pressure closure test and high pressure closure test as a minimum.
- 2.3 Sizing**
- 2.3.1 Unless specifically indicated otherwise in purchaser's data sheet, no sizing shall be carried out for the on-off valve, body size of on-off valve shall be same as the line size. Valve sizing shall be carried out only for those on-off valves where purchaser data sheet specify the same.
- 2.3.2 Vendor shall indicate the offered on-off valve flow coefficient i.e. Cv . Wherever the requirement of valve sizing is indicated, the valve capacities in terms of Cv when shown in the purchaser's data sheets have been arrived at using the formulae given in the standard ISA S 75.01.01-"Control valve sizing equations". In case vendor's sizing formulae differ from above, purchaser shall be provided with the details.
- 2.3.3 Rangeability of valves shall be as per manufacturers' standard. However, where purchaser's data sheet indicate the sizing requirement, the rangeability of the offered valves shall be suitable to meet specified rangeability.
- 2.4 Packing Box, Bonnet and Stem**
- 2.4.1 Packing Box
- 2.4.1.1 The packing box shall be flanged bolted to the bonnet and shall meet the requirements specified in purchaser's data sheet.

- 2.4.1.2 Generally low friction type packing like braided PTFE is preferred wherever operating conditions permit. For high temperature application (Design Temperature > 200°C) and fire safe valves, Grafoil or equivalent gasket suitable for the specified service shall be selected. Asbestos based packing material shall not be used. Selected packing design shall also meet fugitive emission requirements as per clause 2.9.3.
- 2.4.1.3 For application in vacuum service, vendor to provide inverted packing design suitable for vacuum service. For pressure-cum-vacuum service, the on-off valve shall have dual packing design suitable for the application and Fugitive emission requirement is not mandatory for such application. Dual packing / Live loaded design shall also be provided for on-off valves in toxic service, with a facility to connect inert fluid between the packings.
- 2.4.1.4 3-way on-off valves of either diverting or mixing type shall have PTFE box rings, unless otherwise specified.
- 2.4.2 Bonnet
- 2.4.2.1 The bonnet shall be flanged bolted to the body. Threaded bonnets are not permitted.
- 2.4.2.2 Wherever the operating temperature of the fluid is above 200°C, extension or radiation finned bonnet shall be provided. Vendor standard bonnet design shall also be acceptable if these are suitable for higher temperatures.
- 2.4.2.3 For temperature below 0°C, vendor shall provide extended bonnet design. For valves in cryogenic application bonnet extension shall be as per BS-6364 as a minimum.
- 2.4.3 Stem
- 2.4.3.1 The stem surface finish shall be fine. Extra fine surface finish shall be provided wherever the packing material is PTFE.
- 2.4.3.2 The stem/shaft shall be designed for the maximum thrust of the actuator without any measurable deflection.
- 2.4.3.3 The valve stem/shaft shall be connected to the actuator stem/shaft by suitable arrangement to avoid backlash problem.
- 2.5 Pneumatic Actuator**
- 2.5.1 Actuator shall be sized for the shut-off differential pressure indicated in purchaser's data sheets. However, for 3-way type on-off valve, the actuator shall be sized for maximum differential pressure, unless specifically indicated otherwise.
- 2.5.2 The actuator shall be designed to move the valve to the failure position specified in the purchaser's data sheet. For failure position specified as 'fail-last', unless vendor's actuator design has this feature in-built, vendor shall provide air reservoir as per clause 2.7.5 with all required accessories to meet the fail last position of the valve. All accessories shall be SS316 as a minimum and tubing shall be SS 316L as a minimum.
- 2.5.3 Actuator casing shall be made of pressed steel or anodised aluminium. Non-metallic actuator casings shall not be offered.
- 2.5.4 Springs shall be corrosion-resistant and shall preferably be cadmium or nickel-plated. These shall be of the enclosed type. The compression of the springs / number of springs shall be adjustable to get the desired output torque.

- 2.5.5 In general, actuator operating range shall be 0.2 to 1.0 kg/cm<sup>2</sup>g, higher actuator operating range shall be acceptable provided vendor standard actuator model fails to meet specified shutoff pressure.
- 2.5.6 In general, spring return piston actuators shall be used for On-Off valves. Only when this type of actuator becomes extremely unwieldy, based on the data specified in the purchaser's data sheet, should a double acting piston type of actuator be considered.
- 2.5.7 Whenever piston and cylinder actuator is considered, single acting spring return type is preferred.
- 2.5.8 Whenever double acting springless type of actuator is unavoidable, all accessories like pilot valves, booster relays, non-return valve, pressure gauge, volume bottle etc. shall be provided to ensure desired action on air failure. All accessories shall be SS316 as a minimum and tubing shall be SS 316L as a minimum. Volume Bottle is not required when failure position in Purchaser's data sheet is specified as 'Fail lock'/'Fail Last' only.
- 2.5.9 For actuator casing design, vendor shall consider at least any one of the following:
- a) Actuator casing shall be suitable for 1.5 times the maximum pneumatic operating pressure
  - b) Actuator provided with upstream safety valve set at "Actuator Casing suitable pressure less 0.2 kg/sq.cm.g"
  - c) Actuator provided with PST Positioner having Overpressure Limit feature and set for the "Actuator Casing suitable pressure less 0.2 kg/sq.cm.g"
- 2.5.10 Valve stem position indicator shall be provided for every on-off valve, when specified. The position indicator scale shall be calibrated from 0 to 100%.
- 2.5.11 In general, side-mounted handwheels are preferred when specified. Hand wheels shall provide manual on-off in both opening and closing directions independent of spring action. Hand wheels shall be of non-rising type suitable for accurate valve positioning. The hand wheel actuator shall be sized to provide the required thrust for valve positioning with 178N force applied to the hand wheel.
- 2.5.12 Actuator orientation shall be as per purchaser's requirements, in general. When, no requirements are indicated by purchaser, vendor shall provide recommended actuator orientation. It shall be possible to change this orientation at site for the offered valve-actuator combination in case it is found necessary.
- 2.5.13 For the on-off valves where operating times are specified in the purchaser's data sheets, vendor shall design the actuator and its accessories to meet these requirements. Whenever no operating time is specified, the same shall not exceed 1 second per inch of valve.
- 2.5.14 Actuator Sizing
- a) Vendor shall be fully responsible for sizing and selection of correct actuator for the specified on-off valve. While sizing the actuator, vendor shall ensure that the actuator is able to develop sufficient thrust to properly seat the on-off valve at an air pressure which is at least 0.5 units less than the minimum air supply pressure specified in purchaser's datasheet and the specified shut-off conditions.
  - b) While sizing the actuator vendor shall consider actuator thrust at least 1.5 times the total force induced by shut off condition specified in purchaser's data sheet and the force required to overcome packing friction.

## 2.6 Valve Jacketing

2.6.1 The jacketed valves shall have steam inlet/outlet connections as flanged.

2.6.2 The valve end connections shall be same as the jacket line size which shall be higher than the normal valve size. Body size and end connection sizes of jacketed valves shall be as per individual valve datasheets.

## 2.7 Accessories

### 2.7.1 Partial Stroke Testing(PST) Positioners

Partial stroke testing positioners with HART Protocol shall be supplied whenever specified in purchaser's datasheet. These shall meet the following minimum requirements:

- a) Every positioner shall have two pressure gauges mounted on it, one each for air supply and for positioner output to actuator.
- b) Cable entry shall be ½" NPTF to ASME B1.20.1. If connection for cable entry is different than that specified, suitable adapters shall be provided.
- c) Positioners shall be side-mounted on the ON-OFF valve and shall have corrosion resistant linkages and rugged brackets.
- d) The positioner sensor and sensing mechanism shall be rugged and shall not be affected by the line / valve vibration. The performance of the positioners shall be immune to above vibration.
- e) The positioner's output and input range shall be field adjustable without any hardware modification. The output from the positioners shall be available for both single acting as well as double acting actuator.
- f) Each positioner shall be operable, configurable and accessible through HART compatible hand held configurator.
- g) The positioner shall be a two-wire device with HART protocol of latest version and shall be capable of implementing commands from Instrument Asset Management system/hand-held HART configurator.
- h) The positioners shall be suitable to operate with commercially available asset management softwares and shall support the following features, as a minimum:
  - i) It shall allow multimaster for configuration, calibration, diagnosis and maintenance. The primary could be a host computer and secondary could be a hand held communicator.
  - ii) It shall be capable of implementing universal commands. It shall be possible to communicate all commands of commercially available asset management system to/ from smart positioner.
- i) The offered positioners shall meet the following performance characteristics: -
  - i) Overall accuracy shall be better than  $\pm 0.5\%$  of span.
  - ii) Repeatability shall be less than  $\pm 0.25\%$  of span.
  - iii) Hysteresis shall be less than  $\pm 0.5\%$  of span.



- j) All positioners shall have metallic casing and cover either of stainless steel or of anodized aluminum.
- k) The PST Positioner model shall be suitably selected to ensure that failure or closure of PST positioner does not result in the valve going to its fail safe position.

#### 2.7.2 Air Filter Regulator

- 2.7.2.1 Vendor shall supply air filter regulator with each ON-OFF valve complete with an integral output gauge. Air filter regulator shall be downstream regulator type, in general.
- 2.7.2.2 Air filter regulator shall be sized considering the minimum air supply pressure and flow required to meet requirements specified in the purchaser's data sheets.
- 2.7.2.3 Filter material shall be sintered bronze or polypropylene. Filter size shall be maximum 5 microns.

#### 2.7.3 Limit Switches

- 2.7.3.1 Unless otherwise specified, limit switches shall be proximity type and shall meet NAMUR standard. Mechanical type limit switches shall only be used when specifically indicated.
- 2.7.3.2 The limit switches shall be Weather proof to IP 65 and intrinsically safe. Certificates to this effect indicating the entity parameters shall be furnished from statutory body.
- 2.7.3.3 Suitable terminal blocks shall be provided for cable termination. Flying leads shall not be acceptable.

#### 2.7.4 Solenoid Valves

- 2.7.4.1 Solenoid valves provided with all On-Off valves shall be direct acting type only. Pilot operated solenoid valves shall not be acceptable unless specifically indicated in the job specifications / data sheets.
- 2.7.4.2 Wherever solenoid valves are 24V DC Intrinsically safe, Solenoid Valves shall be low power consumption type, suitable for voltage available as per Safety Certification of 3-port isolation type active IS Barrier and considering a cable resistance of 12.3 ohms/km.

#### 2.7.5 Volume Bottle / Air Reservoir

Whenever Volume Bottle / Air Reservoir is specified in purchaser's datasheets or required as per the actuator design:

- 2.7.5.1 Backup volume bottles for the valve operation shall be of SS304 construction and shall be designed in line with ASME Sec. VIII Div. 1 and suitable for the design pressure of 10.5 kg/cm<sup>2</sup>(G). Volume bottle thickness shall be 6 mm as a minimum.
- 2.7.5.2 Volume bottles shall be provided with all required accessories including PG, PSV, NRV, etc. in 316 Stainless steel construction as a minimum.
- 2.7.5.3 Volume Bottle shall be sized at the minimum air supply pressure for a minimum of three full strokes.
- 2.7.5.4 Volume Bottle shall be mounted separate from the actuator assembly as a free standing item. Minimum tubing length of 10 meters shall be considered between the volume bottle and the actuator assembly.

- 2.7.5.5 Volume bottle shall be tagged with the associated on-off valve tag number by the vendor
- 2.7.6 On-Off valve accessories like Air Filter Regulators (AFR), PST Positioners, Solenoid valves, Limit switches, handwheel, Pneumatic lock relay etc. (wherever applicable) shall be supplied in fully assembled conditions with minimum of 1/4" / 6.0mm or 8.0mm OD with 0.049"/ 1 mm wall thickness SS316L air tubing. Material for mounting part/bracket shall be SS as minimum. Tube fittings shall be of flareless compression type of SS316 material. The fitting/ ferrule hardness shall be in the range of RB 85-90 so as to ensure a minimum difference of RB 5 to 10 between tube and fitting. The ferrule shall also be made of stainless steel (SS 316). If required, tubing of higher size like 1/2" / 12.0mm OD or higher, min 0.049"/ 1.2mm thick for proper actuation of On-Off valve shall be provided by vendor. Accessories like AFR shall be selected to match the air tubing requirements
- 2.7.7 Loose Supplied Items
- 2.7.7.1 Whenever tube size of more than 1/2" is considered for any valve to meet stroke time, additional material for interface with purchaser's 1" Air piping shall be loose supplied by vendor for each valve. The items shall include isolation ball valve with required tubing (3 meters of single length) and end connectors/ adapters / swage nipple etc. as a minimum to connect the AFR's inlet port with the 1" PE Air pipe. Material of construction of all loose supplied items shall be SS316 as a minimum.
- 2.7.7.2 Vendor shall furnish a table of valve tags which require air supply tubing greater than 1/2" and detail out the items being loose supplied after order.
- 2.7.8 All accessories in the pneumatic scheme shall be full ported with port size same as the tube size.
- 2.8 **Finish**
- 2.8.1 The body shall be painted as below:
- |                      |   |                            |
|----------------------|---|----------------------------|
| Carbon steel body    | - | Light Grey (RAL 7035)      |
| Alloy steel body     | - | Yellow (RAL 1003)          |
| Stainless steel body | - | Natural                    |
| Above 150°C          | - | Aluminium White (RAL 9006) |
- 2.8.2 The actuator shall be painted as below:
- |   |   |                   |
|---|---|-------------------|
| Direct action (open on air failure including FLDO) valves   | - | Green (RAL 6024)  |
| Reverse acting (close on air failure including FLDC) valves | - | Red (RAL 3001)    |
| Fail Lock / Fail Last (Stay-put on air failure) valve       | - | Yellow (RAL 1004) |
- Items like air volume bottle etc., supplied as an accessory along with the actuators, shall be painted as per corresponding actuator.
- 2.8.3 Valve Body, Actuator and accessory Paint colours complying to equivalent BIS Standard IS-5 in place of specified RAL Codes mentioned above are also acceptable.
- 2.9 **Special Requirements:**
- 2.9.1 Fire Safe Design Requirements

2.9.1.1 Whenever the valves are indicated as fire safe in purchaser's datasheets:

2.9.1.1.1 All Soft seated valves in downstream Oil & Gas applications such as Refineries / Petrochemicals etc. shall be tested for fire safe requirements as per latest edition of API 607 or ISO 10497. Also, vendor's fire safe design shall be such that soft seat is not damaged while closing/opening of the valve.

2.9.1.1.2 All Metal seated valves in downstream Oil & Gas applications and all valves in Offshore and pipeline applications shall be tested for fire safe requirements as per latest edition of API 6FA or API 607 or ISO 10497.

2.9.1.1.3 In case ISO 10497 is referred for testing of valves mentioned in clauses 2.9.1.1.1 & 2.9.1.1.2, only API 607 shall be considered as 'similar internationally recognized fire test standards' mentioned in ISO 10497.

2.9.1.2 Wherever fire safe actuator and controls have been asked for, volume bottle shall be provided, unless otherwise specified in individual datasheets. Actuators and all accessories such as solenoid valves, air volume bottles etc. shall meet the fire proof requirement to ensure normal valve operation even during and after exposure to fire. Vendor shall clearly define the schemes they propose to achieve the above requirements and ensure that the proposed schemes shall meet the requirement in terms of type of exposure and exposure time of the testing procedure given in ISO10497 / API 607 / API 6FA.

2.9.1.3 Vendor must note that all items i.e. actuators, its accessories and interconnecting tubing including Volume bottles is required to be protected under fire exposure conditions. The fire protection methodologies like fully enclosed fireboxes or special material coverage are acceptable provided fire safe certification is provided for complete assembly as indicated above.

2.9.1.4 Vendor shall furnish type test certificate duly witnessed by third party inspection agency like M/S Lloyds Register, BV, DNV, TUV or CEIL . for fire safe testing of valve, actuator and controls for the offered models along with the offer. When fire safe box is offered, vendor to note that fire safe box up to maximum twice the surface area of fire box already satisfactorily fire safe type tested is acceptable provided the clearance inside the fire box with all accessories duly mounted are maintained equal to or greater than those maintained in fire safe box successfully type tested. In case, earlier fire safe test carried out by vendor is not applicable for quoted size/rating of the valve, fire safe box, then vendor shall carry out the test for fire safe design for the offered valves / actuators & controls.

## 2.9.2 Special Service Valves

All on-off valves in oxygen and chlorine service shall be thoroughly degreased using reagents like trichloro-ethylene or equivalent non-toxic reagents. End connections shall be blinded / plugged after this degreasing process in order to avoid entrance of grease and oil particles.

## 2.9.3 Fugitive Emission Requirements

2.9.3.1 Unless otherwise specified, all ON-OFF valves shall comply with the following performance class requirement as per ISO-15848-1:

Service	Tightness Class	Endurance Class	Temperature Class
H <sub>2</sub> , H <sub>2</sub> S and Benzene	AH / AM	CO1	t200 °C
All other services	CH / CM	CO1	t200 °C



- 2.9.3.2 Type test certificates shall be provided by vendor with the offer clearly indicating the extension of qualification to untested valves. All valves supplied by vendor shall fall within this extended qualification criteria.
- 2.9.3.3 In case any valve supplied by vendor is not covered under the extended qualification criteria of type test certificates, vendor shall test the valve as per ISO-15848-1, prove compliance to performance class requirement as per clause 2.9.3.1, furnish the test reports for purchaser's review as part of vendor document submission before inspection and only then proceed for dispatching the valve to site.
- 2.9.3.4 Alternatively, On-Off valves with type test qualification as per API 641 are also acceptable in place of Class CH / CM of ISO-15848-1.

### **3.0 NAMEPLATE**

Each on-off valve shall have a stainless steel nameplate attached firmly to it at a visible place, furnishing the following information:

- a) Tag number as per purchaser's data sheet.
- b) Body and port sizes in inches.
- c) Stem travel in millimetres.
- d) Action on air failure.
- e) Spring range.
- f) Air supply pressure.
- g) Manufacturer's model number for the valve body, actuator and positioner.

### **4.0 INSPECTION AND TESTING**

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

### **5.0 SHIPPING**

- 5.1 The on-off valve and its accessories shall be supplied pre-assembled and pre-tubed.
- 5.2 All threaded and flanged openings shall be suitably protected to prevent entry of foreign material.
- 5.3 Valves with external lubricators shall be lubricated prior to shipment.
- 5.4 Valves in oxygen and chlorine service shall be packed separately along with a certificate indicating 'CERTIFIED FOR OXYGEN / CHLORINE SERVICE', as applicable.

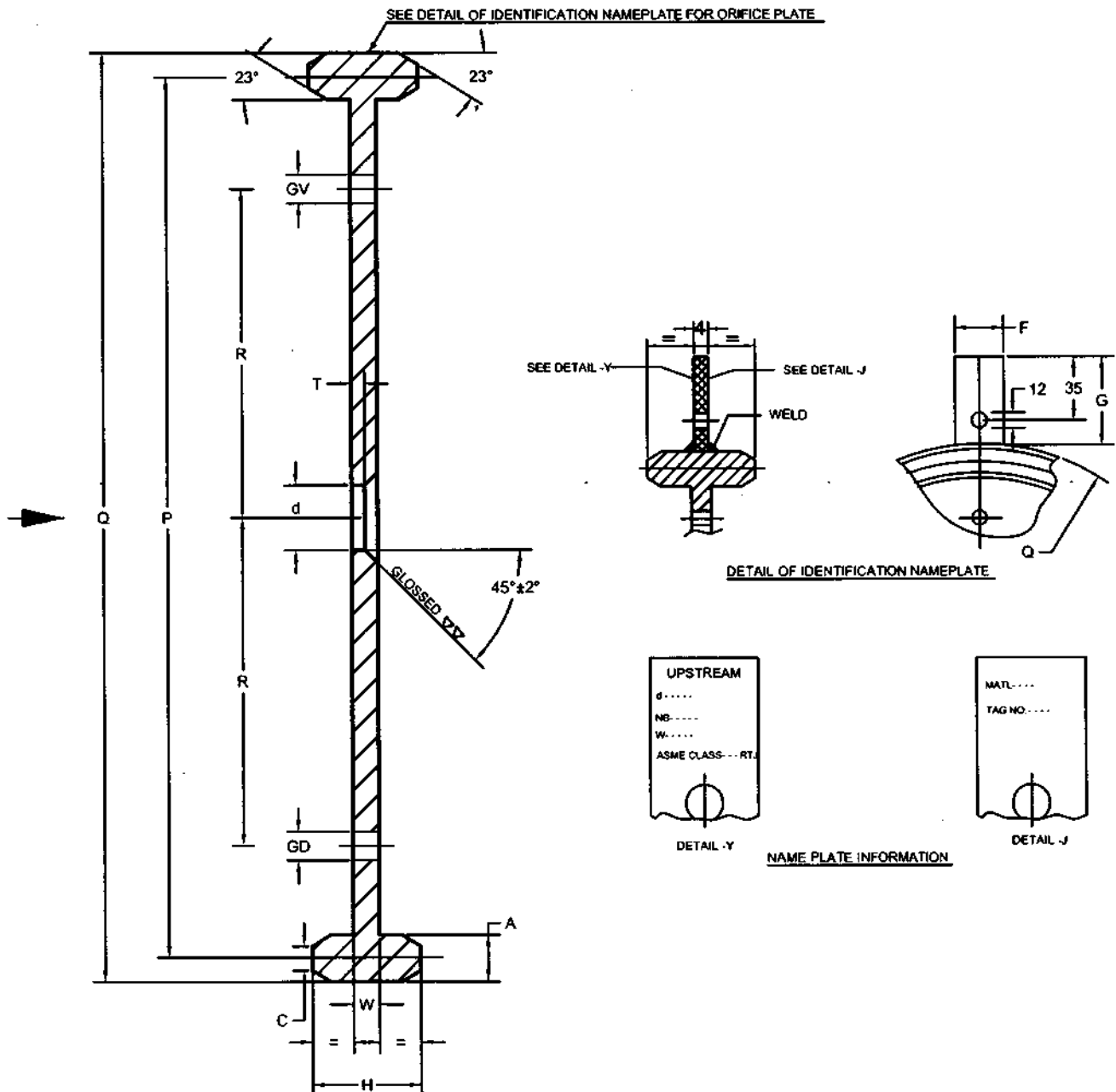
Sr. No.	Piping Classes	Nut and Bolt Material
1	A1A, A2A, A5A, A6A, A7A, A8A, A9A, A10A, A11A, A13A, A14A, A15A, A19A, A20A, A32A, A33A, A1K, A6K, A1M, A1N, B1A, B2A, B5A, B6A, B9A, B13A, B18A, B19A, B32A, B1K, B6K, B18K, B1M, B3M, B5M, B1N, B6N, D1A, D2A, D5A, D18A, D1K, D18K, D18P, E1A, E2A, E5A, E5E, F5A	A-193 Gr. B7 A-194 Gr. 2H
2	A16A, B16A	A-193 Gr. B7M A-194 Gr. 2HM
3	A1B, A1D, A4F, A4G, B1B, B1D, B5D, B1E, B3F, B4F, B4G, D1B, D2B, D1D, D2D, D5D, D5E, F2D	A1-193 Gr. B16 A-194 GR. 4
4	A2K, B2K, D2K	A-320 Gr. B8 CL.2 A-194 Gr. 8
5	A4A, A1H, B4A, B1H, D4A, D1H	A-320 Gr. L7 A-194 Gr. 4
6	A3Y	A-307 Gr. B A-563 Gr. B
7	A3A, A3K, A3Y, A4Y, J3A	A-307 Gr. B A-563 Gr. B
8	A1Z, A4Z, A5Y, A5Z, J2A, J5A	A-307 Gr. B (Galv) A-563 Gr. B (Galv)
9	B4K, B5K	A-193 Gr. B8 M C11 A-194 Gr. 8 MA
10	A32Y	A-193 Gr. B (Galv) A-194 Gr. 2H (Galv)
11	B3M, B4K, B5K, B5M	A-453 Gr. 660 CL.A A-453 Gr. 660 CL.A

1. The nuts and bolt material shall be applicable for loose supply of nuts and bolts.

Sr. No.	Piping Classes	Gasket Material
1	A1A, A6A, A9A, A10A, A11A, A13A, A14A, A19A, A1B, A1D, A1H, A1K, A1M, A4A, A4F, A4G, B1A, B1H, B2A, B4A, B6A, B9A, B13A, B18A, B19A, B32A, B18K, D1A, D2A, D1H, D1K, D4A, D18A, D18K, D18P	SP.WND SS316+GRAFIL+ I Ring
2	B5M	SP WND SS316H+ GRAFIL + I RING
3	A2K, B2K, D2K	SP WND SS 316+GRAFIL+SS 316 I/O RING
4	B1N	SP WND SS 316L+GRAFIL + I RING
5	B6N	SP WND SS 316L + GRAFIL
6	A1Z, A3Y, A4Y, A4Z, J2A	BUTYL RUBBER
7	E1A, E2A, E5A, F5A	SOFT IRON
8	E5E, F2D	5% CR, 0.5% MO
9	B4K, B5K	SS 316H+GRAFIL+I RING SS 316 O RING
10	A5Z	BS 7531 GR X (PTFE JACKETED)
11	A5Y, A8A, A15A, A32Y, A33Y	IS 2712 Gr. A/I
12	B3M	SP WND SS 321+GRAFIL+I RING
13	A1N, A6K, A16A, B16A	SP.WND SS316L+GRAFIL+ I Ring
14	A3A, A3K, A33A, J3A, J5A, A32A, A20A	NON ASBESTOS BS 7531 GR X
15	A2A	SP.WND SS316L+GRAFIL+ I Ring
16	B5A, D5A	SP.WND SS316L+GRAFIL+ I Ring
17	A7A, B1B, B1D, B1E, B1K, B3F, B4F, B4G, B5D, D1B, D1K, D2B, D1D, D2D, D5D, D5E	SP WND SS 316 + GRAFIL + I RING
18	B6K, B1M	SS 316 + GRAFIL

1. The gaskets material shall be applicable for loose supply of gaskets.

ORIFICE PLATE AND HOLDER FOR FLANGE SIZE  $\leq 3"$



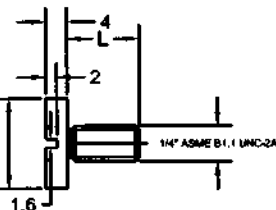
NOTES:-

1. FOR BI-DIRECTIONAL FLOW ELEMENTS BEVELLING SHALL NOT BE PROVIDED. RESTRICTIONS ORIFICE PLATES SHALL NOT BE BEVELED AND THEY SHALL NOT HAVE WEEPHOLES.

1	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
0	19-02-16	ISSUED AS STANDARD	Manoj / RS	MN	RG	SC
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						

ORIFICE PLATE AND HOLDER FOR FLANGE SIZE  $\geq 4"$

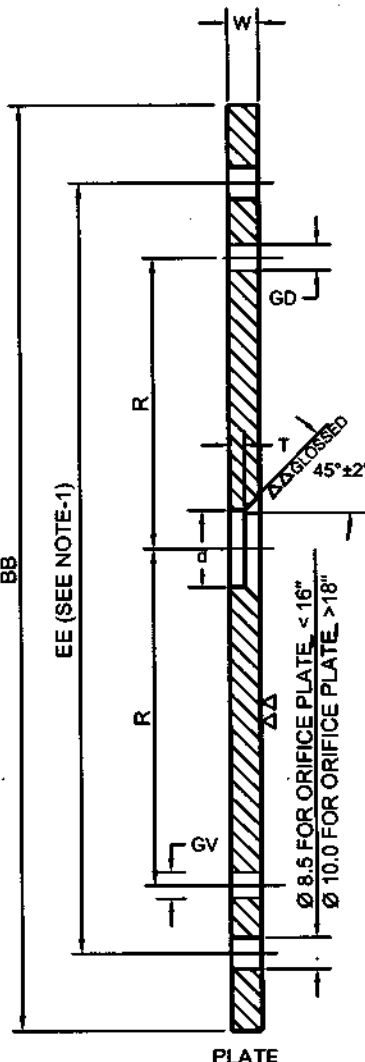
Ø 12.7 FOR ORIFICE PLATE ONLY  $< 18"$   
Ø 15.9 FOR ORIFICE PLATE ONLY  $> 18"$



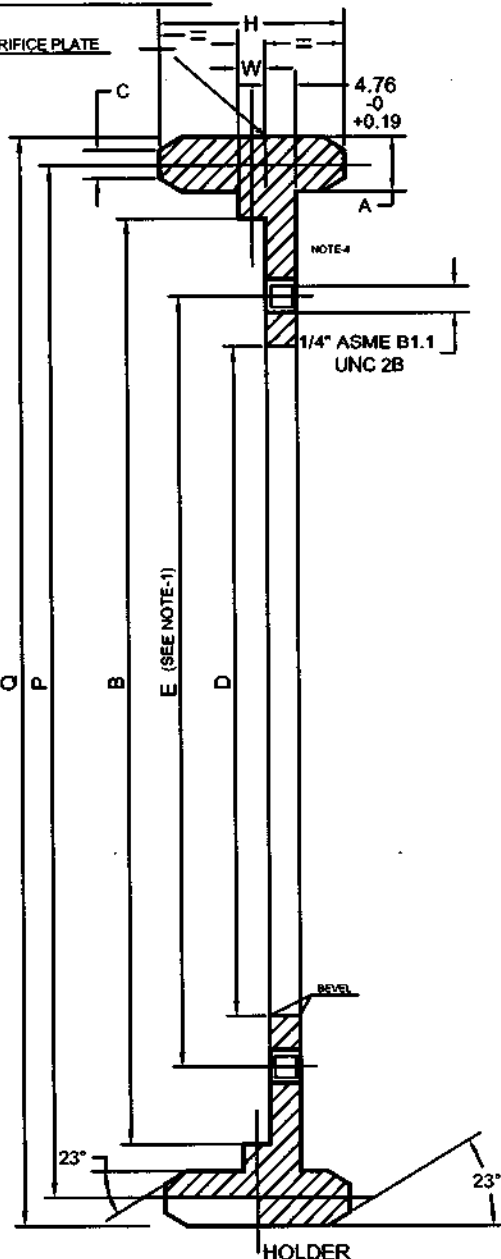
LOCK SCREW DETAIL

W	L
	-0 +0.2
3.18	7.9
6.35	11.1
9.52	14.3
12.7	17.5

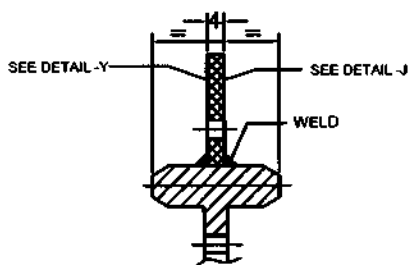
SEE DETAIL OF IDENTIFICATION NAMEPLATE FOR ORIFICE PLATE



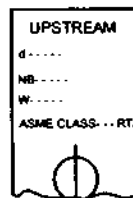
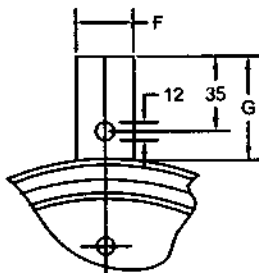
PLATE



HOLDER

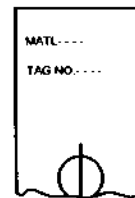


DETAIL OF IDENTIFICATION NAMEPLATE



DETAIL - Y

NAME PLATE INFORMATION



DETAIL - J

NOTES:-

- THE NUMBER OF HOLES AND LOCK SCREWS FOR PLATE SHALL BE  
4 FOR LINE SIZES 4-8 INCH  
8 FOR LINE SIZES 10-16 INCH  
12 FOR LINE SIZES 18-24 INCH  
THESE SHALL BE EQUALLY SPACED FROM CENTER OF ANY VENT/DRAIN HOLE.
- ON ASSEMBLY OF PLATE & HOLDER A DEVIATION OF  $\pm 0.2\text{mm}$  IS ALLOWED BETWEEN CENTRES OF 'Q' AND 'P'.
- FOR BI-DIRECTIONAL FLOW ELEMENTS BEVELLING SHALL NOT BE PROVIDED. RESTRICTIONS ORIFICE PLATES SHALL NOT BE BEVELED AND THEY SHALL NOT HAVE WEEPHOLES.
- MOC OF RTJ HOLDER SHALL BE AS PER DATA SHEET ENSURING HARDNESS OF THE HOLDER SHALL BE 20 BHN LESSER THAN THE FLANGE HARDNESS.  
ADDITIONAL 1 NO. BLIND RTJ HOLDER SHALL BE PROVIDED AS SPARE WITH EACH ORIFICE TAG.

1	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
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					Approved by	

ORIFICE PLATE DIMENSIONS

d		
FROM	TO	TOLER.
<6.350		0.007
6.350	9.525	0.013
9.526	12.700	0.015
12.701	15.875	0.020
15.876	19.050	0.023
19.051	22.225	0.025
22.226	25.400	0.030
25.401	31.750	0.036
31.751	38.100	0.043
38.101	44.450	0.051
44.451	127.000	0.064
>127.000		0.0005 x d

GD/GV		
FOR d		TOLER.
FROM	TO	+0.05
<25.400	-	-
25.400	88.900	2.38
88.901	104.775	3.18
104.776	127.000	3.97
127.001	152.400	4.76
152.401	171.450	5.56
171.451	190.500	6.35
190.501	212.725	7.14
212.726	234.950	7.94
234.951	254.000	8.73
254.001	276.225	9.53
276.226	295.275	10.32
295.276	317.500	11.11
317.501	336.550	11.91
>336.550	-	12.70

NOTE

1. ALL DIMENSIONS ARE IN MM

2. d= ORIFICE BORE DIAMETER , D= INTERNAL DIAMETER OF PIPE

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Approved by						

**ORIFICE PLATE AND HOLDER DIMENSIONAL DETAILS FOR FLANGE SIZE ≤ 3"**

RING & GROOVE NO.	ASME				P	A	C	Q	H	R +0.2 -0.4
	SIZE (INCH) & RATING									
	600	900	1500	2500						
R 16	1	-	1	-	50.8	7.94	5.23	58.7	25.4	$R=\frac{(D-GD)}{2}$
R 18	-	-	-	1	60.3	7.94	5.23	68.3	25.4	
R 20	1 1/2	-	1 1/2	-	68.3	7.94	5.23	76.2	25.4	
R 23	2	-	-	1 1/2	82.6	11.11	7.75	93.7	26.9	$R=\frac{(D-GV)}{2}$
R 24	-	-	2	-	95.3	11.11	7.75	106.4	26.9	
R 26	-	-	-	2	101.6	11.11	7.75	112.7	26.9	
R 31	3	3	-	-	123.8	11.11	7.75	134.9	26.9	
R 32	-	-	-	3	127.0	12.7	8.66	139.7	30.2	
R 35	-	-	3	-	136.5	11.11	7.75	147.6	26.9	

RING & GROOVE NO.	ASME				W		T (NOTE-2,3)		F	G			
	SIZE (INCH) & RATING				TOL +0.12 TOL -0.25	TOL ±0.25	TOL + 0 TOL -0.25	-0, +5					
	600	900	1500	2500	≤315°C	>315°C	≤315°C	>315°C		±0.40	600	900	1500
R 16	1	-	1	-	3.18	6.35	0.51	NOTE-3	30	88	-	100	-
R 18	-	-	-	1	3.18	6.35	0.51	NOTE-3	30	-	-	-	100
R 20	1 1/2	-	1 1/2	-	3.18	6.35	0.76	NOTE-3	30	88	-	100	-
R 23	2	-	-	1 1/2	3.18	6.35	0.79 FOR 2" 0.76 FOR 1.5"	NOTE-3	30	88	-	-	114 FOR 2" 100 FOR 1.5"
R 24	-	-	2	-	3.18	6.35	0.79	NOTE-3	30	-	-	100	-
R 26	-	-	-	2	3.18	6.35	0.79	NOTE-3	30	-	-	-	114
R 31	3	3	-	-	3.18	6.35	0.79	NOTE-3	30	88	100	-	-
R 32	-	-	-	3	3.18	6.35	0.79	NOTE-3	30	-	-	-	114
R 35	-	-	3	-	3.18	6.35	0.79	NOTE-3	30	-	-	114	-

**NOTE**  
1. ALL DIMENSIONS ARE IN MM  
2. FOR BIDIRECTIONAL FLOW BEVELLING SHALL NOT BE PROVIDED.  
3. VALUES OF T SHOWN IN THIS STANDARD ARE VALID FOR THE CORRESPONDING "W" AND "D" (BETA) BETWEEN 0.25 AND 0.70 INCLUSIVE.  
WHEN THE VALUES ARE NOT SHOWN AND FOR BETA <0.25 AND >0.70, "T" SHALL BE CALCULATED EVERY TIME AND SHALL NOT BE HIGHER THAN THE SMALLER OF THE VALUES RESULTING FROM THE RATIOS, D/8, D/50, (D-Q)/8

1	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SC
0	19-02-16	ISSUED AS STANDARD	Manoj / RS	MN	RG	SC
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Approved by						

**ORIFICE PLATE AND HOLDER DIMENSIONAL DETAILS FOR FLANGE SIZE  $\geq 4"$**

RING & GROOVE NO.	ASME SIZE (INCH) & RATING				P	A	C		Q	H	R +0.2 - 0.4	
	600	900	1500	2500			+ 0.18	+ 0.20				+ 0.20
R 37	4	4	-	-	149.2	11.11	7.75	7.75	160.3	26.9	$R=\frac{(D-GD)}{2}$ $R=\frac{(D-GV)}{2}$	
R 38	-	-	-	4	157.2	15.88	10.49	10.49	173.1	33.3		
R 39	-	-	4	-	161.9	11.11	7.75	7.75	173.0	26.9		
R 45	6	6	-	-	211.1	11.11	7.75	7.75	222.2	26.9		
R 46	-	-	6	-	211.1	12.70	8.66	8.66	223.8	28.5		
R 47	-	-	-	6	228.6	19.05	12.32	12.32	247.7	36.6		
R 49	8	8	-	-	269.9	11.11	7.75	7.75	281.0	26.9		
R 50	-	-	8	-	269.9	15.88	10.49	10.49	285.8	33.3		
R 51	-	-	-	8	279.4	22.22	14.81	14.81	301.6	39.6		
R 53	10	10	-	-	323.9	11.11	7.75	7.75	335.0	26.9		
R 54	-	-	10	-	323.9	15.88	10.49	10.49	339.8	33.3		
R 55	-	-	-	10	342.9	28.58	19.81	19.81	371.5	47.8		
R 57	12	12	-	-	381.0	11.11	7.75	7.75	392.1	26.9		
R 58	-	-	12	-	381.0	22.23	14.81	14.81	403.2	39.6		
R 60	-	-	-	12	406.4	31.75	22.33	22.33	438.2	50.8		

**NOTE**

1. ALL DIMENSIONS ARE IN MM

1	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
0	19-02-16	ISSUED AS STANDARD	Manoj / RS	MN	RG	SC
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman
Approved by						



**ORIFICE PLATE AND HOLDER DIMENSIONAL DETAILS FOR FLANGE SIZE  $\geq 4$ "**

RING & GROOVE NO.	ASME				W	T (NOTE 2,3)	B	BB	E	EE	F	G -0, +5					
	SIZE (INCH) & RATING											CLASS					
	600	900	1500	2500								600	900	1500	2500		
					TOL. +0.015 TOL. -0.015	TOL. +0.015 TOL. -0.015	TOL. +0.015 TOL. -0.015	TOL. +0.015 TOL. -0.015									
R 37	4	4	-	-	3.18	6.35	1.59	NOTE 3	138.1	136.5	120.7	119.4	40	100	100	-	-
R 38	-	-	-	4	3.18	6.35	1.59	NOTE 3	134.9	133.4	117.5	116.3	40	-	-	-	127
R 39	-	-	4	-	3.18	6.35	1.59	NOTE 3	144.5	142.9	127.0	125.8	40	-	-	114	-
R 45	6	6	-	-	3.18	6.35	1.59	NOTE 3	193.7	192.1	176.2	175.0	40	100	114	-	-
R 46	-	-	6	-	3.18	6.35	1.59	NOTE 3	192.1	190.5	174.6	173.4	40	-	-	114	-
R 47	-	-	-	6	3.18	6.35	1.59	NOTE 3	203.2	200.0	184.2	182.9	40	-	-	-	158
R 49	8	8	-	-	6.35	9.52	3.18	NOTE 3	252.4	249.2	233.4	232.1	40	114	114	-	-
R 50	-	-	8	-	6.35	9.52	3.18	NOTE 3	247.7	244.5	228.6	227.4	40	-	-	127	-
R 51	-	-	-	8	6.35	9.52	3.18	NOTE 3	250.8	247.7	231.8	230.6	40	-	-	-	158
R 53	10	10	-	-	6.35	9.52	3.18	NOTE 3	306.4	303.2	287.3	286.1	40	114	114	-	-
R 54	-	-	10	-	6.35	9.52	3.18	NOTE 3	301.6	298.5	282.6	281.4	40	-	-	140	-
R 55	-	-	-	10	6.35	9.52	3.18	NOTE 3	308.8	304.8	288.9	287.7	40	-	-	-	165
R 57	12	12	-	-	6.35	9.52	3.18	NOTE 3	363.5	360.4	344.5	343.3	40	114	114	-	-
R 58	-	-	12	-	6.35	9.52	3.18	NOTE 3	352.4	349.3	333.4	332.2	40	-	-	140	-
R 60	-	-	-	12	6.35	9.52	3.18	NOTE 3	368.3	365.1	349.3	348.0	40	-	-	-	177

**NOTE**

1. ALL DIMENSIONS ARE IN MM
2. FOR BIDIRECTIONAL FLOW, BEVELLING SHALL NOT BE PROVIDED.
3. VALUES OF 'T' SHOWN IN THIS STANDARD ARE VALID FOR THE CORRESPONDING 'W' AND 'D' (BETA) BETWEEN 0.25 AND 0.70 INCLUSIVE. WHEN THE VALUES ARE NOT SHOWN AND FOR BETA  $< 0.25$  AND  $> 0.70$ , 'T' SHALL BE CALCULATED EVERY TIME AND SHALL NOT BE HIGHER THAN THE VALUES RESULTING FROM THE RATIOS,  $D/50$ ,  $(D-d)/8$

1	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
0	19-02-16	ISSUED AS STANDARD	Manoj / RS	MN	RG	SC
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						

**ORIFICE PLATE AND HOLDER DIMENSIONAL DETAILS FOR FLANGE SIZE  $\geq 4"$**

RING & GROOVE NO.	ASME				P	A	C	Q	H	R + 0.2 - 0.4
	SIZE (INCH) & RATING									
	600	900	1500	2500						
R 61	14	-	-	-	419.1	11.12	7.75	430.2	26.9	$R = \frac{(D-GD)}{2}$ $R = \frac{(D-GV)}{2}$
R 62	-	14	-	-	419.1	15.88	10.49	435.0	33.2	
R 63	-	-	14	-	419.1	25.40	17.30	444.5	44.4	
R 65	16	-	-	-	469.9	11.12	7.75	481.0	30.2	
R 66	-	16	-	-	469.9	15.88	10.49	485.8	36.5	
R 67	-	-	16	-	469.9	28.58	19.81	498.5	50.8	
R 69	18	-	-	-	533.4	11.12	7.75	544.5	30.2	
R 70	-	18	-	-	533.4	19.05	12.32	552.5	39.6	
R 71	-	-	18	-	533.4	28.58	19.81	562.0	50.8	
R 73	20	-	-	-	584.2	12.70	8.66	596.9	31.8	
R 74	-	20	-	-	584.2	19.05	12.32	603.3	39.6	
R 75	-	-	20	-	584.2	31.75	22.33	616.0	53.8	
R 77	24	-	-	-	692.2	15.88	10.49	708.1	36.5	
R 78	-	24	-	-	692.2	25.40	17.30	717.6	47.8	
R 79	-	-	24	-	692.2	34.93	24.82	727.1	58.7	

**NOTE**

1. ALL DIMENSIONS ARE IN MM

1	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
0	19-02-16	ISSUED AS STANDARD	Manoj / RS	MN	RG	SC
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Approved by						

ORIFICE PLATE AND HOLDER DIMENSIONAL DETAILS FOR FLANGE SIZE  $\geq 4"$

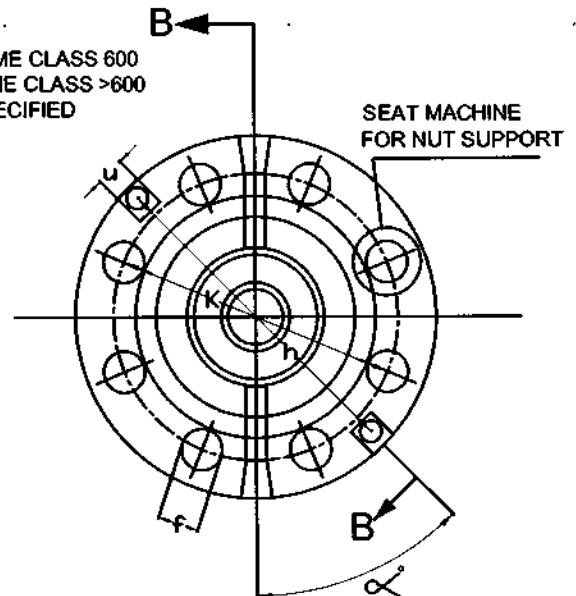
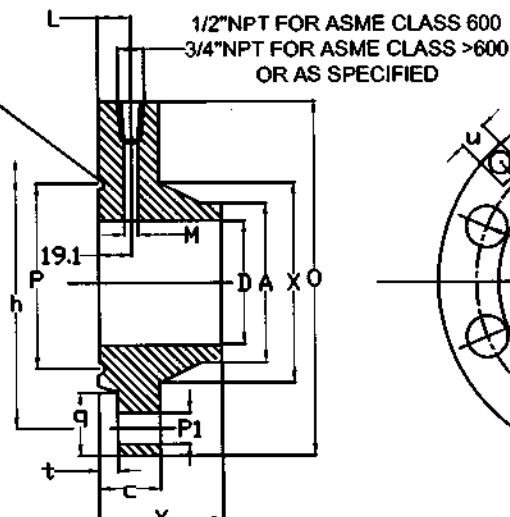
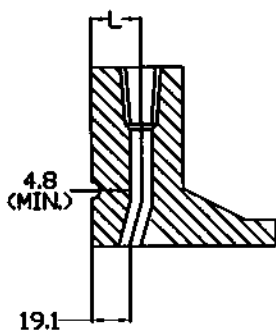
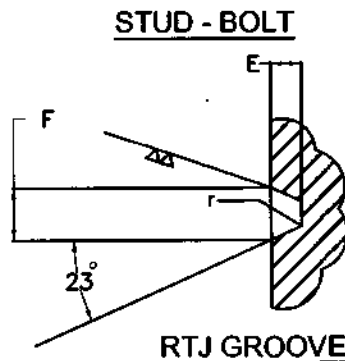
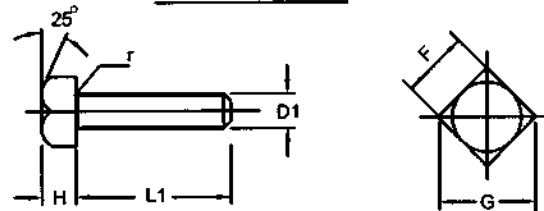
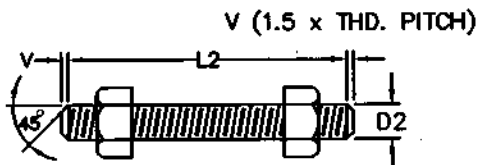
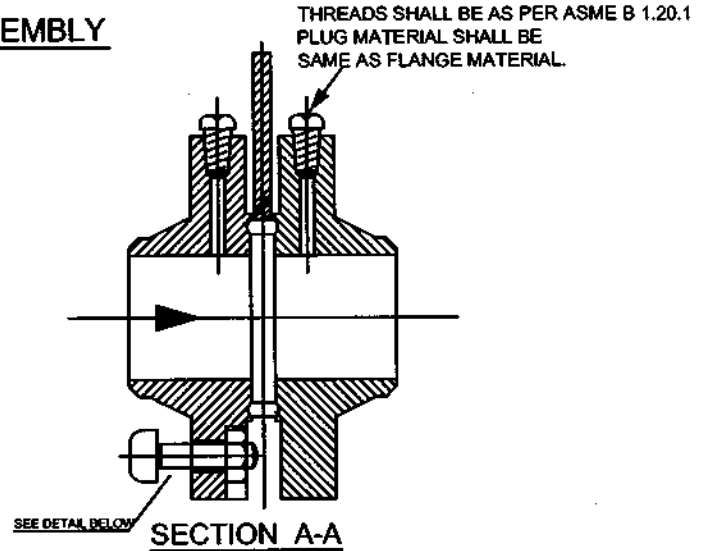
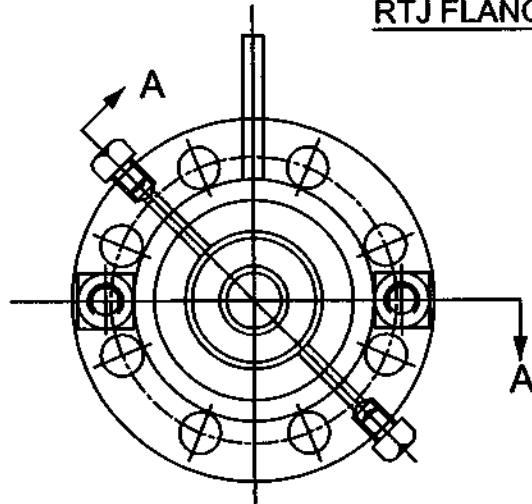
RING & GROOVE NO.	ASME				W		T (NOTE 2,3)		B	BB	E	EE	F	G -0, +5			
	SIZE (INCH) & RATING				TOL -0.025		TOL -0.025		-0	+0	-0	+0	$\pm 0.40$	SIZE (INCH) & RATING			
	600	900	1500	2500	±0.150	±0.150	±0.150	±0.150						600	900	1500	2500
R 61	14	-	-	-	6.35	9.52	3.18	NOTE 3	401.6	398.5	382.5	381.0	50	114	-	-	-
R 62	-	14	-	-	6.35	9.52	3.18	NOTE 3	398.9	393.7	377.8	376.6	50	-	127	-	-
R 63	-	-	14	-	6.35	9.52	3.18	NOTE 3	387.4	384.2	368.3	367.1	50	-	-	152	-
R 65	16	-	-	-	6.35	9.52	6.35	NOTE 3	452.4	449.3	433.4	432.2	50	127	-	-	-
R 66	-	16	-	-	6.35	9.52	6.35	NOTE 3	447.7	444.5	428.6	427.4	50	-	127	-	-
R 67	-	-	16	-	6.35	9.52	6.35	NOTE 3	435.0	431.8	415.9	414.7	50	-	-	152	-
R 69	18	-	-	-	9.52	12.7	9.52	NOTE 3	515.9	512.8	490.5	487.8	50	127	-	-	-
R 70	-	18	-	-	9.52	12.7	9.52	NOTE 3	508.0	504.8	482.6	479.8	50	-	140	-	-
R 71	-	-	18	-	9.52	12.7	9.52	NOTE 3	498.5	495.3	473.1	470.3	50	-	-	177	-
R 73	20	-	-	-	9.52	12.7	9.52	NOTE 3	565.2	560.4	538.2	535.4	50	127	-	-	-
R 74	-	20	-	-	9.52	12.7	9.52	NOTE 3	558.8	554.0	531.8	529.0	50	-	140	-	-
R 75	-	-	20	-	9.52	12.7	9.52	NOTE 3	546.1	541.3	519.1	516.0	50	-	-	177	-
R 77	24	-	-	-	9.52	12.7	9.52	NOTE 3	669.9	665.2	642.9	640.7	50	140	-	-	-
R 78	-	24	-	-	9.52	12.7	9.52	NOTE 3	660.4	655.6	633.4	630.6	50	-	165	-	-
R 79	-	-	24	-	9.52	12.7	9.52	NOTE 3	650.9	646.1	623.9	621.1	50	-	-	203	-

NOTE

1. ALL DIMENSIONS ARE IN MM
2. FOR BIDIRECTIONAL FLOW BEVELLING SHALL NOT BE PROVIDED.
3. VALUES OF 'T' SHOWN IN THIS STANDARD ARE VALID FOR THE CORRESPONDING 'W' AND 'DD' (BETA) BETWEEN 0.25 AND 0.70 INCLUSIVE. WHEN THE VALUES ARE NOT SHOWN AND FOR BETA  $< 0.25$  AND  $> 0.70$ , 'T' SHALL BE CALCULATED EVERY TIME AND SHALL NOT BE HIGHER THAN THE SMALLER OF THE VALUES RESULTING FROM THE RATIOS,  $d/B$ ,  $D/50$ ,  $(D-d)/8$

1	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SC
0	19-02-16	ISSUED AS STANDARD	Manoj / RS	MN	RG	SC
Rev. No.	Date	Purpose	Prepared by	Checked by	Sds. Committee Convenor	Sds. Bureau Chairman
Approved by						

**RTJ FLANGE ASSEMBLY**



**RTJ FLANGE DIMENSIONS**

**NOTES:**

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

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Approved by						

ORIFICE PLATES AND FLANGES  
DIMENSIONAL  
DETAILS  
RTJ FLANGES

STANDARD No.

7-52-0042 Rev. 1

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RTJ ORIFICE FLANGE DIMENSIONS (IN mm)

ASME SIZE (INCH) & RATING	A	X	O	K	C	Y	f	NO. OF HOLES	M	L	h	P1	t	q	u	∠
600	1	33.5	54	124	88.9	44.9	88.9	19.1	6.4	19.1	102.2	12.7	9.6	21.8	19.1	82°30'
	1.5	48.3	69.9	155.5	114.3	44.9	92.1	22.4	6.4	19.1	134.2	12.7	9.6	21.8	19.1	82°30'
	2	60.5	84.1	165.1	127	46.5	93.7	19.1	6.4	19.1	141.2	14.3	11.2	23.8	20.6	45°
	3	88.9	117.4	209.6	168.1	46.5	96.9	22.4	9.5	19.1	186.2	14.3	11.2	23.8	20.6	45°
	4	114.3	152.4	273.1	215.9	46.5	109.6	25.4	12.7	19.1	234.7	22.2	19.3	38.3	33.3	45°
	6	168.4	222.3	355.6	292.1	56	125.4	28.5	12.7	19.1	312.2	25.4	22.5	43.8	38.1	60°
	8	219.2	273.1	419.1	349.3	64	141.3	31.8	12.7	19.1	375.2	25.4	22.5	43.8	38.1	60°
	10	273.1	342.9	508	431.8	71.5	160.4	35.1	12.7	19.1	466.2	25.4	22.5	43.8	38.1	67°30'
	12	323.9	400.1	558.8	489	75	163.6	35.1	12.7	19.1	516.2	25.4	22.5	43.8	38.1	72°
	14	355.6	431.8	603.3	527.1	78	173.1	38.1	12.7	19.1	561.2	25.4	22.5	43.8	38.1	72°
	16	406.4	495.3	685.8	603.3	84.5	185.8	41.2	12.7	19.1	635.7	28.6	25.7	49.3	42.9	72°
	18	457.2	546.1	743	654.1	91	192.1	44.5	12.7	19.1	695.7	28.6	25.7	49.3	42.9	72°
	20	508	609.6	812.2	723.9	98.6	200.1	44.5	12.7	25.4	765.7	28.6	25.7	49.3	42.9	75°
	24	609.6	717.6	939.8	838.2	112.7	214.3	50.8	12.7	25.4	890.7	28.6	25.7	49.3	42.9	75°

1	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
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Rev. No.	Date	Purpose	Prepared by	Checked by	Sds. Committee Convenor	Sds. Bureau Chairman
Approved by						

**ORIFICE PLATES AND FLANGES**  
**DIMENSIONAL**  
**DETAILS**  
**RTJ FLANGES**

STANDARD No.

7-52-0042 Rev. 1

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**RTJ ORIFICE FLANGE DIMENSIONS (IN mm)**

ASME SIZE (INCH) & RATING	A	X	O	K	C	Y	f	NO OF HOLES	M	L	h	P1	t	q	u	α
900	3	88.9	127	241.3	190.5	46.5	109.6	25.4	9.5	19.1	206.2	19.2	16	32.8	28.6	45°
	4	114.3	158.8	292.1	235	52.5	122.3	31.8	12.7	19.1	253.7	22.2	19.3	38.3	33.3	45°
	6	168.4	235	381	317.5	64	147.7	31.8	12.7	19.1	337.2	25.4	22.5	43.8	38.1	60°
	8	219.2	298.5	469.9	393.7	71.5	169.9	38.1	12.7	19.1	420.7	28.6	25.7	49.3	42.9	60°
	10	273.1	368.3	546.1	469.9	78	192.1	38.1	12.7	19.1	495.7	28.6	25.7	49.3	42.9	67°30'
	12	323.9	419.1	609.6	533.4	87.5	208	38.1	12.7	19.1	560.7	28.6	25.7	49.3	42.9	72°
	14	355.6	450.9	641.4	558.8	97	223.8	41.2	12.7	25.4	590.7	28.6	25.7	49.3	42.9	72°
	16	406.4	508	704.9	616	100	227	44.5	12.7	25.4	655.7	28.6	25.7	49.3	42.9	72°
	18	457.2	565.2	787.4	685.8	114.6	241.2	50.8	12.7	25.4	730.2	31.8	28.9	54.8	47.6	72°
	20	508	622.3	857.3	749.3	120.6	260.3	53.9	12.7	25.4	800.2	31.8	28.9	54.8	47.6	72°
	24	609.6	749.3	1041.4	901.7	155.9	307.9	66.6	12.7	25.4	985.2	31.8	28.9	54.8	47.6	72°

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ORIFICE PLATES AND FLANGES  
DIMENSIONAL  
DETAILS  
RTJ FLANGES

STANDARD No.

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RTJ ORIFICE FLANGE DIMENSIONS (IN mm)

ASME SIZE (INCH) & RATING	A	X	O	K	C	Y	f	NO OF HOLES	M	L	h	P1	t	q	u	α
1500	33.5	52.4	149.2	101.6	44.9	88.9	25.4	4	6.4	19.1	116.2	19.1	16	32.8	28.6	82°30'
1.5	48.3	69.9	177.8	124	44.9	95.3	28.5	4	6.4	19.1	145.2	19.1	16	32.8	28.6	82°30'
2	60.5	104.8	215.9	165.1	46.5	109.6	25.4	8	6.4	19.1	183.2	19.1	16	32.8	28.6	45°
3	88.9	133.4	266.7	203.2	56	125.5	31.8	8	9.5	19.1	228.7	22.2	19.3	38.3	33.3	45°
4	114.3	162.1	311.2	241.3	62	131.8	35.1	8	12.7	19.1	272.7	22.2	19.3	38.3	33.3	45°
6	168.4	228.6	393.7	317.5	92.6	181	38.1	12	12.7	19.1	350.2	25.4	22.5	43.8	38.1	60°
8	219.2	292.1	482.6	393.7	103.5	223.8	44.5	12	12.7	25.4	433.7	28.6	25.7	49.3	42.9	60°
10	273.1	368.3	584.2	482.6	119	265	50.8	12	12.7	25.4	535.7	28.6	25.7	49.3	42.9	60°
12	323.9	450.9	673.1	571.5	138.2	296.8	53.9	16	12.7	25.4	625.7	28.6	25.7	49.3	42.9	67°30'
14	355.6	495.3	749.3	635	149.3	314.3	60.5	16	12.7	28.6	695.2	31.8	28.9	54.8	47.6	67°30'
16	406.4	552.5	825.5	704.9	163.9	328.6	66.6	16	12.7	28.6	764.8	34.9	31.8	60.2	52.4	67°30'
18	457.2	596.1	914.4	774.7	179.4	344.5	73.2	16	12.7	28.6	854.8	34.9	31.8	60.2	52.4	67°30'
20	508	641.4	984.3	831.9	195.4	373	79.3	16	12.7	28.6	924.8	34.9	31.8	60.2	52.4	67°30'
24	609.6	762	1168.4	990.6	224	426.9	92	16	12.7	31.8	1109.8	34.9	31.8	60.2	52.4	67°30'

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Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						

ORIFICE PLATES AND FLANGES  
DIMENSIONAL  
DETAILS  
RTJ FLANGES

STANDARD No.

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RTJ ORIFICE FLANGE DIMENSIONS (IN mm)

ASME SIZE (INCH) & RATING	A	X	O	K	C	Y	f	NO OF HOLES	M	L	h	P1	t	q	u	Ø
2500	33.5	57.2	158.8	108	44.9	98.5	25.4	4	6.4	19.1	120.7	22.2	19.3	38.3	33.3	82°30'
1.5	48.3	79.3	203.2	146.1	52.5	119.1	31.8	4	6.4	19.1	154.7	22.2	19.3	38.3	33.3	82°30'
2	60.5	95.3	235	171.5	60.6	136.6	28.5	8	6.4	19.1	196.7	22.2	19.3	38.3	33.3	45°
3	88.9	133.4	304.8	228.6	76.7	177.9	35.1	8	9.5	19.1	255.7	28.6	25.7	49.3	42.9	45°
4	114.3	165.1	355.6	273.1	87.5	201.5	41.2	8	12.7	25.4	306.7	28.6	25.7	49.3	42.9	45°
6	168.4	235	482.6	368.3	120.6	285.7	53.9	8	12.7	25.4	422.8	34.9	31.8	60.2	52.4	45°
8	219.2	304.8	552.5	438.2	141.2	331.7	53.9	12	12.7	25.4	489.8	34.9	31.8	60.2	52.4	60°
10	273.1	374.7	673.1	539.8	182.9	436.5	66.6	12	12.7	28.6	603.8	41.3	38.2	71.2	61.9	60°
12	323.9	441.5	762	619.3	201.9	480.9	73.2	12	12.7	28.6	688.8	41.3	38.2	71.2	61.9	60°

1	12-02-21	REVISED & REISSUED	Manoj	JJ	MN	SM
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Approved by						



RTJ GROOVE DETAILS

ASME SIZE (INCH) & RATING		P	E	F	r(max)	GROOVE NO.
600	1	50.8	6.4	8.7	0.8	R 16
	1.5	68.3	6.4	8.7	0.8	R 20
	2	82.6	7.9	11.9	0.8	R 23
	3	123.8	7.9	11.9	0.8	R 31
	4	149.2	7.9	11.9	0.8	R 37
	6	211.1	7.9	11.9	0.8	R 45
	8	269.9	7.9	11.9	0.8	R 49
	10	323.9	7.9	11.9	0.8	R 53
	12	381	7.9	11.9	0.8	R 57
	14	419.1	7.9	11.9	0.8	R 61
	16	469.9	7.9	11.9	0.8	R 65
	18	533.4	7.9	11.9	0.8	R 69
	20	584.2	9.5	13.5	1.5	R 73
	24	692.2	11.1	16.7	1.5	R 77
900	3	123.8	7.9	11.9	0.8	R 31
	4	149.2	7.9	11.9	0.8	R 37
	6	211.1	7.9	11.9	0.8	R 45
	8	269.9	7.9	11.9	0.8	R 49
	10	323.9	7.9	11.9	0.8	R 53
	12	381	7.9	11.9	0.8	R 57
	14	419.1	11.1	16.7	1.5	R 62
	16	469.9	11.1	16.7	1.5	R 66
	18	533.4	12.7	19.8	1.5	R 70
	20	584.2	12.7	19.8	1.5	R 74
	24	692.2	15.9	27	2.3	R 78

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RTJ GROOVE DETAILS

ASME SIZE (INCH) & RATING		P	E	F	r(max)	GROOVE NO.
1500	1	50.8	6.4	8.7	0.8	R 16
	1.5	68.3	6.4	8.7	0.8	R 20
	2	95.3	7.9	11.9	0.8	R 24
	3	136.5	7.9	11.9	0.8	R 35
	4	161.9	7.9	11.9	0.8	R 39
	6	211.1	9.5	13.5	1.5	R 46
	8	269.9	11.1	16.7	1.5	R 50
	10	323.9	11.1	16.7	1.5	R 54
	12	381	14.3	20.5	1.5	R 58
	14	419.1	15.9	27	2.3	R 63
	16	469.9	17.5	30.2	2.3	R 67
	18	533.4	17.5	30.2	2.3	R 71
	20	584.2	17.5	33.3	2.3	R 75
	24	692.2	20.6	36.5	2.3	R 79
2500	1	60.3	6.4	8.7	0.8	R 18
	1.5	82.6	7.9	11.9	0.8	R 23
	2	101.6	7.9	11.9	0.8	R 26
	3	127	9.5	13.5	1.5	R 32
	4	157.2	11.1	16.7	1.5	R 38
	6	228.6	12.7	19.8	1.5	R 47
	8	279.6	14.3	23	1.5	R 51
	10	342.9	17.5	30.2	2.3	R 55
	12	406.4	17.5	33.3	2.3	R 60

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

DIMENSIONS mm (Inches)		TOLERANCES (Inches)
O	$\leq 609.6$ mm	$\pm 1.59$ *
	$> 609.6$ mm	$\pm 3.18$ *
C	NB $\leq 450$ (18)	$+ 3.18$ $- 0$
	NB $> 450$ (18)	$+ 4.76$ $- 0$
X	$\leq 609.6$ mm	$\pm 1.59$ *
	$> 609.6$ mm	$\pm 3.18$ *
A	NB $\leq 125$ (4)	$+ 2.38$ $- 0.79$
	NB $\geq 150$ (6)	$+ 3.96$ $- 0.79$
Y	NB $\leq 250$ (10)	$\pm 1.59$
	NB $\geq 300$ (12)	$\pm 3.18$
DRILLING	K	$\pm 1.59$
	CENTRES BETWEEN HOLES	$\pm 0.79$
R	FOR GV/GD $< 6.35$ mm	$\pm 0.40$
	FOR GV/GD $\geq 6.35$ mm	$\pm 0.79$
ECCENTRICITY BETWEEN K AND R DIAMETERS		$\pm 0.79$
ECCENTRICITY BETWEEN K AND D DIAMETERS		$\pm 0.79$ *
ECCENTRICITY BETWEEN R AND D DIAMETERS		$\pm 0.79$ *
D	NB $\leq 150$ (6)	$\pm 0.12$ *
	NB 200 & 250 (8 & 10)	$+ 0.12$ $- 0.25$ *
	NB 300 (12)	$+ 0.12$ $- 0.38$ *
	NB 350 & 400 (14 & 16)	$+ 0.12$ $- 0.50$ *
	NB $\geq 450$ (18)	$+ 0.12$ $- 0.76$ *
L	NPS $\leq 4$	$\pm 0.5$
	NPS $> 4$	$\pm 0.8$
t		(-) 0 (*) $\pm 0.4$
E		$\pm 0.4$ (-) 0
F		$\pm 0.20$

\* NOT COVERED BY ASME B16.5

**WELD NECK RTJ ORIFICE FLANGES**

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JACK SCREW DIMENSIONS

ASME SIZE (INCH) & RATING	D1-DIAMETER (inches) AND L1-LENGTH (mm)							
	600		900		1500		2500	
	D1	L1	D1	L1	D1	L1	D1	L1
1	3/8	95	-	-	5/8	110	3/4	115
1 1/2	3/8	95	-	-	5/8	110	3/4	120
2	7/16	100	-	-	5/8	110	3/4	120
3	7/16	100	5/8	110	3/4	120	1	160
4	3/4	115	3/4	120	3/4	135	1	170
6	7/8	135	7/8	140	7/8	165	1 1/4	220
8	7/8	140	1	160	1	185	1 1/4	250
10	7/8	150	1	165	1	210	1 1/2	305
12	7/8	150	1	170	1	235	1 1/2	330
14	7/8	160	1	190	1 1/8	250	-	-
16	1	170	1	190	1 1/4	275	-	-
18	1	185	1 1/8	220	1 1/4	295	-	-
20	1	190	1 1/8	230	1 1/4	320	-	-
24	1	210	1 1/8	265	1 1/4	350	-	-

D1	F	G(max)	G(min)	H	r(max)
3/8	14.3	20.2	19	6.4	0.8
7/16	15.9	22.5	21	7.4	0.8
5/8	23.8	33.7	31.6	10.7	1.5
3/4	28.6	40.4	37.9	12.7	1.5
7/8	33.3	47.1	44.2	15.1	1.5
1	38.1	53.9	50.6	16.7	2.3
1 1/8	42.9	60.6	56.9	19.1	2.3
1 1/4	47.6	67.4	63.2	21.4	2.3
1 1/2	57.2	80.8	75.8	25.4	2.3

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**STUD BOLT DETAILS FOR RTJ FLANGES**

D2 mm(Inches)	THREAD	PITCH	V	2V *
15.9 (5/8)	UNC	2.309	3.46	7
19.0 (3/4)		2.54	3.78	7.5
22.2 (7/8)		2.822	4.23	8.5
25.4 (1)		3.175	4.76	9.5
≥ 28.6 (1 1/8)	8 UN	3.175	4.76	9.5

\* APPROXIMATE VALUE OF THE TWO BEVELS

(ALL RATING AS PER ASME CLASS)

DIAMETER (NB,D2) mm (INCHES) & LENGTH-(L2) IN mm ( NOTE-1 )									
RATING		600		900		1500		2500	
DIM.	N B	D2	L2	D2	L2	D2	L2	D2	L2
25	(1)	15.9 (5/8)	139.7	-	-	22.2 (7/8)	158.75	22.2 (7/8)	158.8
40	(1 1/2)	19.0 (3/4)	139.7	-	-	25.4 (1)	165.1	28.6 (1 1/8)	190.5
50	(2)	15.9 (5/8)	139.7	-	-	22.2 (7/8)	165.1	25.4 (1)	196.9
80	(3)	19.0 (3/4)	146.1	22.2 (7/8)	165.1	28.6 (1 1/8)	184.2	31.8 (1 1/4)	241.3
100	(4)	22.2 (7/8)	165.1	28.6 (1 1/8)	190.5	31.7 (1 1/4)	216	38.1 (1 1/2)	273.1
150	(6)	25.4 (1)	190.5	28.6 (1 1/8)	209.6	34.9 (1 3/8)	279.4	50.8 (2)	368.3
200	(8)	28.6 (1 1/8)	209.6	34.9 (1 3/8)	241.3	41.3 (1 5/8)	311.2	50.8 (2)	406.4
250	(10)	31.7 (1 1/4)	235	34.9 (1 3/8)	254	47.6 (1 7/8)	355.6	63.5 (2 1/2)	514.4
300	(12)	31.7 (1 1/4)	241.3	34.9 (1 3/8)	273.1	50.8 (2)	400.1	69.9 (2 3/4)	571.5
350	(14)	34.9 (1 3/8)	254	38.1 (1 1/2)	292.1	57.1 (2 1/4)	445	-	-
400	(16)	38.1 (1 1/2)	273.1	41.3 (1 5/8)	304.8	63.5 (2 1/2)	482.6	-	-
450	(18)	41.3 (1 5/8)	292.1	47.6 (1 7/8)	349.3	69.8 (2 3/4)	533.4	-	-
500	(20)	41.3 (1 5/8)	317.5	50.8 (2)	374.7	76.2 (3)	571.5	-	-
600	(24)	47.6 (1 7/8)	349.3	63.5 (2 1/2)	470	88.9 (3 1/2)	660.4	-	-

**TOLERANCES ON 'L2'**

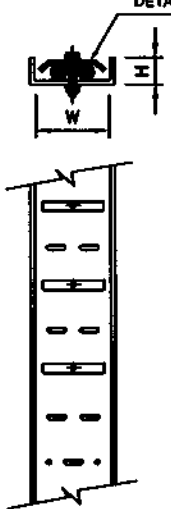
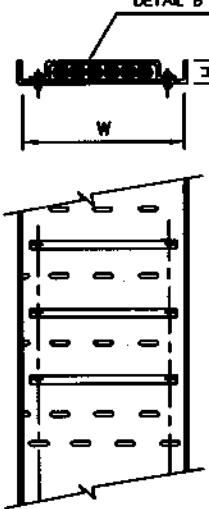
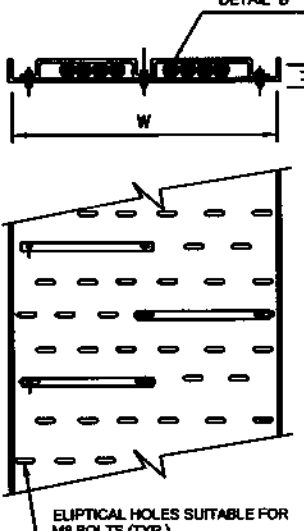
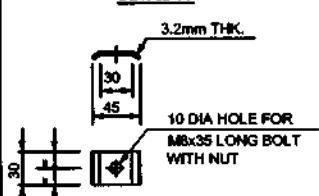
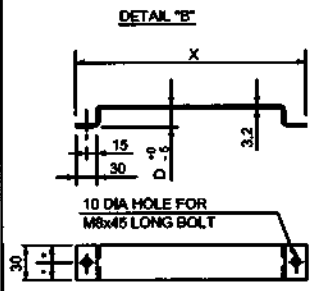
L2-LENGTH mm	≤ 305	310 TO 455	≥ 455
TOLERANCE mm	- 0 + 1.6	- 0 + 3.2	- 0 + 6.4

**NOTES :-**

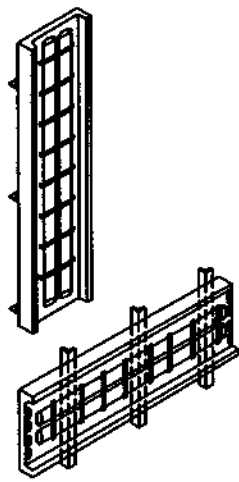
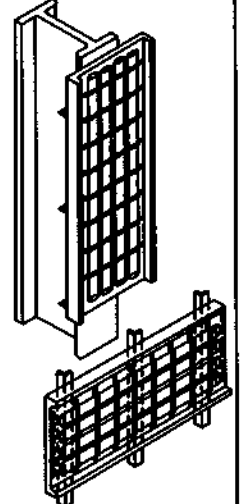
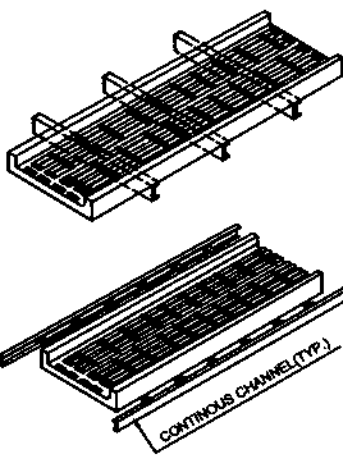
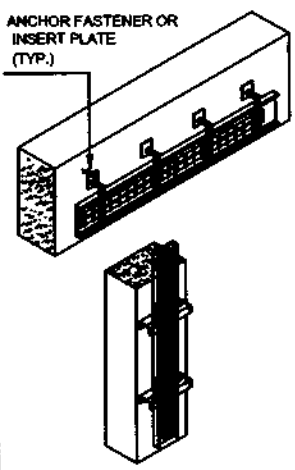
- FOR BOLT DIAMETER 1" (25mm) & ABOVE IN EACH RATING, FOLLOWING SHALL BE CONSIDERED TO TAKE CARE OF BOLT TENSIONING.
  - ONE EXTRA NUT SHALL BE CONSIDERED FOR EACH BOLT/STUD.
  - BOLT/STUD LENGTH SHALL BE INCREASED BY ONE DIAMETER.

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

SINGLE CLAMPING FOR TWO CABLES	SINGLE CLAMPING FOR MULTIPLE CABLES	DUAL CLAMPING FOR MULTIPLE CABLES	CABLE CLAMPS DETAIL
<p>DETAIL "A"</p> 	<p>DETAIL "B"</p> 	<p>DETAIL "B"</p>  <p>ELLIPTICAL HOLES SUITABLE FOR M8 BOLTS (TYP.)</p>	<p>DETAIL "A"</p>  <p>DETAIL "B"</p>  <p>WHERE "W" DENOTES THE INSIDE WIDTH OF TRAY D = CABLE OVERALL DIA. WHERE X = W-10 FOR SINGLE CLAMPING = <math>\frac{W}{2}</math> - 10 FOR DUAL CLAMPING</p>

**PERFORATED TRAY - SUPPORTING DETAILS**

TRAY ROUTING EDGEWISE HOR. / VER. RUNS	TRAY ROUTING EDGEWISE IN HOR. / VER. RUNS	TRAY ROUTING WIDTHWISE IN HORIZONTAL RUNS	TRAY ROUTING CONCRETE BEAM/COLUMN IN HOR. / VER. PLANE
		 <p>CONTINUOUS CHANNEL (TYP.)</p>	 <p>ANCHOR FASTENER OR INSERT PLATE (TYP.)</p>

**NOTES :-**

- ALL DIMENSIONS ARE IN mm.
- PERFORATED TRAYS SHALL BE SUPPORTED AT EVERY 1000 mm (TYP.) INTERVAL FOR HORIZONTAL AS WELL AS VERTICAL RUNS USING MINIMUM ANGLE SIZE AS 50x50x6 OR CONTINUOUS CHANNEL SUPPORT MCS0.
- CLAMPING OF CABLES ON PERFORATED TRAYS SHALL BE AT EVERY 500 mm ON VERTICAL RUNS AND EVERY 1000 mm ON HORIZONTAL RUNS.
- PERFORATED TRAYS SHALL BE SUPPLIED WITH CLAMPS, BOLTS/NUTS AND DOUBLE WASHERS OF GALVANISED MILD STEEL OR ALUMINIUM AS PER TRAY MATERIAL.
- GALVANISING SHALL BE AS PER IS 4759 (66  $\mu$ m/ 460 g / m<sup>2</sup>) AND ALUMINIUM ANODIZING SHALL BE MINIMUM 20 $\mu$ m THICK.
- THE PERFORATED TRAY THICKNESS SHALL BE 2.5 mm.
- TRAY STANDARD LENGTH SHALL BE 2.5 mtr.

**CAPACITY OF PERFORATED TRAYS**

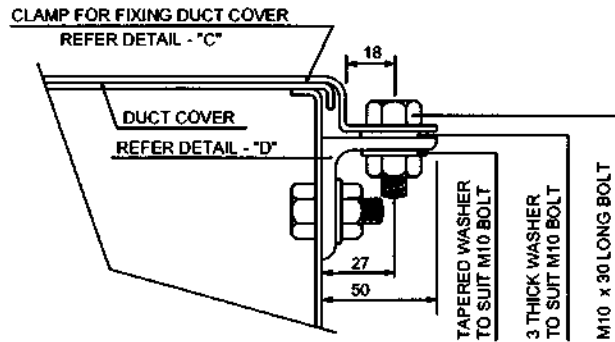
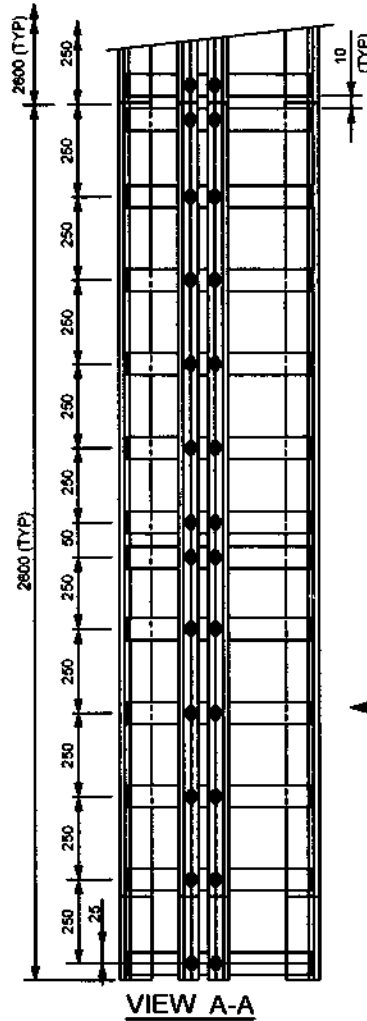
TRAY WIDTH (W)	FLANGE HEIGHT (H)	NO. OF CABLES		
		1 PAIR/ 1 TRIAD	6 PAIR/ 6 TRIAD	12 PAIR/ 8 TRIAD
60	30	2	1	-
60	40	-	-	1
100	40	4	2	2
150	40	6	4	3
300	40	15	8	6

4	03.11.21	Revised & Reissued	Saurav	MN	SM
3	28.03.17	Reaffirmed & Reissued	Manoj	MN	RN
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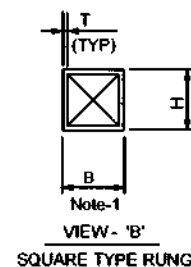
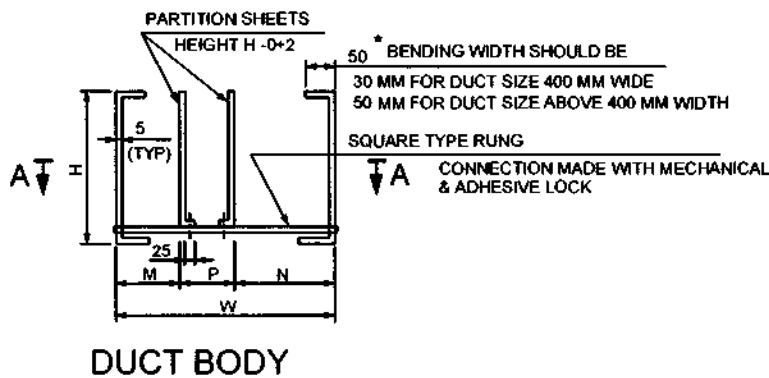
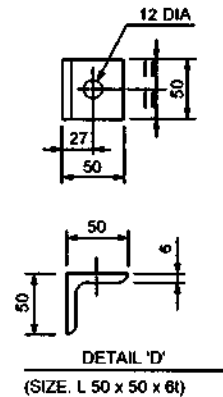
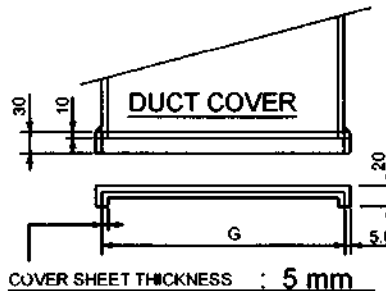
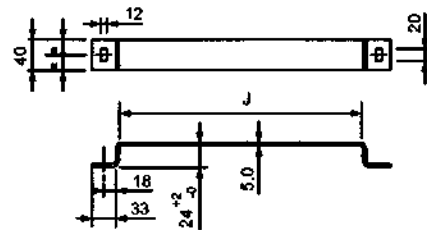
FRP DUCT FABRICATION DETAILS FOR INSTRUMENTATION CABLES  
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ASSEMBLY OF DUCT BODY WITH COVER

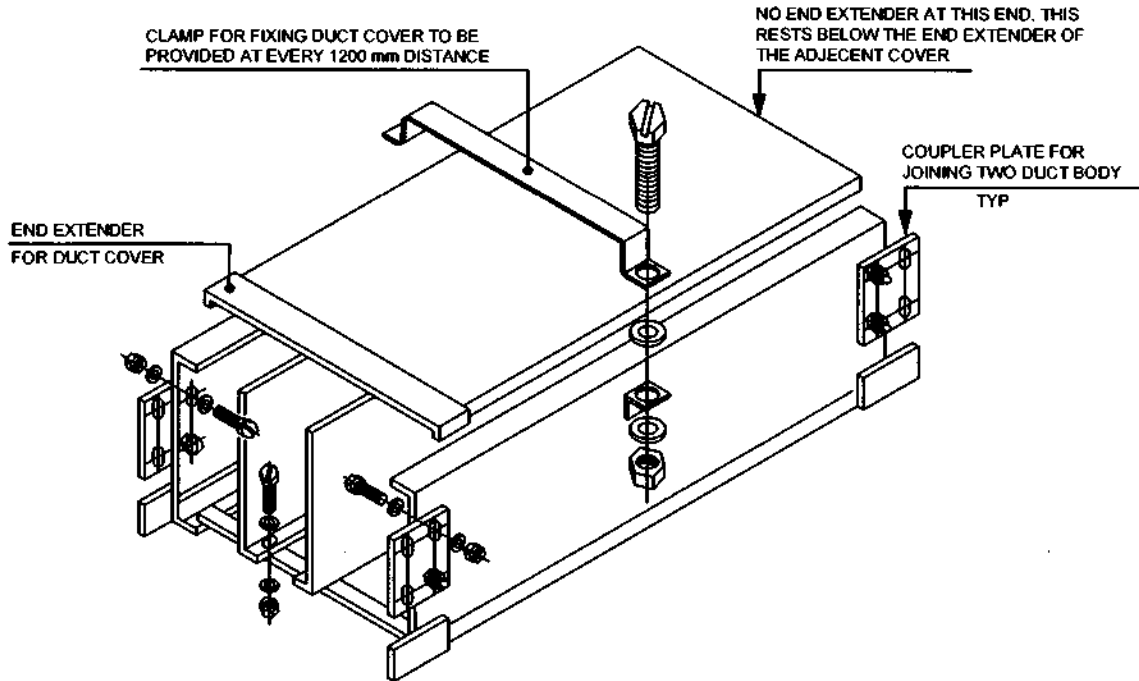


## STRAIGHT RUN OF DUCT

Note-1  
Dimensions T, H & B to be decided by the vendor. Exact rung design shall be decided by the Vendor considering to withstand a load as per Note C.5 of page 41 of 41. Vendor shall provide the exact design along with the calculation for meeting the load criteria per rung.

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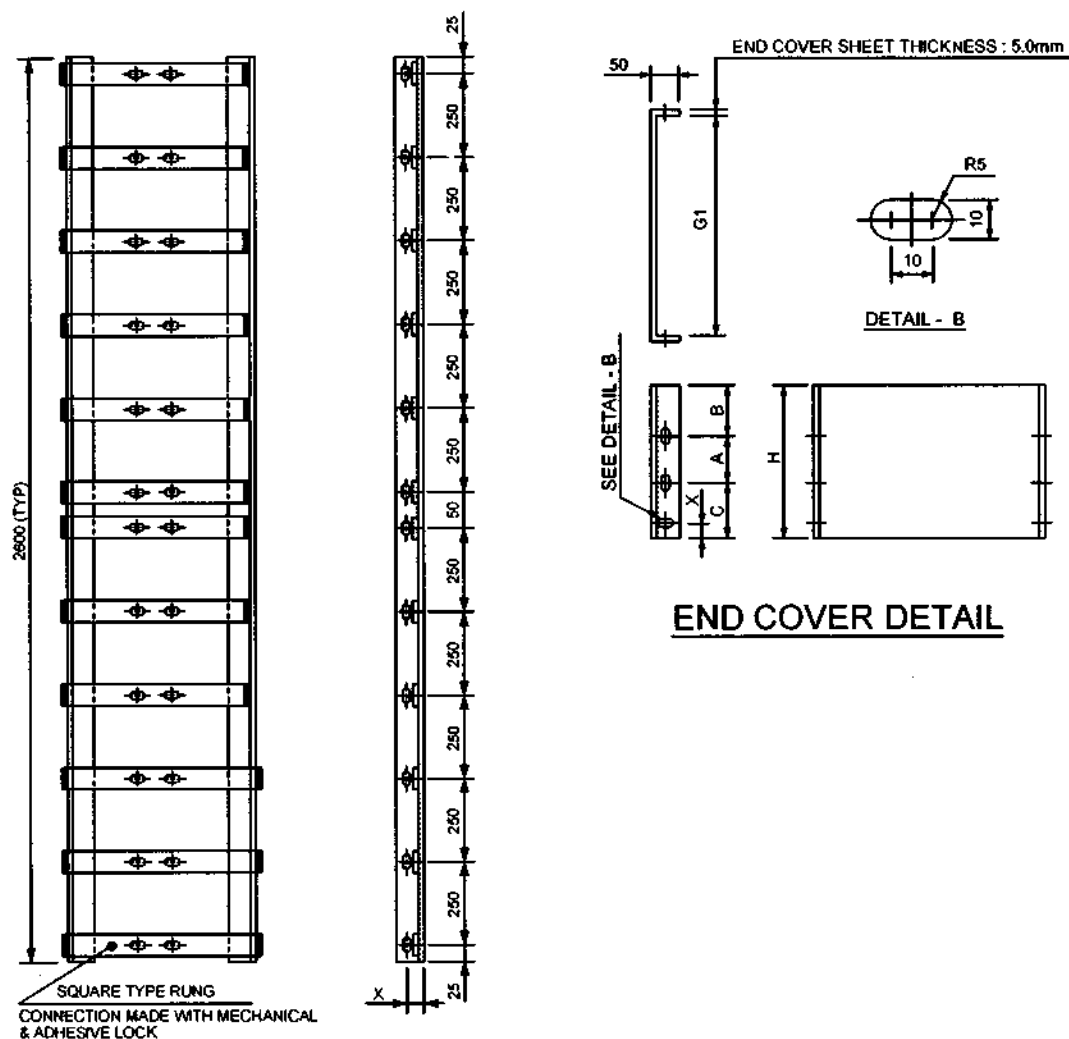
### FIXING OF COVER TO DUCT BODY

**TABLE - A FOR CABLES ONLY**

DETAIL NO.	W	H	M	N	P	G	J
D1-101	1200	400	300	750	150	1210 <sup>+0</sup> / <sub>-2</sub>	1212 <sup>+1</sup> / <sub>-</sub>
D1-102	1000	400	250	600	150	1010 <sup>+0</sup> / <sub>-2</sub>	1012 <sup>+1</sup> / <sub>-</sub>
D1-103	800	300	200	450	150	810 <sup>+0</sup> / <sub>-2</sub>	812 <sup>+1</sup> / <sub>-</sub>
D1-104	600	300	150	300	150	610 <sup>+0</sup> / <sub>-2</sub>	612 <sup>+1</sup> / <sub>-</sub>
D1-105	400	200	100	150	150	410 <sup>+0</sup> / <sub>-2</sub>	412 <sup>+1</sup> / <sub>-</sub>

### DIMENSIONAL DETAILS FOR 1A

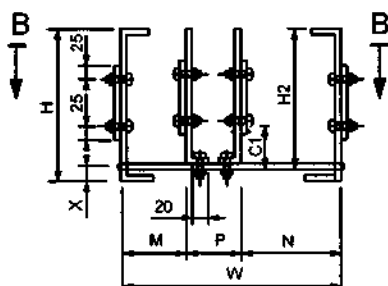
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**END COVER DETAIL**

### TABLE FOR FIXING COUPLER PLATES WITH DUCT SIDES/PARTITION SHEETS

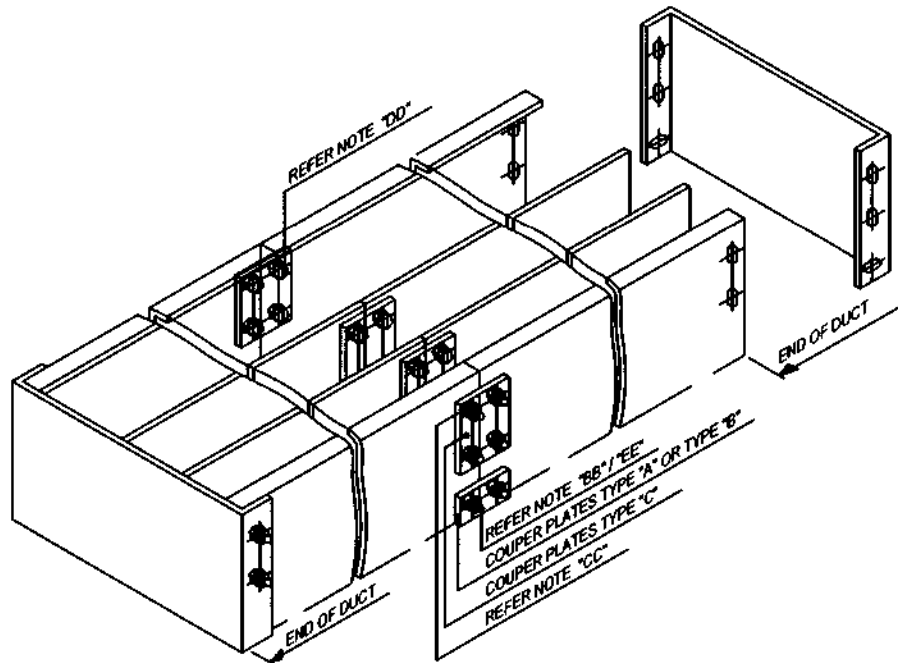
W	A	B	C	F	H2	C1	G1	X
1200	200	80	120	250	384	104	1203	37.5
1000	200	80	120	250	384	104	1003	37.5
800	150	50	100	200	288	88	803	37.5
600	150	50	100	200	288	88	603	37.5
400	75	50	75	125	188	63	403	25



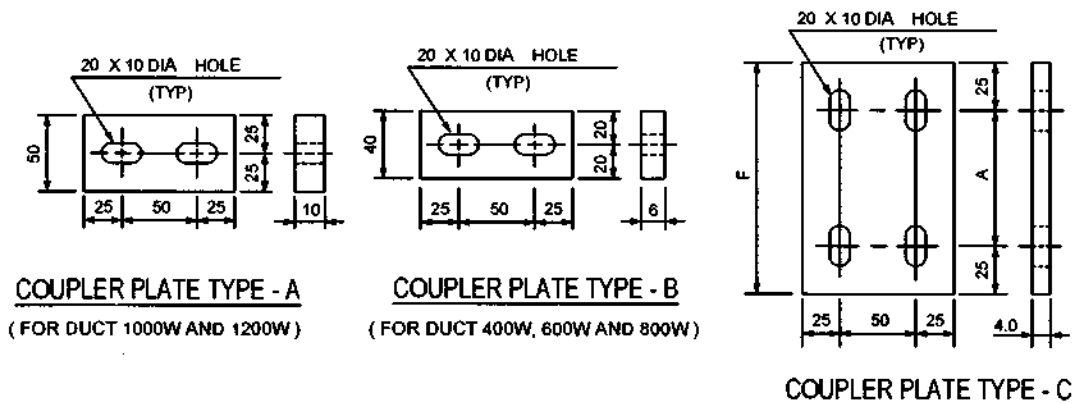
**DUCT BODY BOLTED ASSY.**  
**SECTIONAL VIEW B-B**

## GENERAL BOLTING DETAILS

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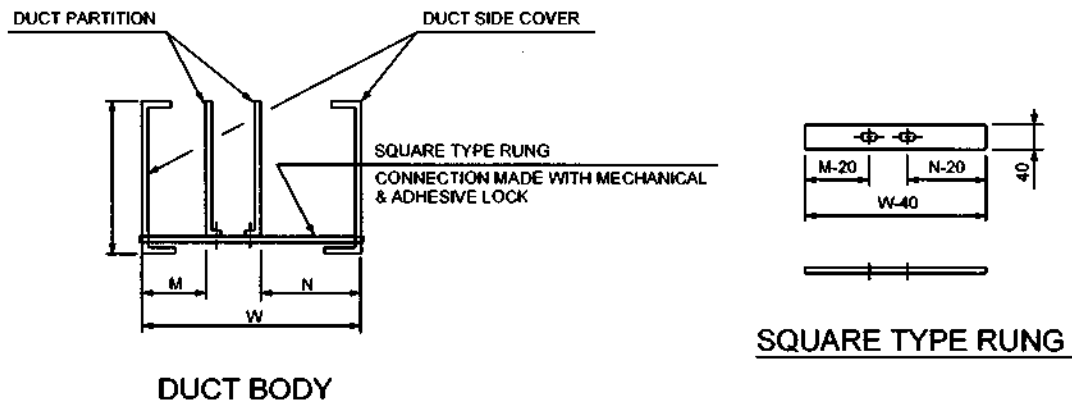
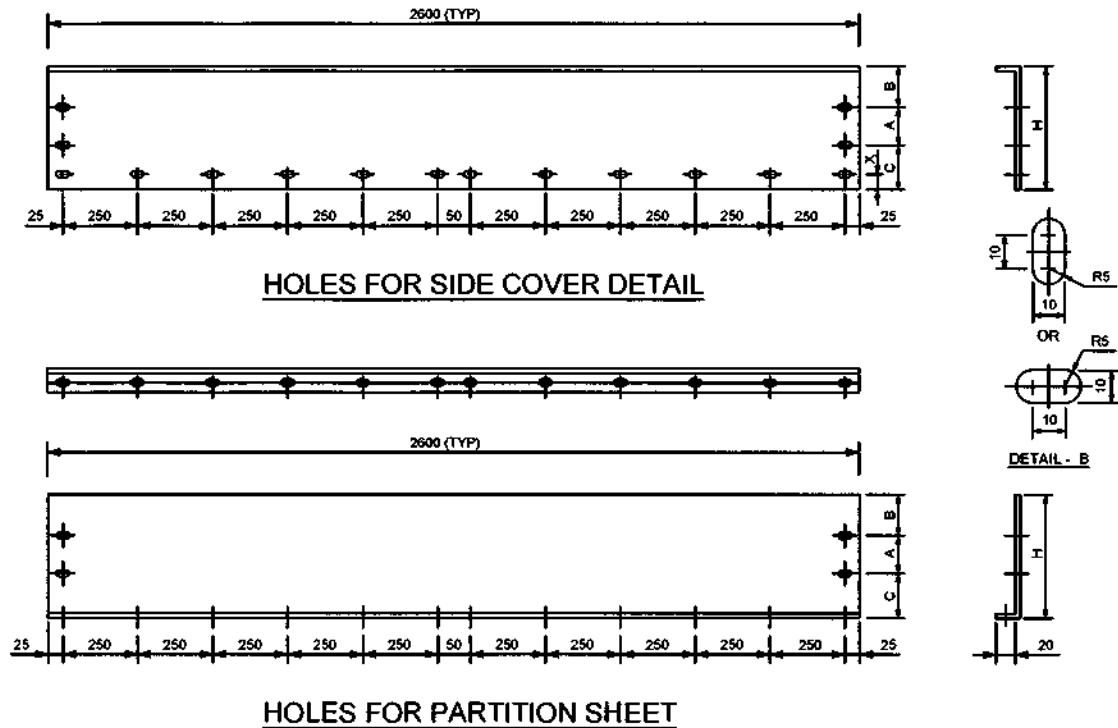
## FIXING OF DUCT END COVER BY BOLTING



## SIZES OF COUPLER PLATE

NOTE "BB" USE SS316 M8X30mm LONG BOLTS WITH SUITABLE NUTS/WASHERS.  
NOTE "CC" USE SS316 M8X20mm LONG BOLTS WITH SUITABLE NUTS/WASHERS.  
NOTE "DD" USE SS316 M8X20mm LONG BOLTS WITH SUITABLE NUTS/WASHERS.  
NOTE "EE" USE SS316 M8X30mm LONG BOLTS WITH SUITABLE NUTS/WASHERS.

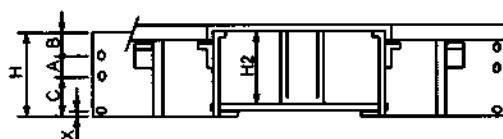
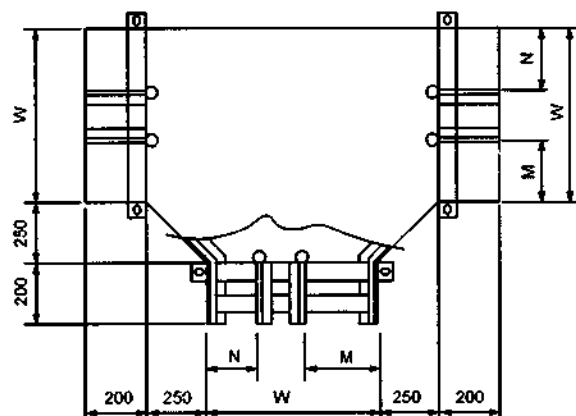
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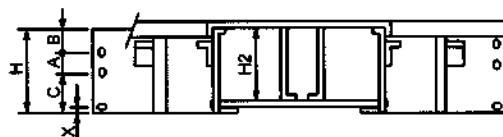
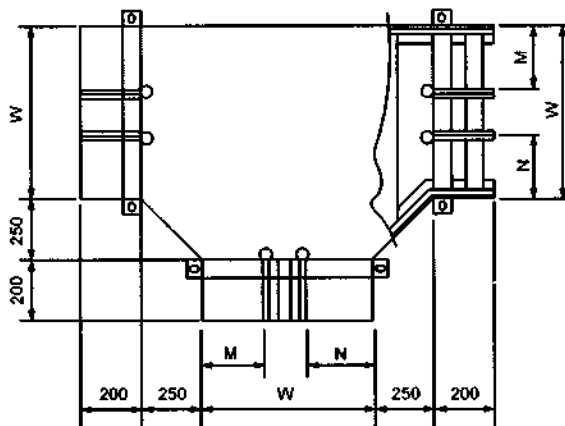
## GENERAL BOLTING DETAILS

DETAIL  
1E

0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman
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**TYPE - 'A'**  
**BRANCH NEAR 'M' PATH**

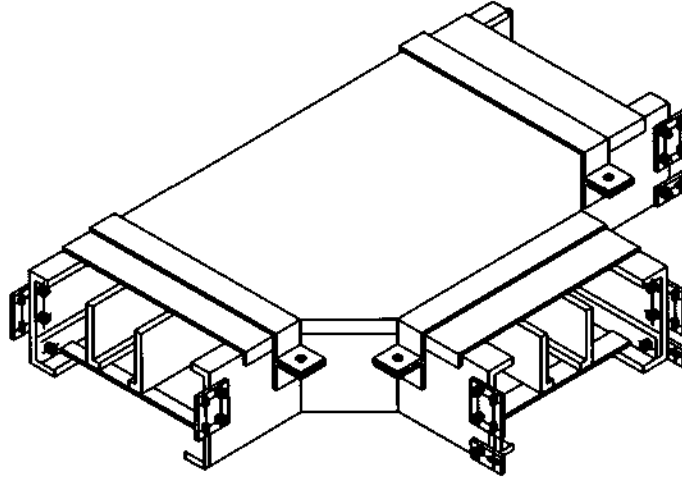


**TYPE - 'B'**  
**BRANCH NEAR 'N' PATH**

## DUCT EQUAL TEE

DETAIL  
2A

0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman
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**TYPE - A**

DETAIL NO.	D2A-101	D2A-102	D2A-103	D2A-104	D2A-105
W	1200	1000	800	600	400
H	400	400	300	300	200

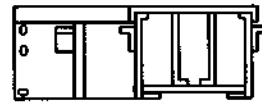
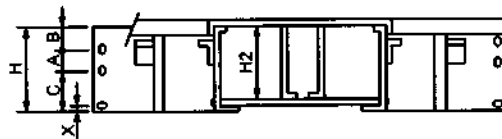
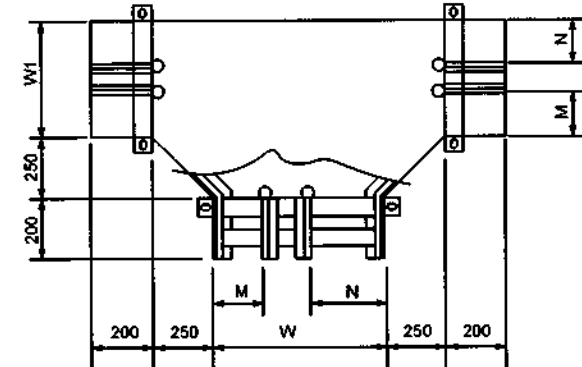
**TYPE - B**

DETAIL NO.	D2A-201	D2A-202	D2A-203	D2A-204	D2A-205
W	1200	1000	800	600	400
H	400	400	300	300	200

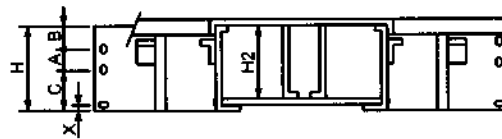
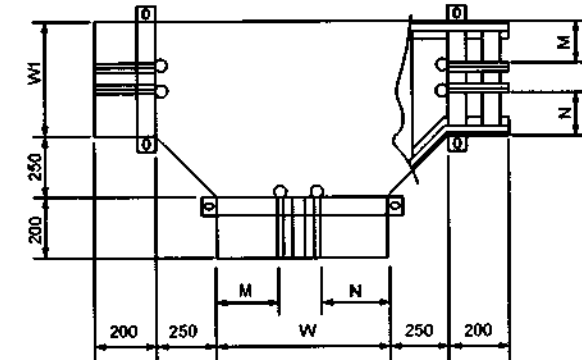
**DIMENSIONAL DETAILS FOR 2A**



0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
Rev. No	Date	Purpose	Prepared by	Checked by	Sids. Committee Convenor	Sids. Bureau Chairman
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**TYPE - 'A'**  
**BRANCH NEAR 'M' PATH**

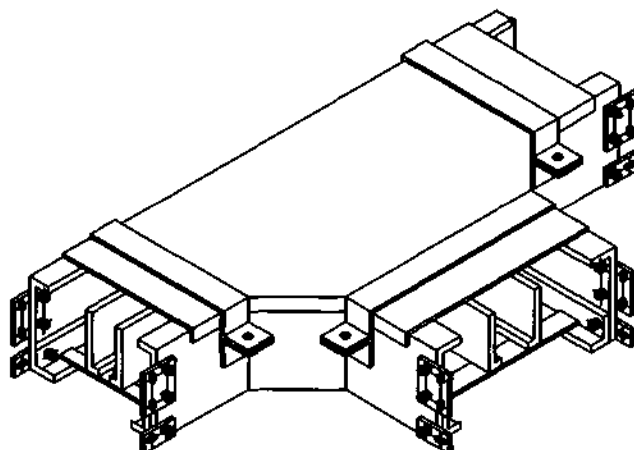


**TYPE - 'B'**  
**BRANCH NEAR 'N' PATH**

## DUCT EXPANDER TEE

DETAIL  
3A

0	13-09-21	ISSUED AS STANDARD	Saurav	XJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman



**TYPE - A**

DETAIL NO.	D2-101	D2-102	D2-103	D2-104	D2-105
W	1200	1200	1000	800	600
W1	800	600	600	400	400
H	400	400	400	300	300

**TYPE - B**

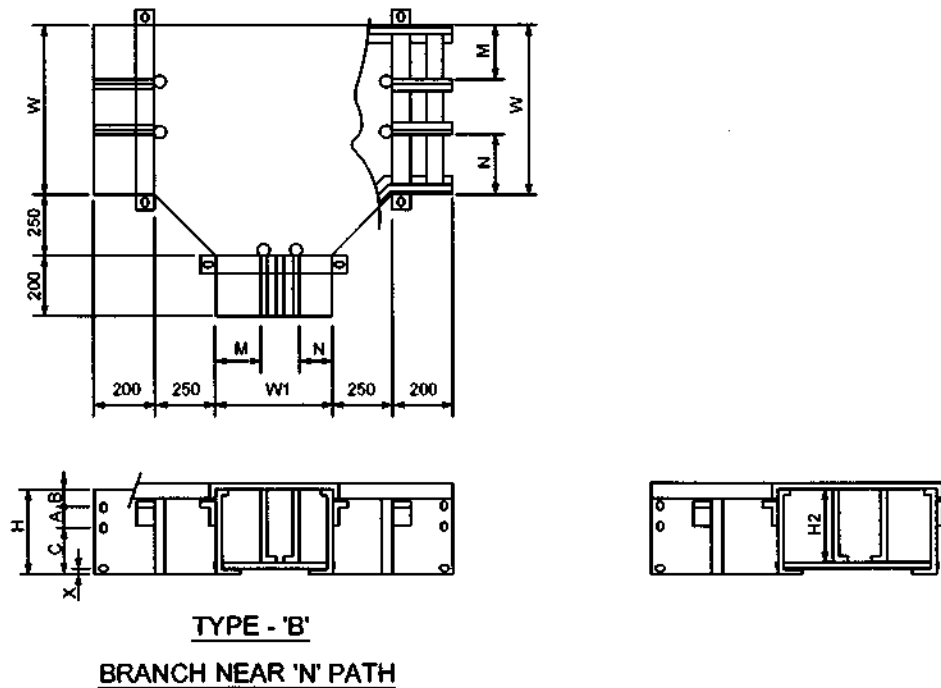
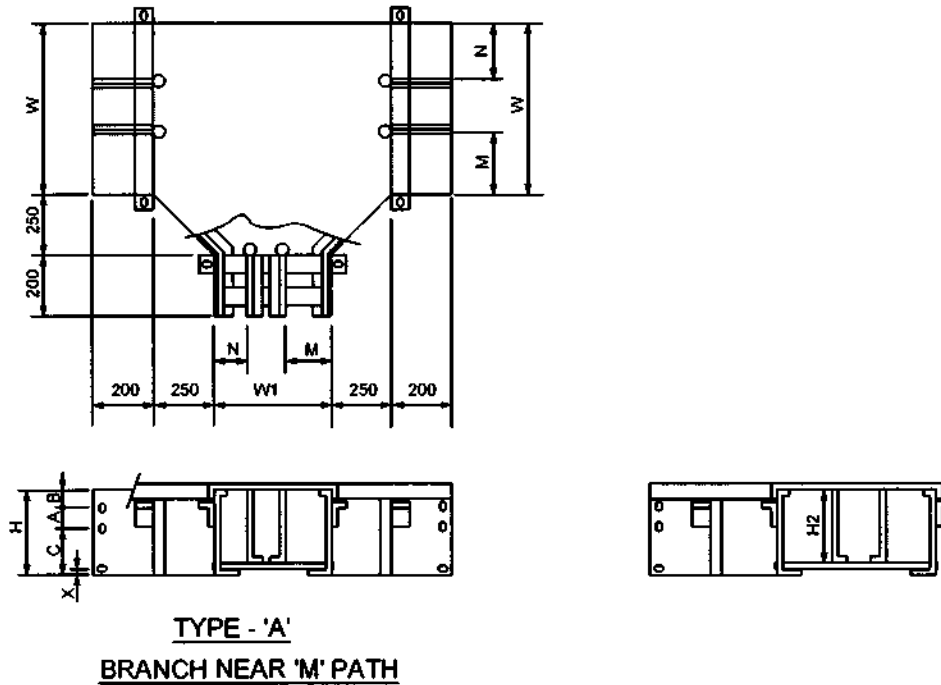
DETAIL NO.	D2-201	D2-202	D2-203	D2-204	D2-205
W	1200	1200	1000	800	600
W1	800	600	600	400	400
H	400	400	400	300	300

## DIMENSIONAL DETAILS FOR 3A

DETAIL  
3B

0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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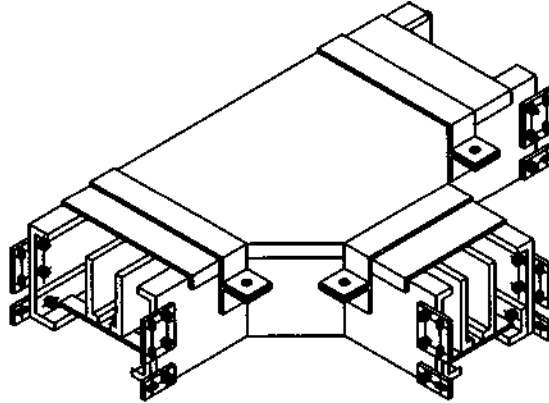




## DUCT REDUCER TEE

DETAIL  
4A

0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
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**TYPE - A**

DETAIL NO.	D3-101	D3-102	D3-103	D3-104	D3-105	D3-106	D3-107
W	1200	1200	1200	1000	1000	800	600
W1	800	600	400	600	400	400	400
H	400	400	400	400	400	300	300

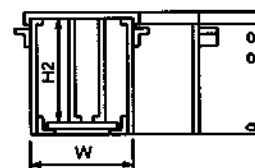
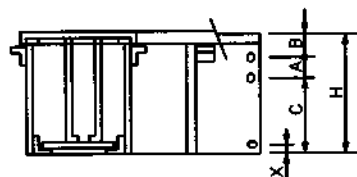
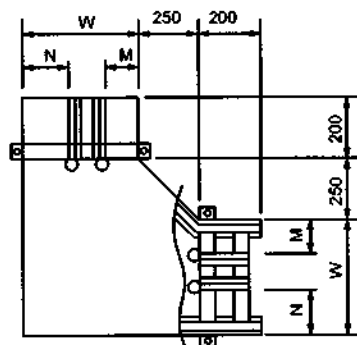
**TYPE - B**

DETAIL NO.	D3-201	D3-202	D3-203	D3-204	D3-205	D3-206	D3-207
W	1200	1200	1200	1000	1000	800	600
W1	800	600	400	600	400	400	400
H	400	400	400	400	400	300	300

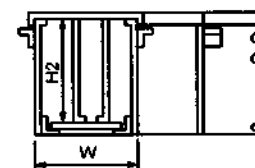
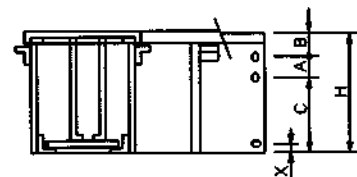
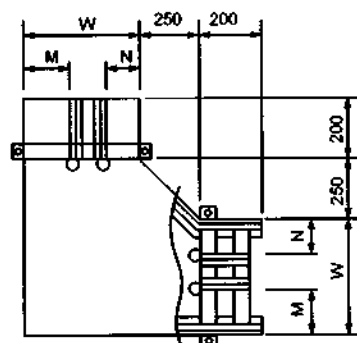
**DIMENSIONAL DETAILS FOR 4A**



0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman
Approved by						



TYPE 'A'

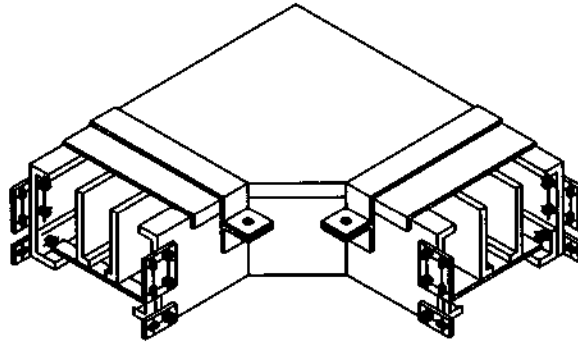


TYPE 'B'

## DUCT ELBOW (HORIZONTAL PLANE)

DETAIL  
5A

0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman



**TYPE - A**

DETAIL NO.	D5-101	D5-102	D5-103	D5-104	D5-105
W	1200	1000	800	600	400
H	400	400	300	300	200

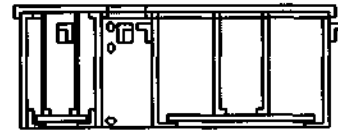
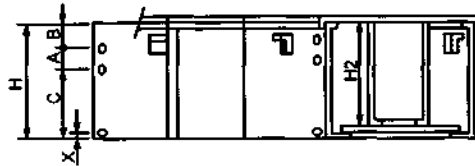
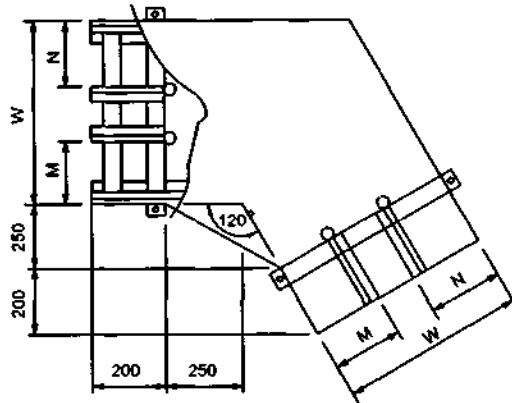
**TYPE - B**

DETAIL NO.	D5-201	D5-202	D5-203	D5-204	D5-205
W	1200	1000	800	600	400
H	400	400	300	300	200

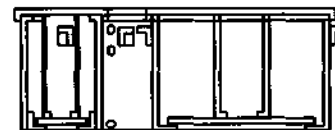
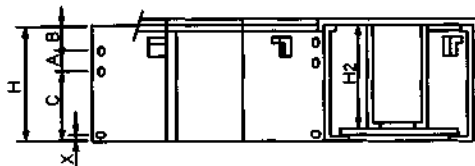
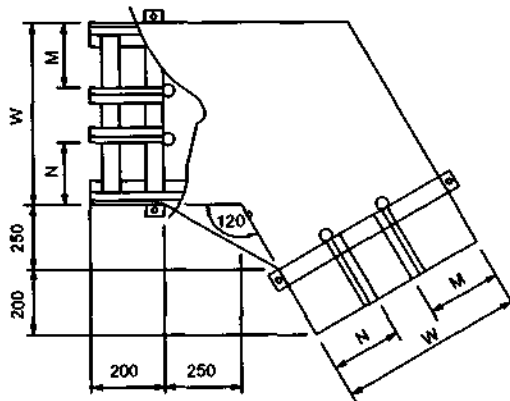
**DIMENSIONAL DETAILS FOR 5A**



0	13-09-21	ISSUED AS STANDARD	Saurav	XJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
						Approved by



TYPE 'A'

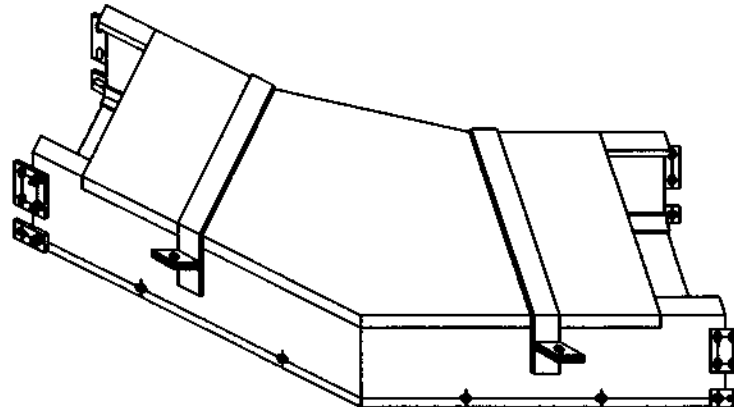


TYPE 'B'

## DUCT OFFSET BEND

DETAIL  
6A

0	13-09-21	ISSUED AS STANDARD	Saurav	XJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman
Approved by						



**TYPE - A**

DETAIL NO.	D8-101	D8-102	D8-103	D8-104	D8-105
W	1200	1000	800	600	400
H	400	400	300	300	200

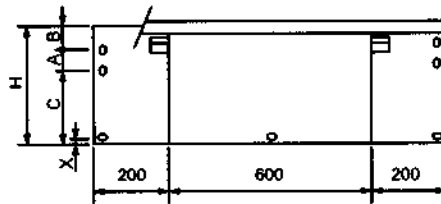
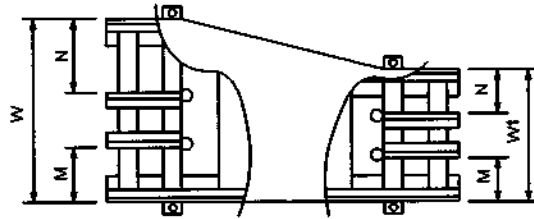
**TYPE - B**

DETAIL NO.	D8-201	D8-202	D8-203	D8-204	D8-205
W	1200	1000	800	600	400
H	400	400	300	300	200

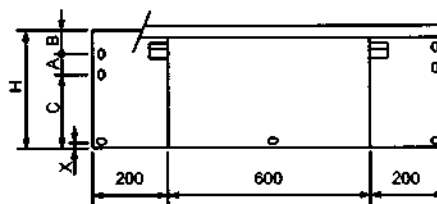
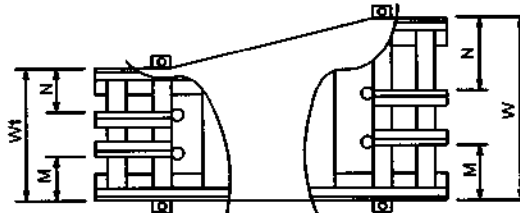
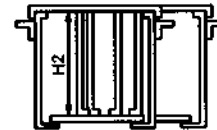
**DIMENSIONAL DETAILS FOR 6A**

DETAIL  
6B

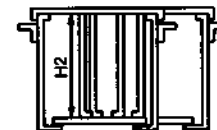
0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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TYPE 'A'



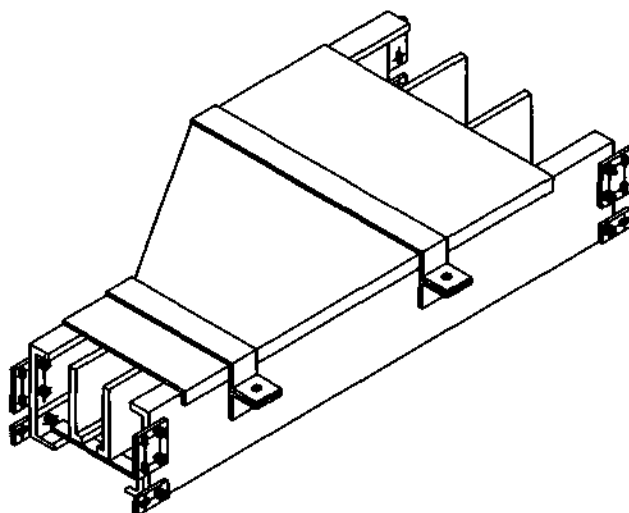
TYPE 'B'



DETAIL  
7A

## DUCT WIDTH REDUCER - 'M' PATH STRAIGHT

0	13-09-21	ISSUED AS STANDARD	Saurav	JS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Sds. Committee Convenor	Sds. Bureau Chairman
					Approved by	



TYPE - A

DETAIL NO.	D7-101	D7-102	D7-103	D7-104	D7-105	D7-106	D7-107
W	1200	1200	1200	1000	1000	800	600
W1	800	600	400	600	400	400	400
H	300	300	200	300	200	200	200

TYPE - B

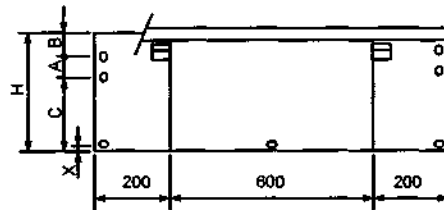
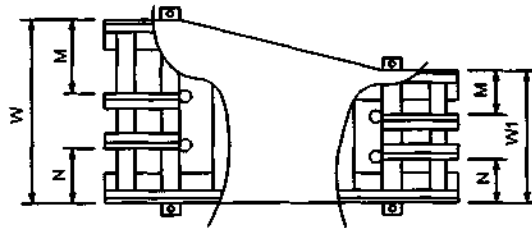
DETAIL NO.	D7-201	D7-202	D7-203	D7-204	D7-205	D7-206	D7-207
W	1200	1200	1200	1000	1000	800	600
W1	800	600	400	600	400	400	400
H	300	300	200	300	200	200	200

DIMENSIONAL DETAILS FOR 7A

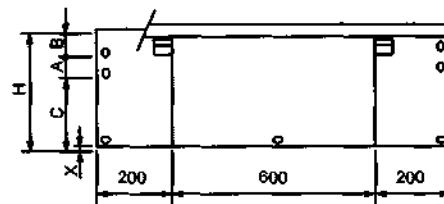
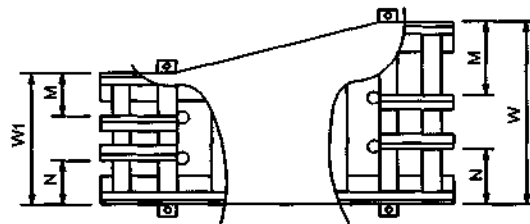
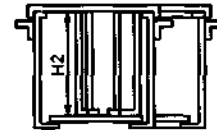
DETAIL  
7B

0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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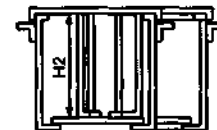




**TYPE 'A'**



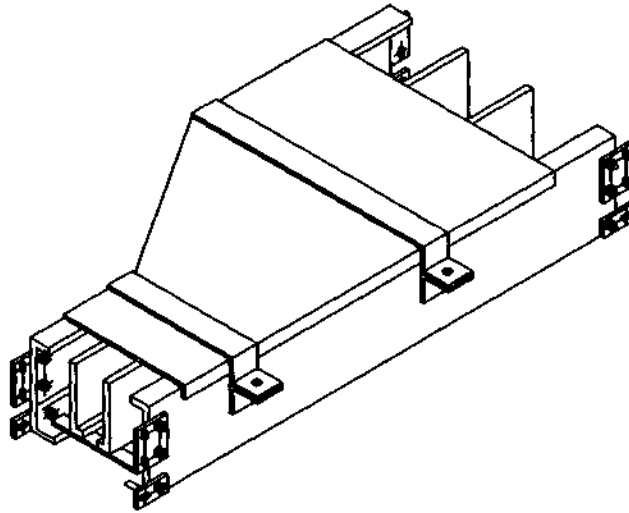
**TYPE 'B'**



DETAIL  
7C

## DUCT WIDTH REDUCER - 'N' PATH STRAIGHT

0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	



TYPE - A

DETAIL NO.	D7A-101	D7A-102	D7A-103	D7A-104	D7A-105	D7A-106	D7A-107
W	1200	1200	1200	1000	1000	800	600
W1	800	600	400	600	400	400	400
H	300	300	200	300	200	200	200

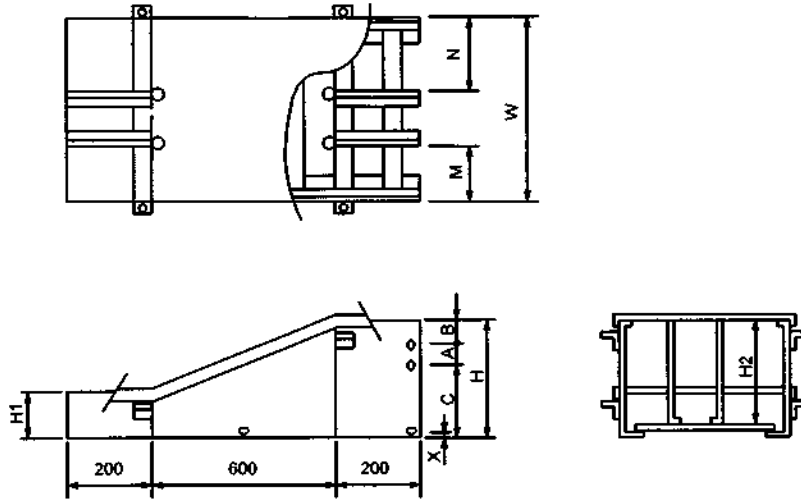
TYPE - B

DETAIL NO.	D7A-201	D7A-202	D7A-203	D7A-204	D7A-205	D7A-206	D7A-207
W	1200	1200	1200	1000	1000	800	600
W1	800	600	400	600	400	400	400
H	300	300	200	300	200	200	200

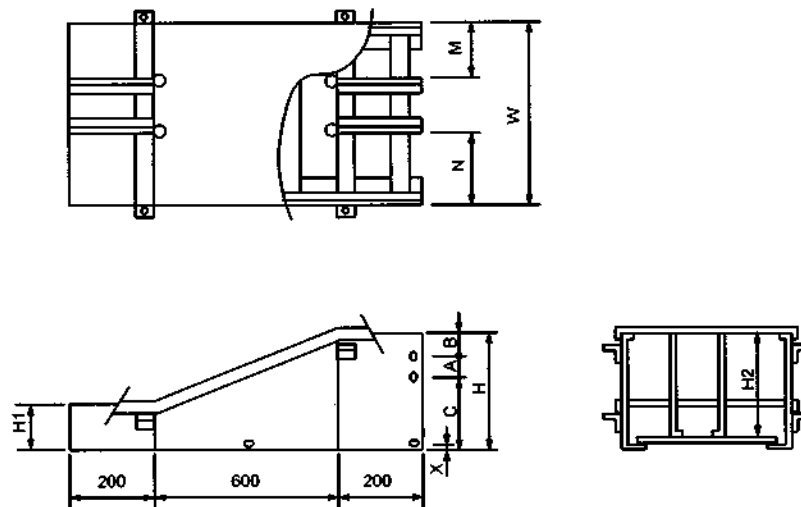
DIMENSIONAL DETAILS FOR 7C



0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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TYPE 'A'

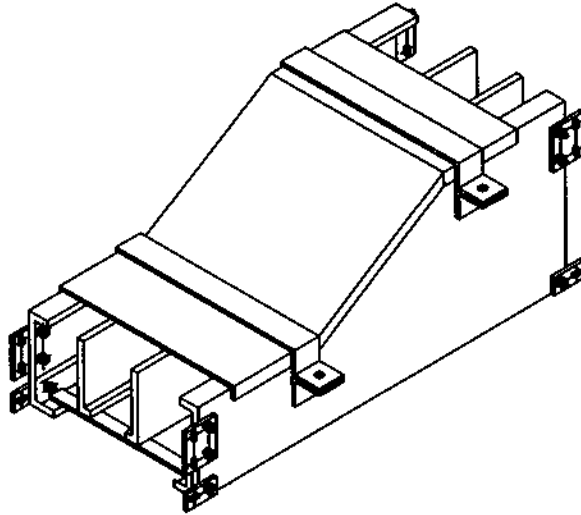


TYPE 'B'

## DUCT HEIGHT REDUCER

DETAIL  
8A

0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	



**TYPE - A**

DETAIL NO.	D6-101	D6-102	D6-103	D6-104	D6-105	D6-106	D6-107
W	1200	1200	1000	1000	800	600	400
H	400	400	400	400	300	300	300
H1	300	200	300	200	200	200	200

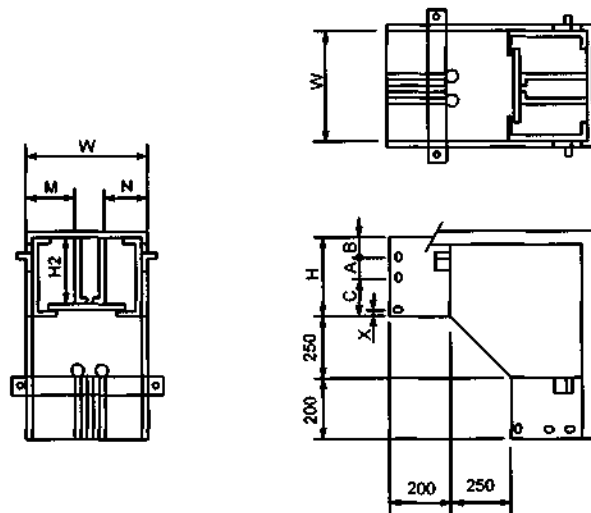
**TYPE - B**

DETAIL NO.	D6-201	D6-202	D6-203	D6-204	D6-205	D6-206	D6-207
W	1200	1200	1000	1000	800	600	400
H	400	400	400	400	300	300	300
H1	300	200	300	200	200	200	200

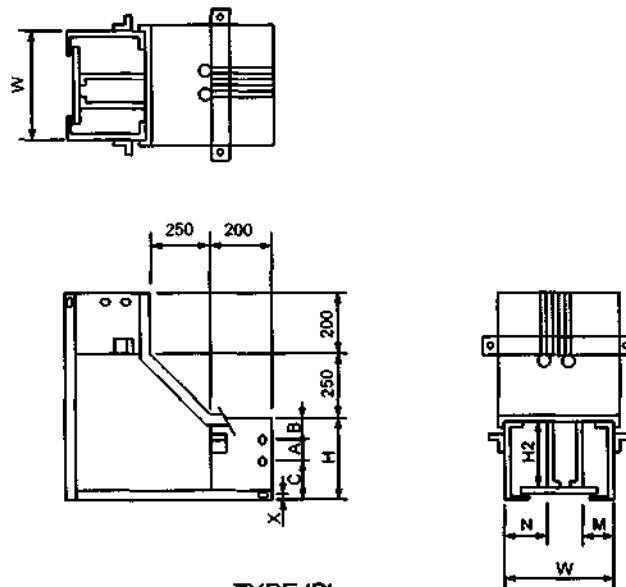
**DIMENSIONAL DETAILS FOR 8A**



0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	



TYPE 'A'

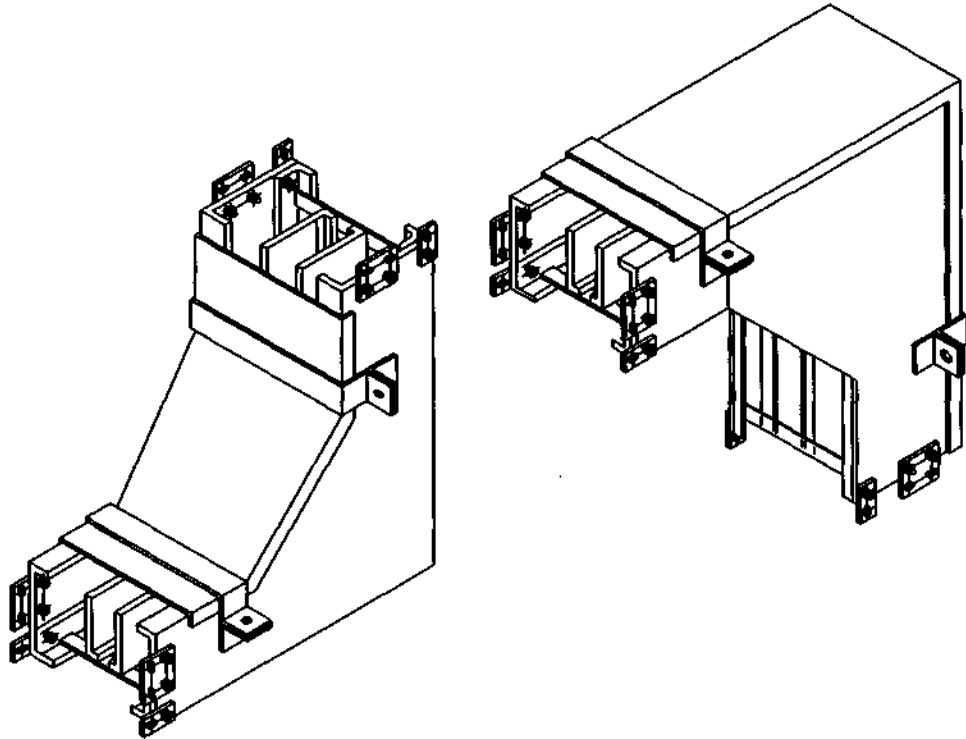


TYPE 'B'

## VERTICAL PLANE ELBOW

DETAIL  
9A

0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						



TYPE - A

DETAIL NO.	D4-101	D4-102	D4-103	D4-104	D4-105
W	1200	1000	800	600	400
H	400	400	300	300	200

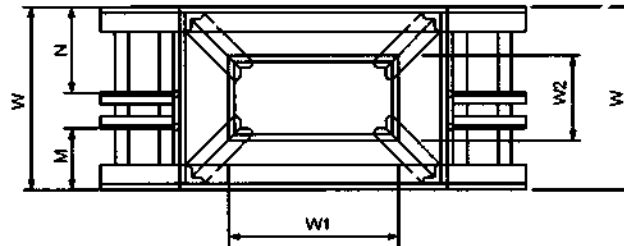
TYPE - B

DETAIL NO.	D4-201	D4-202	D4-203	D4-204	D4-205
W	1200	1000	800	600	400
H	400	400	300	300	200

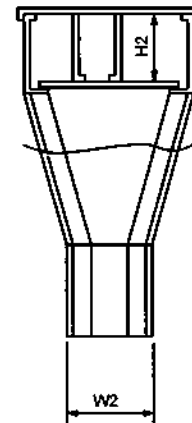
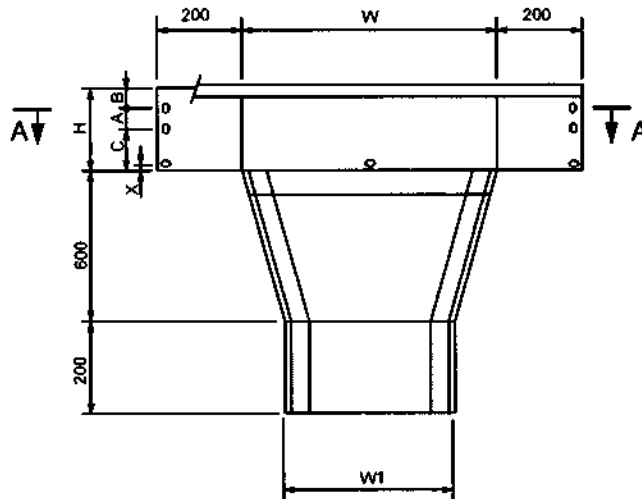
## DIMENSIONAL DETAILS FOR 9A

DETAIL  
9B

0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
						Approved by



**SECTION A-A**



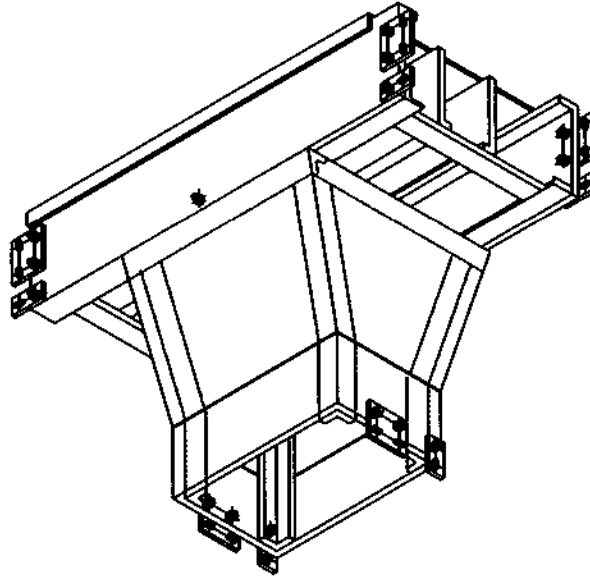
**NOTE :-**

COVER PLATE TO BE DECIDED BASED ON FURTHER CONTINUATION OF THE DUCT.

## VERTICAL PLANE TEE, JOINS UP

DETAIL  
10A

0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman
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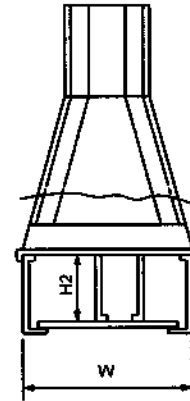
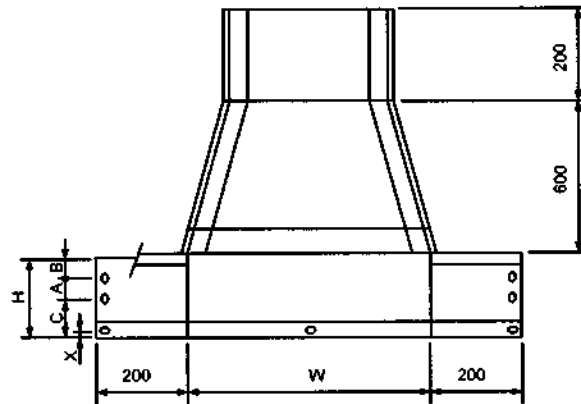
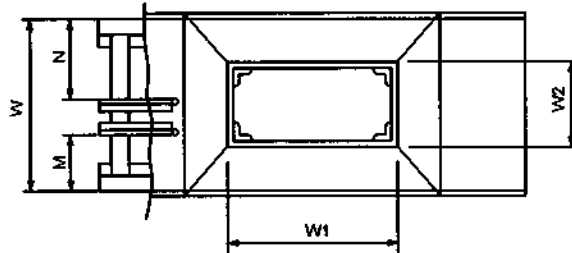
DETAIL NO.	D9-101	D9-102	D9-103	D9-104	D9-105	D9-106	D9-107
W	1200	1200	1200	1000	1000	800	600
H	400	400	400	400	400	300	300
W1	800	800	400	600	400	400	400
W2	300	300	200	300	200	200	200

## DIMENSIONAL DETAILS FOR 10A



0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Sds. Committee Convenor	Sds. Bureau Chairman
					Approved by	





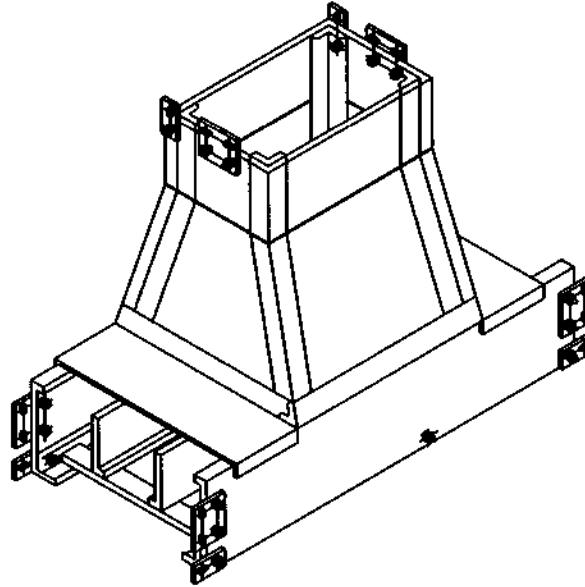
NOTE :-

COVER PLATE TO BE DECIDED BASED ON FURTHER CONTINUATION OF THE DUCT.

## VERTICAL PLANE TEE, JOINS DOWN

DETAIL  
10C

0	13-09-21	ISSUED AS STANDARD	Saurav	XJS	MN	SM
Rev. No.	Date	Purpose	Prepared by	Checked by	Sds. Committee Convenor	Sds. Bureau Chairman
					Approved by	

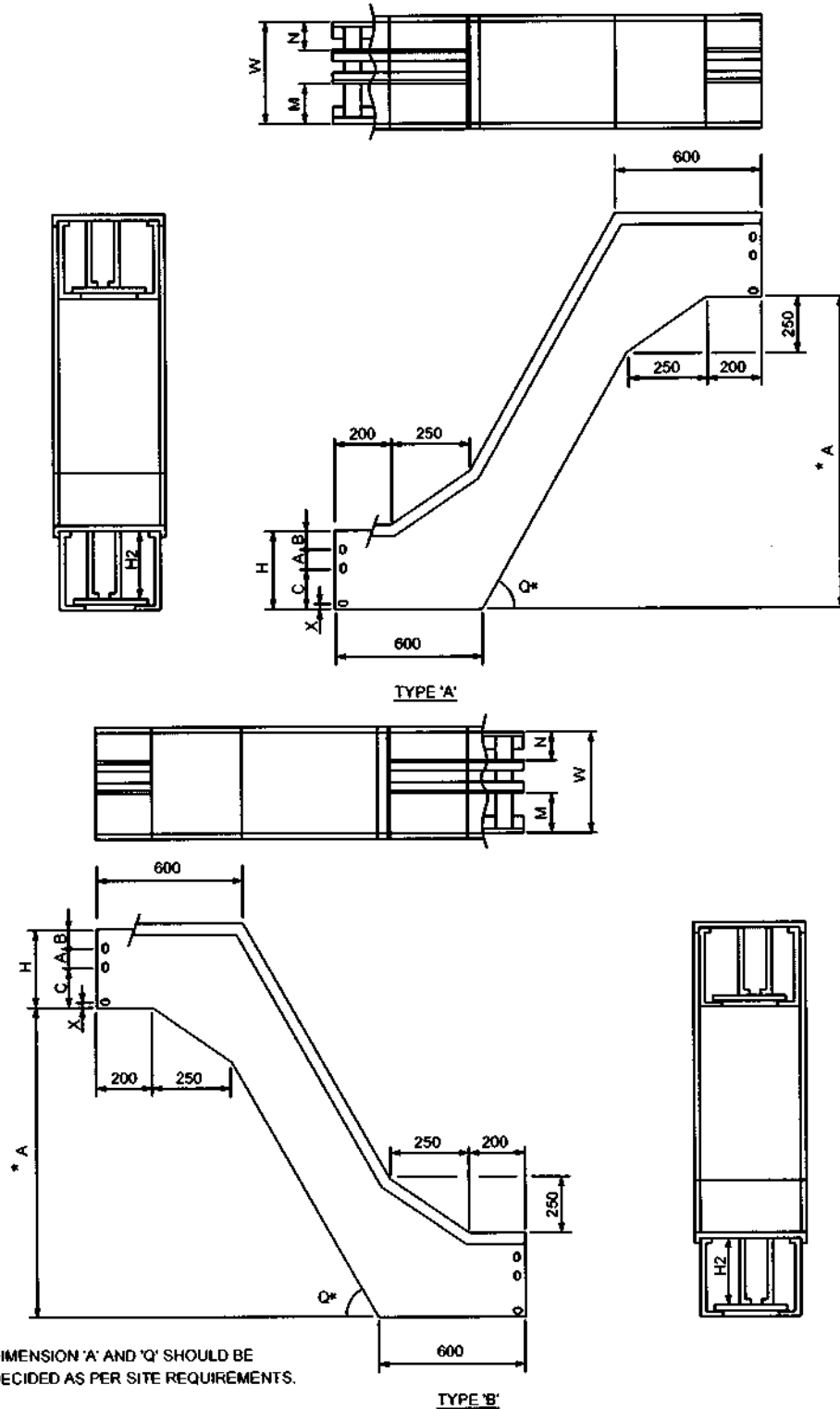


DETAIL NO.	D10-101	D10-102	D10-103	D10-104	D10-105	D10-106	D10-107
W	1200	1200	1200	1000	1000	800	600
H	400	400	400	400	400	300	300
W1	800	600	400	600	400	400	400
W2	300	300	200	300	200	200	200

## DIMENSIONAL DETAILS FOR 10C

DETAIL  
10D

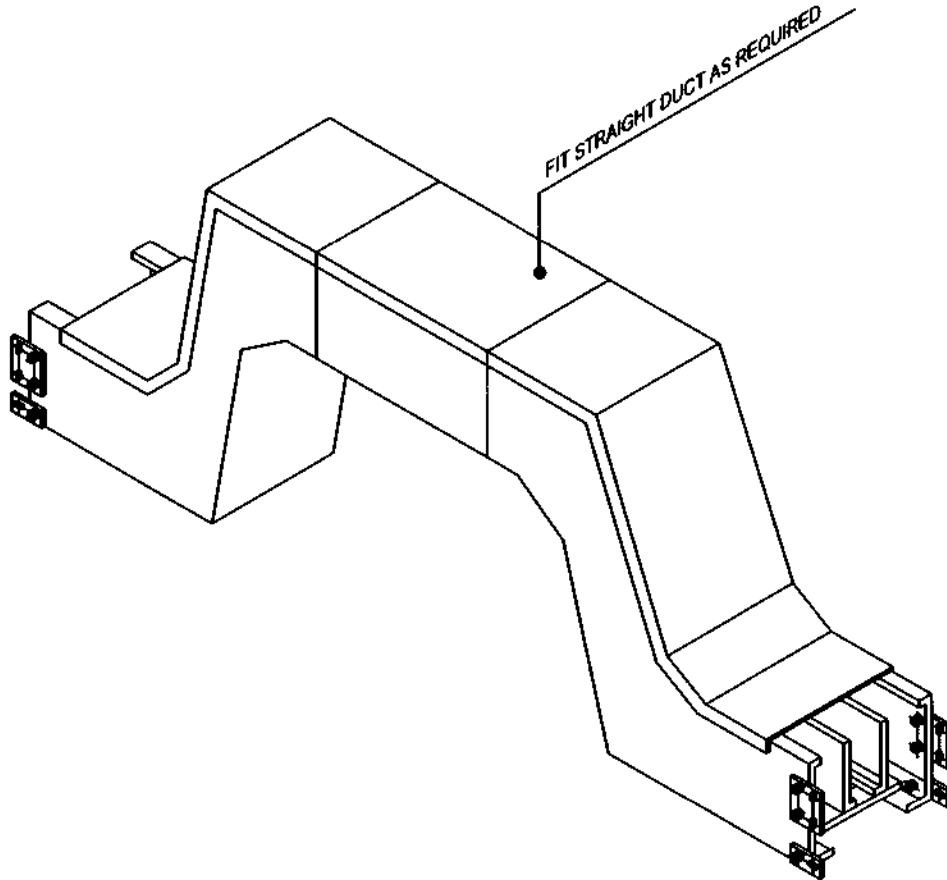
0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
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## DUCT BRIDGE (JUMP-OVER)

DETAIL  
11A

0	13-09-21	ISSUED AS STANDARD	Saurav	XJS	MN	SM
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**TYPE - A**

DETAIL NO.	D11-101	D11-102	D11-103	D11-104	D11-105
W	1200	1000	800	800	400
H	400	400	300	300	200

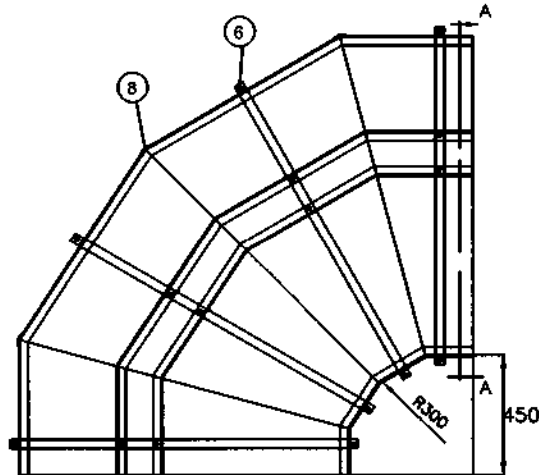
**TYPE - B**

DETAIL NO.	D11-201	D11-202	D11-203	D11-204	D11-205
W	1200	1000	800	600	400
H	400	400	300	300	200

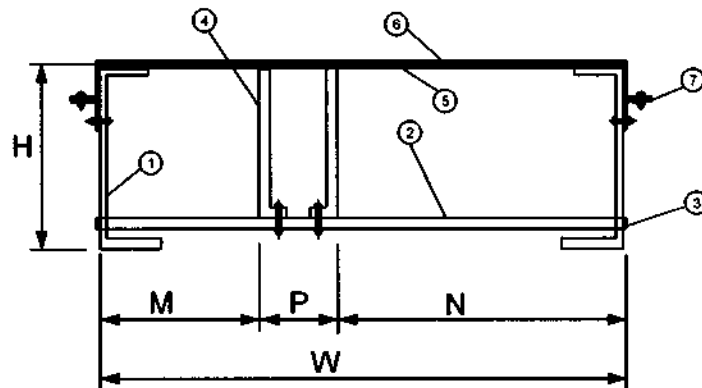
## DIMENSIONAL DETAILS FOR 11A



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**90 DEG HORIZONTAL BEND**

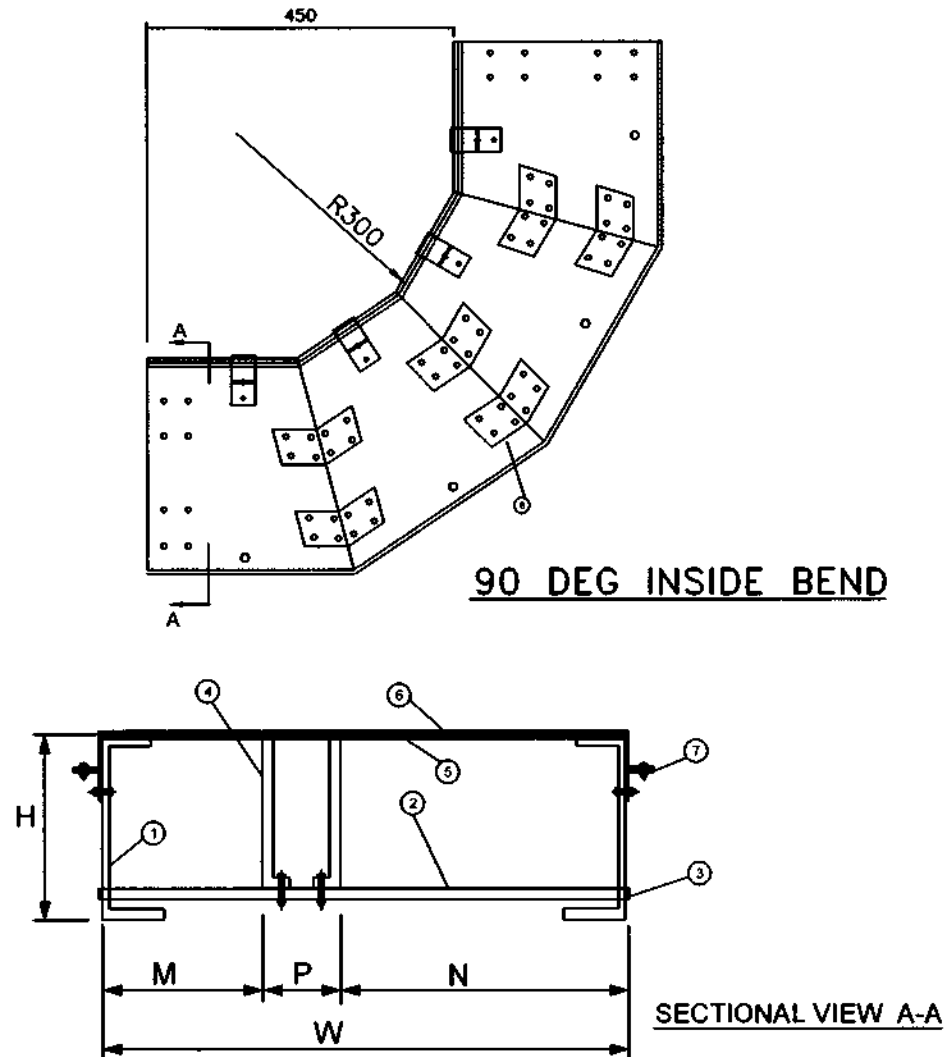


**SECTIONAL VIEW A-A**

S. No.	DESCRIPTION	QTY.	MATERIAL
1	C- CHANNEL	AS REQ.	FRP
2	25x25 SQ. TUBE	AS REQ.	FRP
3	25x25 SQ. TUBE RUNG FIXING PLUG	AS REQ.	FRP
4	SEPARATOR 3MM THK.	AS REQ.	FRP
5	COVER 3MM THK.	AS REQ.	FRP
6	TRAY COVER HOLD DOWN CLAMP WITH SS316 HARDWARE	AS REQ.	SS316
7	ANGLE CLEAT WITH SS316 HARDWARE	AS REQ.	SS316
8	FISH PLATE WITH SS316 HARDWARE	AS REQ.	FRP

DETAIL  
12A

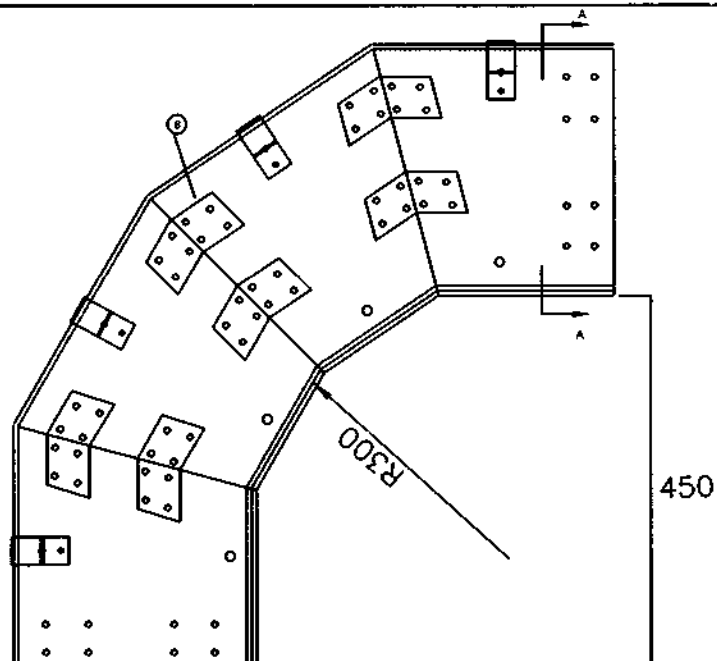
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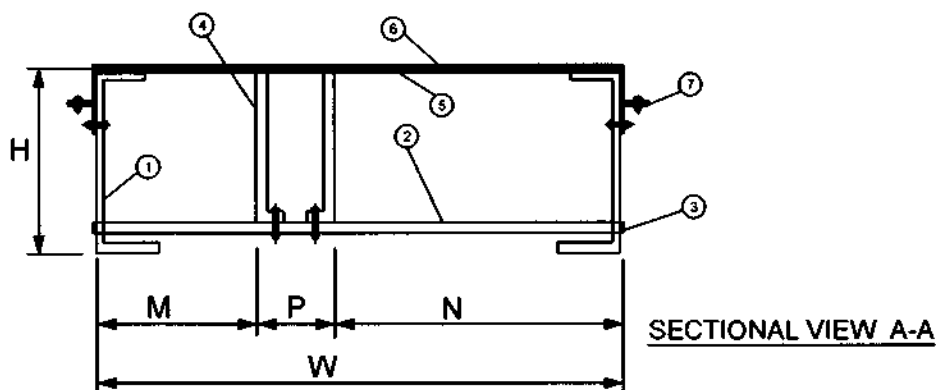
S. No.	DESCRIPTION	QTY.	MATERIAL
1	C- CHANNEL	AS REQ.	FRP
2	25x25 SQ. TUBE	AS REQ.	FRP
3	25x25 SQ. TUBE RUNG FIXING PLUG	AS REQ.	FRP
4	SEPARATOR 3MM THK.	AS REQ.	FRP
5	COVER 3MM THK.	AS REQ.	FRP
6	TRAY COVER HOLD DOWN CLAMP WITH SS316 HARDWARE	AS REQ.	SS316
7	ANGLE CLEAT WITH SS316 HARDWARE	AS REQ.	SS316
8	FISH PLATE WITH SS316 HARDWARE	AS REQ.	FRP

DETAIL  
12B

0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
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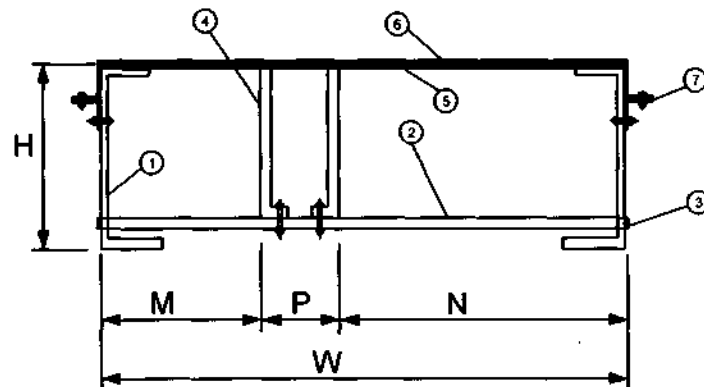
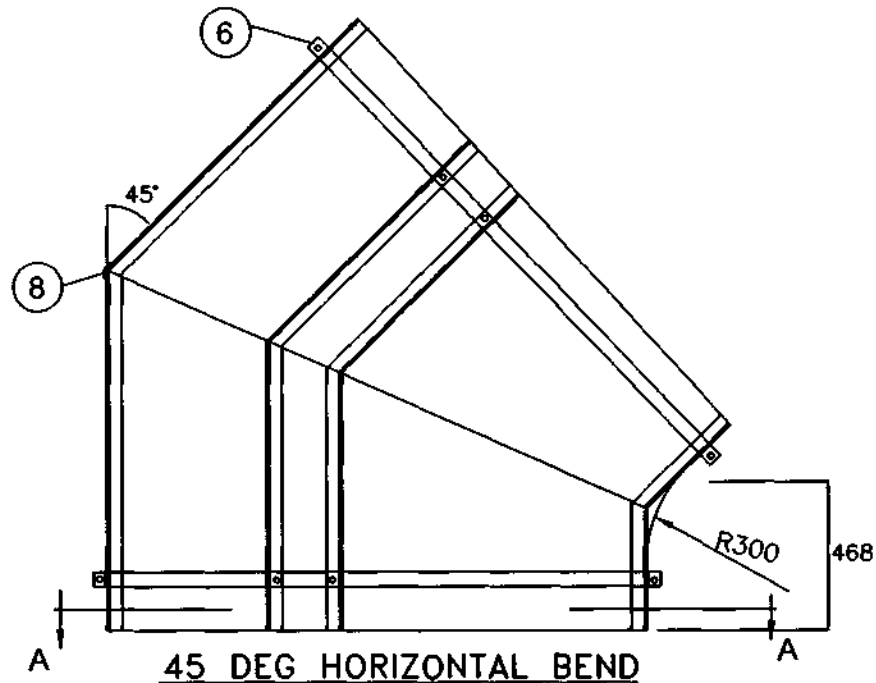
**90 DEG OUTSIDE BEND**



S. No.	DESCRIPTION	QTY.	MATERIAL
1	C- CHANNEL	AS REQ.	FRP
2	25x25 SQ. TUBE	AS REQ.	FRP
3	25x25 SQ. TUBE RUNG FIXING PLUG	AS REQ.	FRP
4	SEPARATOR 3MM THK.	AS REQ.	FRP
5	COVER 3MM THK.	AS REQ.	FRP
6	TRAY COVER HOLD DOWN CLAMP WITH SS316 HARDWARE	AS REQ.	SS316
7	ANGLE CLEAT WITH SS316 HARDWARE	AS REQ.	SS316
8	FISH PLATE WITH SS316 HARDWARE	AS REQ.	FRP

DETAIL  
12C

0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
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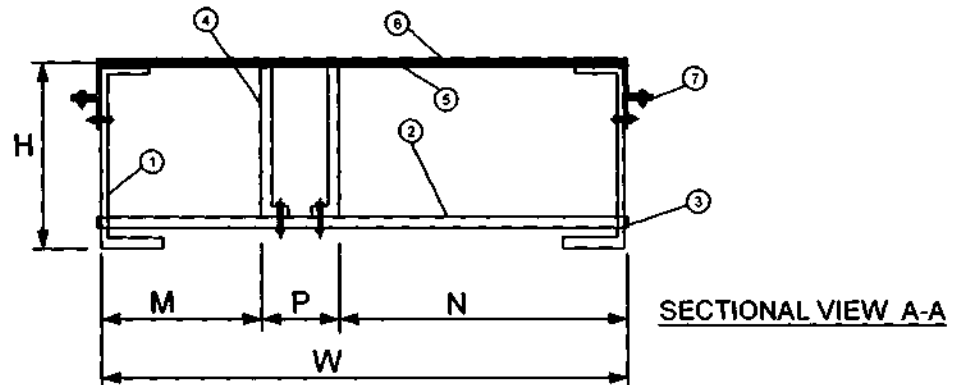
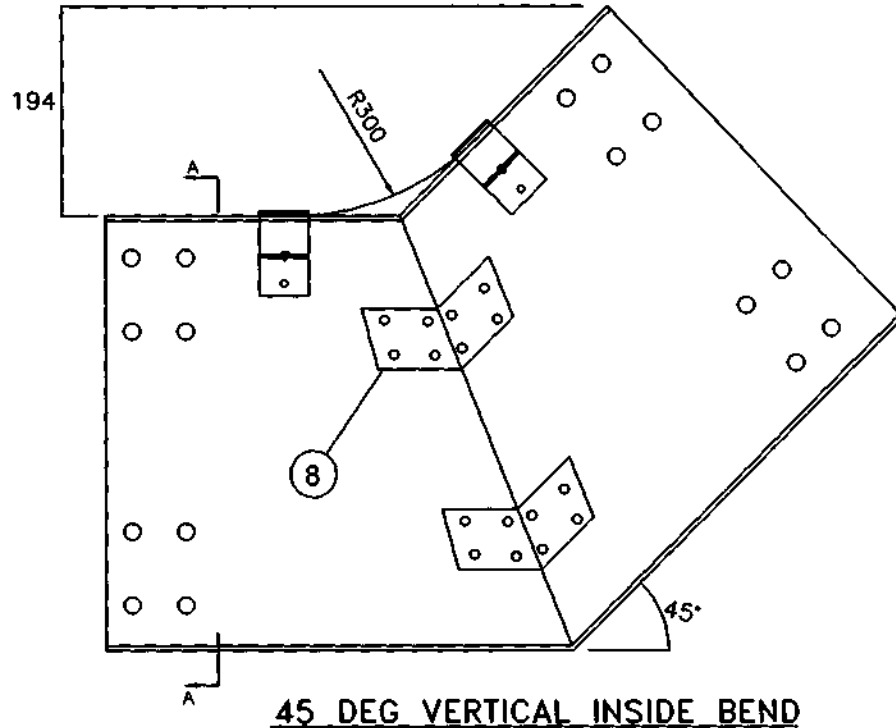
**SECTIONAL VIEW A-A**

S. No.	DESCRIPTION	QTY.	MATERIAL
1	C- CHANNEL	AS REQ.	FRP
2	25x25 SQ. TUBE	AS REQ.	FRP
3	25x25 SQ. TUBE RUNG FIXING PLUG	AS REQ.	FRP
4	SEPARATOR 3MM THK.	AS REQ.	FRP
5	COVER 3MM THK.	AS REQ.	FRP
6	TRAY COVER HOLD DOWN CLAMP WITH SS316 HARDWARE	AS REQ.	SS316
7	ANGLE CLEAT WITH SS316 HARDWARE	AS REQ.	SS316
8	FISH PLATE WITH SS316 HARDWARE	AS REQ.	FRP

DETAIL  
13A

0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
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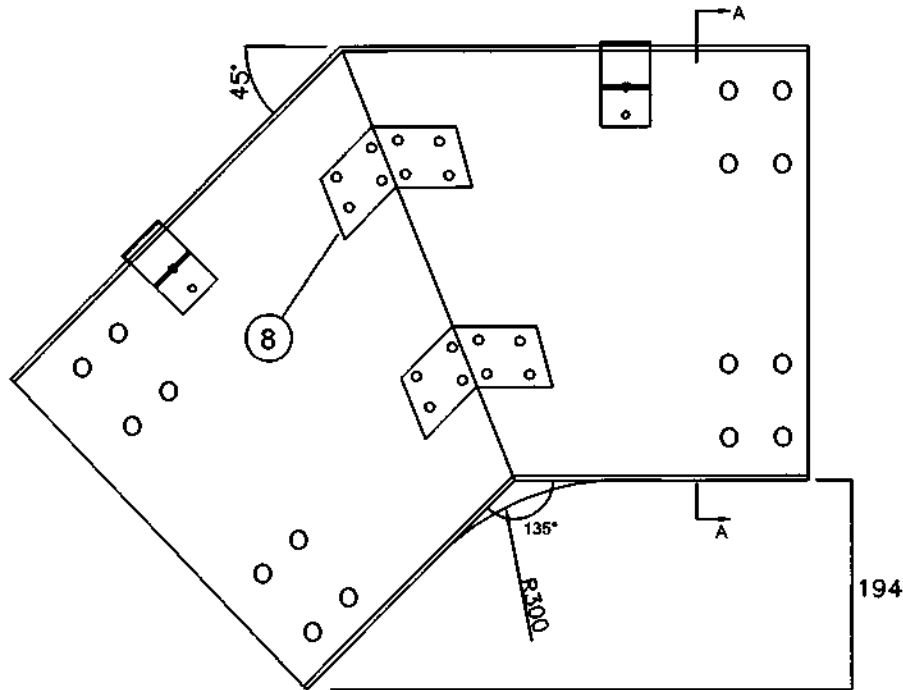




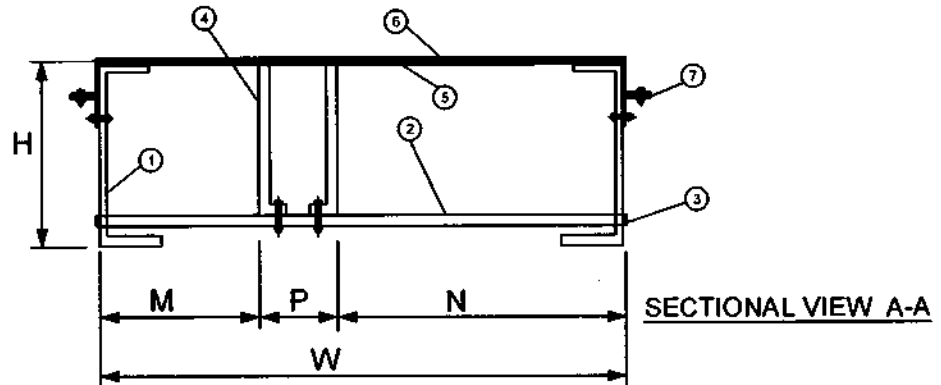
S. No.	DESCRIPTION	QTY.	MATERIAL
1	C- CHANNEL	AS REQ.	FRP
2	25x25 SQ. TUBE	AS REQ.	FRP
3	25x25 SQ. TUBE RUNG FIXING PLUG	AS REQ.	FRP
4	SEPARATOR 3MM THK.	AS REQ.	FRP
5	COVER 3MM THK.	AS REQ.	FRP
6	TRAY COVER HOLD DOWN CLAMP WITH SS316 HARDWARE	AS REQ.	SS316
7	ANGLE CLEAT WITH SS316 HARDWARE	AS REQ.	SS316
8	FISH PLATE WITH SS316 HARDWARE	AS REQ.	FRP

DETAIL  
13B

0	13-09-21	ISSUED AS STANDARD	Saurav	AS	MN	SM
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**45 DEG VERTICAL OUTSIDE BEND**

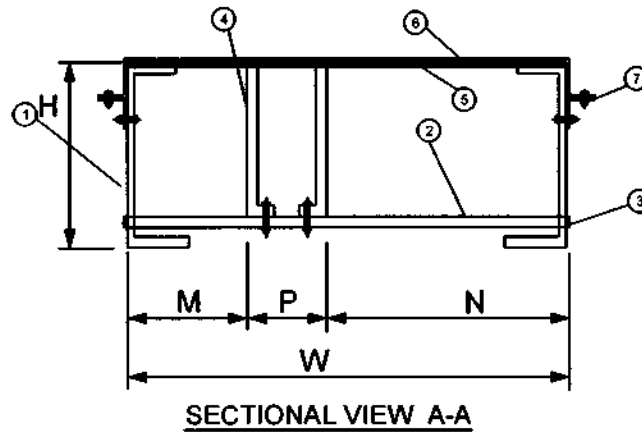
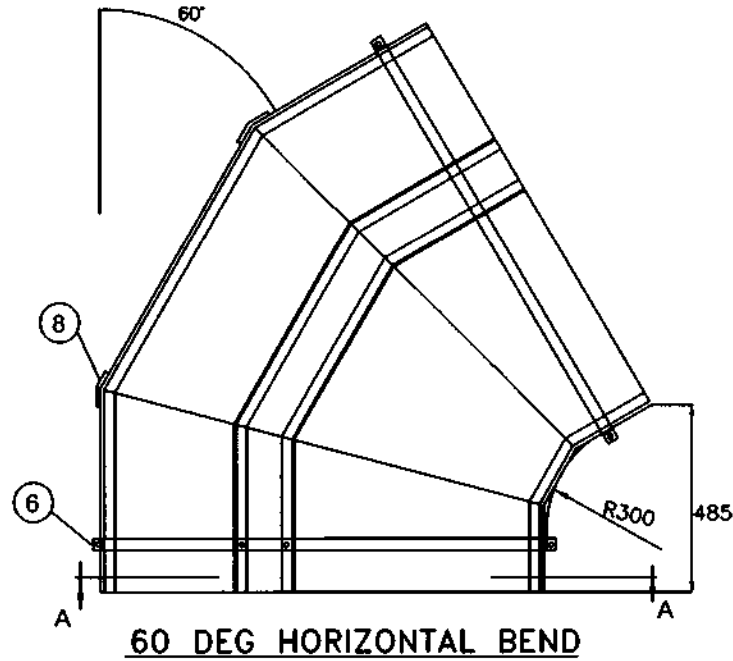


**SECTIONAL VIEW A-A**

S. No.	DESCRIPTION	QTY.	MATERIAL
1	C- CHANNEL	AS REQ.	FRP
2	25x25 SQ. TUBE	AS REQ.	FRP
3	25x25 SQ. TUBE RUNG FIXING PLUG	AS REQ.	FRP
4	SEPARATOR 3MM THK.	AS REQ.	FRP
5	COVER 3MM THK.	AS REQ.	FRP
6	TRAY COVER HOLD DOWN CLAMP WITH SS316 HARDWARE	AS REQ.	SS316
7	ANGLE CLEAT WITH SS316 HARDWARE	AS REQ.	SS316
8	FISH PLATE WITH SS316 HARDWARE	AS REQ.	FRP

DETAIL  
13C

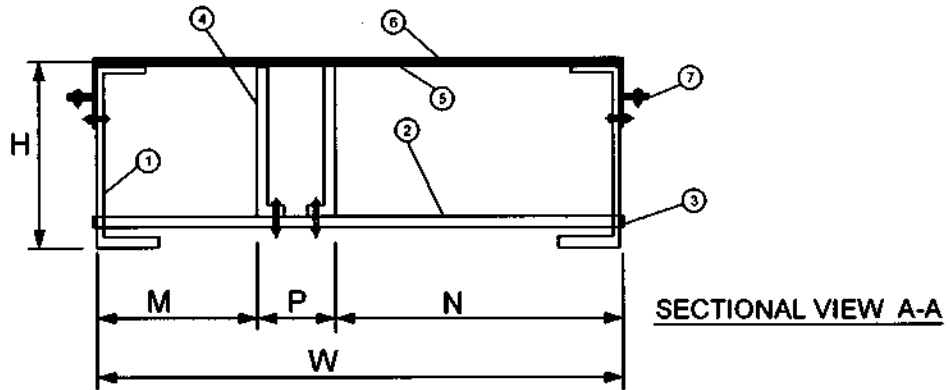
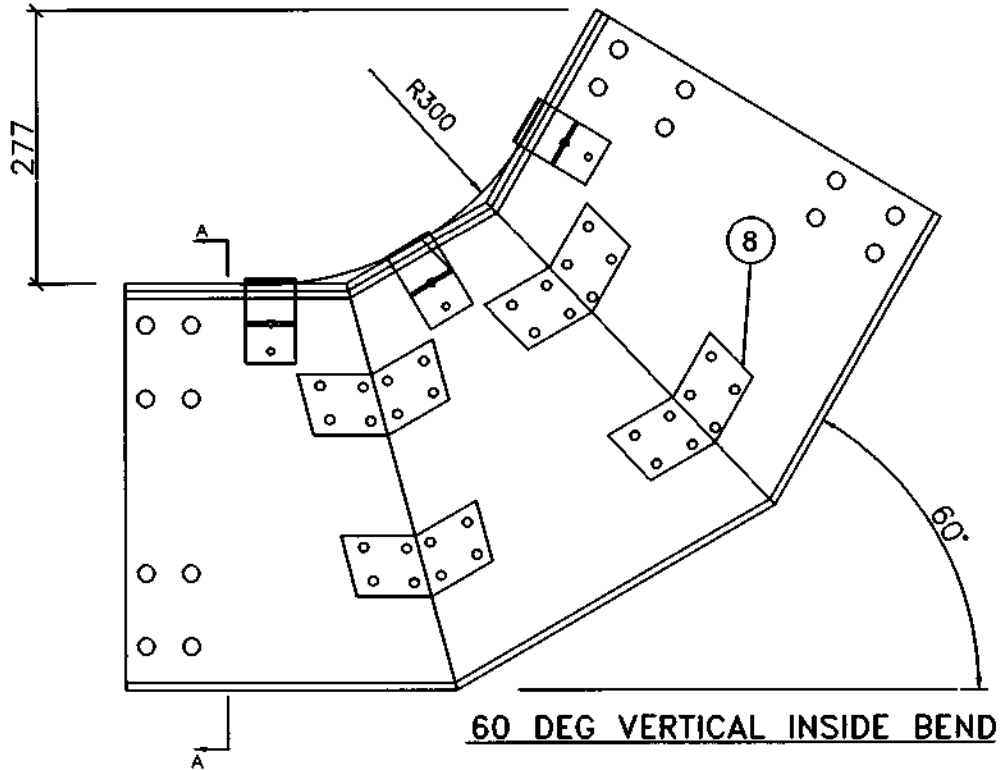
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S. No.	DESCRIPTION	QTY.	MATERIAL
1	C- CHANNEL	AS REQ.	FRP
2	25x25 SQ. TUBE	AS REQ.	FRP
3	25x25 SQ. TUBE RUNG FIXING PLUG	AS REQ.	FRP
4	SEPARATOR 3MM THK.	AS REQ.	FRP
5	COVER 3MM THK.	AS REQ.	FRP
6	TRAY COVER HOLD DOWN CLAMP WITH SS316 HARDWARE	AS REQ.	SS316
7	ANGLE CLEAT WITH SS316 HARDWARE	AS REQ.	SS316
8	FISH PLATE WITH SS316 HARDWARE	AS REQ.	FRP

DETAIL  
14A

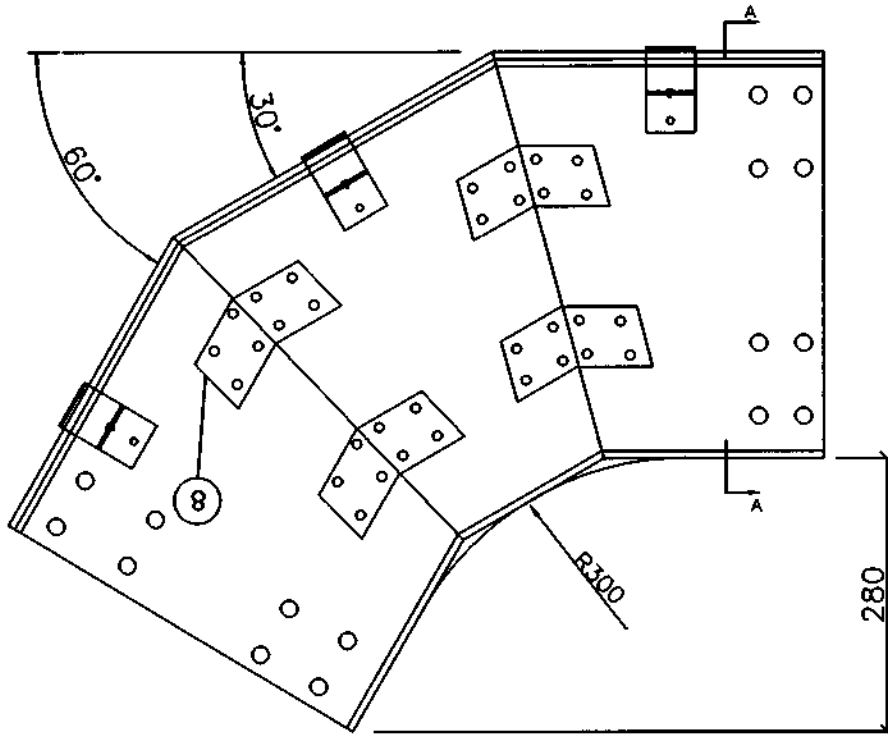
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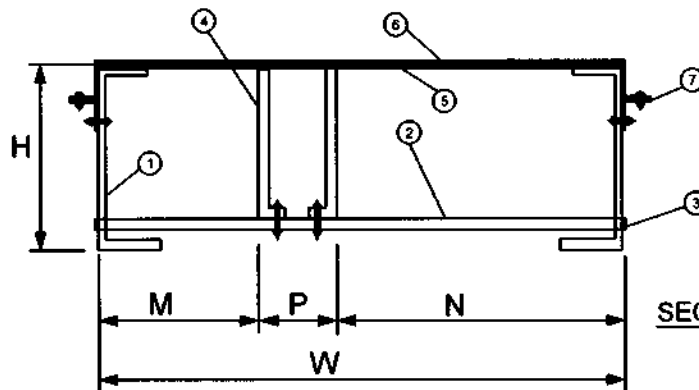
S. No.	DESCRIPTION	QTY.	MATERIAL
1	C- CHANNEL	AS REQ.	FRP
2	25x25 SQ. TUBE	AS REQ.	FRP
3	25x25 SQ. TUBE RUNG FIXING PLUG	AS REQ.	FRP
4	SEPARATOR 3MM THK.	AS REQ.	FRP
5	COVER 3MM THK.	AS REQ.	FRP
6	TRAY COVER HOLD DOWN CLAMP WITH SS316 HARDWARE	AS REQ.	SS316
7	ANGLE CLEAT WITH SS316 HARDWARE	AS REQ.	SS316
8	FISH PLATE WITH SS316 HARDWARE	AS REQ.	FRP

DETAIL  
14B

0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
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**60 DEG VERTICAL OUTSIDE BEND**



**SECTIONAL VIEW A-A**

S. No.	DESCRIPTION	QTY.	MATERIAL
1	C- CHANNEL	AS REQ.	FRP
2	25x25 SQ. TUBE	AS REQ.	FRP
3	25x25 SQ. TUBE RUNG FIXING PLUG	AS REQ.	FRP
4	SEPARATOR 3MM THK.	AS REQ.	FRP
5	COVER 3MM THK.	AS REQ.	FRP
6	TRAY COVER HOLD DOWN CLAMP WITH SS316 HARDWARE	AS REQ.	SS316
7	ANGLE CLEAT WITH SS316 HARDWARE	AS REQ.	SS316
8	FISH PLATE WITH SS316 HARDWARE	AS REQ.	FRP

DETAIL  
14C

0	13-09-21	ISSUED AS STANDARD	Saurav	AJS	MN	SM
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**GENERAL NOTES ON FRP CABLE DUCT**

**A. CODES & STANDARD (CURRENT ISSUE)**

ASTM-D149	Standard test method for dielectric breakdown voltage and dielectric strength of solid electrical insulating materials at commercial power frequencies
ASTM-D256	Standard test methods for determining the Izod pendulum impact resistance of plastics
ASTM-D635	Standard test method for rate of burning and/or extent and time of burning of plastics in a horizontal position
ASTM-D638	Standard test method for tensile properties of plastics
ASTM-D790	Standard test methods for flexural properties of unreinforced and reinforced plastics and electrical insulating materials
ASTM-D2863	Standard test method for measuring the minimum oxygen concentration to Support candle-like combustion of plastics (oxygen index)
ASTM-E84	Standard test method for surface burning characteristics of building materials
IS 6746	Unsaturated polyester resin system for low pressure fiber glass reinforced plastic.
NEMA FGI	Fiber glass cable tray system
UL 94	Standard for safety of flammability of plastic materials for parts in devices and appliance testing
ASTM D 257	Surface Resistivity for Plastics
BS-476	Part 6 : Method of Test for Fire Propagation For Products Part 7: Method For Classification of The Surface Spread of Flame Of Products

DETAIL  
15A

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**NOTES FOR FRP CABLE DUCT**

**B. TECHNICAL REQUIREMENTS OF FRP CABLE DUCT**

1. All dimensions are in MM.
  2. Shall be antistatic, ultra violet resistant & fire retardant , very low flammability as per UL 94 V0.
  3. Manufacturing standard : in accordance with NEMA FG-1-1993 and ASTM E-84 Standard/ IS-6746
  4. Manufacturing process: Pultrusion using automated pultrusion machines. Resin shall be ultraviolet resistant polyester resin in general. The resin shall be Vinyle Ester if specified for highly corrosive environment.
  5. Shall be corrosion / chemical resistant, weather resistant, easy to drill and cut, lightweight, high strength and flame retardant with Class 1 as per ASTM E - 8, very low flammability as per IS 6746 & VO in accordance with UL- 94.
  6. Oxygen index - min 30 as per ASTM-D-2863.
  7. Chemical composition: Manufacturer must use isophthalic resin with minimum 60% glass content by weight.
  8. FRP Duct Thickness : 5 mm min & should be no negative tolerance in Thickness
  9. FRP Cover Thickness: 5 mm min
  10. Standard length of 2600 mm.
  11. Accessories: Each section shall be complete with all necessary connector plate, partition plates and hardware.
  12. Hardware (Nuts, bolts, double washers etc.) MOC: SS304
  13. FRP ducts coupler plates MOC. : Same as FRP duct material
  14. Bending radius : 300mm.
  15. Support : Continuous duct support horizontally throughout the FRP bottom using suitable C channels .
  16. Cable load can be considered as under for:
    - i) 1200mm W x 400mm H :700 kg/Linear Meter
    - ii) 1000mm W x 400mm H: 580 kg/Linear Meter
    - iii) 800mm W x 300mm H: 340 kg/Linear Meter
    - iv) 600mm W x 300mm H: 260 kg/Linear Meter
    - v) 400mm W x 200mm H: 90 kg/Linear Meter
  17. Deflection should be measured as  $\leq L/200\text{mm}$  (Where L stand for Support Span). Shall also be suitable for '80kG concentrated load at the centre of span.
  18. Partition MOC- should be such that it does not corrode neither it should transmit the EMF across the partition. For non metallic portions it should have surface resistivity of max  $10^6$  ohms as per ASTM D257
- General notes
- Tolerance in Length + 30 MM
  - Tolerance in DIMENSIONS + 2 MM
  - Tolerance in thickness + 0.5 MM

**C. TESTING**

1. Testing FRP ducts: as per NEMA-FG1-1984-1993(Current Issue).
2. Additional tests.
  - a) Deflection Test:  $L/200\text{mm}$  (L = Support Span)
  - b) Destruction Load Test
3. Surface burning characteristic test: As per ASTM-E84. The flame spread index shall be minimum possible but not more than 15 and type test report shall be submitted
4. UV Resistance Test: FRP cable ducts material must be U.V stabilized to provide min 15 years of life. It shall meet accelerated weathering test as per ASTM G-154 for min 1500 hours with flexural strength not reducing by more the 10% of original value after U.V exposure. Type test report is to be submitted
5. Rung Load Test:- The rung must be able to withstand a rung load test of minimum load per rung as given below for each duct size. The rung design should be suitable for fixing partitions, providing proper bearing support to the partition.
  - (i) Duct size 1200 mm X 400 mm H :- 350kg/rung.
  - (ii) Duct size 1000 mm X 400 mm H :- 290kg/rung.
  - (iii) Duct size 800 mm X 300 mm H :- 170kg/rung.
  - (iv) Duct size 600 mm X 300 mm H :- 130kg/rung.
  - (v) Duct size 400 mm X 200 mm H :- 45kg/rung.

DETAIL  
15B

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