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INVITATION TO TENDER

Ref.: OS/21-22/2439/MFC-CS/05/020 Date: 25.11.2021

Sub: **Fabrication of CS portion of Main Shell of Main Fractionator Column at Lovagarden site of BHEL-HPVP, Visakhapatnam**

Dear Sir,

Sealed tenders are invited for the subject work in **two-part bid** system from the vendors who are experienced in fabrication of similar jobs subject to the following eligibility criteria:

1. ELIGIBILITY CRITERIA:

1.1 Bidders must have an experience in execution of similar jobs i.e. Columns/Pressure Vessels for process industries in the past 7 Years as on 31.10.2021. Bidders shall enclose Work Order, Work Completion Certificate and all other relevant documents in support of their experience in execution of similar job for at least one project.

1.2 Bidders shall also have to enclose the documents of Registration of Firm/ Factory License/ Certificate of Incorporation, EPF, ESI, PAN, GSTIN, Udyog Aadhar Memorandum (if registered with MSME) etc.

1.3 The works executed in own name of the individual / firm of the tenderer will only be considered for eligibility criteria.

2. VENDOR'S SCOPE OF WORK: Detailed scope of the fabrication work will be as follows:

Fabrication of CS portion only of Main Shell of Main Fractionator Column (vessel Tag No. 111-C-2101; Approx. weight of 80 MT) in two segments i.e., Shell sections (1+2+3) in one segment and Shell sections (4+5+6) in another segment as per the approved drawings, QAP / ITP, WPS, Procedures, Specifications & Standards.

It may be noted that the weight indicated above is tentative and may vary on both sides due to revision in the drawings, if any.

2.1 Collection of all free issue raw materials from HPVP Stores and Transportation to Lovagarden site (A Sea Front facility of BHEL-HPVP near Hindustan Shipyard Limited - OPF Site, Visakhapatnam, Andhra Pradesh) including unloading at the Lovagarden site.

2.2 After receipt of free issue materials at BHEL-HPVP Lovagarden site - Visakhapatnam, the inspection clearance of the same shall be obtained from HPVP (QC) / TPIA / EIL as per approved QAP.

2.3 Marking, Squaring, Cutting, Weld Edge preparation / Beveling of Shell plates as per drawings & approved QAP.

2.4 Rolling of CS shell sections as per approved drawings / QAP

2.5 Assembly, Fit-up & Welding of L-Seams of Shell sections as per drawings & approved QAP along with Production Test Coupons.

2.6 Assembly, Fit-up & Welding of C-Seams of Shell sections as per drawings & approved QAP along with Production Test Coupons wherever required.

2.7 Profile of the rolled segments shall be maintained by temporary spiders / profile plates, for which raw materials shall be Free Issue by the BHEL-HPVP

2.8 100% PT on root & final weld, chipped back L-Seam & C-Seam Welds of Shell as per approved QAP / NDE procedure.

2.9 Radiography Test of L-Seam & C-Seam Welds of Shell and Production Test Coupons as per approved QAP.

2.10 Dimensional inspection as per approved drawing & QAP.

2.11 Offering the job for stage wise inspection and obtaining stage wise inspection clearance, Final Inspection clearance from HPVP (QC) / TPIA / EIL as per approved QAP.

2.12 All NDT activities like DPT, MPT, RT, UT, etc., shall be carried out as per approved QAP by NDT personnel qualified by BHEL as per BHEL Procedure No. BHEL: NDE: WP01.

2.13 NDT agency engaged by fabrication contractors shall have to ensure that their NDE personnel are qualified by BHEL in advance before starting of the job.

2.14 Production Test Coupons after RT to be tested as per approved QAP / Procedures.

2.15 Handing over of Production Test Coupons to SR agency for PWHT / SR along with the Shell segments.

2.16 Welding is to be carried out by ASME qualified welders only. Vendor shall arrange for Qualification of Welders at HPVP under the supervision of BHEL / WT dept. at their own cost. However, Test Coupons shall be provided by BHEL as free issue.

2.17 All machinery, tool & tackles and consumables like welding electrodes, gases, grinding wheels etc. required for fabrication are in the scope of the Vendor. The electrodes / filler wire shall be of BHEL / EIL approved makes only and the vendor shall submit the Batch Test Certificates to BHEL for verification before using on the job.

2.18 Experienced Site-in-charge and Qualified Engineers & Supervisors shall be deployed for proper co-ordination of the job.

2.19 Vendors should deploy Qualified QC personnel for carrying out the inspection activities in coordination with BHEL QC inspector / TPIA / EIL.

2.20 Vendors should deploy Qualified NDT personnel for carrying out the NDT inspection activities in coordination with BHEL QC –NDT / TPIA / EIL. Vendors shall have to engage sufficient man power for fabrication to meet HPVP delivery schedules.

2.21 Vendor shall deploy sufficient no. of calibrated Welding machines, Main Ovens & Portable Ovens required for baking of electrodes etc., at site. All relevant documents shall also be made available for verification & approval by BHEL - HPVP (QC) / TPIA.

2.22 Vendor shall deploy suitable Cranes for handling of the raw materials, plates/ shell segments required during the fabrication. However, for handling of heavy components, BHEL has deployed one no. of 75MT Crawler crane and one no. of 300 MT Crawler Crane.

2.23 Diesel required for the operation of BHEL cranes and DG set will be Free Issue by BHEL. However, transportation of the diesel from BHEL-HPVP to Lovagarden site has to be arranged by the Vendor.

2.24 Sufficient No. of Rollers & Idlers required for fabrication of Shell segments are to be arranged by the vendor.

2.25 Required tools & tackles like Measuring instruments, Thermal Chalks / Pyrometer etc., shall be calibrated and valid calibration certificates must be presented, if required.

2.26 All the Scaffolding materials like Pipes, Clamps, Jallies etc. for temporary platform works are to arranged by the Vendor.

2.27 Gate passes for the Manpower, Materials, Hydra Cranes, Trailers etc., are to be taken care by the contractor.

2.28 Any modification work due to revision of drawings during fabrication is to be carried out by the vendor without any extra cost.

2.29 Submission of economic cutting plans for the plate materials and approval shall be obtained from BHEL-HPVP before taking up the same. Wherever fabrication is done without proper approved cutting plans, any loss of materials arising due to the same will be recovered as per BHEL recovery rates.

2.30 Vendors shall have to return the excess / balance materials including off-cuts and total scrap available with the vendors exclusive of process allowance & invisible wastage to HPVP Stores after material reconciliation but before submission of their final bill. In case the same are not returned by the vendor, Recovery shall be made as per BHEL Rates / MSTC rates plus applicable taxes, prevailing at the time of processing of the final bills.

2.31 Though not mentioned specifically, any activity which is required for completion of the work is deemed to be included in the scope of work of vendor.

3. BHEL SCOPE: BHEL – HPVP shall provide the following as free issue:

3.1 Drawings, GMS, QAP, WPS, applicable Procedures, Standards & Specifications.

3.2 Raw materials like Plates (full / off-cuts) as per GMS from HPVP stores.

3.3 Testing of Production Test Coupons in HPVP QC laboratory

3.4 300 MT & 75 MT crane along with operator will be provided by BHEL free of charge for fabrication. Maintenance of the crane including spares shall also be in the scope of BHEL. However, Riggers required for handling the job shall be arranged by the vendor.

3.5 DG set will be provided as a Standby during power breakdown. However, experienced operator for DG set has to be arranged by the vendor.

3.6 Area required for fabrication, Site office and Stores at Lovagarden site will be provided free of charge.

3.7 Power & Water shall also be provided free of charge at one point inside the fabrication yard but further distribution to the desired location is in vendor's scope.

3.8 Vendor's scope shall include arranging Distribution Board with suitable capacity Switch Fuse unit as incomer, all outgoings with necessary safe trips like MCB, ELCB etc., as per the industrial safety norms and their installation, all outgoing cables from Distribution Board, termination at the distribution board, Working Area Lighting.

4. INSPECTION:

4.1 Inspection shall be carried out by M/s. BHEL–HPVP, Vizag / BHEL Authorized Inspection Agency (TPIA) / EIL / Customer as per approved QAP. Contractor shall have to offer for Stage wise and Final inspection as per approved QAP and obtain necessary stage wise & final clearances before proceeding for further operations.

4.2 Fabrication Vendor shall be solely responsible for preparation and submission of all Inspection Reports & documents duly certified by Inspection Authority.

4.3 All the documentation related to inspection clearance of M/s. BHEL / TPI / EIL / Customer, Generation of Inspection Reports, Preparation of Final Documents as per BHEL standard formats etc., are included in the scope of vendor and scanned copy as well as hard copy of the same is to be submitted to BHEL-QA.

Note: QAP / ITP enclosed with the tender document is tentative only and may be subject to revision due to incorporation of comments of the approving authority. Hence, the approved QAP / ITP issued to the vendor after ordering shall only be followed for execution and inspection of the job.

5. DELIVERY:

5.1 Finished Shell segments along with inspection documents and all other certificates are to be handed over to HPVP within 8 Weeks from the date of issue of First consignment of free issue materials or 4 weeks from the date of issue of Last consignment of materials, whichever is later.

Note: In case the delivery period offered by the vendor is more than the tender delivery, Price quoted by the bidder shall be loaded for additional period @1/2 % per week or part thereof for the purpose of evaluation of Bidder Status.

6. SITE MOBILISATION:

6.1 Successful bidders shall have to complete site mobilization within 7 days from the date of receipt of order (or) from the date of intimation for the same by Outsourcing dept**.** whichever is later.

7. PRICE:

7.1 The price shall be quoted strictly as per the Schedule of Rates enclosed at Annexure – I for the detailed scope of work and the quoted price shall be inclusive of all applicable taxes & duties **except GST**.

7.2 The prices shall be fixed & firm without any escalation during the entire period of contract and till completion of the work.

7.3 GST shall be reimbursable to the vendor as per applicable guidelines.

7.4 Income tax will be deducted at applicable rates from RA & Final bills.

8. GOODS & SERVICES TAX (GST):

8.1 Bidders shall make a note of the following points of GST before submission of their offer:

a) Vendors shall have to mention their GSTIN no. (15 Digits) in their Technical Bid. If any specific exemption is available, a declaration with due supporting documents need to be furnished for considering the offer.

b) Semi-finished goods are to be delivered by the Vendors in BHEL, HPVP premises within a maximum period of one year from the date of issue of the material, failing which the whole transaction will be considered as Supply & Sale and GST is required to be paid along with interest (calculated @ SBI Base Rate + 6%) along with penalty, if any, from the date of Challan on the whole value of materials. Hence vendors shall have to ensure that materials issued to them are returned within 365 days.

c) After fabrication, the vendors shall have to deliver the Semi - finished Goods by fulfilling the following formalities:

i) GST invoice should be raised by the vendors by paying GST on job work charges at applicable rates and by incorporating the HPVP GSTIN no. in the invoice for availing the reimbursement of GST from HPVP.

ii) The vendor shall also have to enter in their GST Return -1 (GSTR-1) the details of invoice raised for payment of GST so as to enable HPVP to avail input credit.

9. REVERSE AUCTION:

9.1 BHEL shall be resorting to Reverse Auction (RA) for this tender. RA shall be conducted among the eligible techno-commercially qualified bidders. Business Rules for Reverse Auction are given at Annexure – V and Guidelines for Reverse Auction are available on our website, **www.bhel.com** → supplier registration → Guidelines for Reverse Auction 2021, before submission of their offer.

9.2 Sealed envelope / Electronic Price bids of all the techno-commercially qualified bidders shall be opened and the same shall be considered as initial bids of the bidders in RA. In case any bidder(s) do(es) not participate in online Reverse Auction, their sealed envelope / Electronic price bid along with applicable loading, if any, shall be considered for ranking.

9.3 BHEL will inform bidders the details of service provider who will provide business rules, all necessary training and assistance before commencement of online bidding. The bidders participating in the Reverse Auction shall have to necessarily submit **'Process Compliance Form'** (PCF) to the designated Service Provider.

9.4 Bidders are advised to read the 'Business Rules' (Annexure – V) indicating details of RA event carefully, before reverse auction event.

10. Other Terms & Conditions, whichever applicable, shall be as per Annexure – III enclosed.

11. RISK PURCHASE:

In case the contractor fails to execute the work within the scheduled time or due to any other reasons, BHEL - HPVP reserves the right to get the same completed through some other party at the risk & cost of the contractor and any additional expenditure incurred due to the same shall be charged to the contractor**.**

12. VALIDITY OF OFFER:

The offer shall be valid for a period of **3 months** from the date of Reverse Auction.

13. GENERAL:

13.1 The bidders shall study the Tender documents, Drawings, Quality Documents and all other relevant documents in detail for understanding the scope of work and the processes involved before submission of offer. Bidders shall get clarifications, if any, from concerned officials on the scope of work, clarifications related to welding or any other details of the tender document, over phone between 09:00 AM and 04:00 PM on any working day or through e-mail.

13.2 Drawings, QAP, Clarifications related to Welding, other reference documents etc., shall be sent to the bidder's e-mail address upon their written/e-mail request.

13.3 **Conditional / Partial Price Bids** and any other deviations to the tender terms & conditions are not acceptable and BHEL reserves the right to reject such offers without further correspondence. Bidders shall confirm their acceptance to all the terms & conditions of the tender enquiry in the Techno-commercial Bids and any deviations mentioned in the Price Bids shall not be considered.

13.4 BHEL reserves the right to modify or cancel the tender enquiry at any stage without assigning any reasons thereof.

13.5 The General Terms & Conditions, if any, contradicting with the specific terms & conditions given in the tender, then specific terms & conditions shall only be considered.

14 The following documents shall form part of the tender enquiry:

i)	Schedule of Rates	: Annexure – I
ii)	List of Reference Drawings & Documents	: Annexure – II
iii)	General Terms & Conditions	: Annexure – III
iv)	Acceptance to Tender terms & conditions	: Annexure – IV
v)	Business Rules for Reverse Auction	: Annexure – V
vi)	GST Compliance for Indigenous Suppliers	: Annexure – GST
vii)	Applicable Drawings, Tentative ITP / QAP	

15 TENDER SUBMISSION (Through E - Mail):

15.1 Techno-commercial bids along with the tender document duly signed & stamped by the bidder on all pages and a covering letter on Company's Letter Head addressed to DGM (Outsourcing), BHEL –HPVP, Visakhapatnam shall be sent through an e-mail to the e-mail ID **technicalbid-hpvp@bhel.in**

15.2 **Tentative List of Man Power, Machinery, Tools & Tackles to be engaged by the vendor shall also be attached to the Techno-Commercial Bid.**

15.3 Price bid (i.e., Annexure – I) shall also be sent separately through e-mail to another e-mail ID **pricebid-hpvp@bhel.in**

15.4 Offers completed in all respects along with all the supporting documents shall be sent to the above e-mails only latest by **14.00 Hrs.** on **02.12.2021** duly mentioning the Name of Work, Tender Ref. No. & Date and Technical Bid / Price Bid in the subject of the e-mail.

Note: Do not mark CC and BCC while submitting your offer as the system is designed to reject such mails having more than one recipient. Max. file size of the attachment shall be 20 MB only. In case the file size is more, bidder can submit their offer through multiple mails within the due date and time.

15.5 Bidders shall ensure correctness of the e-mail addresses while submitting their offer. There shall be no other e-mail address at the receiving end while submission of the above bids otherwise the system will reject such mails. Bidder shall be solely responsible for non-receiving of such mails at the above mentioned e-mail addresses and no communication in this regard will be entertained

15.6 **TENDERS RECEIVED AFTER THE DUE DATE & TIME ARE NOT ACCEPTABLE.**

15.7 **OFFERS SENT IN ANY OTHER FORM WILL BE TREATED AS INVALID AND WILL BE SUMMARILY REJECTED.**

16. TENDER OPENING:

16.1 Techno-commercial Bids will be opened **at 14.00 Hrs** on **02.12.2021.** The bidders may depute their representatives at the time of opening of Technical bids.

16.2 After evaluation of the techno-commercial Bids, intimation regarding date & procedure of conducting reverse auction shall be given by the service provider to all the eligible techno-commercially qualified bidders through an e-mail in advance at an appropriate time.

For Bharat Heavy Electricals Limited,

25/11/21

ANNEXURE - I

SCHEDULE OF RATES

Ref: OS/21-22/2439/MFC-CS/05/020 **Date: 25.11.2021**

Sub : Fabrication of CS portion of Main Shell of Main Fractionator Column at Lovagarden site of BHEL-HPVP, Visakhapatnam

Sl. No.	S.O. No.	Description of Work	Unit	Qty.	Unit Rate (in ₹)	Total Amount (in ₹)
		Fabrication of CS portion of Main Shell of Main Fractionator Column at Lovagarden site with free issue of raw materials which includes Marking, Cutting, Rolling, Assembly, Fit-up, Welding, NDT, inspection as per the approved Drawings, Specifications, QAP, WPS and also includes collection of Free Issue Materials from HPVP Stores, transportation to Lova Garden site, Unloading at Lova Garden site etc., as per the detailed scope of work mentioned in the tender document. (All consumables are in vendor's scope)				
1	**2439**	**Fabrication of CS Portion of Main Shell of Main Fractionator Column - Eqpt. Tag No. 111-C-2101**	**MT**	**80**		
Total Amount in words:						

Notes :

1) The quantity and weights indicated above are approximate and may vary on both sides subject to revision of drawings. However, payment shall be made for the actual weights as per the applicable drawings / BOM.
2) The quoted price shall be inclusive of all applicable taxes & duties except GST. Income Tax shall be deducted at applicable rates from RA & Final Bills and GST shall be reimbursable to the vendor as per applicable guidelines.
3) The prices shall be fixed & firm without any escalation during the entire period of contract and till completion of work.
4) The bidders are advised to go through all the drawings & documents before quoting the tender.
5) The evaluation currency for this tender shall be **INR**.
6) Tenderer should quote the amount in figures & words. It may be noted that corrections, overwriting etc. are not allowed. If there is a discrepancy between amount in figures & words, the amount in words shall prevail unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail. If there is an error in the total corresponding to the addition or subtraction of sub-totals, the sub-totals shall prevail and total shall be corrected accordingly.

   In case of mismatch between rate and amount in figures, rate in figures shall be taken into consideration for further evaluation and processing.

ANNEXURE - II

Ref: OS/21-22/2439/MFC-CS/05/020 **Date: 25.11.2021**

LIST OF REFERENCE DRAWINGS & DOCUMENTS

Sub : Fabrication of CS portion of Main Shell of Main Fractionator Column at Lovagarden site of BHEL-HPVP, Visakhapatnam

Sl. No.	S.O. No.	PGMA	Eqpt. Name	Description of Drawings / Documents	Drawing / Document No.	Rev. No.	No. of Sheets
01	2439	CL-010	Main Fractionator Column (LAS with SS Clad) (Eqpt. Tag No. 111-C-2101)	General Assembly of Main Fractionator	1-CL-010-U0169	A	01
02				General Notes for Main Fractionator	1-CL-010-U0192	00	01
03				Vessel Design data of Main Fractionator Column	B224-111-80-43-DS-3001 Sheet 1 of 7 to 7 of 7	A	07
04				QAP for Main Fractionator Column	CQP 2516 Dtd. 05.02.2021	00	16
05				Procedure for Radiographic Examination	BHE-NDT-RT-07023	02	18
06				Procedure for Ultrasonic Examination	BHE-NDT-UT-07025	02	10
07				Procedure for Magnetic Particle Examination	BHE-NDT-MT-07024	02	13
08				Procedure for Liquid Penetrant Examination	BHE-NDT-PT-07026	02	09

Note : Drawings & Documents indicated above are purely tentative and may be subject to revisions due to incorporation of comments of the approving authority. Hence, the approved drawings and documents issued to the vendor after ordering shall only be followed for execution & inspection of the job.

GENERAL TERMS & CONDITIONS

1. **TECHNICAL DELIVERY CONDITIONS:**

   The work should conform to the technical data given in our drawings, GMS, Shipping List Specifications, QAP, WPS etc.

2. **PARTY'S SCOPE:**

   The scope of the party shall be as follows: -

   a) All welding equipments, baking oven, tools, jigs and fixtures, measuring instruments duly calibrated, handling facilities, testing facilities etc.

   b) All materials other than those mentioned under ñFree Issue Materials", which are required for completion of the work.

   c) All consumables such as electrodes, gases, grinding wheels etc.

   Note: Electrodes of specification mentioned in the drawings / WPS and of BHEL approved brands only shall be used and MTCs of the same shall be submitted to BHEL for verification before use.

3. **REVISION OF DRAWINGS:**

   There may be minor changes in the drawings during execution. In such a case, party should accommodate the same without any extra claim.

4. **WELDING QUALIFICATION:** Qualification of required number of Welders is partyôs responsibility at their cost.

5. **X–RAY:**

   All welding shall be of X-ray quality where specified on drawings. Inspection would specify the quantum of X-ray based on drawings / code requirement. Party should strictly follow the WPS and QAP issued by BHEL during welding. Getting the welds radiographed and getting them cleared by inspection is the responsibility of the party.

6. **RECTIFICATIONS / REJECTIONS:**

   Any rectification due to defective work, if required, shall be done by the party free of charge with a suitable technology approved before hand by BHEL in writing. The cost of material, if any used for rectification work / rejection work, will be estimated by BHEL and the same shall be debited to party's account. In case any rectification / rework is to be carried out due to defective material supplied by BHEL, the replacement material and consumables will be supplied by BHEL free of Cost.

7. **SECURITY DEPOSIT:**

   Vendors shall have to submit a Bank Guarantee for **10%** of the order value towards Security Deposit and safe custody of free issue materials within 15 days from the date of intimation by Outsourcing dept. The BG shall be valid for the entire contract period with a claim period of 12 months. This Bank Guarantee shall be released to the contractor after completion of work and on acceptance of the same by BHEL.

   Bidder agrees to submit performance security required for execution of the contract within the time period mentioned above. In case of delay in submission of performance security, enhanced performance security which would include interest (SBI rate + 6%) for the delayed period, shall be submitted by the bidder. Further, if performance security is not submitted till such time the first bill becomes due, the amount of performance security due shall be recovered as per terms defined in NIT/contract, from the bills along with due interest.

8. **PERFORMANCE BANK GUARANTEE:**

   Vendors shall have to submit Performance Bank Guarantee (claim period of 12 months) for 10% of the order value covering for the defects liability period. If PBG is not submitted, 10% of the order value shall be deducted towards PBG from the final bill and shall be refundable after performance guarantee period, if no defects are found during this period.

9. **RAW MATERIALS ISSUE:**

   Raw materials shall be issued with appropriate processing allowance and invisible wastage over the theoretical requirement of raw materials **(Plates, Sheets, Sections and Pipes).**

10. TRANSFER / RETURN OF LEFT OVER MATERIALS:

Party should maintain proper records for receipt & use of all free issue materials. The left over materials & scrap as per the material accounting statement shall be returned to HPVP stores along with finished job. Material Transfer Vouchers (MTV) from one order to another or from one vendor to another and Material Return Vouchers should be submitted immediately after transfer / return. The material reconciliation statement shall be submitted by the contractor after verification and certification by BHEL along with the final bill **within 30 days from the date of completion of work**. Otherwise, recovery for the balance materials shall be made from any of their pending bills without further intimation.

11. MATERIAL RECONCILIATION:

Orders issued to the vendors have to be completed in all respects including Material Accounting within a maximum of **180 days** from the **date of issue of the first material** from BHEL - HPVP stores.

Maximum of 0.5 % on the requirement of materials **(Plates, Sections and Pipes)** is admitted towards **process allowance and invisible wastage**.

Scrap quantity is permissible up to a **maximum of 1% on Structurals (Beams, Channels, Angles, Rods, Pipes etc.), 2% on Sheets, 3% for Plates** on the theoretical requirement of materials.

If wastage and scrap is beyond the above limits, it should be fully justified with cutting diagrams etc. which are to be approved in advance by BHEL. **Otherwise, the cost of raw materials beyond approved limits will be recovered from the contractor as per BHEL recovery rates including applicable taxes & duties**.

Material reconciliation including return of balance materials, off-cuts is to be completed within 20 days from the date of completion of the order. The material reconciliation statement shall be submitted by the contractor after verification and certification by BHEL-HPVP along with the final bill **within 30 days from the date of completion of work**. Otherwise, recovery for the balance materials shall be made from any of their pending bills without further intimation,

Repeated occurrence of inordinate delays in returning and settling the material accounting will entail BHEL the right to terminate the contract forthwith or impose a temporary suspension on further loading at the discretion of BHEL.

12. SCRAP & OFF-CUT NORMS:

Sl. No.	Description	Scrap Size (in mm)	Off-Cut (in MM)
1.	CS/AS Sheets & Plates	Below 500 × 250	500 × 250 & above
2.	Rolled sections Rod, angles etc. (other than -tubes, pipes)	Below 1000	1000 & above
3.	Tubes & Pipes	Below 500	500 & above
4.	Universal column	Below 1000	1000 & Above
5.	SS Sheets & Plates	Below 500 × 250	500 × 250 & above
6.	SS Structural, Rods, Tubes, Pipes	Below 250	250 & above
7.	Non – ferrous: sheets & plates, rods & tubes	Below 500 × 250 (S & PL), Below 250 (Rods & Tubes)	500 × 250 & above, 250 & above
8.	Big size Scrap	(2500 & above) × (150 to 249)	-

13. INSPECTION:

Party shall contact our Quality Control Dept. for stages of inspection before commencement of job and should strictly follow the stages of inspection as per QAP.

14. WORKMANSHIP GUARANTEE:

The vendors should give workmanship guarantee for fabricated items for a period of 18 months from the date of last delivery of the order. Any defects due to incomplete work, faulty workmanship found in the fabricated items after delivery during the defects liability period shall be rectified / replaced by the vendor free of cost. Otherwise, the expenditure incurred towards the same will be recovered from the pending bills of vendors.

15. WORK PROGRESS:

The fabricator shall furnish a weekly report on the progress of work along with the status of availability of free issue materials and requirement of further materials, if any.

Outsourcing dept. personnel will visit vendorôs works from time to time to assess and review the work progress. Free access shall be provided to BHEL or its inspection agency at all reasonable times of the day / night.

In case the progress is not satisfactory or supplies are delayed abnormally beyond the contractual delivery date, BHEL-HPVP, Visakhapatnam reserves the right to cancel the order in part or full or get the balance job in as is where is condition completed elsewhere by another agency at the risk and cost of Fabricator. The value of the work carried out by the party will be assessed by BHEL and the same shall be final. No compensation will be given to the fabricator in case of cancellation of order or diversion of balance job even if the jobs have been processed partly.

16. DELIVERY:

Finished items should be handed over to BHEL-HPVP on party's delivery challans along with Job completion certificate / Final Inspection Report from inspection agency / HPVP-QC department.

17. PENALTY:

If delivery exceeds the stipulated delivery schedule, penalty 1/2 % of the total value of order per week or part there of subject to a maximum of 10% on the total value of the order will be levied. However, time taken for the following will not be considered as delay on the part of the Sub-Contractor.

1) Intermediate operations, if any, carried out by BHEL.
2) Waiting time for BHEL / Third party Inspection beyond a normal time of 3 days.

18. PAYMENT TERMS:

Payment shall be made against RA Bills within 45 days from the date of submission of Bill.

90% payment will be made after handing over of the finished equipments along with all inspection documents to HPVP shops / Logistics dept. / ADM site / Lova Garden site, duly inspected & cleared by Inspection authority. Balance 10% payment shall be made along with the Final Bill against completion of total order in all respects including documentation.

Vendors shall have to submit the bills in the formats specified by HPVP-Outsourcing and the bills submitted in the specified format along with necessary supporting documents are only admitted for processing. The following documents shall be submitted along with the Final Bill: -

1. No Claim Certificate from the contractor
2. No Dues Certificate from BHEL
3. Work Completion Certificate from BHEL
4. Material Reconciliation Statement submitted by the Contractor and certified by concerned authority of BHEL (if applicable)
5. Workmanship Guarantee certificate from the contractor

19. SECRECY:

All the documents of BHEL inclusive of Drawings, GMS and Standards made available to the fabricator should be kept in strict confidence and under no circumstance be made available to others or allow others to make use of them. Such documents shall be returned to BHEL on demand after completion of the job. This secrecy clause is binding on the employees of the fabricators also. Violation of the same may lead to suspension of business with the vendor and necessary legal action.

20. SUB-LETTING:

In general, sub-letting of jobs will not be permitted. But in special circumstances, this may be allowed. In such case, the party should obtain written approval from BHEL-HPVP, Visakhapatnam before sub-letting.

21. FACTORY RULES AND REGULATIONS:

Party shall abide by all the rules and statutory regulations in force from time to time as per factories act. It shall be partyôs responsibility to ensure the safety of their workmen and fulfilling the ESI, PF and other relevant statutory regulations.

22. **SAFETY:**

a) Contractor shall adhere to safe construction practices, guard against hazardous & unsafe working conditions and shall comply with the safety rules of BHEL and local authorities. He shall maintain First Aid facilities for all his employees and labour. Contractorôs responsibility includes supply of welder kit, all safety items such as safety belts, white and colour glasses, goggles, safety helmets, safety shoes etc.

b) *Contractor and his employees shall follow all fire & safety, security regulations of BHEL.*

23. **HOUSE KEEPING:**

During execution of work, the contractor at all times keep the working place and storage area clean and free from accumulation of waste materials, rubbish etc.,

24. **ACCIDENT / DAMAGE / CONDUCT ETC.:**

Contractor will be held responsible for any disorderly conduct / misconduct, indiscipline, theft, smoking etc., on the part of his men. He will ensure summarily eviction of such men from his premises failing which BHEL would remove them from the factory on his responsibility. Any damage to and or loss of equipment, machinery, building etc., to BHEL or BHEL employees, visitors or other contractors resulting from his own or any of his menôs negligence shall be liable to be made good by him. Contractor shall be solely responsible for any accident in which you or your men or your equipment may be involved during the execution of contract on account of any reason what so ever.

25. **TERMINATION OF CONTRACT:**

In the event of any failure on the part of the contractor, BHEL reserves the right to terminate the contract by giving a notice of 2 weeks for any of the following lapses and contractual violations: -

a) Failure to make labour payments in time as per the rules
b) Failure to progress the job according to the agreed schedule
c) Failure to mobilize adequate man power, tools & tackles and consumables in time
d) Failure to adhere to Quality Standards of BHEL
e) Refused to co-operate with other agencies working in the same area
f) Failure to resolve labour disputes like strikes etc., within 7 days of occurrence
g) Failure to comply with statutory regulations applicable at BHEL

BHEL shall also be free to intervene and take necessary remedial measures. All costs incurred with interest and overheads shall be recovered from contractor by such foreclosing or off-loading any part of the contract work.

26. DISPUTES:

Head of BHEL- HPVP Unit will be the final authority for any disputes arising out of this contract. The disputes / arbitration / settlement of contractual or legal issues shall be under the Jurisdiction of Visakhapatnam Court.

27. For this procurement, Public Procurement (Preference to Make in India), Order 2017 dated 15.06.2017 & 28.05.2018 and subsequent Orders issued by the respective Nodal Ministry shall be applicable even if issued after issue of this NIT but before finalization of Contract / PO / WO against this NIT.

In the event of any Nodal Ministry prescribing higher or lower percentage of purchase preference and / or local content in respect of this procurement, same shall be applicable**.**

28. The Bidder declares that they will not enter into any illegal or undisclosed agreement or understanding, whether formal or informal with other Bidder(s). This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.

In case, the Bidder is found having indulged in above activities, suitable action shall be taken by BHEL as per extant policies/ guidelines.

Signature of the Bidder with Stamp

ANNEXURE – IV

Ref.: OS/21-22/2439/MFC-CS/05/020 Date: 25.11.2021

Acceptance to Tender Terms & Conditions

I / We hereby confirm that the Tender documents, Drawings, Quality documents etc. have been studied in detail and we have fully understood the scope of work.

I / We accept to all the Terms and Conditions of the Tender Enquiry and the prices quoted are in accordance with the same.

I / We give our acceptance to participate in reverse auction for this tender.

Tender documents **duly signed & stamped on all the pages** by the Owner / authorized representative of the bidder are attached herewith.

Signature of the Bidder with Stamp

ANNEXURE – V

Ref.: OS/21-22/2439/MFC-CS/05/020 Date: 25.11.2021

BUSINESS RULES FOR REVERSE AUCTION (RA)

This has reference to tender no. **OS/21-22/2439/MFC-CS/05/020, dated 25.11.2021**. BHEL shall finalize the Rates for **Fabrication of CS portion of Main Shell of Main Fractionator Column at Lovagarden site of BHEL-HPVP, Visakhapatnam** through Reverse Auction mode. BHEL has made arrangement with an authorized Service provider (details will be shared before reverse auction) for conducting RA. Bidders should go through the instructions given below and submit acceptance of the same.

The technical & commercial terms are as per (a) BHEL Tender Enquiry No. **OS/21-22/2439/MFC-CS/05/020, dated 25.11.2021**, (b) Bidders' technical & commercial bid (in case of two-part bid) and (c) subsequent correspondences between BHEL and the bidders, if any.

1. **Procedure of Reverse Auctioning:**
   i) Price bids of all techno-commercially qualified bidders shall be opened.
   ii) **Reverse Auction**: The 'bid decrement' will be decided by BHEL.
   iii) The lowest bidder in sealed envelope price bid shall be shown as current L1 automatically by the system and no acceptance of that price is required. System shall have the provision to indicate this bid as current L1.
   iv) Bidders by offering a minimum bid decrement or the multiples thereof can displace a standing lowest bid and become "L1" and this continues as an iterative process. However, no bidder shall be allowed to lower its bid below the current L1 by more than 5 decrements at one go.
   v) After the completion of the reverse auction, the Closing Price shall be available for further processing.
   vi) Wherever the evaluation is done on total cost basis, after Reverse Auction, prices of individual line items shall be reduced on pro-rata basis.

2. **Schedule for reverse auction:** The Reverse Auction schedule will be intimated to the eligible techno-commercially qualified bidders at a later stage.

3. **Auction extension time:** If a bidder places a bid in the last 5 minutes of closing of the Reverse Auction and if that bid gets accepted, then the auction's duration shall get extended automatically for another 5 minutes, for the entire auction (i.e. for all the items in the auction), from the time that bid comes in. Please note that the auto-extension will take place only if a bid comes in those last 5 minutes and if that bid gets accepted as the lowest bid. If the bid does not get accepted as the lowest bid, the auto-extension will not take place even if that bid might have come in the last 5 minutes. In case, there is no bid in the last 5 minutes of closing of Reverse Auction, the auction shall get closed automatically without any extension. However, bidders are advised not to wait till the last minute or last few seconds to enter their bid during the auto-extension period to avoid complications related with internet connectivity, network problems, system crash down, power failure, etc.
   The above process will continue till completion of Reverse Auction.
   Complaints/ Grievances, if any, regarding denial of service or any related issue should be given in writing thru e-mail/ fax to M/s. {Service provider} with a copy to BHEL within 15 minutes prior to initial closing time of Reverse Auction.

4. **Bid price:** The Bidder has to quote the {……} Price **except GST** but inclusive of Packing & Forwarding charges, all the routine & type tests as per tender scope, taxes, duties, freight and insurance as specified in tender document including loading (if indicated by BHEL due to deviations in technical/ commercial terms) for the Items specified. Details are as shown in Excel Sheet for calculation of total cost to BHEL (To be specified by Unit as per NIT conditions).

5. **Bidding currency and unit of measurement:** Bidding will be conducted in ***Indian Rupees*** **per** ***Unit*** of the material as per the specifications mentioned in the tender.
   In case of foreign currency bids, exchange rate (TT selling rate of State Bank of India) as on scheduled date of tender opening (Part-I bid) shall be considered for conversion in Indian Rupees. If the relevant day happens to be a Bank holiday, then the forex rate as on the previous bank (SBI) working day shall be taken.

6. **Validity of bids:** Price shall be valid for 3 months from the date of reverse auction. These shall not be subjected to any change whatsoever.

7. **Lowest bid of a bidder**: In case the bidder submits more than one bid, the lowest bid at the end of Reverse Auction will be considered as the bidder's final offer to execute the work.

8. Unique user IDs shall be used by bidders during bidding process. All bids made from the Login ID given to the bidders will be deemed to have been made by the bidders/ bidders' company.

9. **Post auction procedure**: BHEL will proceed with the Lowest Bid in the Reverse Auction for further processing.

10. Any commercial/ technical loading shall be separately intimated to respective bidders prior to RA. The excel sheet provided in this regard shall cover all these aspects. Commercial/ technical loading if any, shall be added by the respective bidder in its price during Reverse Auction.
    Modalities of loading & de-loading shall be separately intimated to the bidders. The responsibility for correctness of total cost to BHEL shall lie with the bidders.

11. Reverse auction shall be conducted by BHEL (through M/s {*Service Provider}*), on pre-specified date, while the bidders shall be quoting from their own offices/ place of their choice. Internet connectivity shall have to be ensured by bidders themselves.

    During the RA process if a bidder is not able to bid and requests for extension of time by FAX/ email/ phone then time extension of additional 15 minutes will be given by the service provider provided such requests come before 5 minutes of auction closing time. However, only one such request per bidder can be entertained.

    In order to ward-off contingent situation of connectivity failure bidders are requested to make all the necessary arrangements/ alternatives whatever required so that they are able to circumvent such situation and still be able to participate in the reverse auction successfully. Failure of power or loss of connectivity at the premises of bidders during the Reverse auction cannot be the cause for not participating in the reverse auction. On account of this, the time for the auction cannot be extended and neither BHEL nor M/s. {*Service provider*} is responsible for such eventualities.

12. **Proxy bids:** Proxy bidding feature is a pro-bidder feature to safe guard the bidder's interest of any internet failure or to avoid last minute rush. The proxy feature allows bidders to place an automated bid in the system directly in an auction and bid without having to enter a new amount each time a competing bidder submits a new offer. The bid amount that a bidder enters is the minimum that the bidder is willing to offer. Here the software bids on behalf of the bidder. This obviates the need for the bidder participating in the bidding process until the proxy bid amount is decrementally reached by other bidders. When proxy bid amount is reached, the bidder (who has submitted the proxy bid) has an option to start participating in the bidding process.

    The proxy amount is the minimum amount that the bidder is willing to offer. During the course of bidding, the bidder cannot delete or change the amount of a proxy bid.

    Bids are submitted in decrements (decreasing bid amounts). The application automates proxy bidding by processing proxy bids automatically, according to the decrement that the auction originator originally established when creating the auction, submitting offers to the next bid decrement each time a competing bidder bids, regardless of the fact whether the competing bids are submitted as proxy or standard bids. However, it may please be noted that if a manual bid and proxy bid are submitted at the same instant manual bid will be recognized as the L1 at that instant.

    In case of more than one proxy bid, the system shall bid till it crosses the threshold value of 'each lowest proxy bid' and thereafter allow the competition to decide the final L1 price.

    Proxy bids are fed into the system directly by the respective bidders. As such this information is privy only to the respective bidder(s).

13. Bidders are advised to get fully trained and clear all their doubts such as refreshing of Screen, quantity being auctioned, tender value being auctioned etc. from M/s. {*Service provider*}.

14. M/s. {*Service provider}*, shall arrange to demonstrate/ train the bidder or bidder's nominated person(s), without any cost to bidders. M/s. {*Service provider}*, shall also explain the bidders, all the business rules related to the Reverse Auction. Bidders are required to submit their acceptance to the terms/ conditions/ modalities before participating in the Reverse Auction in the process compliance form as enclosed. Without this, the bidder will not be eligible to participate in the event.

15. Successful bidder shall be required to submit the final prices (L1) in prescribed format (Annexure – VI) for price breakup, quoted during the Reverse Auction, duly signed and stamped as token of acceptance without any new condition (other than those already agreed to before start of auction), after the completion of auction to M/s. {*Service provider*} besides BHEL within two working days of Auction without fail.

16. Any variation between the final bid value and that in the confirmatory signed price breakup document will be considered as tampering the tender process and will invite action by BHEL as per extant guidelines for suspension of business dealings (as available on www.bhel.com).

17. Bidders' bid will be taken as an offer to execute the work/ supplies the item as per enquiry no. **OS/21-22/2439/MFC-CS/05/020, dated 25.11.2021.** Bids once made by the bidder, cannot be cancelled/ withdrawn and bidder shall be bound to execute the work as mentioned above at bidder's final bid price. Should bidder back out and not execute the contract as per the rates quoted, BHEL shall take action as per extant guidelines for suspension of business dealings (as available on www.bhel.com).

18. Bidders shall be able to view the following on their screen along with the necessary fields during Reverse Auction:
a. Leading (Running Lowest) Bid in the Auction (only total price of package)
b. Bid Placed by the bidder
c. Start Price
d. Decrement value
e. Rank of their own bid during bidding as well as at the close of auction.

19. BHEL's decision on award of contract shall be final and binding on all the Bidders.

20. BHEL reserves the right to extend, reschedule or cancel the Reverse Auction process at any time, before ordering, without assigning any reason, with intimation to bidders.

21. BHEL shall not have any liability to bidders for any interruption or delay in access to the site irrespective of the cause. In such cases, the decision of BHEL shall be binding on the bidders.

22. Other terms and conditions shall be as per bidder's techno-commercial offers and other correspondences, if any, till date.

23. If there is any clash between this business document and the FAQ available, if any, in the website of M/s. {*Service provider},* the terms & conditions given in this business document will supersede the information contained in the FAQs. Any changes made by BHEL/ service provider (due to unforeseen contingencies) after the first posting shall be deemed to have been accepted if the bidder continues to access the portal after that time.

24. Bidder shall not divulge either his Bids or any other exclusive details of BHEL to any other party. If the Bidder or any of his representatives are found to be involved in Price manipulation/ cartel formation of any kind, directly or indirectly by communicating with other bidders, action *as per extant BHEL guidelines for suspension of business dealings (as available on www.bhel.com)*, shall be initiated by BHEL.

Signature of the Bidder with Stamp

ANNEXURE – GST

Ref.: OS/21-22/2439/MFC-CS/05/020 Date: 25.11.2021

GST COMPLIANCE FOR INDIGENOUS SUPPLIERS

1. In Response to Tenders for Indigenous supplier will be entertained only if the vendor has a valid GSTIN which should be clearly mentioned in the offer. If any specific exemption is available, a declaration with due supporting documents need to be furnished for considering the offer.

2. Supplier shall mention their GSTIN in all their invoices and invoices shall be in the format as specified/prescribed under GST laws. Invoices shall necessarily contain Invoice number (in case of multiple numbering system is being followed for billing like SAP invoice no, commercial invoice no etc., then the Invoice No which is linked/uploaded in GSTN network shall be clearly indicated), item description as per P0, Quantity, Rate, Value, applicable taxes with nomenclature (like IGST, SGST, CGST & UTGST) separately, HSN/ SAC Code, etc.

3. All invoices shall bear the HSN Code for each item separately (Harmonized System of Nomenclature)/ SAC code (Services Accounting Code).

4. A declaration to the effect that all invoice particulars are/were uploaded in the GSTN network/ portal & all tax liability as per GST rules and regulations have been and will be discharged, shall be mentioned in the invoice. If not mentioned in the invoice, a separate declaration shall be submitted as per the requirement of BHEL.

5. All documents like Test Certificate, LR copy, Guarantee/Warrantee certificate, work completion certificate, any other document mentioned in PO, shall be sent along with the vehicle/consignment where ever applicable. For all consignments received within the calendar month, input credit will be availed within that month in line with monthly returns filing cycle. In case of any discrepancy in the document or non-submission of documents mentioned in the PO, then BHEL will not be able to accept or account the material, in such case availing of tax credit will be deferred to next month or so.

6. In case of discrepancy in the data uploaded by supplier in the GSTN portal or in case of any shortages or rejection in the supply, then BHEL will not be able to avail the tax credit and will notify the supplier of the same. Supplier has to rectify the data discrepancy in the GSTN portal or issue credit note (details to be uploaded in GSTN portal) for the shortages or rejections in the suppliers, within the calendar month notified by BHEL.

7. For any such delay in availing of tax credit for reasons attributable to supplier (as mentioned above), interest (calculated @ SBI Base Rate + 6%) along with penalty if any will be deducted for the delayed period i.e. from the month of receipt till the month tax credit is availed, from the running bills.

8. Under GST regime, BHEL has to discharge GST liability on LD recovered from suppliers/contractors. Hence applicable GST shall also be recoverable from suppliers/contractors on LD amount. For this Debit note will be issued by BHEL indicating the respective supply invoice number.

9. This is to inform that GST portion of invoice, shall be released only upon Vendor declaring such invoice in his GSTR-1 and receipt of goods and Tax invoice by BHEL and Confirmation of payment of GST thereon by vendor on GSTN portal. Alternatively, BG of appropriate value may be obtained from vendor which shall be valid At least one month after the confirmation of date of payment of GST by vendor on GSTN portal and receipt of Tax invoice and receipt of goods, whichever is later. Above is subject to receipt of goods/service and tax invoice thereof along with vendor declaring invoice in his return and paying GST within timeline prescribed for availing ITC by BHEL.

10. That in case vendor delays Declaring such invoice in his return and GST credit availed by BHEL is denied or reversed subsequently as per GST law, GST amount paid by BHEL towards such ITC reversal as per GST law shall be recoverable from vendor/contractor along with interest levied/ leviable on BHEL.

Note: The above will be followed strictly for processing vendor payments to ensure GST Compliance.

Signature of the Bidder with Stamp

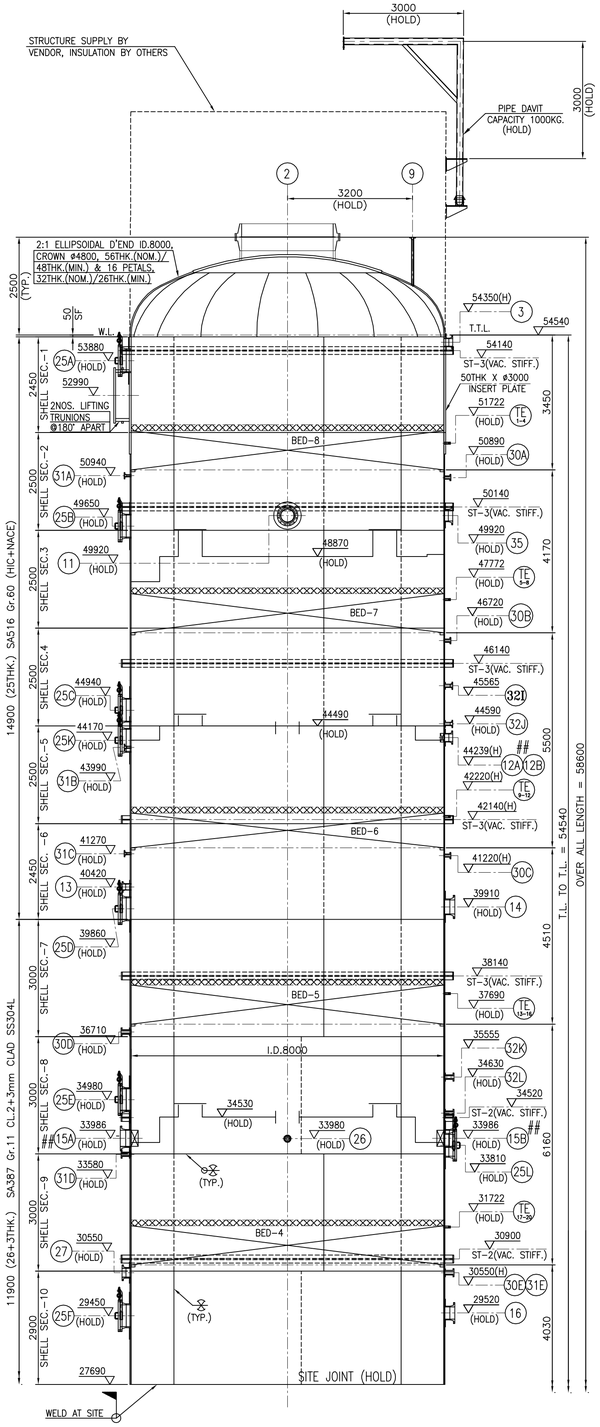
DRAWING NO: 1-CL-010-U0169

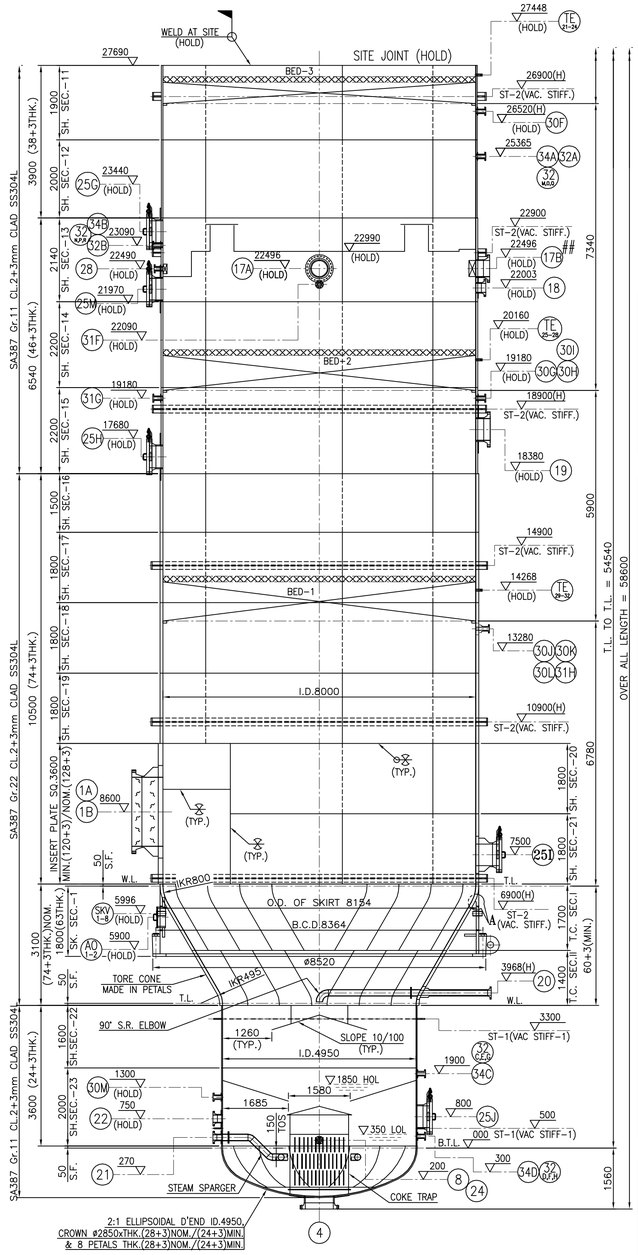
TABLE-1				
BEDS		BOTTOM	MIDDLE	TOP
		1-2	3-5	6-8
OPERATING PRESSURE (Kg/Cm²g)	NORMAL	0.79	0.78	0.72
	MAXIMUM	1.083	1.065	1.009
OPERATING TEMPERATURE (°C)	NORMAL	349	271	172
	MAXIMUM	355	277	178

** TOP SECTION=200°C, MIDDLE SECTION=295', BOTTOM SECTION=475°C, BOTTOM SECTION FROM TOP OF BED1 TO BOTTOM OF CONE SECTION DESIGNED FOR INTERMITTENT/EXCURSION OF 570°C FOR ≤100 HOURS/YEAR FOR 30 YEARS.

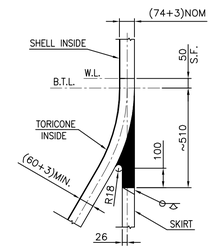
*** TOP SECTION = 40 mm
MIDDLE SECTION = 65 mm
BOTTOM SECTION = 90 mm
NO INSULATION SHALL BE PROVEDED FOR NOZZLE-1

DESIGN DATA			
OPERATING MEDIUM / SERVICE	--		
DESIGN PRESSURE (Kg/Cm²g)	INT. 3.5 AT TOP	EXT. FV @ 200°C	
WORKING PRESSURE (Kg/Cm²g)	REFER TABLE-1		
WORKING TEMPERATURE (°C)	REFER TABLE-1		
DESIGN TEMPERATURE (°C)	**		
MDMT (°C)	3.4		
CORROSION ALLOWANCE (mm)	3.0 (FOR CS PORTION ONLY)		
JOINT EFFICIENCY	SHELL : 1.0	HEAD/TORICONE : 1.0	
RADIOGRAPHY	SHELL : 100%	HEAD/TORICONE : 100%	
POST WELD HEAT TREATMENT	YES		
HEAT TREATMENT	NO (IF COLD FORMED)		
SP. GRAVITY	0.91 @ 340°	ERECTION WEIGHT (Kg)	~664,000
CAPACITY (M³)	2640	OPERATING WT. (Kg)	~11,46,300
INSULATION THICKNESS (MM) (BY OTHERS)	*** (HOT)	HYD.TEST WEIGHT (Kg) (SHOP)	~3304,000
FIRE PROOFING (BY OTHERS)	50 mm	HYD.TEST WEIGHT (Kg) (FIELD)	~3426,000
HYTDROSTATIC TEST (kg/cm²g) PRESSURE (NEW & COLD)	4.732 VERTICAL (AT TOP)	WIND SPECIFICATION	IS: 875
		EARTH QUAKE SPECIFICATION	IS: 1893 & SITE SPECTRA
CODE	ASME SEC VIII DIV.1 EDITION 2017	VESSEL SL. No.	26686
		CONSIGNMENT SIZE	O.D.C.
INSPECTION :	TPIA		





ELEVATION



DETAIL-A

# R.F. PAD SIZE	
NOZZLE MARK	W X T
30D & 30E	45 X 26
30F	45 X 38
30G-I	45 X 46
31D & 31E	45 X 26
31F & 31G	45 X 46
32A,32M,32O,32Q	45 X 38
32B,32N,32P,32R	45 X 46

MARK NO.	QTY.	SERVICE	N.P.S	O.D.	SCH. THK.	R.F.PAD WIDTH x THK.	RATING CLASS	TYPE / FACE	PROJE.	REMARKS
NOZZLES (2.25 Cr+1 MO+CLAD ZONE)										
31H	1	PRESSURE CONNECTION	3" I.D.	--	-- / 20.4 + ⊕	--	300	SRLWN/RF	4350	LIP TYPE ⊕=5mm WOL
30 J-L	3	THERMOWELLS (LIQUID SHIELD)	3" I.D.	--	-- / 20.4 + ⊕	--	300	SRLWN/RF	4350	LIP TYPE ⊕=5mm WOL
25J	1	MANHOLE + B.F. + DAVIT	24"	609.6	-- / 30+3 CLAD	--	300	SRWN/RF	4600	LIP TYPE
20	1	QUENCH RETURN	6"	168.3	-- / 20+3 CLAD	--	300	SRWN/RF	4400	LIP TYPE
1 A-B	2	FEED (NOTE-XX & XX)	72"	1828.8	-- / 30+3 CLAD	--	300	SRWN/RF	4800	LIP TYPE
AO 1-2	2	ACCESS OPENING	20"	--	-- / 32THK.	250 x 63	--	--	--	
SKV 1-8	8	SKIRT VENT	4"	114.3	40 / 6.02	--	--	--	--	
34 C-D	2	MAGNETIC LEVEL GAUGE	3" I.D.	76.2 (I.D.)	-- / 20.4 + ⊕	45 x 28	300	L.W.N/R.F.	2720	⊕=5mm WOL
34 A-B	2	MAGNETIC LEVEL GAUGE	3" I.D.	76.2 (I.D.)	-- / 20.4 + ⊕	45 x 50	300	L.W.N/R.F.	4260	⊕=5mm WOL
32 K-L	2	DP TYPE LEVEL TRANSMITTER	3" I.D.	76.2 (I.D.)	-- / 20.4 + ⊕	45 x 28	300	L.W.N/R.F.	4260	⊕=5mm WOL
32 C-H	6	DP TYPE LEVEL TRANSMITTER	3" I.D.	76.2 (I.D.)	-- / 20.4 + ⊕	45 x 24	300	L.W.N/R.F.	2720	⊕=5mm WOL # REFER TABLE
32 A,M-R	8	DP TYPE LEVEL TRANSMITTER	3" I.D.	76.2 (I.D.)	-- / 20.4 + ⊕	45 x #	300	L.W.N/R.F.	4260	⊕=5mm WOL # REFER TABLE
31 D-G	4	PRESSURE CONNECTION	3" I.D.	76.2 (I.D.)	-- / 20.4 + ⊕	45 x #	300	L.W.N/R.F.	4260	⊕=5mm WOL # REFER TABLE
30M	1	THERMOWELL	3" I.D.	76.2 (I.D.)	-- / 20.4 + ⊕	45 x 28	300	L.W.N/R.F.	2720	⊕=5mm WOL
30 D-I	6	THERMOWELLS (LIQUID SHIELD)	3" I.D.	76.2 (I.D.)	-- / 20.4 + ⊕	45 x #	300	L.W.N/R.F.	4260	⊕=5mm WOL # REFER TABLE
28	1	PRESSURE BALANCE (FROM 111-V-2601)	3" I.D.	76.2 (I.D.)	-- / 20.4 + ⊕	45 x 50	300	L.W.N/R.F.	4230	⊕=5mm WOL
26	1	PRESSURE BALANCE (FROM 111-V-2602)	3" I.D.	76.2 (I.D.)	-- / 15.9 + ⊕	45 x 28	150	L.W.N/R.F.	4230	⊕=5mm WOL
27	1	PRESSURE BALANCE (FROM 111-V-1104)	10"	273.0	-- / 24+3 CLAD	135 x 28	150	W.N/R.F.	4230	
25J	1	MANHOLE + B.F. + DAVIT	24"	610	-- / 24+3 CLAD	300 x 28	300	W.N/R.F.	2820	
25 G,H,M	3	MANHOLE + B.F. + DAVIT	24"	610	-- / 24+3 CLAD	300 x 50	300	W.N/R.F.	4350	
25 E,F,L	3	MANHOLE + B.F. + DAVIT	24"	610	-- / 24+3 CLAD	300 x 28	150	W.N/R.F.	4280	
24	1	UTILITY	3" I.D.	76.2 (I.D.)	-- / 20.4 + ⊕	45 x 28	300	L.W.N/R.F.	2720	⊕=5mm WOL
22	1	FRESH FEED (START UP)	8"	219.1	-- / 24+3 CLAD	110 x 28	300	W.N/R.F.	2720	
21	1	SPARGE STEAM	6"	168.3	80 / 10.97 + ⊕	85 x 28	300	W.N/R.F.	2720	⊕=5mm WOL
19	1	SLURRY PA RET.	20"	508.0	-- / 24+3 CLAD	250 x 50	300	W.N/R.F.	4370	
18	1	HCO WASH	10"	273.0	-- / 24+3 CLAD	135 x 50	300	W.N/R.F.	4260	
17 A-B	2	HCO DRAW+ VORTEX BREAKER	18"	457.0	-- / 24+3 CLAD	225 x 50	300	W.N/R.F.	4360	
16	1	HCO PA RETURN	14"	355.6	-- / 24+3 CLAD	175 x 28	150	W.N/R.F.	4280	
15 A-B	2	LCO DRAW+ VORTEX BREAKER	18"	457.0	-- / 24+3 CLAD	225 x 28	150	W.N/R.F.	4280	
8	1	STEAM OUT	3" I.D.	76.2 (I.D.)	-- / 20.4 + ⊕	45 x 28	300	L.W.N/R.F.	2720	⊕=5mm WOL
4	1	BOTTOMS	30"	768.4	-- / 24+3 CLAD	380 x 28	300	W.N/R.F.	SEE DRG.	
NOZZLES (1.25 Cr+0.5 MO+CLAD ZONE)										
35	1	LO STRIPPER VAP. RET.	12"	323.8	-- / 25THK.	160 x 25	150	W.N/R.F.	4230	
32 I-J	2	DP TYPE LEVEL TRANSMITTER	3"	88.9	160 / 11.13	45 x 25	150	W.N/R.F.	4230	
31 A-C	3	PRESSURE CONNECTION	2"	60.3	160 / 8.74	--	300	W.N/R.F.	4180	
30 A-C	3	THERMOWELLS + (LIQUID SHIELD)	2 1/2"	50.8 (I.D.)	160 / 13.6	--	300	L.W.N/R.F.	4180	
25 A-D,K	5	MANHOLE + B.F. + DAVIT	24"	610	-- / 25THK.	300 x 25	150	W.N/R.F.	4280	
14	1	LCO PA RERURN	16"	406.4	-- / 25THK.	200 x 25	150	W.N/R.F.	4280	
13	1	LCO STRIPPER VP. RET.	6"	168.3	80 / 10.97	85 x 25	150	W.N/R.F.	4230	
12A-B	2	LEAN OIL DRAW + VORTEX BREAKER	8"	219.1	80 / 12.70	110 x 25	150	W.N/R.F.	4230	
11	1	RICH OIL RETURN	14"	355.6	-- / 25THK.	175 x 25	150	W.N/R.F.	4250	
9	1	VENT	2"	60.3	160 / 8.74	--	150	W.N/R.F.	SEE DRG.	
3	1	REFLUX IN	8"	219.1	80 / 12.70	110 x 25	150	W.N/R.F.	4230	
2	1	O.H. VAPOR+COMP. FLG.	96"	2438.4	-- / 50THK.	48THK.(MIN.)	--	W.N/R.F.	SEE DRG.	INSERT PL. ø4800 x 48THK.(MIN.)
NOZZLES (CS+HIC & NACE ZONE)										

TABLE OF NOZZLES AND FLANGES

ENGINEERING STANDARDS / SPECIFICATIONS / REFERENCE DRAWINGS	
1. GENERAL SPECN. FOR PRESSURE VESSELS.	6-12-0001 REV.6
2. SUPP. SPEC. FOR C.S VESSELS.	6-12-0002 REV.8
3. SUPP. SPEC. FOR LOW ALLOY STEEL VESSELS.	6-12-0003 REV.5
4. SUPP. SPEC. FOR CLAD VESSELS.	6-12-0007 REV.5
5. STD. SPEC. FOR BQCS PLATE.	6-12-0011 REV.8
6. STD. SPEC. FOR STRUCTURAL QUALITY PLATES.	6-12-0014 REV.6
7. STD. SPEC. FOR CLAD PLATES.	6-12-0015 REV.5
8. STD. SPEC. FOR 1.25% Cr.-1/2% Mo STEEL PLATES.	6-12-0017 REV.5
9. STD. SPEC. FOR 2.25% Cr.-12% Mo STEEL PLATES.	6-12-0018 REV.4
10. STD. SPEC. FOR SS PLATES.	6-12-0020 REV.8
11. SPEC. FOR SURFACE PREPARATION & PROTECTIVE COATING.	B224-000-79-41-PLS-01 REV.5
12. STD. SPEC. FOR CS COMPONENT IN SOUR SERVICE.	6-79-0013 REV.2
13. VESSEL TOLERANCES.	7-12-0001 REV.6
14. SKIRT BASE DETAILS.	7-12-0004 REV.7
15. SKIRT OPENING DETAILS.	7-12-0005 REV.6
16. MANHOLE WITH DAVIT.	7-12-0010 REV.7
17. LADDER RUNGS FOR MANHOLE / DEMISTER	7-12-0011 REV.6
18. NOZZLE REINFORCEMENT AND PROJECTION.	7-12-0013 REV.7
19. STANDARD BOLT HOLE ORIENTATION.	7-12-0015 REV.6
20. ALLOY LINER DETAILS.	7-12-0016 REV.6
21. SUPPORT RING SIZES FOR PACKED TOWERS.	7-12-0022 REV.6
22. PIPE DAVIT (FOR GUIDANCE)	7-12-0023 REV.7
23. FIRE PROOFING AND INSULATION SUPPORTS	7-12-0025 REV.6
24. EARTHING LUG.	7-12-0026 REV.6
25. NAME PLATE.	7-12-0027 REV.6
26. MANUFACTURER NAME PLATE.	7-12-0028 REV.6
27. BRACKET FOR NAME PLATE.	7-12-0029 REV.6
28. SUPPORTS FOR INTERNAL FEED PIPE.	7-12-0032 REV.5
29. S.R. NOZZLE NECK.	7-12-0037 REV.4
30. SKIN THERMOCOUPLE MOUNTING DRG.	B224-111-YT-SK-6003
31. PROCESS DATA SHEETS	076405C001-111-PDS-0500-2101

S.NO.	BHEL DRAWING NO.	DRAWING TITLE
40	3-CL-010-U0216	DETAILS OF ANCHOR BOLTS FOR MAIN FRACTIONATOR(111-C-2101)
39	1-CL-010-U0205	DETAILS OF FOUNDATION TEMPLATE FOR MAIN FRACTIONATOR(111-C-2101)
38	1-CL-010-U0204	DETAILS OF ACCESS LADDERS FOR MAIN FRACTIONATOR(111-C-2101)
37	1-CL-010-U0203	DETAILS OF ACCESS LADDERS OF MAIN FRACTIONATOR(111-C-2101)
36	1-CL-010-U0202	GRATING DETAILS OF MAIN FRACTIONATOR(111-C-2101)
35	1-CL-010-U0201	GRATING DETAILS FOR MAIN FRACTIONATOR(111-C-2101)
34	1-CL-010-U0200	DETAILS OF PLATFORMS IN P22 SECTION FOR MAIN FRACTIONATOR(111-C-2101)
33	1-CL-010-U0199	DETAILS OF PLATFORMS IN P11 SECTION FOR MAIN FRACTIONATOR(111-C-2101)
32	1-CL-010-U0198	DETAILS OF PLATFORMS IN BQ SECTION FOR MAIN FRACTIONATOR(111-C-2101)
31	1-CL-010-U0197	DETAILS OF TRANSPORTATION OF MAIN FRACTIONATOR(111-C-2101)
30	1-CL-010-U0196	LIST OF SPARES OF MAIN FRACTIONATOR(111-C-2101)
29	1-CL-010-U0195	DETAILS OF PIPE DAVIT OF MAIN FRACTIONATOR(111-C-2101)
28	1-CL-010-U0194	DETAILS OF ACCESS OPENING OF MAIN FRACTIONATOR(111-C-2101)
27	1-CL-010-U0193	DETAILS OF NAME PLATE OF MAIN FRACTIONATOR(111-C-2101)
26	1-CL-010-U0192	GENERAL NOTES OF MAIN FRACTIONATOR(111-C-2101)
25	1-CL-010-U0191	ORIENTATION DETAILS OF MAIN FRACTIONATOR(111-C-2101)
24	1-CL-010-U0190	LIFTING DETAILS OF MAIN FRACTIONATOR(111-C-2101)
23	1-CL-010-U0189	ANCHOR CHAIR DETAILS OF MAIN FRACTIONATOR(111-C-2101)
22	0-CL-010-U0011	SHELL DEVELOPMENT OF P22 SECTION OF MAIN FRACTIONATOR(111-C-2101)
21	1-CL-010-U0188	MH Davit Details on P22 Section of Main Fractionator(111-C-2101)
20	1-CL-010-U0187	INSULATION & FIREPROOFING DETAILS ON P22 SECTION OF MAIN FRACTIONATOR(111-C-2101)
19	1-CL-010-U0186	PLATFORM CLEAT DETAILS ON P22 SECTION OF MAIN FRACTIONATOR(111-C-2101)
18	1-CL-010-U0185	PIPE SUPPORT CLEAT ON P22 SECTION OF MAIN FRACTIONATOR(111-C-2101)
17	1-CL-010-U0184	INTERNAL DETAILS IN P22 SECTION OF MAIN FRACTIONATOR(111-C-2101)
16	1-CL-010-U0183	ASSEMBLY DETAILS OF P22 SECTION OF MAIN FRACTIONATOR(111-C-2101)
15	0-CL-010-U0010	SHELL DEVELOPMENT OF P11 SECTION OF MAIN FRACTIONATOR(111-C-2101)
14	1-CL-010-U0182	MH DAVIT DETAILS ON P11 SECTION OF MAIN FRACTIONATOR(111-C-2101)
13	1-CL-010-U0181	INSULATION CLEAT DETAILS ON P11 SECTION OF MAIN FRACTIONATOR(111-C-2101)
12	1-CL-010-U0180	PLATFORM CLEAT DETAILS ON P11 SECTION OF MAIN FRACTIONATOR(111-C-2101
11	1-CL-010-U0179	PIPE SUPPORT CLEAT ON P11 SECTION OF MAIN FRACTIONATOR(111-C-2101)
10	1-CL-010-U0178	INTERNAL DETAILS IN P11 SECTION OF MAIN FRACTIONATOR(111-C-2101)
9	1-CL-010-U0177	ASSEMBLY DETAILS OF P11 SECTION OF MAIN FRACTIONATOR(111-C-2101)
8	0-CL-010-U0009	SHELL DEVELOPMENT OF BQ SECTION OF MAIN FRACTIONATOR(111-C-2101)
7	1-CL-010-U0176	MH DAVIT DETAILS ON BQ SECTION OF MAIN FRACTIONATOR(111-C-2101)
6	1-CL-010-U0175	INSULATION CLEAT DETAILS ON BQ SECTION OF MAIN FRACTIONATOR(111-C-2101)
5	1-CL-010-U0174	PLATFORM CLEAT DETAILS ON BQ SECTION OF MAIN FRACTIONATOR(111-C-2101)
4	1-CL-010-U0173	PIPE SUPPORT CLEAT ON BQ SECTION OF MAIN FRACTIONATOR(111-C-2101)
3	1-CL-010-U0172	INTERNAL DETAILS IN BQ SECTION OF MAIN FRACTIONATOR(111-C-2101)
2	1-CL-010-U0171	ASSEMBLY DETAILS OF BQ SECTION OF MAIN FRACTIONATOR(111-C-2101)
1	1-CL-010-U0170	ASSEMBLY DETAIL OF MAIN FRACTIONATOR(111-C-2101)

REFER NOTE : INVERT INSIDE OF WITH DRAWAL NOZZLE TO BE FLUSH WITH TOP OF DRAW-OFF PAN SUPPORT RING

FOUNDATION LOADING DATA (OPERATING CONDITION)		
TYPE	MAX. MOMENT AT BASE (M) (kgm)	MAX. SHEAR FORCE AT BASE (H) (Kg)
SEISMIC (DBE)	9953000	261000
SEISMIC (MCE)	12740000	342000
WIND	7896000	227000

REV NO.	ZONE	BRIEF RECORD OF REVISIONS	PPD.	CHD.	APPD.

इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उद्यम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

Customer : HPCL Rajasthan Refinery Limited Barmer

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.

Bharat Heavy Electricals Ltd
UNIT: HEAVY PLATES & VESSELS PLANT
VISAKHAPATNAM-530012

	NAME	DATE
DRN	G.DEMUDU	22.12.20
CHD	D.SATISH	22.12.20
APPD	D.SATISH	22.12.20

DEPT P.P.ENGG. | CODE 031 | ALL DIMENSIONS ARE IN MM | PROJECTION | SCALE 1 : 75 & N.T.S | WEIGHT (Kg.) - | REF TO ASSY / OLD DWG --

TITLE: GENERAL ASSEMBLY OF MAIN FRACTIONATOR (ITEM NO. 111-C-2101)

DRAWING NO : 1-CL-010-U0169 | REV A

FORM NO. 0425/2

A1 SIZE

DRAWING NO: 1-CL-010-U0192

A. GENERAL

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2. ALL ANCHOR BOLT HOLES TO STRADDLE NORTH/SOUTH CENTRE LINE.
3. NORTH DIRECTION WHEREVER SHOWN IS WITH RESPECT TO PLAN VIEW.
4. COLUMN SHALL BE SUBJECTED TO STEAM OUT CONDITIONS OF 0.5 kg/sq. cm^2 g @150°C

B. MATERIAL

1. DIMENSIONS OF FLANGES FOR NOZZLES UPTO 600 NB (24") SHALL BE AS PER ASME B16.5 AND FOR NOZZLE ABOVE 600 NB (24") SHALL BE AS PER ASMEB16.47 SERIES 'B' UNLESS SPECIFIED OTHERWISE. FLANGE GASKET FACE SHALL HAVE 125 AARH FINISH.
2. ALL INTERNAL GASKETS SHALL BE SUITABLE FOR THE DESIGN TEMPERATURE.
3. CS/LAS PLATES SHALL BE IMPACT TESTED AS PER CODE/SPEC.
4. ALL CLAD PLATES SHALL CONFIRM TO SA263.
5. THE CLAD SURFACE SHALL BEAR No. 1 FINISH AS PER SA 480 OR THE FINISH OBTAINED BY GRINDING WITH GRIT 80 ABRASIVE BELT.
6. PLATE MATERIAL TO SPECIFICATION IS 2062 MAY BE REPLACED BY B.Q. PLATES TO SPECN. SA515/516 GR.60/70.
7. MOC FOR NOZZLE NECK / FLANGE / GASKET / NUTS / BOLTS SHALL BE COMPATIBLE WITH CORRESPONDING SHELL MOC.
8. ALL INTERNALS SHALL HAVE ANSI RF FLANGE CONNECTIONS & BE SIZED TO PASS THROUGH THE NEAREST MANHOLE.
9. ALL BOLTS/STUDS SHALL HAVE ISO THREADING UNLESS OTHERWISE SPECIFIED.
10. PLATES & FORGINGS USED FOR PRESSURE PARTS SHALL CONFORM TO EN 10204 TYPE 3.2

C. FABRICATION

1. FOR NOZZLES ON SHELL, PROJECTIONS ARE REFERRED FROM VESSEL CENTER LINE TO FLANGE CONTACT FACE AND FOR NOZZLES ON HEAD, PROJECTIONS ARE REFERRED FROM HEAD T.L TO FLANGE CONTACT FACE.
2. NOZZLES 50 NB AND BELOW SHALL BE STIFFENED WITH 2 NOS. FLATS 90° APART. SIZE OF STIFFENERS SHALL BE 60 mm WIDE X 6 mm(Min.) THICK.
3. ALL REMOVABLE INTERNALS SHALL BE SIZED SO AS TO PASS THROUGH NEAREST MANHOLE.
4. WHEREVER R.F.PADS/ PADS CROSS OVER THE WELD SEAMS OF COLUMN THE WELD SEAM IS TO BE GROUND FLUSH AND PADS WELDED OVER IT & RADIOGRAPHED AS PER CODE. WELD EDGE TO EDGE DISTANCE SHALL BE AS PER CL. 4.7.5 OF GENERAL SPECIFICATION FOR PRESSURE VESSEL 6-12-0001.
5. ALL MAIN WELD SEAMS SHALL BE CLEAR OF NOZZLES, REINFORCEMENT PADS, INTERNALS, TRAY SUPPORT RINGS, CLEATS AND STIFFENING RINGS BY 50 mm MINIMUM (WELD EDGE TO WELD EDGE). IN CASE THE SAME IS UNAVAOIDABLE FOLLOWING REQUIREMENTS SHALL APPLY:

   a) NOZZLES WITHOUT REINFORCING PAD

   i) ANY WELD SEAM HAVING DISTANCE (WELD EDGE TO WELD EDGE) TO NOZZLE WITHIN 50 mm (BUT NOT FOULING WITH WELD SEAM) SHALL BE FULLY RADIOGRAPHED AND DYE PENETRANT EXAMINED TO A LENGTH EQUAL TO 100 mm ON EACH SIDE MEASURED FROM NEAREST POINT TO NOZZLE EDGE.

   ii) ANY WELD SEAM FOULING WITH NOZZLE OPENING SHALL BE FULLY RADIOGRAPHED AND DYE PENETRANT EXAMINED TO A LENGTH EQUAL TO 3 TIMES OF OUTSIDE DIAMETER OF NOZZLE i.e. 1.5 TIMES OF OUTSIDE DIAMETER OF NOZZLE ON EACH SIDE AFTER INSTALLATION OF NOZZLES. NOZZLE TO VESSEL FILLET WELD SHALL BE PROVIDED WITH SMOOTH CONCAVE RADIUS.

   b) NOZZLES WITH REINFORCING PAD

   i) ANY WELD SEAM HAVING DISTANCE (WELD EDGE TO WELD EDGE) TO REINFORCING PAD WITHIN 50 mm (BUT NOT FOULING WITH WELD SEAM) SHALL BE FULLY RADIOGRAPHED AND DYE PENETRANT EXAMINED TO A LENGTH EQUAL TO 100 mm ON EACH SIDE MEASURED FROM NEAREST POINT TO REINFORCING PAD EDGE.

   ii) ANY WELD SEAM NOT FOULING WITH NOZZLE OPENING BUT COMING UNDER REINFORCEMENT PAD SHALL BE GROUND FLUSH, FULLY RADIOGRAPHED AND DYE PENETRANT EXAMINED TO A LENGTH EQUAL TO PORTION OF WELD SEAM BELOW REINFORCEMENT PAD + 100 mm ON EACH SIDE.

   iii) ANY WELD SEAM FOULING WITH NOZZLE OPENING SHALL BE GROUND FLUSH, FULLY RADIOGRAPHED AND DYE PENETRANT EXAMINED TO A LENGTH EQUAL TO HIGHER OF 3 TIMES OF OUTSIDE DIAMETER OF NOZZLE i.e. 1.5 TIMES OF OUTSIDE DIAMETER OF NOZZLE ON EACH SIDE OR LENGTH EQUAL TO PORTION OF WELD SEAM BELOW REINFORCEMENT PAD + 100 mm ON EACH SIDE.

   IN CASE OF OTHER ATTACHMENTS LIKE INTERNALS, TRAY SUPPORT RINGS, CLEATS ETC. IS FOULING WITH WELD SEAM, THE WELD SEAM PORTION COMING UNDER THE ATTACHMENT PLUS 100 mm LENGTH ON EACH SIDE SHALL BE GROUND FLUSH, FULLY RADIOGRAPHED AND DYE PENETRANT EXAMINED BEFORE WELDING OF ANY SUCH ATTACHMENT.

6. ID OF WELD NECK FLANGES SHALL MATCH WITH CORRESPONDING ID OF NOZZLE PIPE.
7. NOZZLE SCHEDULES INDICATED FOR WELD OVERLAY NOZZLES ARE MINIMUM REQUIRED.
8. ALL SS SURFACES SHALL BE PICKLED AND PASSIVATED AS PER ASTM A380.
9. ALL 80 NB NOZZLES COMING IN CLAD PORTION SHALL BE LWN TYPE AND WELD OVERLAY.
10. INVERT INSIDE OF WITHDRAWAL NOZZLE TO BE FLUSH WITH TOP OF DRAW-OFF PAN SUPPORT RING.
11. NO INSULATION SHALL BE PROVIDED FOR NOZZLE-1. PROVIDE RETAINING PLATE FOR REINFORCING REFRACTORY.
12. ALL FLANGE BOLT HOLES SHALL BE STRADDLE TO CENTRE LINES AS PER E.I.L.STD.No. 7-12-0015 REV.6
13. PROTECT ALL MACHINED SURFACES AND THREADED CONNECTIONS WITH RUST PREVENTIVE IMMEDIATELY AFTER MACHINING. INSTALL WOOD OR STEEL PROTECTORS FOR FITTINGS IMMEDIATELY AFTER TESTING .
14. DISHED ENDS SHALL BE IN CROWN & PETAL CONSTRUCTION.
15. R.F. PAD IS TO BE WELDED TO SHELL SUCH THAT ONE TELL-TALE HOLE WILL BE AT THE BOTTOM OF THE PAD IN ASSEMBLED POSITION OF THE COLUMN.
16. NO ATTACHMENT OTHER THAN SHOWN ON THE DRAWING IS TO BE WELDED WITHOUT PRIOR APPROVAL OF THE TECHNOLOGY DEPARTMENT.
17. NO WELDING IS TO BE DONE ON THE COLUMN AFTE RHEAT TREATMENT UNLESS OTHERWISE PERMITTED BY CODE/ SPECN.
18. ALL SHARP CORNERS ARE TO BE ROUNDED OFF TO A MINIMUM RADIUS OF 5 mm (OR) AS SPECIFIED IN DRAWING.
19. FILLET WELD SIZES INDICATED ARE MINIMUM.
20. TRAY ELEVATIONS GIVEN ARE TO THE TOP OF SUPPORT RINGS.
21. WELDING SHALL NOT COMMENCE UNLESS THE CONCERNED PROCEDURES ARE APPROVED.

D. TOLERANCES

1. EQUIPMENT TOLERANCE SHALL BE IN ACCORDANCE WITH EIL STD. 7-12-0001 OR DESIGN CODE WHICH EVER IS STRINGENT.
2. THE INDICATED THICKNESS IS THE MINIMUM ACCEPTABLE AFTER CONSTRUCTION.
3. TOLERANCE ON COLUMN DIAMETER UPTO & ABOVE 8000mm SHALL BE GREATER OF ±20mm OR ±0.2% OF DIAMETER. HOWEVER IF STRINGER TOLERANCE ARE RECOMMENDED BY INTERNALS SUPPLIER. THE SAME SHALL BE COMPLIED WITH.
4. TOLERANCES INDICATED IN THE DRAWING ARE NON CUMULATIVE.

E. NDE

1. ALL FABRICATED NOZZLES SHALL BE FULLY RADIOGRAPHED.
2. ALL C & L SEAMS INCLUDING C-SEAM, NOZZLE NECK TO FLANGE, PIPE TO PIPE FITTING & PIPE TO PIPE SHALL BE FULLY RADIOGRAPHED.
3. ALL C & L SEAMS OF SKIRT SHALL BE FULLY RADIOGRAPHED.
4. FULL RADIOGRAPHY WHEREVER SPECIFIED SHALL IMPLY 100% RADIOGRAPHY OF ALL BUTT WELDS.
5. ALL BUTT WELDED JOINTS IN DISHED ENDS AND TORICONES SHALL BE FULLY RADIOGRAPHED.
6. CLAD DISHED ENDS AND TORICONES SHALL BE ULTRA SONICALLY TESTED AFTER FORMING AS PER A:578 AND SHALL MEET THE SUPPLEMENTARY REQUIREMENTS OF S6, WITH ACCEPTABLE LEVEL-II
7. KNUCKLE PORTIONS OF DISHED ENDS/TORICONES BOTH INSIDE AND OUTSIDE SHALL BE D.P.CHECKED.

F. SHIPMENT & HANDLING

1. COLUMN SHALL BE TRANSPORTED TO THE SITE IN TWO PIECES & SITE ASSEMBLED AS PER JOB SPEC. NO. 8224-80-43-SP-6006.
2. AFTER HYDROTEST, EQUIPMENT SHALL BE THOROUGHLY DRAINED & DRIED OUT.
3. ALL THE NOZZLE OPENINGS SHALL BE CLOSED WITH SUITABLE STEEL COVERS.

G. TESTING

1. R.F.PADS SHALL BE PNEUMATICALLY TESTED FOR LEAK TIGHTNESS TO 1.05 Kg./ Sq. Cm IN C.S. PORTION AND TO 1.8 Kg/Sq.Cm BEFORE DEPOSITING S.S WELD METAL IN CLAD ZONE WITH SOAP SOLUTION ON ALL ATTACHMENT WELDS.
2. ALL REINFORCING PADS SHALL BE PROVIDED WITH TWO 1/8" (3 mm) NPT TAPPED HOLES 180° APART FOR AIR SOAP SOLUTION TEST. HIGHER TEST PRESSURES ARE NOT RECOMMENDED BECAUSE OF ACCOMPANYING RISKS AND ALSO BECAUSE THE SOAP BUBBLES HAVE A CHANCE TO BLOW OFF. TELL-TALE HOLES IN THE REINFORCING PADS SHALL BE PLUGGED WITH HARD GREASE UNLESS OTHERWISE INDICATED AFTER THE HYDRO TEST OF THE VESSEL.
3. GASKETS USED DURING HYDRAULIC TEST SHALL BE OF SAME SPECIFICATION AS SERVICE GASKETS.
4. COLUMN SHALL BE HYDROTEST IN SHOP.
5. IN SITE: i) SITE JOINT SHALL BE HYDRO TESTED (BOX TYPE).
   ii) SITE JOINT SHALL BE FULLY RADIOGRAPHED.

H. PAINTING

A) SECTION : FOR 8000 mm DIA SHELL SECTION & 8000 mm DIA D'END AND RESPECTIVE ATTACHMENTS ON IT.
LOCATION : SHOP PRIMER / PRE-ERECTION.
SURFACE PREPARATION : SSPC-SP-10.
PRIMER PAINT : 1 COAT OF F16 @ 125 µ DFT / COAT.
FINAL PAINT : 1 COAT OF F16 @ 125 µ DFT / COAT.

B) SECTION : FROM TORI CONE & BOTTOM SHELL/SKIRT SECTIONS.
LOCATION : SHOP PRIMER / PRE-ERECTION.
SURFACE PREPARATION : SSPC-SP-10.
PRIMER PAINT : 1 COAT OF F16 @ 125 µ DFT / COAT.
FINAL PAINT : 1 COAT OF F16 @ 125 µ DFT / COAT.

REV NO.	ZONE	BRIEF RECORD OF REVISIONS	PPD.	CHD.	APPD.

ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

Customer : HPCL Rajasthan Refinery Limited Barmer

Bharat Heavy Electricals Ltd
UNIT: HEAVY PLATES & VESSELS PLANT
VISAKHAPATNAM-530012

	NAME	DATE
DRN	G.DEMUDU	04.01.21
CHD	D.SATISH	04.01.21
APPD	D.SATISH	04.01.21

DEPT: P.P.ENGG. | CODE: 031 | ALL DIMENSIONS ARE IN MM | PROJECTION | SCALE: 1 : 75 & N.T.S | WEIGHT (Kg.): - | REF TO ASSY / OLD DWG: 1-CL-010-U0169

TITLE: GENERAL NOTES FOR MAIN FRACTIONATOR (ITEM NO. 111-C-2101)

DRAWING NO : 1-CL-010-U0192 | REV: 0

FORM NO. 0425/2

A1 SIZE

FILE NAME: B224-111-80-43-DS-3001-A-1

NOZZLES AND CONNECTIONS (नोजल व कनैक्शन) **(CS+HIC & NACE ZONE)**

MARK	QTY	NOM. DIA (INCH)	SCH./THK.	FLANGES			PROJECTION NOTE-4	PAD WxT	SERVICE
				CLASS	TYPE	FACING			
मार्क	क्वान्टिटी	नामिनल डायां इंच	शेड्यूल व थिकनैस	क्लास	टाईप	फेसिंग	प्रोजेशन	पैड	सर्विस
2	1	96	48 THK.	-	WN	RF	REF SHT.-5	##	O.H. VAPOR+COMP. FLG.
3	1	8	80	150	WN	RF	4230	110xT	REFLUX IN (NOTE-38)
9	1	2	160	150	WN	RF	REF. SHT.-5	-	VENT
11	1	14	24 THK.	150	WN	RF	4250	175xT	RICH OIL RETURN
12 A-B	2	8	80	150	WN	RF	4230	110xT	LEAN OIL DRAW+VORTEX BREAKER
13	1	6	80	150	WN	RF	4230	85xT	LCO STRIPPER VP. RET.
14	1	16	24 THK.	150	WN	RF	4280	200xT	LCO PA RERURN (NOTE-38)
25 A-D, K	5	24	24 THK.	150	WN	RF	4280	300xT	MANHOLE + B.F. + DAVIT
30 A-C	3	2 I/D	-	300	LWN	RF	4180	-	THERMOWELLS + (LIQUID SHIELD)
31 A-C	3	2	160	300	WN	RF	4180	-	PRESSURE CONNECTION (NOTE-42)
32 I-J	2	3 (H)	160	150	WN	RF	4230	45xT	LEVEL XMTR (HOLD)
35	1	12	24 THK.	150	WN	RF	4230	160xT	LO STRIPPER VAP. RET.
		## INSERT PLATE OF 4800 Ø X 48 THK.							

`T' DENOTES CORRESPONDING NOMINAL THICKNESS OF SHELL/DISH END.

TABLE-1

BEDS		BOTTOM 1-2	MIDDLE 3-5	TOP 6-8
OPERATING PRESSURE (Kg/cm2g)	NORMAL	0.79	0.78	0.72
	MAXIMUM	1.083	1.065	1.009
OPERATING TEMP. (^{0}C)	NORMAL	349	271	172
	MAXIMUM	355	277	178

LICENSOR'S SPECIFICATION
लाईसन्सर स्पेसिफिकेशन्स

LICENSOR'S STANDARD
लाईसन्सर स्टैण्डर्ड्स

FOUNDATION LOADING DATA (OPERATING CONDITION)
फाऊंडेशन लोडिंग डाटा (ऑपरेटिंग कन्डिशन)

TYPE	MAX MOMENT AT BASE (M) (kgm)	MAX. SHEAR FORCE AT BASE (H) (kg)
SEISMIC (DBE)	274200	10656000
SEISMIC (MCE)	353900	13370050
WIND	239200	8585300

GENERAL NOTES (जनरल नोट्स)

UNLESS STATED OTHER WISE

1 ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
2 ALL ANCHOR BOLT HOLES TO STRADDLE N/S CENTRE LINE.
3 NORTH DIRECTION WHEREVER SHOWN IS WITH RESPECT TO PLAN VIEW.
4 (A) FOR NOZZLES ON SHELL PROJECTIONS ARE REFERRED FROM VESSEL CENTER LINE TO FLANGE CONTACT FACE.
4 (B) FOR NOZZLES ON HEAD PROJECTIONS ARE REFERRED FROM HEAD T.L TO FLANGE CONTACT FACE.
5 THE INDICATED THICKNESS IS THE MINIMUM ACCEPTABLE AFTER CONSTRUCTION.
6 FLANGE GASKET FACE SHALL HAVE 125 AARH FINISH.
7 DIMENSIONS OF FLANGES FOR NOZZLES UPTO 600NB SHALL BE AS PER ASME B16.5 AND FOR NOZZLE ABOVE 600NB SHALL BE AS PER ASME B16.47 SERIES-B UNLESS SPECIFIED OTHERWISE.
8 ID OF WELD NECK FLANGES SHALL MATCH WITH CORRESPONDING ID OF NOZZLE PIPE.
9 ALL REMOVABLE INTERNALS (EXCEPT COKE TRAP) SHALL BE SIZED SO AS TO PASS THROUGH MANHOLE. SUITABLE MANWAY CHECK SHALL BE CARRIED OUT BY VENDOR. NUMBER OF INTERNAL FLANGES FOR DISTRIBUTORS SHALL DECIDED BY VENDOR ACCORDINGLY.
10 PAINTING: SURFACE PREPARATION, PRIMER (PRE-ERECTION) & FINAL PAINT (PRE-ERECTION/FIELD) AS PER B224-000-79-41-PLS-01. TABLE 11.1.2 FOR TOP/MIDDLE SECTION & TABLE 11.3.2 FOR BOTTOM SECTION SHALL BE FOLLOWED.
11 LIFTING TRUNION, TAILING LUGS INCLUDING BRACING ARRANGEMENT FOR SKIRT SHALL BE DESIGNED BY VENDOR. (CONSIDERING AN IMPACT FACTOR OF 2). CALCULATION TO BE SUBMITTED FOR REVIEW. VENDOR TO PROVIDE INSERT PLATE OF 2 x SHELL THK. WHEREVER TAILING LUGS & LIFTING TRUNIONS ARE WELDED TO SHELL. VENDOR TO DESIGN TRUNION & TAILING LUGS FOR HANDLING COLUMN SECTIONS AT SITE. TOPMOST TRUNION & BOTTOM MOST TAILING LUG SHALL BE ADEQUATE ENOUGH TO WITHSTAND TOTAL ERECTION WT. OF COMPLETE COLUMN.
12 NOZZLE 50NB & BELOW SHALL BE STIFFENED WITH 2 NOS. 40x6 THK. FLATS 90^0 APART.
13 ALL FABRICATED NOZZLES SHALL BE FULLY RADIOGRAPHED.
14 TOLERANCE ON COLUMN DIAMETER UPTO & ABOVE 8000mm SHALL BE GREATER OF ± 20mm OR ±0.2% OF DIAMETER. HOWEVER IF STRINGER TOLERANCE ARE RECOMMENDED BY INTERNALS SUPPLIER, THE SAME SHALL BE COMPLIED WITH.
15 COLUMN SHALL BE SUBJECTED TO STEAM OUT CONDITIONS OF 0.5 Kg/cm^{2}g @150^{0}C.
16 NOZZLE SCHEDULES INDICATED FOR WELD OVERLAY NOZZLES ARE MINIMUM REQUIRED. IT SHALL BE FABRICATORS RESPONSIBILITY TO SELECT NOZZLE SCHEDULES SO THAT NO SHRINKAGE OR WRAPPING OCCURS DURING WELD OVERLAY.
17 ALL SS SURFACES SHALL BE PICKLED AND PASSIVATED AS PER ASTM A380.
18 A) ALL C & L SEAMS INCLUDING C-SEAM, NOZZLE NECK TO FLANGE, PIPE TO PIPE FITTING & PIPE TO PIPE SHALL BE FULLY RADIOGRAPHED.
B) ALL C & L SEAMS OF SKIRT SHALL BE FULLY RADIOGRAPHED.
19 **LICENSOR SHALL REVIEW FINAL DESIGN OF INTERNALS. ANY COMMENTS OF LICENSOR SHALL BE ABSORBED BY FABRICATOR WITHOUT ANY TIME & PRICE IMPLICATION.**
20 CS SHELL SECTION & TOP DISHED END INCLUDING NOZZLE SHALL MEET NACE+HIC REQUIREMENTS AS PER NACE MR 0103 & EIL SPEC. 6-79-0013. HARDNESS OF BASE METAL, WELD & HAZ AFTER PWHT SHALL BE 200 BHN MAXIMUM.
21 INTERNAL DETAILS SHOWN IN MDS ARE MINIMUM REQUIRED TO BE FOLLOWED. HOWEVER, FABRICATOR TO REFER PDS FOR FINALIZING DETAIL ON INTERNALS WHILE OBTAINING FEEDBACK OF THEIR APPOINTED INTERNAL SUPPLIER.
22 WELDED QUENCH THICKNESS GIVEN IS TENTATIVE AND MINIMUM. VENDOR SHALL DESIGN THE QUENCH TRAYS & SUPPORTING ARRANGEMENT CONSIDERING LOAD=1000 Kg/m^2 AND PROVIDE HIGHER THICKNESS, IF REQUIRED. FINAL SWAGE DIMENSION AND DIMENSION FROM SWAGE TO QUENCH NOZZLES TO BE FINALIZED BY FABRICATOR IN CONSULTATION WITH THEIR APPOINTED INTERNAL SUPPLIER.
23 ALL 80 NB NOZZLES COMING IN CLAD PORTION SHALL BE LWN TYPE AND WELD OVERLAYED.
24 INLET LINE TO COLUMN IS REFRACTORY LINED. ACTUAL PROCESS I/D IS 63". (REFRACTORY ON NOZZLE ASSEMBLY BY OTHERS) (DETAIL AS PER SHT.6 OF 7) (REFRACTORY ANCHORS BY VENDOR). NOZZLES ARE 180° APART.
25 HOT INSULATION :
TOP SECTION = 40 mm.
MIDDLE SECTION = 65mm
BOTTOM SECTION = 90 mm.
26 ALL INTERNAL GASKETS SHALL BE SUITABLE FOR THE DESIGN TEMPERATURE.
27 PROCURement & SUPPLY OF ANCHOR BOLTS/NUTS (BY COLUMN FABRICATOR)- SA 193 GR.B7/SA 194 GR.2H. FOR DETAIL REFER SKETCH ATTACHED WITH MR.
28 COLUMN SHALL BE TRANSPORTED TO THE SITE IN TWO PIECES & SITE ASSEMBLED AS PER JOB SPEC. NO. B224-80-43-SP-6006 ATTACHED ELSEWHERE IN MR.
29 LOCAL HYDROTEST, 100% RADIOGRAPHY & LOCAL PWHT SHALL BE CARRIED OUT FOR SITE JOINT.
30 FOUR SKIN THERMOCOUPLES (BY OTHERS) REQUIRED ON COLUMN AT MID POINT OF EACH BED 90º APART **(DETAIL OF SKIN THERMOCOUPLE INSTALLATION-HOLD)**.
31 MOC FOR NOZZLE NECK / FLANGE / GASKET / NUTS / BOLTS SHALL BE COMPATIBLE WITH CORRESPONDING SHELL MOC.

SPECIFICATIONS (स्पेसिफिकेशन्स)

X	DENOTES APPLICABLITY	
X	GENERAL SPEC. FOR PRESSURE VESSELS	6-12-0001
X	SUPP. SPEC. FOR CS VESSELS	6-12-0002
X	SUPP. SPEC. FOR LOW ALLOY STEEL VESSELS	6-12-0003
X	SUPP. SPEC. FOR CLAD VESSELS	6-12-0007
X	STD. SPEC. FOR BQCS PLATE	6-12-0011
X	STD. SPEC. FOR STRUCTRAL QUALITY PLATES	6-12-0014
X	STD. SPEC. FOR CLAD PLATES	6-12-0015
X	STD. SPEC. FOR 1.25% Cr-1/2% Mo STEEL PLATES	6-12-0017
X	STD. SPEC. FOR 2.25% Cr-1 MO STEEL PLATES	6-12-0018
X	STD. SPEC. FOR SS PLATES	6-12-0020
X	SPEC. FOR SURFACE PREPARATION & PROTECTIVE COATING	B224-000-79-41-PLS-01
X	STD. SPEC. FOR CS COMPONENT IN SOUR SERVICE	6-79-0013

STANDARDS (स्टैण्डर्ड्स)

X	VESSEL TOLERANCES	7-12-0001
	SUPPORT FOR HORIZONTAL VESSEL	7-12-0002
	WOODEN PILLOWS FOR SADDLE SUPPORT	7-12-0003
X	SKIRT BASE DETAILS	7-12-0004
X	SKIRT OPENING DETAILS	7-12-0005
	ANGLE LEG SUPPORT	7-12-0006
	PIPE LEG SUPPORT	7-12-0007
	BRACKET SUPPORT FOR VERTICAL VESSEL	
	MANHOLE WITH HINGED COVER	7-12-0009
X	MANHOLE WITH DAVIT	7-12-0010
X	LADDER RUNGS FOR MANHOLE/DEMISTER	7-12-0011
	RETAINING PLATE	7-12-0012
X	NOZZLE REINFORCEMENT AND PROJECTION	7-12-0013
	PAD NOZZLES FOR VESSELS	7-12-0014
X	STANDARD BOLT HOLE ORIENTATION	7-12-0015
X	ALLOY LINER DETAILS	7-12-0016
	SIGHT GLASSES FOR PRESSURE VESSELS	7-12-0017
	INTERNAL FLANGES	7-12-0018
	VORTEX BREAKERS	7-12-0019
	INLET DEFLECTOR BAFFLE	7-12-0020
	SUPPORT RING AND BOLTING BAR	7-12-0021
X	SUPPORT RING SIZES FOR PACKED TOWERS	7-12-0022
X	PIPE DAVIT (FOR GUIDANCE)	7-12-0023
	LIFTING LUG TOP HEAD TYPE	7-12-0024
X	FIRE PROOFING AND INSULATION SUPPORTS	7-12-0025
X	EARTHING LUG	7-12-0026
X	NAME PLATE	7-12-0027
X	MANUFACTURER NAME PLATE	7-12-0028
X	BRACKET FOR NAME PLATE	7-12-0029
	NAME PLATE FOR SMALL EQUIPMENT	7-12-0030
	DETAILS OF FORGED NOZZLES	7-12-0031
X	SUPPORTS FOR INTERNAL FEED PIPE	7-12-0032
	HOT INSULATION SUPPORT FOR HORIZONTAL VESSEL	7-12-0033
	PIPE DAVIT SUPPORT FOR COLD INS. VESSELS	7-12-0034
	TYP. DETAILS OF WIRE MESH DEMISTER SUPPORTS	7-12-0036
X	S.R NOZZLE NECK	7-12-0037
	ALLOWABLE NOZZLE LOADS	7-12-0038

REFERENCE DRAWINGS(रेफरेन्स डाईंग)

	NOZZLE ORIENTATIONS	
	LADDERS/PLATFORM CLEATS	
	PIPE SUPPORT CLEATS	
	TRAY SUPPORT AND BOLTING BARS	N.A.
	DEMISTER DATA SHEET	N.A.
X	PROCESS DATA SHEETS	076405C001-111-PDS-0500-2101

HOLD UPS (होल्ड अप्स)

X	NOZZLE ORIENTATIONS	X	SIZE OF NOZZLES (AS MARKED)
X	NOZZLE ELEVATIONS - AS MARKED	X	PIPE SUPPORT CLEATS
		X	LADDER/PLATFORM CLEATS
X	SUPPORT HEIGHT		TRAY SUPPORT/BOLTING BARS
X	DETAILS OF INTERNALS	X	PIPE DAVIT
			DETAILS OF SKIN THERMOCOUPLES INSTALLATION ON SHELL

DESIGN DATA (डिजाइन डाटा)

CODE	ASME SEC.VIII DIV.-1 2017			
WORKING PRESSURE (kg/cm^{2}g)	SEE TABLE-1			
DESIGN PRESSURE (kg/cm^{2}g)	INT. 3.5 AT TOP	EXT. F.V. @ 200° C		
WORKING TEMPERATURE (^{0}C)	SEE TABLE-1			
DESIGN TEMPERATURE (^{0}C)	**			
MDMT (^{0}C)	3.4			
CORROSION ALLLOWANCE (MM)	3.0 (FOR CS PORTION ONLY)			
TYPE OF HEAD	2:1 ELLIPSOIDAL			
JOINT EFFICIENCY	SHELL SEE DRG.	HEAD/TORICONE	1	
RADIOGRAPHY (NOTE-19)	SHELL SEE DRG.	HEAD/TORICONE	FULL	
POST WELD HEAT TREATMENT (NOTE-22)	SEE DRG.			
HEAT TREATMENT	HEAD/TORICONE-AS PER SPEC.			
OPERATING MEDIUM	-			
SP. GRAVITY	0.91 @340^{0}C			
WIND SPECIFICATION	IS:875			
EARTH QUAKE SPECIFICATION	IS: 1893 & SITE SPECTRA			
CAPACITY (M^3)	2662			
PAINTING/CLEANING	AS PER SPEC. (NOTE-10)			
INSULATION THICKNESS (mm) (IH) (BY OTHERS)	(NOTE-25, 37a)	[X] HOT	[ ] COLD	
FIRE PROOFING (BY OTHERS)	50 mm	[X] YES	[ ] NO	
HYDROSTATIC TEST (kg/cm2g)	~~HORIZONTAL~~	VERTICAL (AT TOP)		
PRESSURE (NEW & COLD)	4.732			
INSPECTION BY	[ ] EIL	[ ] CIB	[X] TPIA	

** TOP SECTION=200°C, MIDDLE SECTION=295°C, BOTTOM SECTION=475°C; BOTTOM SECTION FROM TOP OF BED1 TO BOTTOM OF CONE SECTION DESIGNED FOR INTERMITTENT/EXCURSION OF 570 ºC FOR ≤ 100 HOURS/YEAR FOR 30 YEARS.

MATERIAL OF CONSTRUCTION (मैटिरियल ऑफ कन्सट्रक्शन)

(AS PER ASME / IS ~~OR EQUIVALENT~~) **(CS ZONE)**

SHELL/INSERT PLATE	SA 516 GR.60 *
REINFORCEMENT PAD	SA 516 GR.60
HEADS	SA 516 GR.60 *
SHELL FLANGES	-
NOZZLE FLANGES/LWN NOZZLES	SA 105 *
NOZZLE NECK UPTO 250 NB	SA 106 GR. B *
NOZZLE NECK ABOVE 250 NB	SA 516 GR.60 *
PIPE FITTINGS (SEAMLESS)	SA 234 GR.WPB *
GASKET EXTERNAL	SPIRAL WOUND WITH SS 316L METAL WINDING & GRAFOIL FILLER WITH SS INNER & CS OUTER RING AS PER ASME B16.20
GASKET INTERNAL	CNAF (SEE NOTE-26)
EXTERNAL STUDS/BOLTS/NUTS	SA 193 GR.B7M / SA 194 GR.2HM
INTERNAL STUDS/BOLTS/NUTS	SS 316L
SKIRT/ ~~SUPPORT~~	-
SKIRT/ ~~SUPPORT~~ BASE	-
INTERNAL PARTS (BOLTED)	SS 316L
INTERNAL SUPPORTS (WELDED)	SA 516 Gr.60*
INTERNAL PIPE DISTRIBUTOR	SA 106 GR. B * / SA 516 GR.60 *
CLIPS & ATTACHMENTS (EXTERNAL)	SA 516 GR.60
INTERNALS PARTS (WELDED)	SA 516 GR.60 *
DEMISTER/GRID	-
PAD FOR EXTERNAL ATTACHMENT	SA 516 GR.60
PIPE DAVIT	SA 106 GR.B / SA 53
LIFTING TRUNION	SA 516 GR.60
TAILING LUG	SA 516 GR.70
VACUUM STIFFENER	SA 516 GR.60
CHIMNEY TRAYS	SS 316L
PACKED BED SUPPORT & HOLD DOWN	SS 316L
PACKING & ASSOCIATE ATTACHMENTS	SS 316L
DAVIT STRUCTURE	IS 2062 E250 QUALITY BR

*** (REFER NOTE-20 & 33)**

$ EXCLUDING WEIGHT OF BOLTED INTERNALS

STATUTORY REGULATIONS (स्टैचुअरी रेगुलेशन्स)

INDIAN BOILER REGULATIONS (IBR)

DEPARTMENT OF EXPLOSIVES, NAGPUR (CCOE)

$ APPROXIMATE WEIGHT (kgs) (PER ITEM) (एपरौक्सिमेंट वजन)

ERECTION	$ 650000	OPERATING	1146300
HYDROTEST(SHOP)	$ 3312000	HYDROTEST (FIELD)	3426000

NUMBER OF ITEMS : **ONE**

A	23.08.2019	ISSUED FOR ENGG/BIDS	AKP	NNM/RKM	KJH				
REV	DATE	REVISION	BY	CHECKED	APPROVED				

ENGINEERS INDIA LIMITED
NEW DELHI
इंजीनियर्स इंडिया लिमिटेड
(भारत सरकार का उपक्रम)

JOB NO: कार्य संख्या: B224 | UNIT NO: यूनिट संख्या: 111
CLIENT : क्लाईट: M/S HRRL, RAJASTHAN
PLANT : प्लांट: RAJASTHAN REFINERY PROJECT

DESIGN DATA	डिजाइन डाटा	DRAWING NUMBER / डाईंग नम्बर	REV
MAIN FRACTIONATOR	मेन फरैक्शनेटर	B224-111-80-43-DS-3001	A
ITEM NO. : 111-C-2101	आइटम नम्बर : 111-सी-2101	SHEET 1 OF 7	

FORMAT NO.3-1646-0113 REV.2 (20.09.2011) A3-420 X 297

FILE NAME : B224-111-80-43-DS-3001-A-2

NOZZLES AND CONNECTIONS (नोजल व कनैक्शन) (1.25 Cr+0.5 MO+CLAD ZONE)

MARK	QTY	NOM. DIA (INCH)	SCH./THK.	FLANGES			PROJECTION NOTE-4	PAD WxT	SERVICE
				CLASS	TYPE	FACING			
मार्क	क्वान्टिटी	नामिनल डायां (इंच)	शड्यूल व थिकनैस	क्लास	टाईप	फेसिंग	प्रोजेशन	पैड	सर्विस
4	1	30	24+3 CLAD	300	WN	RF	REF. SHT.-5	380xT	BOTTOMS
8	1	3 I/D	@	300	LWN	RF	2720	45xT	STEAM OUT
15 A-B	2	18	20+3 CLAD	150	WN	RF	4280	225xT	LCO DRAW+VORTEX BREAKER
16	1	14	20+3 CLAD	150	WN	RF	4280	175xT	HCO PA RETURN (NOTE-38)
17 A-B	2	18	20+3 CLAD	300	WN	RF	4360	225xT	HCO DRAW+VORTEX BREAKER
18	1	10	20+3 CLAD	300	WN	RF	4260	135xT	HCO WASH
19	1	20	24+3 CLAD	300	WN	RF	4370	250xT	SLURRY PA RET. (NOTE-38)
21	1	6	80+@	300	WN	RF	2720	85xT	SPARGE STEAM
22	1	8	14+3 CLAD	300	WN	RF	2720	110xT	FRESH FEED
24	1	3 I/D	@	300	LWN	RF	2720	45xT	UTILITY
25E,F, L	3	24	24+3 CLAD	150	WN	RF	4280	300xT	MANHOLE + B.F. + DAVIT
25G,H, M	3	24	24+3 CLAD	300	WN	RF	4350	300xT	MANHOLE + B.F. + DAVIT
25J	1	24	24+3 CLAD	300	WN	RF	2820	300xT	MANHOLE + B.F. + DAVIT
26	1	10	20+3 CLAD	150	WN	RF	4230	135xT	PRESSURE BALANCE (FROM 111-V-2601)
27	1	3 I/D	@	150	LWN	RF	4230	45xT	PRESSURE BALANCE (FROM 111-V-1104)
28	1	3 I/D	@	300	LWN	RF	4230	45xT	PRESSURE BALANCE (FROM 111-V-2602)
30D-I	6	3 I/D	@	300	LWN	RF	4260	45xT	THERMOWELLS (LIQUID SHIELD)
30 M	1	3 I/D	@	300	LWN	RF	2720	45xT	THERMOWELL
31 D-G	4	3 I/D	@	300	LWN	RF	4260	45xT	PRESSURE CONNECTION (NOTE-42)
32 A-B, M-R	8	3 I/D	@	300	LWN	RF	4260	45xT	LEVEL XMTR (HOLD)
32 C-H	6	3 I/D	@	300	LWN	RF	2720	45xT	LEVEL XMTR (HOLD)
32 K-L	2	3 I/D	@	300	LWN	RF	4260	45xT	LEVEL XMTR (HOLD)
34 A-B	2	3 I/D	@	300	LWN	RF	4260	45xT	LEVEL GAUGE (HOLD)
34 C-D	2	3 I/D	@	300	LWN	RF	2720	45xT	LEVEL GAUGE (HOLD)
SKV 1-8	8	4	40	AS PER EIL STD.				-	SKIRT VENT
AO 1-2	2	20	30 THK.	AS PER EIL STD.				250x60	ACCESS OPENING

LICENSOR'S SPECIFICATION
लाईसन्सर स्पेसिफिकेशन

LICENSOR'S STANDARD
लाईसन्सर स्टैण्डर्स

FOUNDATION LOADING DATA (OPERATING CONDITION)
फाऊंडेशन लोडिगं डाटा (आपरेटिंग कनडिशन)

TYPE	MAX MOMENT AT BASE (M) (kgm)	MAX. SHEAR FORCE AT BASE (H) (kg)
SEISMIC (DB)	-	-
SEISMIC (MC)	-	-
WIND	-	-

GENERAL NOTES (जनरल नोट्स)

UNLESS STATED OTHER WISE

32 ALL SELF REINFORCED INTEGRALLY FORGED NOZZLES SHALL HAVE LIP CONFIGURATION (100% RADIOGRAPHABLE) WITH SMOOTH RADIUS AT CORNERS AS SHOWN IN SKETCH.

33 CS/LAS PLATES SHALL BE IMPACT TESTED AS PER CODE/SPEC.

34 ALL CLAD PLATES SHALL CONFIRM TO SA263.

35 ONLY ISR IS ACCEPTABLE. DHT IN PLACE OF ISR IS NOT PERMITTED.

36 FULL RADIOGRAPHY WHEREVER SPECIFIED SHALL IMPLY 100% RADIOGRAPHY OF ALL BUTT WELDS.

37 a) NO INSULATION SHALL BE PROVIDED FOR NOZZLE-1.

37 b) PROVIDE RETAINING PLATE FOR REINFORCING REFRACTORY (DETAILS AS SHOWN ON SHEET 6 OF 7).

38 PACKING VENDOR TO DESIGN THE COLLECTOR TRAYS, PACKED BED, DISTRIBUTORS & INTERNAL PIPE DISTRIBUTOR.

39 PACKING VENDOR TO CONFIRM PACKED BED HEIGHT.

40 LOCATE THERMOWELLS IN: VAPOR SPACE BELOW PACKING: NOZZLES 30A-F; BOTTOMS LIQ: NOZZLE 30M

41 FEED ZONE/SLURRY BED TOP AT 120° SPACING: NOZZLES 30G, 30H, 30I & 30J, 30K, 30L.

42 LOCATE ALL PRESSURE INSTRUMENTS IN VAPOR PHASE.

43 SPARES SHALL BE SUPPLIED BY FABRICATOR AR PER MR SCOPE OF WORK/SUPPLY DOC.

44 ALL REQUIREMENTS MENTIONED IN COLUMN PROCESS DATA SHEET ATTACHED WITH MR SHALL BE COMPILED BY VENDOR.

45 DESIGN (BOTH HYDRAULIC & MECHANICAL) PROCUREMENT, FABRICATION, SUPPLY & INSTALLATION OF COLUMN INTERNALS (BOTH WELDED AND BOLTED) ARE IN SCOPE OF COLUMN FABRICATOR. REFER JOB SPECIFICATION & OTHER DOCUMENTS RELATED TO SAME IN BID DOCUMENT.

46 SUPPLY OF LADDER & PLATFORMS IS IN SCOPE OF VENDOR. COLUMN VENDOR SHALL PROVIDE MATCH MARKED STRUCTURAL MEMBERS FOR PLATFORMS & LADDER SUPPORTED ON COLUMN.

47 TENTATIVE LOCATION OF SITE JOINT IS MARKED ON SHT.4 OF 7. HOWEVER ACTUAL LOCATION SHALL BE FINALIZED BY COLUMN VENDOR. VENDOR SHALL CONSIDER EXTRA LENGTH SUITABLY TO ACCOUNT FOR CUTTING SECTION, EDGE PREPARATION FOR REWELDING AT SITE BEFORE TRANSPORTATION FROM SHOP TO SITE.

48 FOR DETAIL OF SHEILD FOR LIQUID THERMOWELL (EXCEPT NOZZLE 30M) & DETAIL OF VORTEX BREAKER REFER SHT. 22 OF PDS.

49 ALL INTERNALS SHALL HAVE ANSI RF FLANGE CONNECTIONS & BE SIZED TO PASS THROUGH THE NEAREST MANHOLE.

50 **LAS MOC OF MIDDLE & BOTTOM SECTION AS DEFINED IN SHT.4 SHALL BE N & T.**

51 COLUMN VENDOR SHALL USE CROWN AND PETAL CONSTRUCTION FOR DISH ENDS. WHENEVER A NOZZLE IS POSITIONED AT THE CENTRE OF THE DISHED END, CROWN DIAMETER SHOULD BE LARGER THAN NOZZLE/ RF PAD DIAMETER.

@ 5 mm MINIMUM SS 304L WELD OVERLAY (FOR MIN. 3 mm UNDILUTED SS304L CHEMISTRY)

SPECIFICATIONS (स्पेसिफिकेशन्स)

X	DENOTES APPLICABLITY	
	GENERAL SPEC. FOR PRESSURE VESSELS	6-12-0001
	SUPP. SPEC. FOR CS VESSELS	6-12-0002
	STD. SPEC. FOR BQCS PLATE	6-12-0011
	STD. SPEC. FOR STRUCTRAL QUALITY PLATES	6-12-0014
	STD. SPEC. FOR SHOP & FIELD PAINTING	6-44-0004

STANDARDS (स्टैण्डर्डस)

	VESSEL TOLERANCES	7-12-0001
	SUPPORT FOR HORIZONTAL VESSEL	7-12-0002
	WOODEN PILLOWS FOR SADDLE SUPPORT	7-12-0003
	SKIRT BASE DETAILS	7-12-0004
	SKIRT OPENING DETAILS	7-12-0005
	ANGLE LEG SUPPORT	7-12-0006
	PIPE LEG SUPPORT	7-12-0007
	BRACKET SUPPORT FOR VERTICAL VESSEL	7-12-0008
	MANHOLE WITH HINGED COVER	7-12-0009
	MANHOLE WITH DAVIT	7-12-0010
	LADDER RUNGS FOR MANHOLE/DEMISTER	7-12-0011
	RETAINING PLATE	7-12-0012
	NOZZLE REINFORCEMENT AND PROJECTION	7-12-0013
	PAD NOZZLES FOR VESSELS	7-12-0014
	STANDARD BOLT HOLE ORIENTATION	7-12-0015
	ALLOY LINER DETAILS	7-12-0016
	SIGHT GLASSES FOR PRESSURE VESSELS	7-12-0017
	INTERNAL FLANGES	7-12-0018
	VORTEX BREAKERS	7-12-0019
	INLET DEFLECTOR BAFFLE	7-12-0020
	SUPPORT RING AND BOLTING BAR	7-12-0021
	SUPPORT RING SIZES FOR PACKED TOWERS	7-12-0022
	PIPE DAVIT	7-12-0023
	LIFTING LUG TOP HEAD TYPE	7-12-0024
	FIRE PROOFING AND INSULATION SUPPORTS	7-12-0025
	EARTHING LUG	7-12-0026
	NAME PLATE	7-12-0027
	MANUFACTURER NAME PLATE	7-12-0028
	BRACKET FOR NAME PLATE	7-12-0029
	NAME PLATE FOR SMALL EQUIPMENT	7-12-0030
	DETAILS OF FORGED NOZZLES	7-12-0031
	SUPPORTS FOR INTERNAL FEED PIPE	7-12-0032
	HOT INSULATION SUPPORT FOR HORIZONTAL VESSEL	7-12-0033
	PIPE DAVIT SUPPORT FOR COLD INS. VESSELS	7-12-0034
	TYP. DETAILS OF WIRE MESH DEMISTER SUPPORTS	7-12-0036
	S.R NOZZLE NECK	7-12-0037

REFERENCE DRAWINGS(रेफरेन्स डाईग)

NOZZLE ORIENTATIONS	
LADDERS/PLATFORM CLEATS	
PIPE SUPPORT CLEATS	
TRAY SUPPORT AND BOLTING BARS	
DEMISTER DATA SHEET	

HOLD UPS (होल्ड अप्स)

NOZZLE ORIENTATIONS	SIZE OF NOZZLES
NOZZLE ELEVATIONS	PIPE SUPPORT CLEATS
SUPPORT HEIGHT	LADDER/PLATFORM CLEATS
DETAILS OF INTERNALS	TRAY SUPPORT/BOLTING BARS
	PIPE DAVIT

DESIGN DATA (डिजाइन डाटा)

CODE	ASME SEC.VIII DIV.-1 (LATEST)			
WORKING PRESSURE (kg/cm^2g)	INT. TOP -		BOT. -	
DESIGN PRESSURE (kg/cm^2g)	INT. TOP -		BOT. -	
WORKING TEMPERATURE (^0C)	TOP -		BOT. -	
DESIGN TEMPERATURE (^0C)	-			
MDMT (^0C)	15			
CORROSION ALLLOWANCE (MM)	-			
TYPE OF HEAD	-			
JOINT EFFICIENCY	SHELL -	HEAD/TORICONE	-	
RADIOGRAPHY	SHELL -	HEAD/TORICONE	-	
POST WELD HEAT TREATMENT	AS PER CODE			
HEAT TREATMENT	HEAD/TORICONE-			
OPERATING MEDIUM	-			
SP. GRAVITY	-			
WIND SPECIFICATION	IS:875			
EARTH QUAKE SPECIFICATION	IS: 1893 + SITE SPECTRA			
CAPACITY (M^3)	-			
PAINTING/CLEANING	AS PER SPEC.			
INSULATION THICKNESS (mm)	-	☐ HOT	☐ COLD	
FIRE PROOFING		☐ YES	☐ NO	
HYDROSTATIC TEST (kg/cm2g)	~~HORIZONTAL~~	VERTICAL (AT TOP)		
PRESSURE (NEW & COLD)	-			
INSPECTION BY	☐ EIL	☐ CIB	☐ LLOYDS	

MATERIAL OF CONSTRUCTION (मैटिरियल ऑफ कन्सट्रक्शन)

(AS PER ASME / IS ~~OR EQUIVALENT~~) **(CLAD ZONE) (NOTE-33 & 34)**

SHELL/INSERT PLATE	SA 387 GR.11 CL.2 + SS 304L CLAD
REINFORCEMENT PAD	SA 387 GR.11 CL.2
HEADS	SA 387 GR.11 CL.2 + SS 304L CLAD
SHELL FLANGES	-
NOZZLE FLANGES/LWN	$$
SELF REINFORCED NOZZLES+NECK EXTENSION	-
NOZZLE NECK ABOVE 80 NB UPTO 150 NB	SA 335 P11+SS304L WELD OVERLAY
NOZZLE NECK ABOVE 150 NB	SA 387 Gr.11 CL.2+SS304L CLAD
PIPE FITTINGS (SEAMLESS)	SA 234 WP 11+SS304L WELD OVERLAY
GASKET EXTERNAL	SPIRAL WOUND WITH SS 321H METAL WINDING & GRAFOIL FILLER WITH CS OUTER & SS INNER RING AS PER ASME B16.20
GASKET INTERNAL	
EXTERNAL STUDS/BOLTS/NUTS	SA 193 GR.B16 / SA 194 GR.4
INTERNAL STUDS/BOLTS/NUTS	SS 304L
SKIRT/ ~~SUPPORT~~	-
SKIRT/ ~~SUPPORT~~ BASE	-
INTERNAL PARTS (WELDED/BOLTED)	SS 304L
SKIRT VENT	SA 335 GR.P11
VACUUM STIFFENER	SA 387 GR.11 CL.2
PAD FOR EXTERNAL ATTACHMENTS	SA 387 GR.11 CL.2
CLIPS & ATTACHMENTS (EXTERNAL)	SA 387 GR.11 CL.2
LIFTING TRUNION/TAILING LUG	SA 387 GR.11 CL.2
ANCHOR BOLTS/NUTS/WASHER	SA 193 GR.B7 / SA 194 GR.2H / ASTM F436
BED SUPPORT & HOLD DOWN	SS 304H
PACKING + CHIMNEY TRAY & ASSOCIATE ATTACHMENT	SS304L

$$ SA 182 GR.F11 CL.2 + SS 304L WELD OVERLAY/ SA 336 GR.F11 CL.2 + SS 304L WELD OVERLAY.

STATUTORY REGULATIONS (स्टैचुअरी रेगुलेशन्स)

INDIAN BOILER REGULATIONS (IBR)

DEPARTMENT OF EXPLOSIVES, NAGPUR (CCOE)

APPROXIMATE WEIGHT (kgs) (PER ITEM) (एपरौक्सिमेंट वजन)

ERECTION	-	OPERATING	-
HYDROTEST(SHOP)	-	HYDROTEST (FIELD)	-
NUMBER OF ITEMS :	-		

A	23.08.2019	ISSUED FOR ENGG/BIDS	AKP	NNM/RKM	KJH		
REV	DATE	REVISION	BY	CHECKED	APPROVED		

ENGINEERS INDIA LIMITED
NEW DELHI
इंजीनियर्स इंडिया लिमिटेड
(भारत सरकार का उपक्रम)

JOB NO: कार्य सख्या B224 | UNIT NO: युनिट सख्या 111
CLIENT : क्लाईट M/S HRRL, RAJASTHAN
PLANT : प्लांट RAJASTHAN REFINERY PROJECT

DESIGN DATA डिजाइन डाटा
MAIN FRACTIONATOR | मेन फरैक्शनेटर
ITEM NO. 111-C-2101 | आइटम नम्बर : 111-सी-2101

DRAWING NUMBER डाईग नम्बर: **B224-111-80-43-DS-3001** REV: A
SHEET 2 OF 7

FORMAT NO.3-1646-0113 REV.2 (20.09.2011) A3-420 X 297

NOZZLES AND CONNECTIONS (नोजल व कनैक्शन) **(2.25 Cr.+1 MO+CLAD ZONE)**

MARK	QTY	NOM. DIA (INCH)	SCH./THK.	FLANGES			PROJECTION NOTE-4	PAD WxT	SERVICE
				CLASS	TYPE	FACING			
मार्क	क्वान्टिटी	नामिनल डायमा (इंच)	शेड्यूल व थिकनैस	क्लास	टाईप	फेसिंग	प्रोजेशन	पैड	सर्विस
1 A-B	2	72	REFER SHT.-7						FEED (NOTE-24 & 37)+COMP. FLG.+SPACER/ BLIND
20	1	6	REF. SHT.-7	300	SRWN	RF	REF. SHT.-7	-	QUENCH RETURN
25I	1	24	REF. SHT.-7	300	SRWN	RF	REF. SHT.-7	-	MANHOLE + B.F. + DAVIT
30J-L	3	3 I/D	@	300	SRLWN	RF	REF SHT.7	-	THERMOWELLS (LIQUID SHIELD)
31H	1	3 I/D	@	300	SRLWN	RF	REF SHT.7	-	PRESSURE CONNECTION (NOTE-42)

LICENSOR'S SPECIFICATION
लाईसन्सर स्पेसिफिकेशन्स

LICENSOR'S STANDARD
लाईसन्सर स्टैण्डर्स

FOUNDATION LOADING DATA (OPERATING CONDITION)
फाऊंडेशन लोडिंग डाटा (आपरेटिंग कनडिशन)

TYPE	MAX MOMENT AT BASE (M) (kgm)	MAX. SHEAR FORCE AT BASE (H) (kg)
SEISMIC (DB)	-	-
SEISMIC (MC)	-	-
WIND	-	-

GENERAL NOTES (जनरल नोट्स)

UNLESS STATED OTHER WISE

@ 5-6 mm SS 304L WELD OVERLAY (FOR MIN. 3 mm UNDILUTED SS304L CHEMISTRY)

SPECIFICATIONS (स्पेसिफिकेशन्स)

X	DENOTES APPLICABLITY	
	GENERAL SPEC. FOR PRESSURE VESSELS	6-12-0001
	SUPP. SPEC. FOR CS VESSELS	6-12-0002
	STD. SPEC. FOR BQCS PLATE	6-12-0011
	STD. SPEC. FOR STRUCTRAL QUALITY PLATES	6-12-0014
	STD. SPEC. FOR SHOP & FIELD PAINTING	6-44-0004

STANDARDS (स्टैण्डर्डस)

VESSEL TOLERANCES	7-12-0001
SUPPORT FOR HORIZONTAL VESSEL	7-12-0002
WOODEN PILLOWS FOR SADDLE SUPPORT	7-12-0003
SKIRT BASE DETAILS	7-12-0004
SKIRT OPENING DETAILS	7-12-0005
ANGLE LEG SUPPORT	7-12-0006
PIPE LEG SUPPORT	7-12-0007
BRACKET SUPPORT FOR VERTICAL VESSEL	7-12-0008
MANHOLE WITH HINGED COVER	7-12-0009
MANHOLE WITH DAVIT	7-12-0010
LADDER RUNGS FOR MANHOLE/DEMISTER	7-12-0011
RETAINING PLATE	7-12-0012
NOZZLE REINFORCEMENT AND PROJECTION	7-12-0013
PAD NOZZLES FOR VESSELS	7-12-0014
STANDARD BOLT HOLE ORIENTATION	7-12-0015
ALLOY LINER DETAILS	7-12-0016
SIGHT GLASSES FOR PRESSURE VESSELS	7-12-0017
INTERNAL FLANGES	7-12-0018
VORTEX BREAKERS	7-12-0019
INLET DEFLECTOR BAFFLE	7-12-0020
SUPPORT RING AND BOLTING BAR	7-12-0021
SUPPORT RING SIZES FOR PACKED TOWERS	7-12-0022
PIPE DAVIT	7-12-0023
LIFTING LUG TOP HEAD TYPE	7-12-0024
FIRE PROOFING AND INSULATION SUPPORTS	7-12-0025
EARTHING LUG	7-12-0026
NAME PLATE	7-12-0027
MANUFACTURER NAME PLATE	7-12-0028
BRACKET FOR NAME PLATE	7-12-0029
NAME PLATE FOR SMALL EQUIPMENT	7-12-0030
DETAILS OF FORGED NOZZLES	7-12-0031
SUPPORTS FOR INTERNAL FEED PIPE	7-12-0032
HOT INSULATION SUPPORT FOR HORIZONTAL VESSEL	7-12-0033
PIPE DAVIT SUPPORT FOR COLD INS. VESSELS	7-12-0034
TYP. DETAILS OF WIRE MESH DEMISTER SUPPORTS	7-12-0036
S.R NOZZLE NECK	7-12-0037

REFERENCE DRAWINGS(रेफरेन्स डाईग)

NOZZLE ORIENTATIONS
LADDERS/PLATFORM CLEATS
PIPE SUPPORT CLEATS
TRAY SUPPORT AND BOLTING BARS
DEMISTER DATA SHEET

HOLD UPS (होल्ड अप्स)

NOZZLE ORIENTATIONS	SIZE OF NOZZLES
NOZZLE ELEVATIONS	
SUPPORT HEIGHT	PIPE SUPPORT CLEATS
DETAILS OF INTERNALS	LADDER/PLATFORM CLEATS
	TRAY SUPPORT/BOLTING BARS
	PIPE DAVIT

DESIGN DATA (डिजाइन डाटा)

CODE	ASME SEC.VIII DIV.-1 (LATEST)			
WORKING PRESSURE (kg/cm^2g)	INT. TOP -		BOT. -	
DESIGN PRESSURE (kg/cm^2g)	INT. TOP -		BOT. -	
WORKING TEMPERATURE (^0C)	TOP -		BOT. -	
DESIGN TEMPERATURE (^0C)	-			
MDMT (^0C)	15			
CORROSION ALLLOWANCE (MM)	-			
TYPE OF HEAD	-			
JOINT EFFICIENCY	SHELL -	HEAD/TORICONE	-	
RADIOGRAPHY	SHELL -	HEAD/TORICONE	-	
POST WELD HEAT TREATMENT	AS PER CODE			
HEAT TREATMENT	HEAD/TORICONE-			
OPERATING MEDIUM	-			
SP. GRAVITY	-			
WIND SPECIFICATION	IS:875			
EARTH QUAKE SPECIFICATION	IS: 1893 + SITE SPECTRA			
CAPACITY (M^3)	-			
PAINTING/CLEANING	AS PER SPEC.			
INSULATION THICKNESS (mm)	-	☐ HOT	☐ COLD	
FIRE PROOFING		☐ YES	☐ NO	
HYDROSTATIC TEST (kg/cm2g)	~~HORIZONTAL~~	VERTICAL (AT TOP)		
PRESSURE (NEW & COLD)	-			
INSPECTION BY	☐ EIL	☐ CIB	☐ LLOYDS	

MATERIAL OF CONSTRUCTION (मैटिरियल ऑफ कन्सट्रक्शन)

(AS PER ASME / IS ~~OR EQUIVALENT~~) **(CLAD ZONE) (NOTE-33 & 34, #*)**

SHELL/INSERT PLATE	SA 387 GR.22 CL.2 + SS 304L CLAD
REINFORCEMENT PAD	-
TORICONE	SA 387 Gr. 22 CL.2+SS 304L CLAD
SHELL FLANGES	-
NOZZLE FLANGES/LWN	$$
SELF REINFORCED NOZZLES+NECK EXTENSION	$$
NOZZLE NECK ABOVE 80 NB UPTO 150 NB	-
NOZZLE NECK ABOVE 150 NB	SA 387 Gr.22 CL.2+SS304L CLAD
PIPE FITTINGS (SEAMLESS)	SA 234 WP 22+SS304L WELD OVERLAY
GASKET EXTERNAL	SPIRAL WOUND WITH SS 321H METAL WINDING & GRAFOIL FILLER WITH CS OUTER & SS INNER RING AS PER ASME B16.20
GASKET INTERNAL	
EXTERNAL STUDS/BOLTS/NUTS	SA 193 GR.B5 / SA 194 GR.3
INTERNAL STUDS/BOLTS/NUTS	SS 304L
SKIRT/ ~~SUPPORT~~	SA 387 Gr. 11 CL.2
SKIRT/ ~~SUPPORT~~ BASE	SA 516 Gr.70
INTERNAL PARTS (WELDED/BOLTED)	SS 304L
~~SKIRT VENT~~	~~SA 335 GR.P11 CL.1~~
~~SPOOL PIECE FOR NOZZLE 1 & 2~~	~~SA 336 GR.11 CL.2 + SS 304L WELD OVERLAY~~
VACUUM STIFFENER	SA 387 GR.22 CL.2
PAD FOR EXTERNAL ATTACHMENTS	SA 387 GR.22 CL.2
CLIPS & ATTACHMENTS (EXTERNAL)	SA 387 GR.22 CL.2
LIFTING TRUNION/TAILING LUG	SA 387 GR.22 CL.2/SA 516 Gr.70 (FOR TAILING LUG ON SKIRT ONLY)
~~ANCHOR BOLTS/NUTS/WASHER~~	~~SA 193 GR.B7 / SA 194 GR.2H / ASTM F436~~
BED SUPPORT & HOLD DOWN	SS 304H
PACKING+CHIMNEY TRAYS	SS 304L

$$ SA 182 GR.F22 CL.3 + SS 304L WELD OVERLAY/ SA 336 GR.F22 CL.3 + SS 304L WELD OVERLAY.

#* 2.25 Cr.+1 MO SHALL COMPLY WITH REQUIREMENT FOR STEP COOLING, J FACTOR LESS THAN OR EQUAL TO 100 & X FACTOR LESS THAN OR EQUAL TO 15.

STATUTORY REGULATIONS (स्टैचुअरी रेगुलेशन्स)

INDIAN BOILER REGULATIONS (IBR)

DEPARTMENT OF EXPLOSIVES, NAGPUR (CCOE)

APPROXIMATE WEIGHT (kgs) (PER ITEM) (एपरौक्सिमेंट वजन)

ERECTION	-	OPERATING	-
HYDROTEST(SHOP)	-	HYDROTEST (FIELD)	-
NUMBER OF ITEMS :	-		

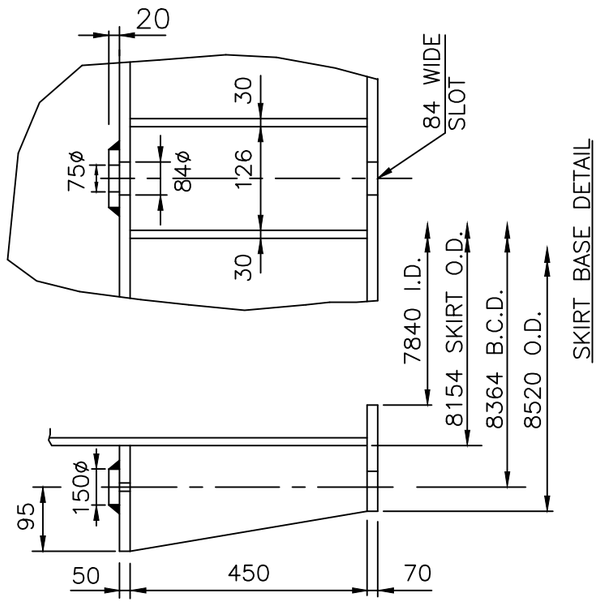
FILE NAME : B224-111-80-43-DS-3001-A-3

ENGINEERS INDIA LIMITED NEW DELHI इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम)	JOB NO: कार्य सख्या	B224	UNIT NO: युनिट सख्या	111					DESIGN DATA / डिजाइन डाटा
	CLIENT : क्लाईट	M/S HRRL, RAJASTHAN							MAIN FRACTIONATOR / मेन फरैक्शनेटर
	PLANT : प्लांट	RAJASTHAN REFINERY PROJECT							ITEM NO. 111-C-2101 / आइटम नम्बर : 111-सी-2101
			A	23.08.2019	ISSUED FOR ENGG/BIDS	AKP	NNM/RKM	KJH	
			REV	DATE	REVISION	BY	CHECKED	APPROVED	

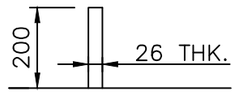
DRAWING NUMBER / डाईग नम्बर: **B224-111-80-43-DS-3001** REV: A

SHEET 3 OF 7

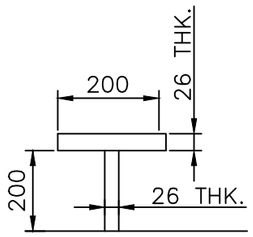
FORMAT NO.3-1646-0113 REV.2 (20.09.2011) A3-420 X 297



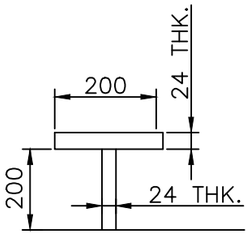
WFMT SHALL BE CARRIED OUT ON ALL WELD SEAMS OF CS (NACE+HIC) SECTION & TOP DISH HEAD INCLUDING L & C SEAM OF CS (NACE+HIC) AND LAS+CLAD SECTION AFTER PWHT.



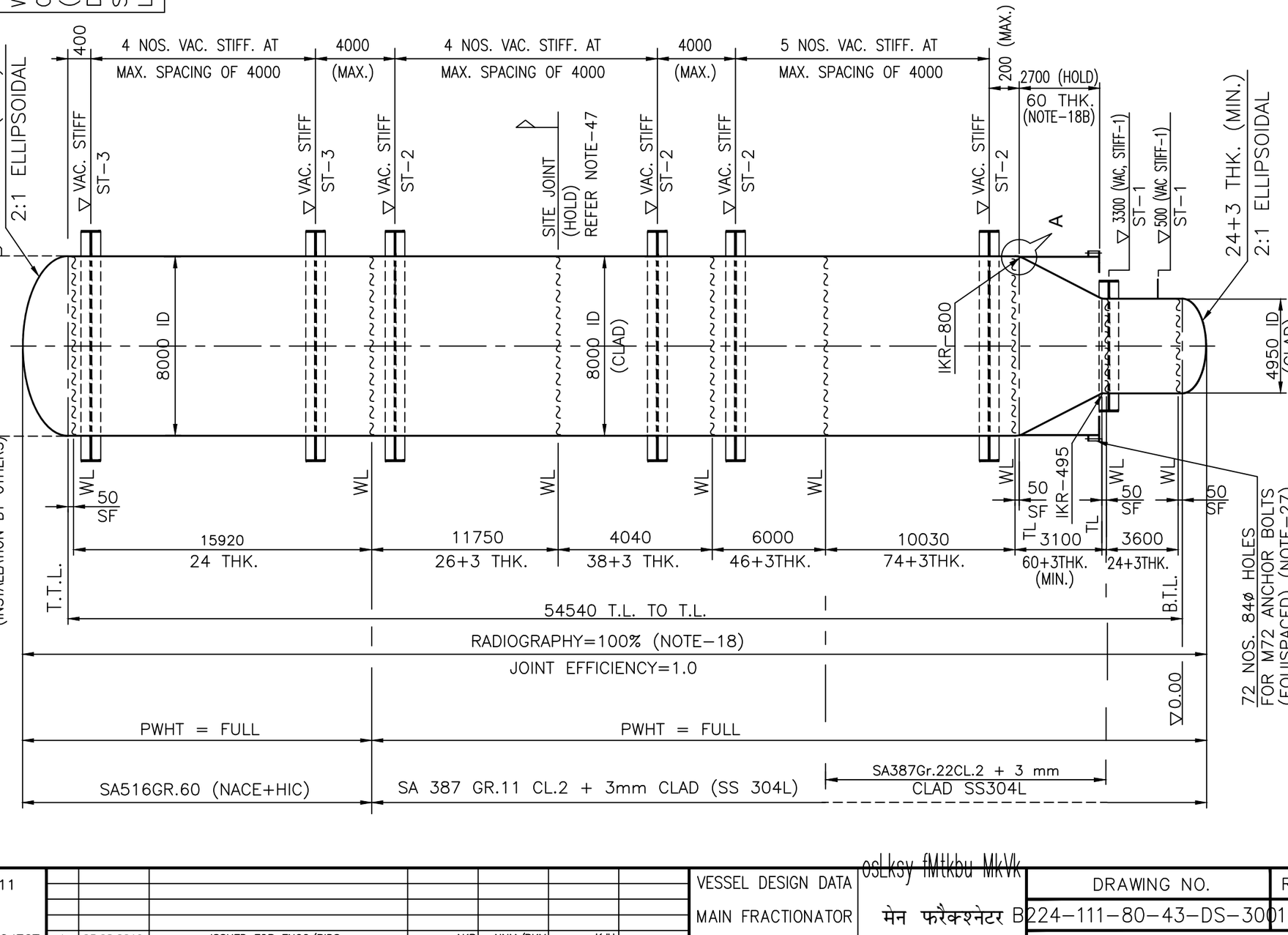
DETAIL OF STIFFENERS (TYP.) (ST-1)

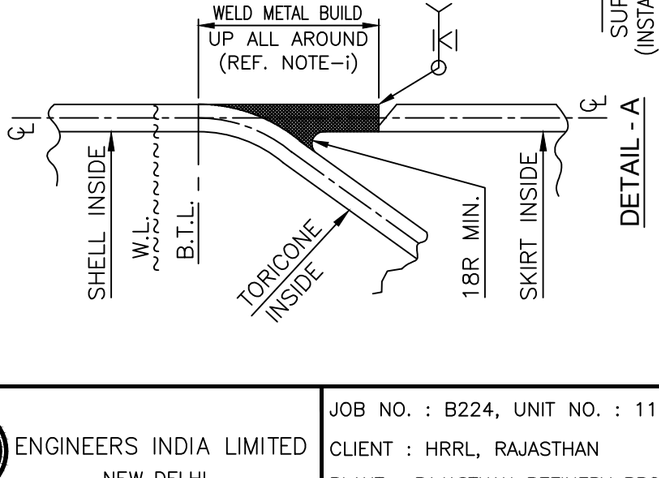


DETAIL OF STIFFENERS (TYP.) (ST-2)



DETAIL OF STIFFENERS (TYP.) (ST-3)





DETAIL - A

NOTE:-

(i) THE JOINT BETWEEN THE SUPPORT SKIRT & BOTTOM HEAD SHALL HAVE THE SMOOTH STREAMLINE GEOMETRY AS SHOWN. THE JOINT DETAIL SHALL BE MADE BY WELD METAL BUILD WELDS SHALL BE GROUND OR MACHINED TO A SMOOTH, FLUSH CONTOUR. 100% MAGNETIC PARTICLE EXAMINATION OF ALL WELD SURFACES (INSIDE & OUTSIDE) SHALL BE PERFORMED AFTER FINAL POST WELD HEAT TREATMENT. 100% ULTRASONIC EXAMINATION SHALL BE CARRIED OUT ON WELD BUILT-UP AFTER COMPLETION AND AFTER FINAL PWHT.

ENGINEERS INDIA LIMITED, NEW DELHI	JOB NO. : B224, UNIT NO. : 111 CLIENT : HRRL, RAJASTHAN PLANT : RAJASTHAN REFINERY PROJECT					
		A	23.08.2019	ISSUED FOR ENGG/BIDS	AKP	NNM/RKM	KJH	
		REV.	DATE	REVISION	BY	CHK	APPROVED	APPROVED

VESSEL DESIGN DATA	osLksy fMtkbu MkVk	DRAWING NO.	REV.
MAIN FRACTIONATOR	मेन फरैक्शनेटर	B224-111-80-43-DS-3001	A
TEM NO. : 111-C-2101	आइटम नम्बर : 111-सी-2101	SHEET 4 OF 7	

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FILE NAME : B224-111-80-43-DS-3001-5-A

ENGINEERS INDIA LIMITED
NEW DELHI

JOB NO. : B224, UNIT NO. : 111
CLIENT : HRRL, RAJASTHAN
PLANT : RAJASTHAN REFINERY PROJECT

REV.	DATE	REVISION	BY	CHK	APPROVED	APPROVED
A	23.08.2019	ISSUED FOR ENGG/BIDS	AKP	NNM/RKM	KJH	

VESSEL DESIGN DATA

ITEM NO. 111-C-2101

MAIN FRACTIONATOR

आइटम नम्बर : 111-सी-2101

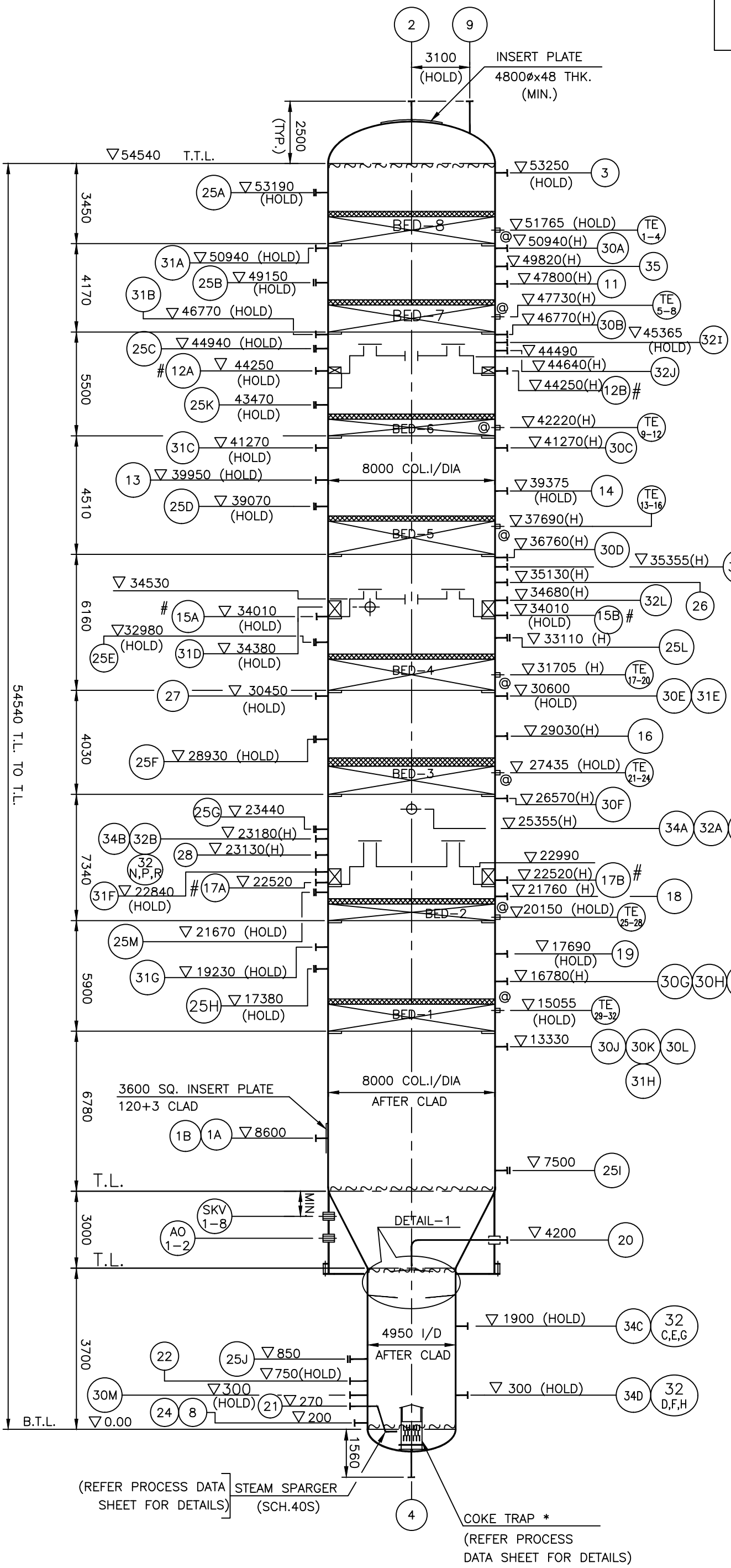
मेन फ्रैक्शनेटर

DRAWING NO. B224-111-80-43-DS-3001 A

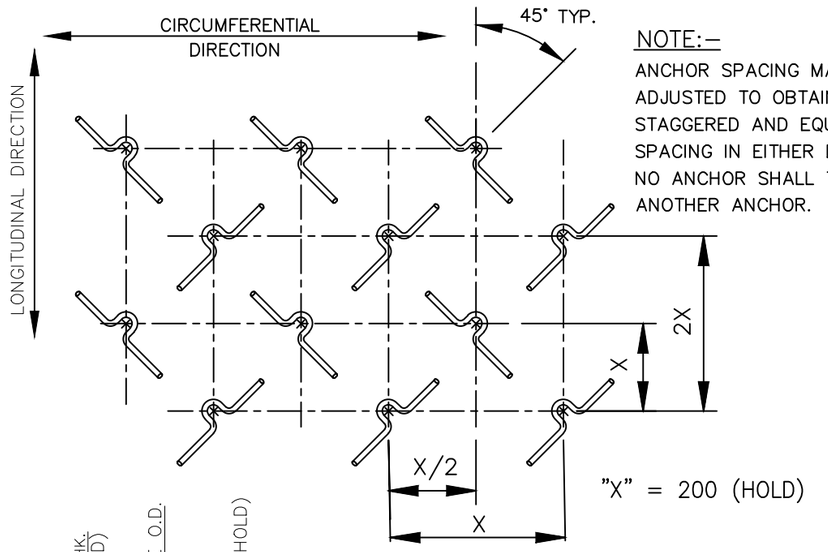
REV.

SHEET 5 OF 7

1-1641-0503 REV.0 A3-420x297

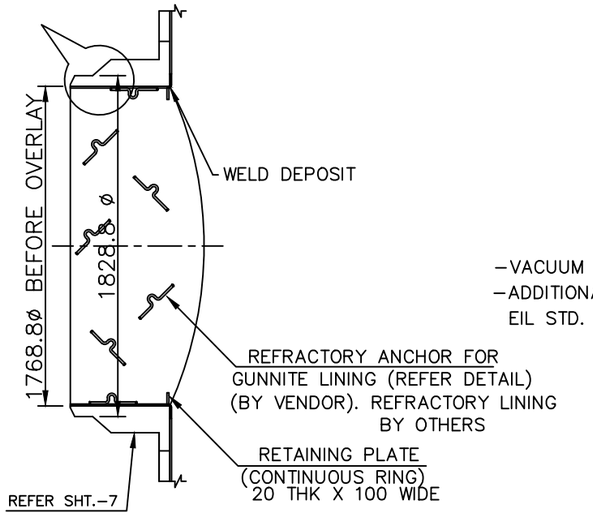


FILE NAME : B224-111-80-43-DS-3001-6-A

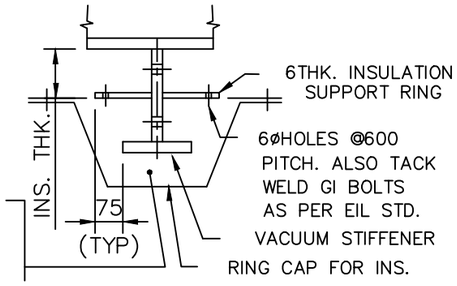


NOTE:–
ANCHOR SPACING MAY BE ADJUSTED TO OBTAIN A STAGGERED AND EQUAL SPACING IN EITHER DIRECTION. NO ANCHOR SHALL TOUCH ANOTHER ANCHOR.

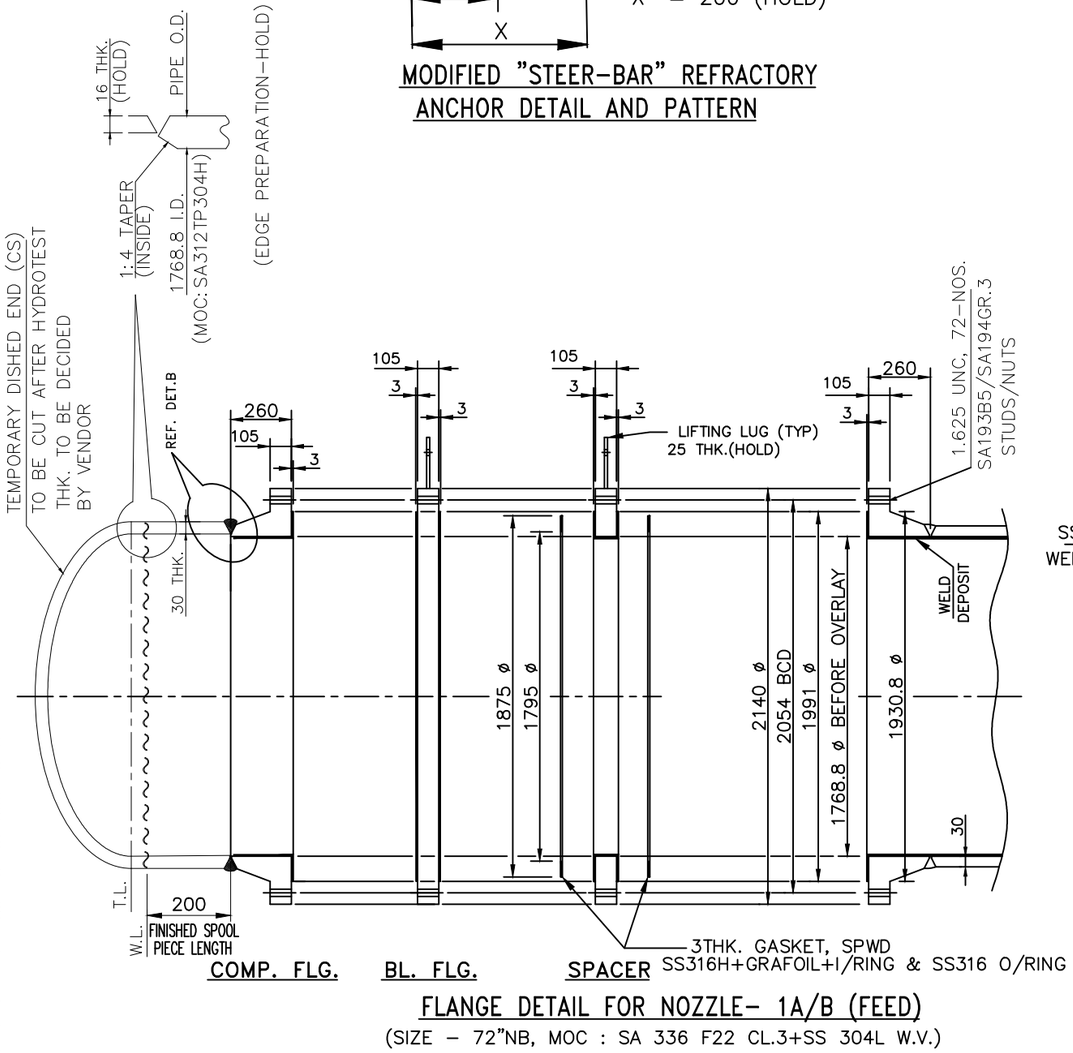
MODIFIED "STEER-BAR" REFRACTORY ANCHOR DETAIL AND PATTERN



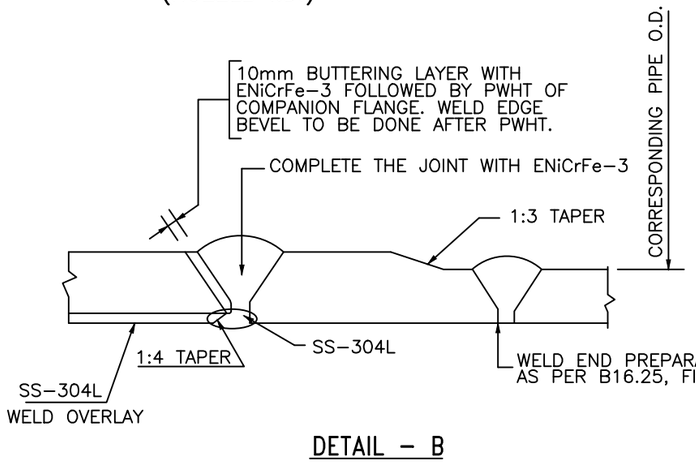
DETAIL FOR NOZZLE– 1 A/B (FEED)
(NOZZLE I.D.)



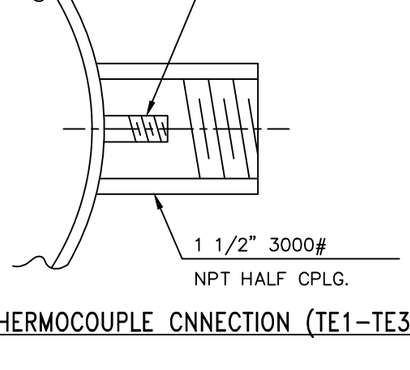
–VACUUM STIFFENERS SHALL BE USED AS INSULATION SUPPORT.
–ADDITIONAL INSULATION SUPPORTS TO BE PROVIDED AS PER EIL STD. WHEREVER REQUIRED.



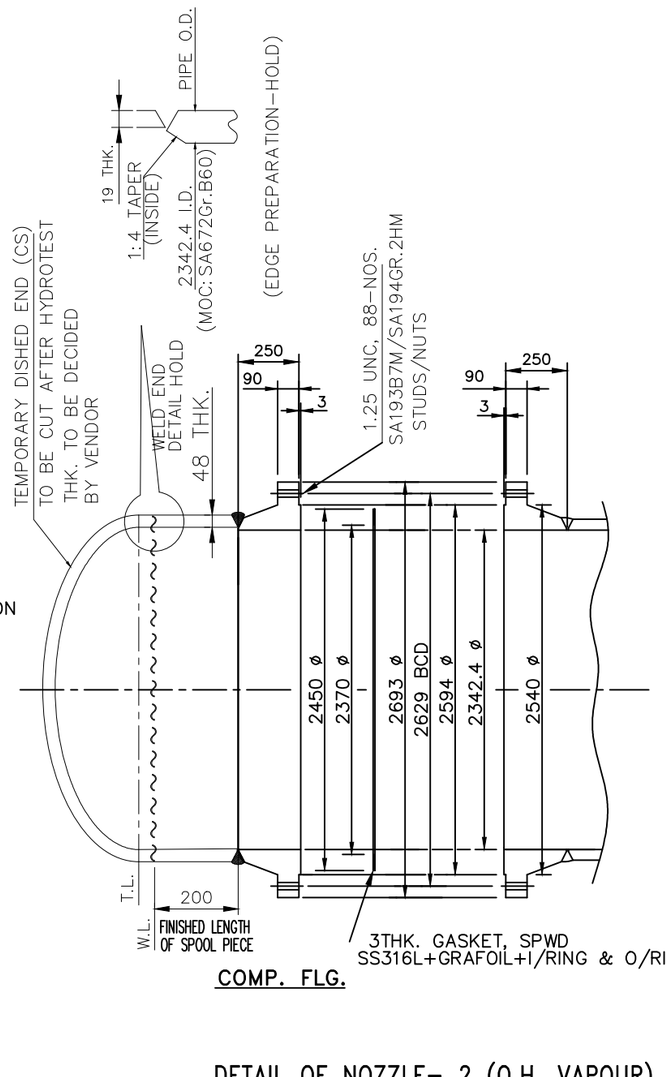
FLANGE DETAIL FOR NOZZLE– 1A/B (FEED)
(SIZE – 72"NB, MOC : SA 336 F22 CL.3+SS 304L W.V.)
(DIMENSIONS INDICATED ARE MINIMUM TO BE FOLLOWED AND SHALL BE DESIGNED AND FIRMED BY VENDOR)



DETAIL – B



SKIN THERMOCOUPLE CNNECTION (TE1–TE32) DETAIL



DETAIL OF NOZZLE– 2 (O.H. VAPOUR)
(SIZE : 96"NB, MOC : SA 266 Gr.4)
(DIMENSIONS INDICATED ARE MINIMUM TO BE FOLLOWED AND SHALL BE DESIGNED AND FIRMED BY VENDOR)

ENGINEERS INDIA LIMITED NEW DELHI	JOB NO. : B224, UNIT NO. : 111 (FCCU)						
	CLIENT : HRRL, RAJASTHAN						
	PLANT : RAJASTHAN REFINERY PROJECT						
		A	23.08.2019	ISSUED FOR ENGG/BIDS	AKP	NNM/RKM	KJH
		REV.	DATE	REVISION	BY	CHK	APPROVED APPROVED

VESSEL DESIGN DATA
MAIN FRACTIONATOR
ITEM NO. 111–C–2101

मेन फरैक्शनेटर
आइटम नम्बर : 111-सी-2101

DRAWING NO. B224–111–80–43–DS–3001 A | REV.

SHEET 6 OF 7

1–1641–0503 REV.0 A3–420x297

FILE NAME : B224-111-80-43-DS-3001-7-A

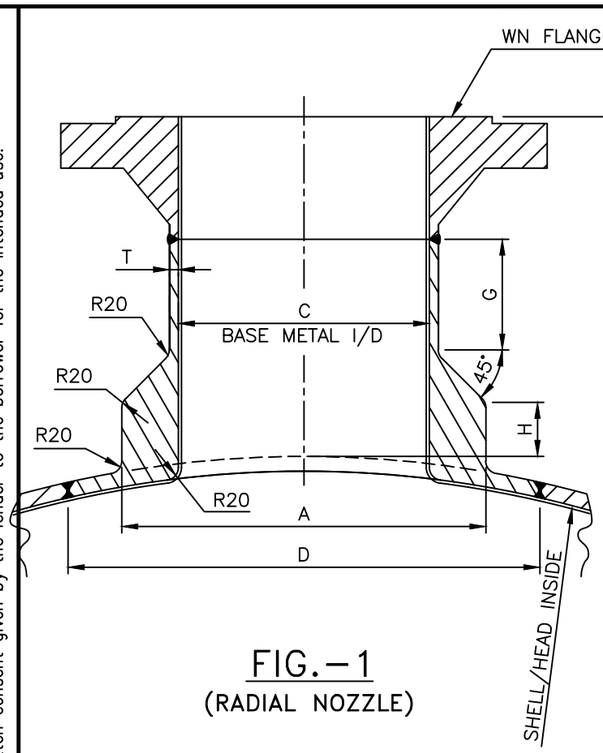


FIG.-1
(RADIAL NOZZLE)

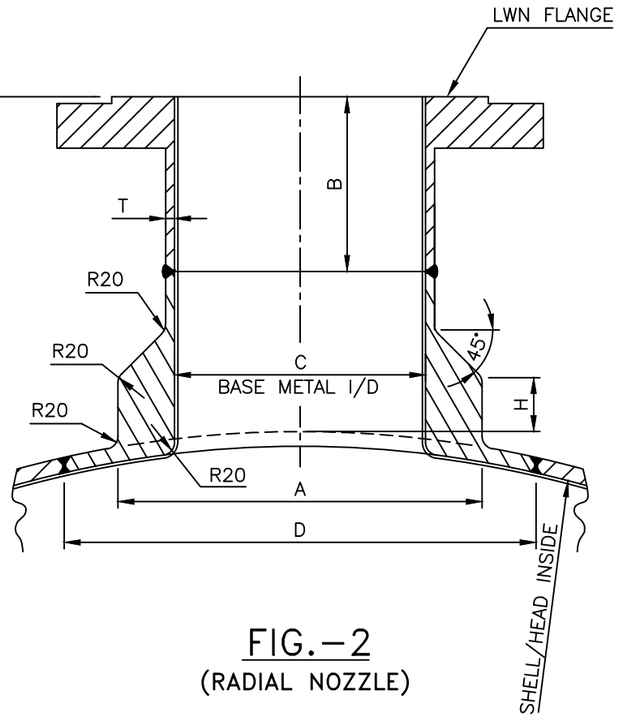


FIG.-2
(RADIAL NOZZLE)

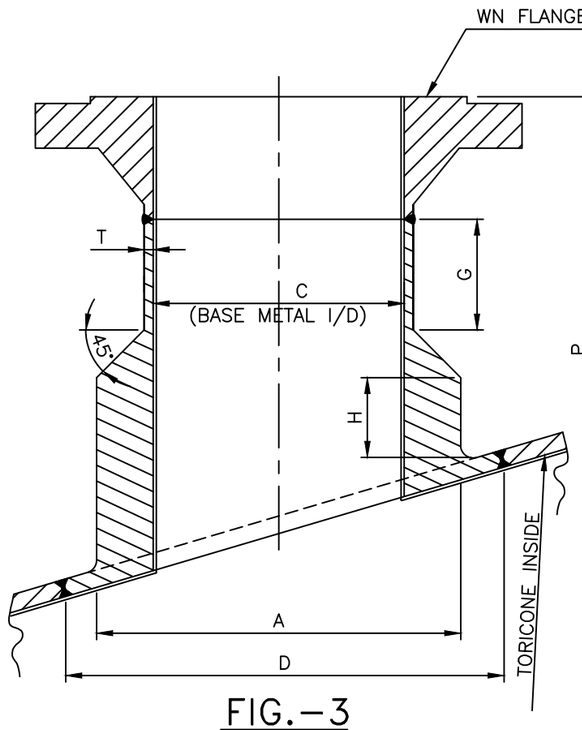


FIG.-3
(CONE NOZZLES)

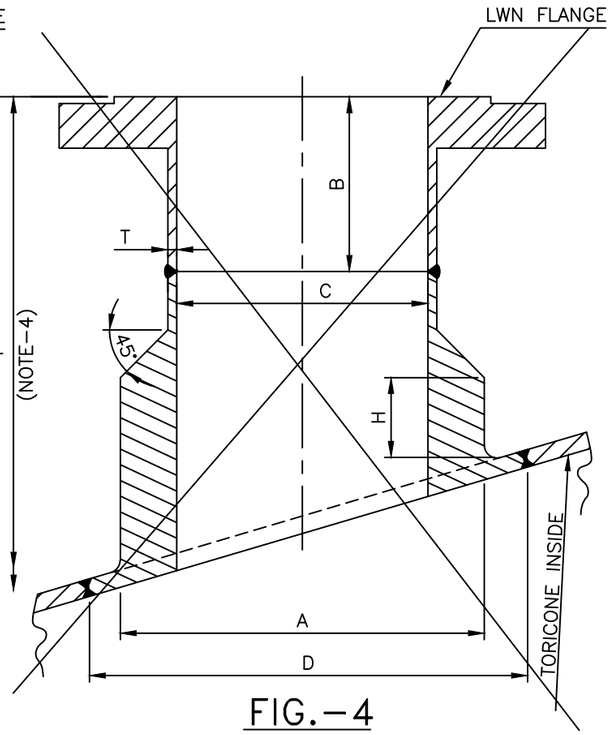
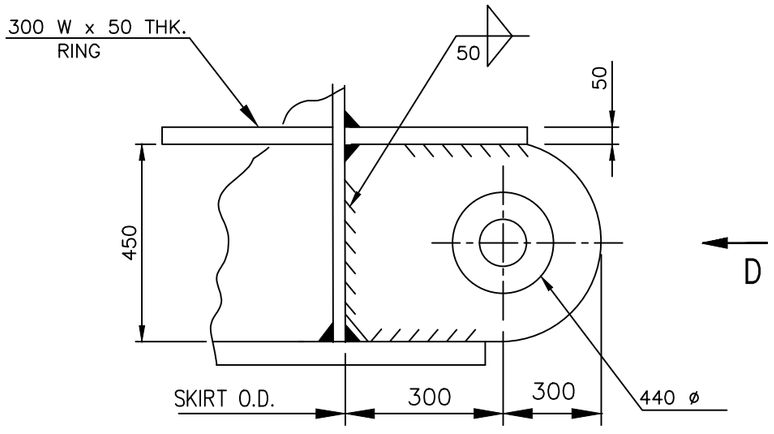


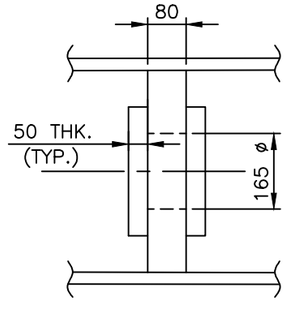
FIG.-4
(CONE NOZZLES)

NOZZLE MARK	SIZE (INCH)	P (MM)	A (MM)	C (MM)	H (MM)	T (MM)	G (MM) (MIN.)	B (MM) (MIN.)	D (MM)	FIG.
1A/B	72	4800	2270	1768.8	180	30	–	–	2370	1
25 I	24	4600	850	549.6	150	30	–	–	950	1
20	6	4400	230	128.3	100	20	–	–	330	3
31H,30J/K/L	3	4350	200	76.2	50	20.5	–	–	300	2

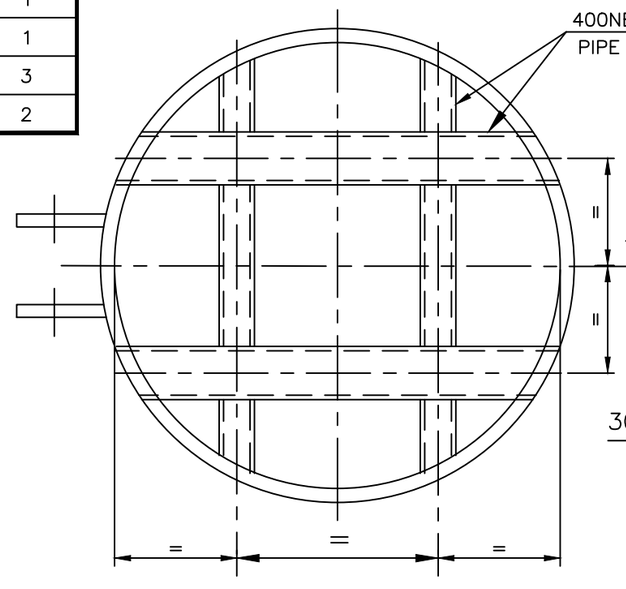
DETAIL OF SELF REINFORCED NOZZLE



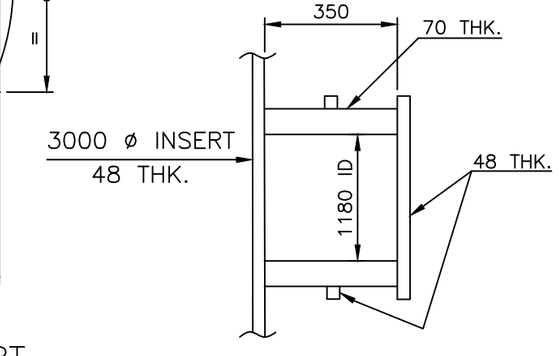
2 NOS OF TAILING LUG DETAIL
(DESIGN BY VENDOR-DIMENSIONS ARE MIN. TO BE FOLLOWED)



VIEW-D



STIFFENING DETAIL OF SKIRT
(DESIGN BY VENDOR)



LIFTING TRUNION DETAIL
(DIMENSIONS ARE MINIMUM TO BE FOLLOWED)
(DESIGN BY VENDOR)

ENGINEERS INDIA LIMITED NEW DELHI	JOB NO. : B224, UNIT NO. : 111 (FCCU)							VESSEL DESIGN DATA
	CLIENT : HRRL, RAJASTHAN							MAIN FRACTIONATOR
	PLANT : RAJASTHAN REFINERY PROJECT	A	23.08.2019	ISSUED FOR ENGG/BIDS	AKP	NNM/RKM	KJH	ITEM NO. 111-C-2101
		REV.	DATE	REVISION	BY	CHK	APPROVED	

os|ksy fMtkbu MkVk
मेन फरैक्शनेटर
आइटम नम्बर : 111-सी-2101

DRAWING NO. B224-111-80-43-DS-3001 A REV.

SHEET 7 OF 7

1-1641-0503 REV.0 A3-420x297

	MANUFACTURER'S NAME & ADDRESS **BHEL-VISAKHAPATNAM OR APPROVED SUB-CONTRACTORS**	**QUALITY ASSURANCE PLAN FOR MAIN FRACTIONATOR COLUMN** Item: **Main Fractionator Column** Project: **Rajasthan Refinery Project (RRP)**	QAP No: CQP 2516 Rev **0** Date: 05.02.2021 Page 1 of 16	Customer: HPCL Rajasthan Refinery Limited (HRRL), Barmer. Consultant: Engineers India Limited(EIL) BHEL Sale Order No: 2439 Customer LOA Ref: HRRL/LOA/2020/25 Dt:29.09.2020

Code of Construction: ASME Section VIII Div.1, Edition 2017

Sl. No.	Item Description	Tag Number
1.	Main Fractionator Column	111-C-2101

To be resubmitted with resolution of comments

CERTIFICATION ENGINEERS INTERNATIONAL LTD. (Y-114)

Prepared By	Reviewed By	Approved by
P. Gopi Kishore/Mgr/QA/BHEL	A.K. Mandal/AGM/Q & BE /BHEL	

MANUFACTURER'S NAME & ADDRESS :**BHEL-VISAKHAPATNAM OR APPROVED SUB-CONTRACTORS**	**QUALITY ASSURANCE PLAN FOR MAIN FRACTIONATOR COLUMN** Item**: Main Fractionator Column** QAP No: CQP 2516 Rev **0** Date: 05.02.2021 Project: **Rajasthan Refinery Project** (**RRP**) Page 2 of 16	Customer: HPCL Rajasthan Refinery Limited (HRRL), Barmer. Consultant: Engineers India Limited(EIL) BHEL Sale Order No: 2439 Customer LOA Ref: HRRL/LOA/2020/25 Dt:29.09.2020

SL NO	ACTIVITY	REFERENCE DOCUMENT	CHARACTERISITIC TO BE VERIFIED	ACCEPTANCE NORMS	VERIFYING DOCUMENTS /RECORDS	BHEL		TPIA	Remarks
						Prod	Qua		
1.0	Design & Drawings approval	ASME Sec VIII Div.1 Ed 2017, MDS	Approved Drawings & Calculations	ASME Sec VIII Div.1 Ed 2017	Approved Drawings	-	H	R	
2.0	Inspection & Test Plan	ASME Sec VIII Div.1 Ed 2017 & Approved Drawings, PR	Documents & inspection stages	ASME Sec VIII Div.1 Ed 2017 & Approved Drg & PR	ITP	-	H	R	
3.0	**Review of Procedures**								
3.1	All Manufacturing, Test procedures (NDE, Surface Preparation & Painting, Forming & Heat Treatment)	ASME SEC.V, ASME Sec IX & Sec VIII Div.1 1 Ed 2017, PR, APPROVED DRAWING, PR Specifications.	Compliance to ASME CODES & PR	ASME SEC.V, ASME Sec IX & Sec VIII Div.1 1 Ed 2017, PR, APPROVED DRAWING	Procedures	-	H	R	To be submitted for information
3.2	Welding Process	WPS/PQR/WPQ (shall be within 5 years)	Compliance to ASME CODES & PR.	ASME SEC.V, ASME Sec IX & Sec VIII Div.1 1 Ed 2017, PR, APPROVED DRAWING	WPS/PQR/WPQ	-	H	R / W	R-for existing; W-for New.
4.0	**Raw materials**								
4.1	Plates, Pipes & Forgings at sourcing locations	Approved Drawings & Purchase Order, PR	As per PR and ASME Sec IIA Ed 2017	As per PR and ASME Sec IIA Ed 2017	Test Certificates	-	H	*	*Refer Note -9

All CS materials shall meet the requirements of EIL Specification, 6-12-0011, 6-79-0013. Plates shall be procured with HIC test as per TM-02-84 and shall meet the requirements of specification

All Low alloy steel materials shall meet the requirements 6-12-0017, 6-12-0018,clad plates 6-12-0015, stain less steel plates6-12-0020 with respect to C, CE,Composition, NDT, Simulation HT, hardness, impact, mechanical properties etc

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						Prod	Qua		
4.2	**Raw materials after receipt**								
4.2.1	Plates for shells, PTC and dished ends, All parts welded to Pr parts + All process wetted parts	Approved Drawings & Purchase Order, PR	As per PR and ASME Sec IIA Ed 2017	As per PR and ASME Sec IIA Ed 2017	Test Certificates	-	H	H	
4.2.2	Nozzles, forgings, pipes & flanges, and Fittings.	Approved Drawings & Purchase Order	As per TDC and ASME Sec IIA Ed 2017 & PR	As per TDC and ASME Sec IIA Ed 2017 & PR	Test Certificates	-	H	H	
4.2.3	Non-Pressure parts	Approved Drawings & Purchase Order	As per material specification	As per material specification	Test Certificates	-	H	R	
4.2.4	Welding consumables	Purchase Order	As per ASME Sec IIC Ed 2017 & PR	As per ASME Sec IIC Ed 2017 & PR	Test Certificates	-	H	R	
4.2.5	Fasteners and Gaskets	Approved Drawings & Purchase Order	As per TDC and ASME Sec IIA Ed 2017	As per TDC and ASME Sec IIA Ed 2017	Test Certificates	-	H	R	
4.2.6	Base Ring Template	Approved Drawings & Purchase Order	As per TDC and ASME Sec IIA Ed 2017	As per TDC and ASME Sec IIA Ed 2017	Test Certificates	P	H	R	.

SL NO	ACTIVITY	REFERENCE DOCUMENT	CHARACTERISITIC TO BE VERIFIED	ACCEPTANCE NORMS	VERIFYING DOCUMENTS /RECORDS	BHEL		TPIA	Remarks
						Prod	Qua		
5.0	**Fabrication of Dished ends**								
5.1	Transfer of marking and heat number	As per Material test certificates	Heat no and material specification	Approved drawing	-	P	H	W	
5.2	Fit up & welding of long seam	Approved Drawings	Offset & weld geometry	Approved drawing & WPS	Fit up report	P	H	W	
5.3	100 % PT on root & final weld, chipped back LS weld, Cu SO4 solution test after clad removal $ (typ)	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	RW	
5.4	100 % RT of completed LS weld	Approved Drawings	Detection of flaws	Approved RT Procedure	RT Films	P	H	R	
5.5	Clad restoration on Long seam $	Approved Drawings	Parameters as per WPS, Welder Qualification	WPS	-	P	H	-	
5.6	100 % PT on clad restoration after each pass $	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	RW	
5.7	Chemical analysis of clad (2 samples) per seam $	ASME Sec IIC & Clad procedure	As per specification	As per specification	Analysis report (Note-3)	-	H	R	Per WPS/ Welder basis

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						Prod	Qua		
5.8	Forming of dished end	Approved Drawings ASME Sec VIII Div. 1	Visual & Dimensional check, Template check	Approved Drawings	Dimension Report	P	H	-	
5.9	100 % PT of knuckle area (Note-2)	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	W	
5.10	100% UT on Crown , Knuckle, WEP and straight face	Approved procedures	Thickness measurement & Dis-bondment check $	Approved Drawing, procedures	UT report	P	H	W	
5.11	Visual & Final Dimensions including Dished end profile checking with Template	Approved Drawing ASME Sec VIII Div. 1	Dimensions	Approved Drawing	Dimension Report	P	H	W #	# Trial Assembly & fit-up in case of Crown & Petal construction
6.0	**Fabrication of Main shell along with PTC**								
6.1	Plate marking & cutting	Approved drawing & cutting plan	Dimensions	Approved Drawings	-	P	-	-	Refer Note-6
6.2	Shell rolling	Approved drawing & cutting plan	Dimensions	Approved Drawings	-	P	H	-	
6.3	Long seam fit up & welding along with test coupon	Approved Drawings	Offset & weld geometry	Approved drawing & WPS	Fit up report	P	H	W	

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						Prod	Qua		
6.4	100 % PT on root & final weld ,chipped back LS weld	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	R	
6.5	RT of completed LS weld & test coupon	Approved drawings	Detection of flaws	Approved RT Procedure	RT Films	P	H	R	
6.6	Clad restoration on Long seam & test coupon $	Approved Drawings	Parameters as per WPS	WPS	-	P	-	-	
6.7	100 % PT on clad restoration each layer $	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	RW	
6.8	Chemical analysis of clad (2 samples) per seam $	ASME Sec IIC & Clad procedure	As per specification & PR	As per specification & PR	Analysis report (Note-3)	-	H	W	Per welder / WPS/ shell course basis
6.9	Ferrite check of clad overlay (2 spots per seam) $	ASME Sec IIC Ed 2017	Ferrite content	As per drawing	Ferrite Report	-	H	RW	
6.10	UT on Rolled sections of clad and weld overlay $	Approved procedures	Disbondment	Approved procedures,	UT report	P	H	W	
6.11	Testing of test coupon	ASME Sec VIII Div.1 Ed 2017	Tensile & Hardness	ASME Sec VIII Div.1 Ed 2017	Test reports	-	H	RW	

SL NO	ACTIVITY	REFERENCE DOCUMENT	CHARACTERISITIC TO BE VERIFIED	ACCEPTANCE NORMS	VERIFYING DOCUMENTS /RECORDS	BHEL		TPIA	Remarks
						Prod	Qua		
7.0	**Shell to Shell to Circular seam fabrication**								
7.1	CS fit up & welding	Approved Drawings	Offset & weld geometry	Approved drawing & WPS	Fit up report	P	H	W	
7.2	100 % PT on root & final weld, chipped back CS weld	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	R	
7.3	RT of completed CS weld	Approved drawings	Detection of flaws	Approved RT Procedure	RT Films	P	H	R	
7.4	Clad restoration on C- seam $	Approved Drawings	Parameters as per WPS	WPS	-	P	-	-	
7.5	100 % PT on clad restoration after each pass $	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	RW	
7.6	Chemical analysis of clad (2 samples) per seam $	ASME Sec IIC & Clad procedure	As per specification & PR	As per specification & PR	Analysis report (Note-3)	-	H	RW	
7.7	Ferrite check of clad overlay (2 spots per seam) $	ASME Sec IIC Ed 2017	Ferrite content	As per drawing	Ferrite Report	-	H	RW	

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						Prod	Qua		
8.0	**Shell to Dished end circular seam fabrication**								
8.1	CS fit up & welding	Approved Drawings	Offset & weld geometry	Approved drawing & WPS	Fit up report	P	H	W	
8.2	100 % PT on root & final weld, chipped back CS weld	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	R	
8.3	RT of completed CS weld	Approved Drawings	Detection of flaws	Approved RT Procedure	RT Films	P	H	R	
8.4	Clad restoration on C- seam $	Approved Drawings	Parameters as per WPS	WPS	-	P	H	-	
8.5	100 % PT on clad restoration after each pass $	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	RW	
8.6	Chemical analysis of clad (2 samples) per seam $	ASME Sec IIC & Clad procedure	As per specification & PR	As per specification & PR	Analysis report (Note-3)	-	H	RW	
8.7	Ferrite check of clad overlay (2 spots per seam) $	ASME Sec IIC Ed 2017	Ferrite content	As per drawing	Ferrite Report	-	H	RW	

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						Prod	Qua		
9.0	**Weld overlay of Nozzles, Pipes, Elbows and blind flanges**								
9.1	Weld overlay $	Approved drawings	Welding parameters	Adherence to WPS	-	P	-	-	
9.2	Weld overlay thickness from inside the nozzles $	Approved drawings	Thickness	Approved drawings	Inspection Report	-	H	W	
9.3	Chemical analysis of weld overlay (1 sample per size representing manual weld overlays of Nozzles, Pipes, Fittings) per seam $	ASME Sec IIC & Clad procedure	As per specification	As per specification	Analysis report (Note-3)	-	H	RW	RW-by TPIA is applicable during sample collection only.
9.4	Ferrite check of weld overlay(2 spots per weld overlay) (1 sample per size representing manual weld overlays of Nozzles, Pipes, Fittings) $	ASME Sec IIC Ed 2017	Ferrite content	As per drawing	Ferrite Report	-	H	RW	
9.5	100 % PT of weld overlay after each pass $	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	R	

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						Prod	Qua		
10.0	**Fabrication of Nozzle Assemblies**								
10.1	Fit up & welding of C-seams of pipes/ elbows/ flanges / nozzle neck, internal pipes	Approved Drawings	Offset & weld geometry	Approved drawing & WPS	Fit up report	P	H	R	Functional test for Davit.
10.2	RT of completed CS weld & L-seam of rolled nozzles	Approved Drawings	Detection of flaws	Approved RT Procedure	RT Films	P	H	R	
10.3	Clad restoration on C-seam $	Approved Drawings	Parameters as per WPS	WPS	-	P	-	-	
10.4	100 % PT of weld overlay after each pass $, nozzle to flange root welds	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	RW	
10.5	Chemical analysis of weld overlay(2 samples) per seam $	ASME Sec IIC & Clad procedure	As per specification	As per specification	Analysis report (Note-3)	-	H	RW	RW-by TPIA is applicable during sample collection only.
10.6	Ferrite check of weld overlay (2 spots per seam (1 sample per size representing Nozzles, Pipes, Fittings) $	ASME Sec IIC Ed 2017	Ferrite content	As per drawing	Ferrite Report	-	H	RW	

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						Prod	Qua		
11.0	**Nozzle to shell/dished end fabrication**								
11.1	Marking and openings of nozzles on shells	Approved Drawings	Location and orientation	Approved Drawings	-	P	H	R	
11.2	PT on gas cut edges	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	R	
11.3	Fit up & welding of nozzles on shells or dished ends	Approved Drawings	Offset & weld geometry	Approved drawing & WPS	Fit up report	P	H	RW	
11.3.1	Pneumatic test on RF Pads	Approved Drawing	Detection of leakage	Approved Drawing	Approved Drawing	P	H	RW	
11.4	100 % PT on chipped back CS weld	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	R	
11.5	Clad restoration on welds $	Approved Drawings	Parameters as per WPS	WPS	-	P	-	-	
11.6	100 % PT of weld overlay after each pass $	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	RW	
11.7	Chemical analysis of weld overlay(2 samples) per seam $	ASME Sec IIC & Clad procedure	As per specification	As per specification	Analysis report (Note-3)	-	H	RW	RW-by TPIA is applicable during sample collection only.
11.8	Ferrite check of weld overlay (2 spots per seam) $	ASME Sec IIC Ed 2017	Ferrite content	As per drawing	Ferrite Report	-	H	RW	
11.9	100 % UT for nozzle to shells and nozzle to pipe	Approved Drawings	Detection of flaws	Approved UT Procedure	UT Report	P	H	W	

SL NO	ACTIVITY	REFERENCE DOCUMENT	CHARACTERISITIC TO BE VERIFIED	ACCEPTANCE NORMS	VERIFYING DOCUMENTS /RECORDS	BHEL		TPIA	Remarks
						Prod	Qua		
12.0	**Skirt fabrication, assembly and Final Inspection**								
12.1	Fit up & welding of Skirt, Skirt with Vessel	Approved Drawings	Dimensions & weld geometry	Approved drawing & WPS	Fit up report	P	H	W	
12.2	RT of C-seam & L-seam	Approved Drawings	Detection of flaws	Approved RT Procedure	RT Films	P	H	R	
12.3	100 % PT of welds (including root and final welds as applicable)	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	W	
12.4	Dimensional inspection of Skirt	Approved Drawings	Dimensions	Approved Drawings	Report	P	H	W	
12.5	Marking of Internal and external cleats, supports	Approved Drawings	Dimensions	Approved Drawings	Report	P	H	R	
13.0	100% UT of attachments welded directly to cladding	Approved procedures	Detection of flaws	Approved procedures	UT report	P	H	R	Refer Note-12
14.0	Pneumatic test on RF Pads	Approved Drawing	Detection of leakage	Approved Drawing	Approved Drawing	P	H	RW	
15.0	Visual & Final dimensional inspection before PWHT including internals	Approved Drawings	Dimensions, orientations	Approved Drawings	Dimensional report	P	H	H	

MANUFACTURER'S NAME & ADDRESS :**BHEL-VISAKHAPATNAM OR APPROVED SUB-CONTRACTORS**	**QUALITY ASSURANCE PLAN FOR MAIN FRACTIONATOR COLUMN** Item: **Main Fractionator Column** QAP No: CQP 2516 Rev **0** Date: 05.02.2021 Project: **Rajasthan Refinery Project** (**RRP**) Page 13 of 16	Customer: HPCL Rajasthan Refinery Limited (HRRL), Barmer. Consultant: Engineers India Limited(EIL) BHEL Sale Order No: 2439 Customer LOA Ref: HRRL/LOA/2020/25 Dt:29.09.2020	

SL NO	ACTIVITY	REFERENCE DOCUMENT	CHARACTERISITIC TO BE VERIFIED	ACCEPTANCE NORMS	VERIFYING DOCUMENTS /RECORDS	BHEL		TPIA	Remarks
						Prod	Qua		
15.1	Internals inside the column	Approved Drawings	Dimension, Orientation and 1) Ovality in Column ID 2) Support Ring Levelness	Approved Drawings, & EIL Standard 7-12-0001	Dimensional report	P	H	H	
16.0	PWHT of equipment along with PTC	PWHT procedure	Calibration of thermocouples/ Recorders	PWHT procedure	HT Chart review	P	H	H for release	
17.0	Testing of test coupons (PTC)	ASME Sec VIII Div. 1Ed 2017 See comment 1	Tensile & Hardness See comment 2	ASME Sec VIII Div. 1Ed 2017	Test Reports	P	H	W	
18.0	NDE after PWHT 100% UT on pressure retaining weld	Approved Drawings See comment 3	Detection of flaws	Approved UT Procedures	UT Report	P	H	W	
19.0	Spot PT on internal & external welds.	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	W	
20.0	Hardness check of all pressure part joints on weld / HAZ / PM	ASME Sec VIII Div. 1Ed 2017 6-12-0003, 6-12-0002 6-12-0007 MR-01-03,6-79-0013	Hardness	ASME Sec VIII Div. 1Ed 2017 & PR	Test report	P	H	RW	
21.0	Final dimensional inspection after PWHT	Approved Drawings	Dimensions, orientations	Approved Drawings	Dimensional report	P	H	H	

Comment 1: 6-12-0002 para 4.4, 6-12-0003 para 7, 6-12-0007 para 6.5

Comment 2:Tensile,side bend, hardness, macro/ micro, IGC tests

Comment 3: (a)Radiography required after PWHT. (b) UT in lieu of Radiography requires PMC approval ref. para 5.4.8 of 6-12-0001(c)Clad dished end, toricone, hot formed shells require 100% UT, 10% rest clad for bond integrity

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						Prod	Qua		
22.0	PMI Check (only for SS , Alloy Steels)	PR Specification	As per ASME Sec IIC Ed 2017	ASME Sec IIA Ed 2017.	PMI report	P	H	RW	
23.0	Shop Hydro test & Draining, drying, inside cleaning.	Approved Drawings	No pressure drop or leaks	Approved hydro test procedure; draining & drying procedure	Test report	P	H	H	Chloride content in hydro testing water to be as specified in PR
	MPI Inspection of all welds as per 5.4.3 of 6-12-0003								
24.0	Pickling & passivation of weld overlay of nozzles, clad surface of shells, dished ends and further cleaning and drying	Approved Drawings	Visual examination	Approved Drawings & PR	Report	P	H	RW	
25.0	Surface preparation & Primer painting,	Approved Drawings	Visual examination & DFT check	Approved Drawings	Report	P	H	RW	
26.0	Primer Paint application	Approved Drawings	Visual & DFT	Approved Drawings	Report	P	H	R	
27.0	Cutting of Complete Vessel into sections & Weld edge preparation for site weld	Approved drawing / cutting plan	Dimensions	Approved Drawings	-	P	H	W	Refer Note-6
28.0	Trial assembly of cut sections, match marking	Approved drawing / cutting plan	Dimensions	Approved Drawings	-	P	H	W	
29.0	Issue of IRN & clearance for dispatch	Approved drawings	All stages as per this approved ITP	-	Release Note	-	-	H	

SL NO	ACTIVITY	REFERENCE DOCUMENT	CHARACTERISITIC TO BE VERIFIED	ACCEPTANCE NORMS	VERIFYING DOCUMENTS /RECORDS	BHEL		TPIA	Remarks
						Prod	Qua		
30.0	**Site fabrication**								
30.1	Weld edge, CS fit up & welding	Approved Drawings	Visual, Offset & weld geometry	Approved drawing & WPS	Fit up report	P	H	W	
30.2	100 % PT on root & final weld, chipped back CS weld	Approved Drawings	Detection of flaws	Approved PT Procedure	PT Report	P	H	R	
30.3	RT of completed CS weld	approved drawings	Detection of flaws	Approved RT Procedure	RT Films	P	H	R	For site weld in Pressure part
30.4	Local PWHT for the column	PWHT procedure	Calibration of thermocouples/ Recorders	PWHT procedure	HT Chart review	P	H	H for relea se	
30.5	Local Box Type Hydro test (as specified in drawing)	Approved Drawings	No pressure drop or leaks	Approved hydro test procedure; draining & drying procedure	Test report	P	H	H	
30.6	Surface preparation & Primer painting	Approved Drawings	Visual examination & DFT check	Approved Drawings	Report	P	H	RW	Only where touch up is applicable
30.7	Issue of site IRN	Approved drawings	All stages as per this approved ITP	-	Release Note	-	-	H	
30.8	Manufacturer's Data Report & Final documentation	Approved drawings & this ITP	Completeness	Approved drawings & this ITP	Reports	-	H	H	QAP sign off by TPIA

MANUFACTURER'S NAME & ADDRESS :**BHEL-VISAKHAPATNAM OR APPROVED SUB-CONTRACTORS**	**QUALITY ASSURANCE PLAN FOR MAIN FRACTIONATOR COLUMN** Item**: Main Fractionator Column** QAP No: CQP 2516 Rev **0** Date: 05.02.2021 Project: **Rajasthan Refinery Project** (**RRP**) Page 16 of 16	Customer: HPCL Rajasthan Refinery Limited (HRRL), Barmer. Consultant: Engineers India Limited(EIL) BHEL Sale Order No: 2439 Customer LOA Ref: HRRL/LOA/2020/25 Dt:29.09.2020	

SL NO	ACTIVITY	REFERENCE DOCUMENT	CHARACTERISITIC TO BE VERIFIED	ACCEPTANCE NORMS	VERIFYING DOCUMENTS /RECORDS	BHEL		TPIA	Remarks
						Prod	Qua		

(a)Low alloy steels: All weld edges shall be checked by MPI (b) UT of weld edges shall be done as per specifcation 6-12-0003

Notes:

1) For qualification any new WPS, or new WPQ, witness of TPIA is envisaged.
2) In case, the bevel edges are made with gas cutting, the edges shall be 100 % PT tested.
3) Wherever chemical analysis of weld metal overlay shall be measured, it shall be at a depth of 2/3rd of the cladding thickness from top of the finished overlay surface.
4) Weld over lay thickness cannot be more than 3 mm over and above the required clad thickness.
5) All specifications as available in drawings shall be complied.
6) In case site weld is required to be done in line to drawing, suitable extra dimensions are to be provided such that complete equipment after shop hydro test is cut into pieces and transported to site followed by seam welding at site.
7) All requirements as per PR (Purchase Requisition) shall be met.
8) For weld overlay, electrode for barrier layer E309MoL shall be used in line with EIL Spec. No. 6-12-0007.
9) Witness by TPIA for indigenous clad plates during explosion bonding activity of base plate with stainless steel plate followed by identification. Witness by TPIA for imported plate material.
10) Extent of RT will be in line to approved drawings.
11) EIL Spec 6-12-0007 Rev 5 Cl. No. 5.1.5: For welding of clad piping components such as pipe to pipe / pipe fitting from single side where approach from clad side is not accessible, shall be done with a welding consumable matching the clad material followed by an intermediate layer of pure iron (ARMCO/KARDO Iron) welding filler material and then by a welding consumable matching the base material.
12) EIL Spec 6-12-0007 Rev 5 Cl. No. 6.1.4: 100% UT shall be carried out of areas where attachments are to be welded directly to the cladding. The above areas shall include 50mm width of adjacent areas on both sides of attachment.
13) $ These stages are applicable for Clad zone only.

Legends:

P: Perform	**WPS: Welding procedure specification**	**DFT: Dry film thickness**	**LS: Longitudinal Seam welding**
R: Review	**WPQ; Welder performance Qualification**	**HT Chart: Heat Treatment chart**	**CS-Circular Seam welding**
H: Hold	**RT: Radiographic testing**	**PR-Purchase Requisition**	
W: Witness	**UT: Ultrasonic testing**	**Prod: Production**	
RW: Random Witness	**PT: Dye penetrant testing**	**Qua: Quality**	
	MPT: Magnetic particle testing	**IRN: Inspection release note issued by TPIA**	

ISSUE NO. : 2

PROCEDURE FOR RADIOGRAPHIC EXAMINATION

Issue No	Rev No	Date of Revision	Brief Records of Revision
1	0	02-02-2015	First Edition
1	1	11-04-2017	Cl. no. 3,7,10,12,13,15 revised as per ASME Sec V Edition 2015
2	1	25-04-2018	Cl. no. 3,14,15,18 revised as per ASME Sec V Edition 2017
2	2	15-05-2020	Cl. no. 3.1,3.2,9.2,11,12.1,12.4,16.5 revised; Cl. no.1,5,6,9,14,15,16.2 Modified.

Prepared by	Reviewed & Approved by
(K. JANAKI RAMULU) NDE LEVEL-II	VENKATA RAVI CHANDRA M. ASNT NDT LEVEL III-RT,UT,MT,PT CERTIFICATE No. 204694 (M.V. RAVI CHANDRA) NDE LEVEL-III

TABLE OF CONTENTS

1. SCOPE

This procedure specifies the requirement for radiographic examination of butt welded joints in steel(Carbon Steel, Alloy Steel, Stainless Steel etc.) and non-ferrous materials using x-rays or gamma rays as a source of radiation for detecting and evaluating flaws within the weld and HAZ (heat affected zone). It applies to the welded joints in pressure vessels, heat exchangers, columns and pipes etc. Radiographic technique used to demonstrate that required IQI sensitivity and density requirements are achieved.

2. POLICY

2.1. The radiographic examination be carried out either as or one of the procedures enumerated in the following pages which are verified and found to be in accordance with latest ASME SEC V or as per any other applicable referencing code sections and specifications.

2.2. Only personnel qualified in accordance with BHEL HPVP NDE Written Practice shall carry out any radiographic examination.

3. APPLICABLE STANDARDS

3.1. ASME SEC V Edition 2019.
3.2. Construction code sections ASME Sec I, ASME Sec VIII Div 1, ASME Sec VIII Div 2 Edition 2019, ASME B31.1 Edition 2016, NBIC NB 23 Edition 2019, SNT-TC-1A Edition 2016 & ASME SEC V Edition 2019 Art.1.

4. SYSTEM

All radiographic examination procedures be amended and approved as required by NDE level III taking into consideration of

4.1. Experience gained in various examination procedures.
4.2. Recommendations of audit teams.
4.3. Referencing code sections.

Each page of the document be independently controlled and revision status be indicated on the title page.

5. SURFACE PREPARATION:

The weld ripples or weld surface irregularities on both inside(where accessible) and outside shall be removed by any suitable process to such a degree that the images of surface irregularities cannot mask or be confused with the image of any discontinuity on the resulting radiograph.

The finished surface of all butt-welded joints may be flush with the base material or may have reasonably uniform crones, with reinforcement not to exceed that specified in the referencing code section.

Welds be visually examined to ensure free from surface irregularities which can mask or cause difficulty in detecting discontinuities. If required surface be ground and surface imperfections removed.

6. REINFORCEMENT

The thickness of reinforcement on each side of all butt welded longitudinal and circumferential joints not exceed the limits as given below:

As per ASME Sec-VIII Div 1:

Material thickness (Nominal) (mm)	Permitted Maximum Reinforcement	
	Cat B& C Butt welds (mm)	Other welds (mm)
< 2.4	2.4	0.8
2.4 to 4.8	3.0	1.5
>4.8 to 13	4.0	2.5
>13 to 25	5.0	2.5
>25 to 51	6.0	3.0
>51 to 76	6.0	4.0
>76 to 102	6.0	5.5
>102 to 127	6.0	6.0
>127	8.0	8.0

As per ASME Sec-VIII Div 2:

Material thickness (Nominal) (mm)	Permitted Maximum Reinforcement	
	Circumferential welds in Pipes & Tubes (mm)	Other welds (mm)
< 2.5	2.5	0.8
≥ 2.5 to < 5.0	2.5	1.5
≥ 5.0 to < 13.0	3.0	2.5
≥ 13.0 to < 25.0	4.0	2.5
≥ 25.0 to < 50.0	4.0	3.0
≥ 50.0 to < 76.0	4.0	4.0
≥ 76.0 to < 100.0	5.5	5.5
≥ 100.0 to < 125.0	6.0	6.0
≥ 125.0	8.0	8.0

As per ASME Sec-I:

Material thickness (Nominal) (mm)	Permitted Maximum Reinforcement	
	Circumferential welds in Pipes & Tubes (mm)	Other welds (mm)
< 3.0	2.5	2.5
3.0 to 5.0	3.0	2.5
>5.0 to 13.0	4.0	2.5
>13.0 to 25.0	5.0	2.5
>25.0 to 50.0	6.0	3.0
>50.0 to 75.0	The greater of 6 mm or 1/8 times the width of the Weld (in mm).	4.0
>75.0 to 100.0		5.5
>100.0 to 125.0		6.0
>125.0		8.0

7. SELECTION OF RADIOGRAPH

Either Agfa D4/D7 or Fuji IX 50/100 brand radiographs be used

8. INTENSIFYING SCREENS

For Iridium 192,X-ray(150 KV – 200 KV) 0.15 mm thick, Co-60 0.25 mm thick front and back Lead intensifying screens shall be used.

9. IMAGE QUALITY INDICATIORS (IQI)

9.1. SELECTION :

9.1.1. MATERIAL:

IQI shall be selected from either the same alloy material group or grade as identified in SE-747 for ASTM wire type or SE-1025 for hole type IQI or grade with less radiation absorption than the material being radiographed.

9.1.2. SIZE:

Nominal single wall Thickness of the base metal (thickness of the thinner incase dissimilar thickness base metals are joined) including the estimated allowed weld reinforcement both in ID and OD be considered for IQI selection. The values used for the estimated weld reinforcement thicknesses shall be representative of the weld conditions and shall not exceed the maximums permitted by the referencing code section. Physical measurement of the actual weld reinforcements not required. Backing rings or strips shall not be considered as part of the thickness in IQI selection. Refer Clause. 14 below for the selection of IQI designation.

9.2. PLACEMENT:

IQI(s) be placed on source side of the object unless hand placing of IQI is not feasible. In such case, the IQI be placed on radiograph side of weld with a letter ‘F’ placed adjacent to the IQI.

Wire type IQI’s be placed on the weld so that the lengths of the wires are transverse to the longitudinal axis of the weld and Hole type IQI’s be placed adjacent and parallel to the weld axis, one at each end of the radiography spot..

When weld reinforcement or backing strip is not removed, a shim of material radiographically similar to weld metal be kept under the hole type IQI.

9.3. NUMBER OF IQI's:

For unidirectional exposures, at least one IQI image appears on each radiograph where one or more radiograph holders are used for an exposure. If the density of the radiograph varies by more than –15% or +30% from the density through the body of hole type IQI, or adjacent to the required wire, an additional IQI be used for each exceptional area or areas and the radiograph is retaken.

For cylindrical components where the source is placed on the axis of the component for a single exposure at least three IQI's be placed approximately 120^0 apart.

10. RADIATION ENERGY SELECTION (SOURSE SELECTION):

The selection be such that required IQI sensitivity and density are achieved.

The recommended source for radiography of objects is as below.

Applicable ranges shall be as per provisions in Article 22 SE 94

a) Iridium 192 – with thickness from 6 to 65 mm.
b) Co-60 – for thickness above 35 mm.
c) X-ray equipments (100 KV – 200 KV) may be used for thickness 12 mm and below to achieve higher sensitivity, if required.

11. BACK-SCATTER RADIATION

A lead symbol 'B' shall be placed within the area of radiograph with minimum dimensions of 11 mm height and 1.5 mm thick be attached on the back side of each radiograph holder to determine if back-scatter radiation is exposing the radiograph.

12. SYSTEM OF IDENTIFICATION:

Each radiograph must be identified uniquely so that there is a permanent correlation between the part radiographed and the radiograph.

A system of permanent identification of the radiograph be provided with the following minimum details.

12.1. HPVP Manufacturer Symbol/Name and NDE Subcontractor's Symbol/Name.
12.2. Work Order Number.
12.3. SAP generated RT number if requisition raised through SAP.
12.4. Welder No. and Part Number for Non SAP Requisitions.
12.5. Equipment number, if any.
12.6. Weld seam number, if any.
12.7. Segment number (location marker).
12.8. Date of radiography.
12.9. Letter 'R1, R2' to indicate first repair, second repair etc. when required.
12.10. Letter 'RT' to indicate retaken radiograph when required.

13. RADIOGRAPH MAKING TECHNIQUES:

Normally a single wall single image (SWSI) radiography technique be used.

For test objects with external diameter less than 89 mm (DWDI) double wall double image Elliptical technique or (DWSI) double wall single image technique or Super imposition technique be used.

(Note: When DWDI technique is used, one exposure be taken unless otherwise specified. The source position be such that two weld images are clearly separated. The maximum separation between two weld images / distance between two weld images be one weld width. IQI be placed on the source side.

In case of DWSI or Super imposition techniques sufficient number of radiography shots ensuring full coverage of the weld seam be used. The IQI be placed close to the radiograph with a lead letter "F")

14. IQI SELECTION: As per Table T-276 of ASME Sec V Edition 2019

Weld thickness (base metal thickness + Estimated allowed reinforcement) (mm)	Source side			Radiograph side		
	Hole Type Designation	Essential hole	Wire-type Essential wire	Hole Type Designation	Essential hole	Wire type Essential wire
Upto 6.4	12	2T	5	10	2T	4
Over 6.4 to9.5	15	2T	6	12	2T	5
Over 9.5 to12.7	17	2T	7	15	2T	6
Over12.7 to19.0	20	2T	8	17	2T	7
Over 19.0 to25.4	25	2T	9	20	2T	8
Over 25.4 to38.1	30	2T	10	25	2T	9
Over 38.1 to50.8	35	2T	11	30	2T	10
Over 50.8to 63.5	40	2T	12	35	2T	11
Over 63.5to 101.6	50	2T	13	40	2T	12
Over 101.6 to 152.4	60	2T	14	50	2T	13

15. GEOMETRIC UNSHARPNESS:

Recommended maximum values of Ug are tabulated below

Material Thickness (mm)	Ug Maximum (mm)
Under 50	0.51
50-75	0.76
75-100	1.01
>100	1.78

$$\text{Exposure Time (Ci minutes)} = \frac{\text{Film factor} * (\text{SFD in Meters})^2 * 2^{(\text{thickness of job/HVT of material})}}{(\text{RHM of Source})} \times 60$$

General requirements:

- Persons working in radiation areas be provided with Personnel monitoring device (TLDs) and Radiation area monitoring devices (Survey meters).

- Personnel Qualification: The minimum qualification of radiography operator be BARC qualified and certified radiographer.

- The minimum Qualification of Radiography Evaluation personnel be ASNT / ISNT Level II.

- Extent of Examination: As per Applicable Drawing / QA plan / NDE plan.

- Marking and identification of the radiograph: Work order no., Joint No., Spot No(s). be permanently marked on the job by stamping. Where stamping is not permitted by code / specification (< 6mm for ferrous plates) sketches be prepared to identify weld joints and radiography spots.

- Location of weld in the radiograph: Set of Markers (arrows or V's) be placed on both sides of the weld at least 5 mm from the edge of the weld. At least two such sets be placed at each end of the radiography spot.

- Alignment of radiation beam: be directed to the centre of the area being radiographed and shall be perpendicular to the object surface at that point.

- Over lap of radiographs: When multiple radiographs are used to cover entire length of weld seams adjacent radiographs overlap at least 25 mm.

- Radiation Exposure times: Exposure charts indicating thickness vs exposure time (Gamma ray-Ir-192) or thickness vs milli Ampere minutes(mA-mts) (X-ray) prepared exclusively for a particular brand / type industrial x-ray radiograph shall be used.

16. EVALUATION:

16.1. FACILITIES FOR RADIOGRAPH VIEWING:

Radiographs shall be viewed in a room with subdued light after dark adaptation of eyes (minimum 5 minutes) using an illuminator of sufficient illumination. The illuminator shall have facility to adjust the illumination level required for the particular radiograph.

16.2. QUALITY OF RADIOGRAPHS:

All radiographs be free from mechanical, chemical or other blemishes to the extent that they cannot mask or be confused with the image of any discontinuity in the area of interest including:

i. Fogging
ii. Processing marks such as streaks, chemical stains, water marks, air bubble marks
iii. Handling marks such as scratches, finger marks, nail marks, static marks, marks due to dirt on lead intensifying screens.
iv. False indications due to defective screens.

16.3. RADIOGRAPHIC DENSITY:

Density estimation / measurement: The Density be estimated either with a calibrated densitometer or with a step wedge comparison radiograph.

Density of a radiograph at adjacent to essential hole/ wire and area of interest shall be from 1.8 minimum for single film viewing with X-Ray and 2.0(minimum) for Gamma Rays. For composite viewing of multiple film exposures, each film of the composite set shall have a minimum density of 1.3. The maximum density shall be 4.0 for single or composite viewing.

The density anywhere through the area of interest be within – 15% and +30% of that density obtained through the body of the hole type IQI adjacent to the essential hole or adjacent to the essential wire of wire-type IQI.

A tolerance of 0.05 in density is allowed for variation between densitometer readings.

When shims are used with hole type IQI(s) the +30% restriction may be exceeded, and the minimum density requirements mentioned above do not apply provided required IQI sensitivity is met.

16.4. EXCESSIVE BACKSCATTER

If a white image of a letter 'B' appears against a darker background, protection from back scatter radiation is needed and the radiograph be retaken by keeping a lead sheet of 1/16" thick at the back of the radiograph cassette.

16.5. IQI SENSITIVITY:

Essential Hole or Essential wire as referred above in "Clause 14" IQI selection be visible. For wire type IQI's the essential wire shall be visible within the area of interest representing the thickness used for determining the essential wire, inclusive of the allowable density variations described in Clause 16.3.

17. DISPOSITION OF WELDS:

Radiography review form shown in Exhibit 1 be used for recording, reporting evaluation and disposition details.

The indications shown on the radiographs which are unacceptable after interpretation and evaluation be repaired by grinding, welding or gouging. Repair welding be performed using qualified procedure and in a manner acceptable to the inspector. The weld repaired areas be re radiographed in accordance with written procedure.

18. PRESERVATION OF RADIOGRAPHS & EVALUATION REPORTS

The complete set of radiographs and radiography evaluation reports be preserved as per the following.

ASME Sec I & B 31.1	…. 5 Years
ASME Sec VIII Div 1	Radiographs-- Till Data Reports are signed by AI RT Reports – 3 Years
ASME Sec VIII Div 2	…. 3 Years
NBIC Part 3	…. 5 Years

RADIOGRAPHY ACCEPTANCE LEVELS

Ref : ASME SEC I , ASME SEC VIII Div 1, ASME SEC VIII Div 2 Edition 2019.

Full Radiography

Imperfection	Maximum permitted size / length
Any indication characterized as a crack or zone of incomplete fusion or penetration	Unacceptable
Elongated indications (also see notes 1. & 2. Below)	(a) 6 mm for t up to19 mm (b) 1⁄3t for t from 19 mm to 57 mm (c) 19 mm for t over 57 mm Where t is the thickness of the weld excluding any allowable reinforcement
Rounded indications	As specified by the acceptance standards given in pages 13 to 16.

Note:

1. For a butt weld joining two members having different thicknesses at the weld, t is the thinner of these two thicknesses. If a full penetration weld includes a fillet weld, the thickness of the throat of the fillet be included in t.
2. Any group of aligned indications that have an aggregate length greater than t in a length of 12t, except when the distance between the successive imperfections exceeds 6L where L is the length of the longest imperfection in the group.

Spot Radiography

Imperfection	Maximum permitted size / length
any indication characterized as a crack or zone of incomplete fusion or penetration	Unacceptable
slag inclusions or cavities	2⁄3t where t is the thickness of the weld excluding any allowable reinforcement.
Rounded indications	Not a factor in the acceptability of welds not required to be fully radiographed.

Note:

- If a full penetration weld includes a fillet weld, the thickness of the throat of the fillet be included in t.
- If several indications within the above limitations exist in line, the welds be judged acceptable if the sum of the longest dimensions of all such indications is not more than t in a length of 6t (or proportionately for radiographs shorter than 6t) and if the longest indications considered are separated by at least 3L of acceptable weld metal where L is the length of the longest indication. The maximum length of acceptable indications be 3⁄4 in.(19 mm). Any such indications shorter than 1⁄4 in. (6 mm) be acceptable for any plate thickness.

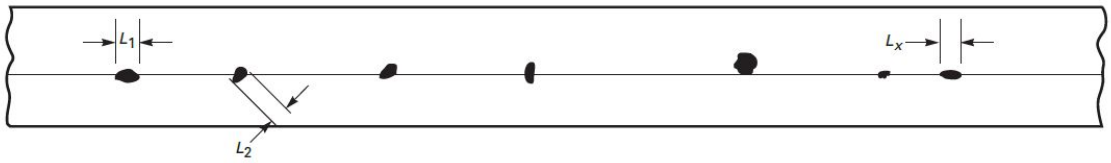
Acceptance Criteria for Rounded Indications

(Ref: Mandatory Appendix 4 ASME SEC I, SEC VIII DIV I Edition 2019)

SI Units

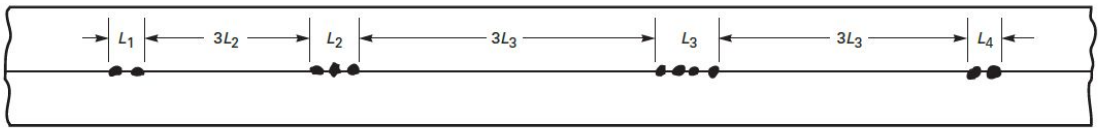
Thickness, t, mm	Maximum Size of Acceptable Rounded Indication, mm		Maximum Size of Nonrelevant Indication, mm
	Random	Isolated	
Less than 3	$\frac{1}{4}\,t$	$\frac{1}{3}\,t$	$\frac{1}{10}\,t$
3	0.79	1.07	0.38
5	1.19	1.60	0.38
6	1.60	2.11	0.38
8	1.98	2.64	0.79
10	2.31	3.18	0.79
11	2.77	3.71	0.79
13	3.18	4.27	0.79
14	3.61	4.78	0.79
16	3.96	5.33	0.79
17	3.96	5.84	0.79
19.0 to 50, incl.	3.96	6.35	0.79
Over 50	3.96	9.53	1.60

Figure 4-1
Aligned Rounded Indications



GENERAL NOTE: Sum of L_1 to L_x shall be less than t in a length of $12t$.

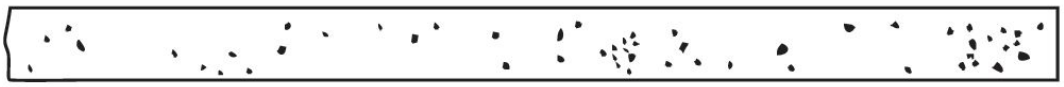
Figure 4-2
Groups of Aligned Rounded Indications



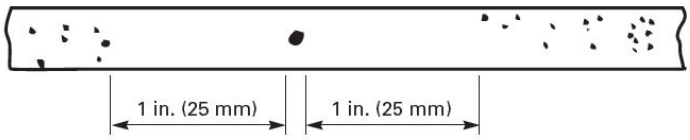
Maximum Group Length	Minimum Group Spacing
L = $^1/_4$ in. (6 mm) for t less than $^3/_4$ in. (19 mm) L = $^1/_3t$ for t $^3/_4$ in. (19 mm) to $2^1/_4$ in. (57 mm) L = $^3/_4$ in. (19 mm) for t greater than $2^1/_4$ in. (57 mm)	$3L$ where L is the length of the longest adjacent group being evaluated

GENERAL NOTE: Sum of the group lengths shall be less than t in a length of $12t$.

Figure 4-3
Charts for t Equal to $^1/_8$ in. to $^1/_4$ in. (3 mm to 6 mm), Inclusive



(a) Random Rounded Indications [See Note (1)]



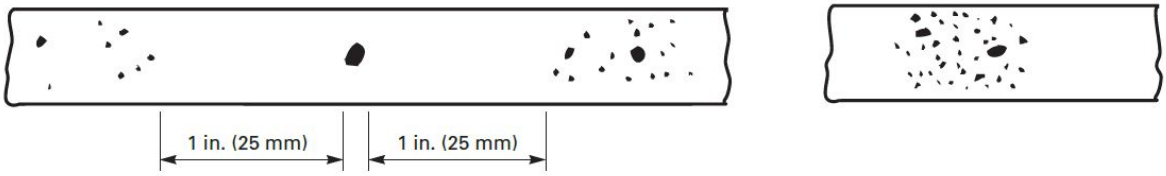
(b) Isolated Indication [See Note (2)]

(c) Cluster

NOTES:
(1) Typical concentration and size permitted in any 6 in. (150 mm) length of weld.
(2) Maximum size per Table 4-1.

Figure 4-4
Charts for *t* Over 1/4 in. to 3/8 in. (6 mm to 10 mm), Inclusive

(a) Random Rounded Indications [See Note (1)]



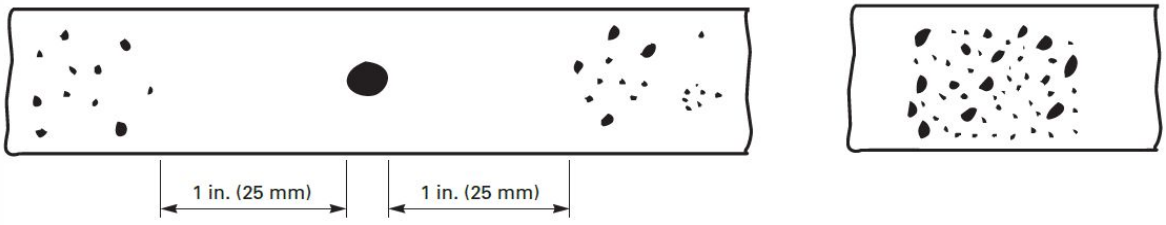
(b) Isolated Indication [See Note (2)]

(c) Cluster

NOTES:
(1) Typical concentration and size permitted in any 6 in. (150 mm) length of weld.
(2) Maximum size per Table 4-1.

Figure 4-5
Charts for *t* Over 3/8 in. to 3/4 in. (10 mm to 19 mm), Inclusive

(a) Random Rounded Indications [See Note (1)]

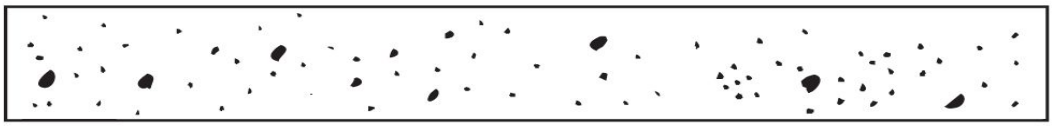


(b) Isolated Indication [See Note (2)]

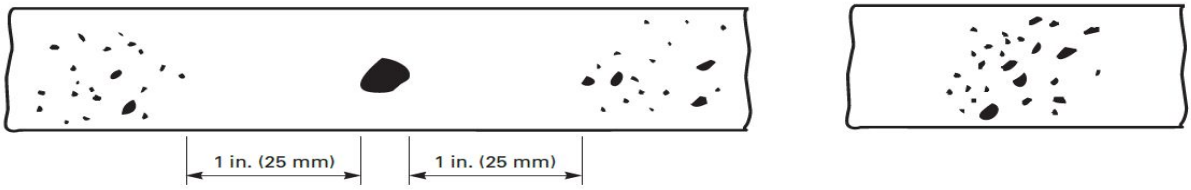
(c) Cluster

NOTES:
(1) Typical concentration and size permitted in any 6 in. (150 mm) length of weld.
(2) Maximum size per Table 4-1.

Figure 4-6
Charts for *t* Over ¾ in. to 2 in. (19 mm to 50 mm), Inclusive



(a) Random Rounded Indications [See Note (1)]

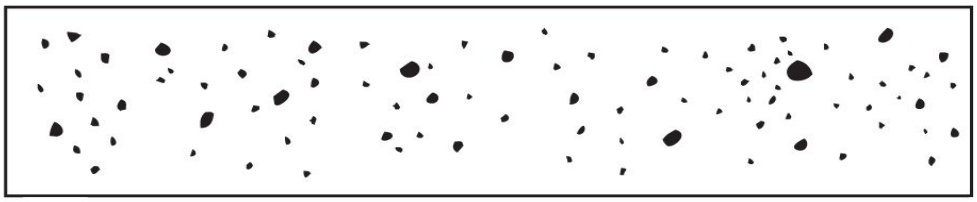


(b) Isolated Indication [See Note (2)]

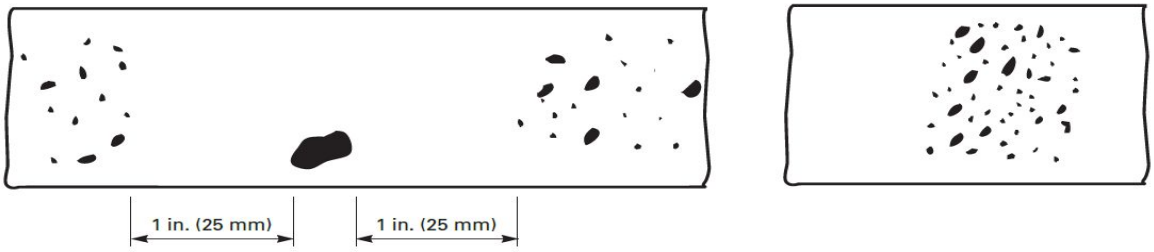
(c) Cluster

NOTES:
(1) Typical concentration and size permitted in any 6 in. (150 mm) length of weld.
(2) Maximum size per Table 4-1.

Figure 4-7
Charts for *t* Over 2 in. to 4 in. (50 mm to 100 mm), Inclusive



(a) Random Rounded Indications [See Note (1)]



(b) Isolated Indication [See Note (2)]

(c) Cluster

NOTES:
(1) Typical concentration and size permitted in any 6 in. (150 mm) length of weld.
(2) Maximum size per Table 4-1.

(For other Codes such as ASME B31.1, NBIC NB23 refer respective current Edition)

ISSUE NO.2

PROCEDURE FOR ULTRASONIC EXAMINATION

Issue No	Rev No	Date of Revision	Brief Records of Revision
1	0	02-02-2015	First Edition
1	1	11-04-2017	Cl no. 2,3,12,13 revised as per ASME Sec V Edition 2015
2	1	25-04-2018	Cl no. 2,3,12,13 revised as per ASME Sec V Edition 2017
2	2	15-05-2020	Cl no. 1,5,7,12 Modified and Cl no. 2.2,2.3,3,12 Revised as per ASME Sec V Edition 2019

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1. SCOPE:

This procedure covers Ultrasonic Examination for Ferritic welds (Carbon or Alloy steels) and Claddings by Manual, A-Scan, pulse-echo direct contact method of testing for detection of inclusions(slag) and planar discontinuities (cracks, non-fusion, etc.) and thickness measurement as

a) Full penetration butt welds (double V, single V type), Full penetration corner welded nozzle joints for boiler and pressure vessels of equal to or greater than 10mm thickness.
b) Butt joints in pipes with thickness equal to or greater than 10mm thickness.
c) Claddings.
d) Direct thickness read out by manual Ultrasonic Pulse echo contact method.

2. SYSTEM:

2.1 EXAMINATION PROCEDURE AND APPLICABLE STANDARDS:

All Ultrasonic Examination procedures shall be prepared in accordance with ASME SEC V Edition 2019 by at least NDE Level II and reviewed and approved by NDE Level III.

2.2 REFERENCING CODE SECTION FOR ACCEPTANCE CRITERIA:

ASME SEC I, ASME SEC VIII Div 1, ASME SEC VIII Div 2 Edition 2019, ASME B31.1 Edition 2018 & NBIC NB 23 Edition 2019, SNT-TC-1A Edition 2016 & ASME SEC V Edition 2019 Art.1.

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2.3 EXAMINATION PERSONNEL AND APPLICABLE STANDARDS:

All NDE Level – I, NDE Level – II and NDE Level III personnel are qualified in accordance with NDE written practice (Based on SNT-TC-1A 2016& ASME Sec V Edition 2019 Art.1) and appearing in Latest List of Qualified NDE Personnel shall carry out any Ultrasonic Examination.

At the appropriate stage, the Ultrasonic Examination shall be carried out as per the requisitions from production shops endorsed by concerned Quality Controls.

3. WRITTEN PROCEDURE REQUIREMENTS:

This procedure based on T-421 of ASME SEC V Edition 2019 shall contain the requirements listed in the Table below of this procedure.

Table T-421
Requirements of an Ultrasonic Examination Procedure

Requirement	Essential Variable	Nonessential Variable
Weld configurations to be examined, including thickness dimensions and base material product form (pipe, plate, etc.)	X	...
The surfaces from which the examination shall be performed	X	...
Technique(s) (straight beam, angle beam, contact, and/or immersion)	X	...
Angle(s) and mode(s) of wave propagation in the material	X	...
Search unit type(s), frequency(ies), and element size(s)/shape(s)	X	...
Special search units, wedges, shoes, or saddles, when used	X	...
Ultrasonic instrument(s)	X	...
Calibration [calibration block(s) and technique(s)]	X	...
Directions and extent of scanning	X	...
Scanning (manual vs. automatic)	X	...
Method for discriminating geometric from flaw indications	X	...
Method for sizing indications	X	...
Computer enhanced data acquisition, when used	X	...
Scan overlap (decrease only)	X	...
Personnel performance requirements, when required	X	...
Personnel qualification requirements	...	X
Surface condition (examination surface, calibration block)	...	X
Couplant: brand name or type	...	X
Post-examination cleaning technique	...	X
Automatic alarm and/or recording equipment, when applicable	...	X
Records, including minimum calibration data to be recorded (e.g., instrument settings)	...	X

It shall establish a single value, or range of values for each requirement. When required performance shall be demonstrated to the inspector. Any change in specified value or range of values of the essential variables mentioned above shall require requalification of the written procedure.

4. SURFACE CONDITION :

4.1 BASE MATERIAL, WELD, CALIBRATION BLOCK:

The base material and weld surface shall be prepared by grinding and sandering. The scanning surfaces of the basic calibration block shall be done by sandering.

4.2 TEMPERATURE DIFFERENCE:(examination surface vs calibration block)

The temperature difference between examination surfaces and the calibration block shall be within +/- 14 deg C (25 deg F) .

5. EQUIPMENT:

5.1 INSTRUMENT:

A Pulse-echo-type of ultrasonic instrument appearing in current list of NDE equipments under calibration and capable of operation at frequencies over the range of 2-4 MHz equipped with 2dB stepped gain control shall be used.

5.2 SEARCH UNITS:

Longitudinal wave Straight beam probe of size 10 mm to 24 mm Ø, 2 - 4 MHz ; Transverse wave angled beam probes 45º, 60º , 70º of nominal size (miniature size) 8 x 9 mm² ; make Modsonic / Olympus / GE with suitable 2mtr long probe cables shall be used.

5.3 COUPLANT:

SAE 30 Hylube machine oil or grease oil mixture shall be used. Calibration shall be carried out using the same couplant to be used in examination of welds.

6. TECHNIQUE (S):

Manual, A-Scan, pulse-echo direct contact using either single or dual element straight beam and angle beam search units.

7. CALIBRATION:

7.1 EQUIPMENT CALIBRATION:

The screen height linearity and amplitude control linearity shall be performed in accordance with Procedure No. 07013 (latest revision) at the beginning of each period of extended use or every 3 months.

7.2 TECHNIQUES FOR STRAIGHT BEAM AND ANGLE BEAM CALIBRATION:

7.2.1. SWEEP RANGE CALIBRATION:

The sweep range shall be adjusted to minimum 2T for straight beam, 3T for 45º angle beam and 4T for 60º using an IIW - V1 or V2 reference block.

7.2.2. SENSITIVITY CALIBRATION:

DAC curve plotted on the CRT screen Using Flat basic calibration block 1.5 inch ASME Block for Both Straight beam and Angle beam.

7.2.3. CALIBRATION VERIFICATION FREQUENCY:

Sweep range and DAC curve shall be calibrated at the beginning of each test and shall be verified at the end of each test,

- Whenever any component of test system is changed,
- Whenever operator is changed,
- At intervals of 4 hours during continuous testing.

7.2.4. CONFIRMATION ACCEPTANCE VALUES:

- If the deviation in distance range points exceeds 10% of the distance reading or 5% of full sweep which ever is greater, correct the distance range calibration, reexamine areas since last calibration and record.
- If the sensitivity decreases by 20% or 2dB of its amplitude correct the sensitivity and reexamine areas since last calibration and record. If the sensitivity increases by 20%

or 2dB of its amplitude correct the sensitivity correct the data sheets since last valid calibration. If the sensitivity varies beyond 20% or 2dB of its amplitude recalibrate and reexamine areas since last valid calibration and record.

7.3 WELD METAL OVERLAY CLADDING CALIBRATION BLOCKS

7.3.1. CALIBRATION BLOCKS FOR TECHNIQUE ONE:

The basic calibration block configuration and reflectors shall be as shown in figure T-434.4.1 of ASME Sec V Article 4. Either a side –drilled hole or flat bottom hole may be used. The thickness of the weld metal overlay cladding shall be at least as thick as that to be examined. The thickness of the base material shall be at least twice the thickness of the weld metal overlay cladding.

7.3.2. ALTERNATE CALIBRATION BLOCKS FOR TECHNIQUE ONE:

Alternately, calibration blocks as shown in figure T-434.4.2.1. or figure T-434.4.2.2. of ASME Sec V Article 4 may be used. The thickness of the weld metal overlay cladding shall be at least as thick as that to be examined. The thickness of the base material shall be at least twice the thickness of the weld metal overlay cladding.

7.3.3. CALIBRATION BLOCK FOR TECHNIQUE TWO:

The basic calibration block configuration and reflectors shall be as shown in the figure T-434.4.3 of ASME Sec V Article 4. A flat bottom hole drilled to the weld /base metal interface shall be used. This hole may be drilled from the base material or weld metal overlay cladding side. The thickness of the weld metal overlay cladding shall be at least as thick as that to be examined. The thickness of the base metal shall be within 1 in. (25mm) of the calibration block thickness when the examination is performed from the base material surface. The thickness of the base material on the calibration block shall be at least twice the thickness of the weld metal overlay cladding when the examination is performed from the weld metal overlay cladding surface.

7.4 CALIBRATION FOR WELD METAL OVERLAY CLADDING

Dished end of clad plates shall be Ultrasonically examined after final heat treatment for lack of bond. 100% UT examination shall be carried out on areas where attachments are to be welded directly to the cladding. Above areas shall include 50mm of adjacent areas on both sides of attachment.

7.4.1. CALIBRATION FOR TECHNIQUE ONE:

Calibrations shall be performed utilizing the calibration block shown in figure T-432.4.1 of ASME Sec V Article 4. The search unit shall be positioned for the maximum response from the calibration reflector. When a side –drilled hole is used for calibration, the plane separating the elements search unit shall be positioned parallel to the axis of the hole. The gain control shall be set so that this response is 80% ± 5% of full screen height. This shall be the primary reference level.

7.4.2. CALIBRATION FOR TECHNIQUE TWO:

Calibrations shall be performed utilizing the calibration block shown in figure T-434.4.3 of ASME Sec V Article 4. The search unit shall be positioned for the maximum response of the first resolvable indication from the bottom of the calibration reflector. The gain shall be set so that this response is 80%± 5% of full screen height. This shall be the primary reference level.

7.4.3. ALTERNATE CALIBRATION FOR TECHNIQUE ONE:

Calibration shall be performed utilizing the calibration blocks shown in figure T-434.4.2.1. or figure T-434.4.2.2 of ASME Sec V Article 4. The calibration shall be performed as follows;

(a) The search unit shall be positioned for the maximum response from the reflector, which gives the highest amplitude.
(b)When the block shown in the figure T-434.4.2.2 is used, the plane separating the elements of the dual elements search unit shall be positioned parallel to the axis of the hole.
(c) The gain shall be set so that this response is 80% ± 5% of full screen height. This shall be the primary reference level. Mark the peak of the indication on the screen.
(d)Without changing the instrument settings, position the search unit for maximum response from each of the other reflectors and mark their peaks on the screen.
(e) Connect the screen marks for each reflector to provide a DAC curve.

Note: When examination for lack of bond and weld metal overlay cladding flaw indications is required, Technique One shall be used. When examination for lack of bond only is required, Technique Two may be used.

8. SCANNING:

8.1 GENERAL:

8.1.1. EXAMINATION SURFACE:
Examination shall be carried out from identity-punched surface.

8.1.2. COVERAGE:
Shall be on both sides of the weld from 0 to 1½ skip.

8.1.3. SCAN OVERLAP:
Each pass of the search unit shall overlap a minimum of 10% of the active transducer (piezoelectric element) dimension perpendicular to the direction of the scan.

8.1.4. SPEED AND SENSITIVITY:
The weld shall be scanned at a speed not exceeding 6” per second at a scanning sensitivity 6 dB above the DAC or primary Reference Level (PRL).

8.2 BASE MATERIAL:

Prior to angle beam examination of weld, adjacent parent material up to a width of 4T on both sides of the weld shall be scanned with a straight beam search unit to find discontinuities that could interfere with interpretation of indications obtained during subsequent angle beam scanning.
Any discontinuity found by straight beam search unit shall be investigated and not be a cause of rejection of element.

8.3 WELD:

Weld shall be scanned with two different angles beam search units for detection of Longitudinal and transverse discontinuities

8.3.1. DIRECTION AND EXTENT OF SCANNING:

8.3.1.1. REFLECTORS PARALLEL TO THE WELD SEAM:

The angle beam shall be directed at approximate right angles to the weld axis from both side of the weld (i.e., is from 2 directions) on the same surface when possible and probe manipulated so as to pass ultrasonic energy thro' the required volume of the weld and adjacent base material.

8.3.1.2. REFLECTORS TRANSVERSE TO THE WELD:

The angle beam shall be directed essentially parallel to the weld axis. The search unit shall be manipulated so that the ultrasonic energy passes thro' the required volume of weld and adjacent base material. Search unit shall be rotated 180 ° and the examination repeated.

9. SIZING:

9.1 METHOD OF SIZING INDICATIONS:

Length dimension of indications shall be measured by half maximum amplitude method.

9.2 CALIBRATION CORRECTION:

The surface finish difference between calibration block &scanning surface shall be compensated by using Transfer Correction.

Calibration correction due to Mode conversion and redirection for planar reflectors perpendicular to the examination surface at or near the opposite surface is carried out as per the following.

Position the search unit for maximum amplitude from the notch on the opposite surface of the basic calibration block and mark the position of peak of the indication on the screen
The opposite surface notch may give an indication 2 to 1 above DAC for a 45º angle beam search unit and ½ DAC for a 60º search unit. Therefore, the indications from the notch must be considered when evaluating reflectors at the opposite surface

10. EVALUATION :

It shall be carried out by at least NDE Level II personnel as per the following.

- All indications exceeding 20% of DAC shall be scanned for their nature and location and recorded. The gain shall be increased an additional amount so that no calibration reflector indication is less than 40% FSH during evaluation.

- The identity, maximum amplitude, location and extent of reflector causing a geometric indication(s) (segregates in the heat-affected zone, surface conditions such as weld root geometry) shall be recorded.

- Following shall be considered for Classifying an indication as geometric or not.
  - Plot and verify the reflector coordinates. Prepare a cross-sectional sketch showing the reflector position and surface discontinuities such as root and counter bore.
  - Review fabrication or weld preparation drawing. Other ultrasonic techniques or nondestructive examination methods may be helpful in determining a reflector's true position, size, and orientation.

11. RECORDING AND REPORTING:

11.1 METHOD OF RECORDING:

- Test data shall be recorded manually in the Proforma appended in exhibit-1 Annexed and reported and Direct thickness read out by manual Ultrasonic pulse echo contact method is recorded in exhibit-2.
- As a minimum all rejectable indications, type of indications (Crack, non-fusion, slag etc.), location and extent (length), depth below surface shall be recorded.
- Non-rejectable indications exceeding 50% of DAC shall be recorded

Report shall contain the following in addition to those mentioned in the table appended next page.

- Procedure identification and revision.
- Instrument reference level gain and, if used, damping and reject settings(s).
- Calibration data (including reference reflector(s) indication amplitude(s), and distance reading(s).
- Identification and location of weld or volume scanned.
- Map or record of rejectable indications detected or areas cleared.
- Areas of restricted access or inaccessible welds;
- Examination personnel identity and, when required by referencing code section qualification level.
- Date of examination.

12. ACCEPTANCE STANDARDS:

As per ASME SEC I, ASME SEC VIII Div 1, ASME SEC VIII Div 2 Edition 2019, ASME B31.1, NBIC NB 23 Latest Edition.

UT on clad plate (Dished ends) shall be performed as per ASME A 578.

ACCEPTANCE-REJECTION STANDARDS:

(Ref: ASME SEC I, ASME SEC VIII Div 1,ASME SEC VIII DIV 2 Edition 2019)

Imperfections recorded as per para 10 above shall be evaluated as below.

1. Indications characterized as cracks, lack of fusion or incomplete penetration are unacceptable regardless of length.

2. Other imperfections are unacceptable if the indications exceed the reference level amplitude and have lengths which exceed 1/3 T - (weld thickness(T) excluding any allowable reinforcement) or 6 mm whichever is greater.

Notes: Butt welds joining two different thicknesses at the weld, T is the thinner of these two thicknesses.

(For other Codes such as ASME B31.1, NBIC NB23 refer respective current Edition)

13. PRESERVATION OF DATA REPORTS:

All the reports of ultrasonic test shall be preserved till MDR signed.

ISSUE NO.2

PROCEDURE FOR MAGNETIC PARTICLE EXAMINATION

Issue No	Rev No	Date of Revision	Brief Records of Revision
1	0	02-02-2015	First Edition
1	1	11-04-2017	Cl no. 3,5,8.6,9,14 revised as per ASME Sec V Edition 2015
2	1	25-04-2018	Cl no. 3,5,8.2,19,14 revised as per ASME Sec V Edition 2017
2	2	15-05-2020	Cl. no. 1,6,7.1,7.2 Modified; 13,14,15,16,17,18 renumbered; Cl. no. 3,4,9.2,18 revised; Cl.no.8,10,11,12 added.

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1. SCOPE :

This Procedure shall be applied for detecting of surface and near surface discontinuities in Butt welds, fillet welds, partial penetration welds, Back Gouging welds, Full penetration butt and corner welds, Nozzles of Boiler components, pressure vessels, heat exchangers, power piping and Non pressure parts welds, plates, forgings, etc. of Ferro Magnetic Materials to detect surface and subsurface discontinuities using visible Dry & wet particle Continuous Prod or Yoke technique and Fluorescent Wet Prod or Yoke Techniques.

2. POLICY:

2.1 The Magnetic Particle Examination shall be carried out either as per one of the procedures enumerated in the following pages which are verified and found to be in accordance with ASME SEC V or as per any other applicable referencing code sections and specifications.

2.2 Only personnel qualified to MT NDE Level II / MT NDE Level III in accordance with NDE written practice shall carry out any Magnetic Particle Examination.

3. APPLICABLE STANDARDS:

3.1 ASME SEC V Edition 2019

3.2 Construction code sections ASME Sec I, ASME Sec VIII Div 1, ASME Sec VIII Div 2 Edition 2019, ASME B31.1 Edition 2018, NBIC NB 23 Edition 2019, SNT-TC-1A Edition 2016 & ASME SEC V Edition 2019 Art.1.

4. SYSTEM:

All Magnetic particle examination procedures shall be amended and approved as required by NDE level III taking into consideration of

4.1 Experience gained in various examination procedures

4.2 Recommendation of Audit Teams

4.3 Referencing Code sections.

5. WRITTEN PROCEDURE REQUIREMENTS:

This procedure based on Table T-721 of ASME SEC V Edition 2019 shall contain the requirements listed in the Table below.

It shall establish a single value, or range of values for each requirement. When required performance shall be demonstrated to the inspector. Any change in specified value or range of values of the essential variables mentioned in Table shall require requalification of the written procedure.

Table T-721
Requirements of a Magnetic Particle Examination Procedure

Requirement	Essential Variable	Nonessential Variable
Magnetizing technique	X	...
Magnetizing current type or amperage outside range specified by this Article or as previously qualified	X	...
Surface preparation	X	...
Magnetic particles (fluorescent/ visible, color, particle size, wet/ dry)	X	...
Method of particle application	X	...
Method of excess particle removal	X	...
Minimum light intensity	X	...
Existing coatings, greater than the thickness demonstrated	X	...
Nonmagnetic surface contrast enhancement, when utilized	X	...
Performance demonstration, when required	X	...
Examination part surface temperature outside of the temperature range recommended by the manufacturer of the particles or as previously qualified	X	...
Shape or size of the examination object	...	X
Equipment of the same type	...	X
Temperature (within those specified by manufacturer or as previously qualified)	...	X
Demagnetizing technique	...	X
Post-examination cleaning technique	...	X
Personnel qualification requirements	...	X

6. SURFACE CONDITIONING :

6.1 SURFACE PREPARATION:

6.1.1. Prior to Magnetic Particle Examination, the surface to be examined and all adjacent areas within at least 1” shall be dry and free of all dirt, grease, lint, scale, welding flux & spatter, oil and other extraneous matter that could interfere with examination.

6.1.2. As welded, ground, Machined and Back Gouged conditions are preferable. However, Surface preparation by grinding or machining may be necessary where surface irregularities could mask indications due to discontinuities. This

procedure does not address the testing of parts covered with coatings and / or non magnetic surface contrast enhancement.

6.1.3. The surfaces which are to be examined by Magnetic particle testing shall be free from any external Nonmagnetic coatings. If any nonmagnetic coatings are present, it shall be demonstrated that indications can be detected through the existing maximum coating thickness applied.

6.1.4. Nonmagnetic Surface Contrast Enhancement:

Nonmagnetic surface contrasts may be applied by the examiner to uncoated surfaces, only in amounts sufficient to enhance particle contrast. When nonmagnetic surface contrasts are used, it shall be demonstrated that indications can be detected through the enhancement. Thickness measurement of surface contract enhancement is not required.

6.2 TEMPERATURE OF PART SURFACE:

The surface temperature of the part examined with dry particles shall be within the range of 17 ºC to 315 ºC (within maximum temperature specified by the manufacturer of the particles) and wet particles shall be maximum 57 ºC or temperature specified by the manufacturer of the particles.

7. EQUIPMENT:

7.1 TYPE OF EQUIPMENT:

7.1.1. Portable magnetic particle testing equipments appearing in the current list of NDE Equipments under calibration (230V, single phase, open circuit voltage <25V) provided with stepped / continuous current control, remote control switch for momentarily switching on / off, prods for application of current and capable of generating max 1000A HWDC shall be used for magnetization.

7.1.2. Direct/Alternating current electromagnetic yokes shall be used to detect discontinuities that are open to the surface of the part by longitudinal magnetization method and to examine the surfaces where arcing is not permitted or prod method is not practicable.

7.2 CALIBRATION OF EQUIPMENT:

7.2.1. Each magnetizing equipment with an ammeter shall be calibrated at least once a year, or whenever the equipment has been subjected to major electric repair, periodic overhaul, or damage.

7.2.2. The magnetizing power of yokes shall be verified prior to use on every day the yoke is used. The magnetizing power of yokes shall be verified whenever the yoke has been damaged or repaired.

7.2.3. Each alternating current electromagnetic yoke shall have a lifting power of at least 4.5 kg at the maximum pole spacing that will be used with contact similar to what will be used during the examination.

7.2.4. Each direct current or permanent magnetic yoke shall have a lifting power of at least 18 kg at the maximum pole spacing that will be used with contact similar to what will be used during the examination.

7.2.5. Each weight shall be weighed with a scale from a reputable manufacturer and stencilled with the applicable nominal weight prior to first use. Weight need only be verified again if damaged in a manner that could have caused potential loss of material.

8. EXAMINATION MEDIUM:

8.1 DRY PARTICLES:

Finely divided ferromagnetic dry particles (non-fluorescent free flowing dry particles of colors either red or grey.) supplied by M/s Arora / M/s Pradeep with brand name Automag RD-7 Red or M/s Ferrochem with Brand names Ferrochem grey and Ferrochem Red shall be used.

8.2 WET PARTICLES:

8.2.1. WET PARTICLE CONCENTRATION:

Non fluorescent or fluorescent wet particles will be black or reddish brown in color that provide adequate contrast with the surface being examined.

Wet particles shall be suspended in kerosene or water for application to the test surface by flowing or spraying. Suitable conditioning agents shall be added to the water to provide proper wetting and corrosion protection for the parts being examined.

The bath concentration shall be determined by measuring the settling volume through the use of pear-shaped centrifuge tube with a 1-mL stem (0.05-mL divisions) for fluorescent particle suspensions or a 1.5-mL stem (0.1-mL divisions) for non-fluorescent suspensions. The suspension shall be mixed thoroughly or shall be run through the re-circulating system for at least 30 minutes to ensure thorough mixing of all particles. Take a 100-mL portion of the suspension from the hose or nozzle, demagnetize and allow it to settle for 30 minutes' minimum with water based suspension or 60 minutes' minimum with petroleum distillate suspension before taking the reading.
For fluorescent particles, the required settling volume is from 0.1 mL to 0.4 mL in a 100-mL bath sample and from 1.2 mL to 2.4 mL per 100 mL of vehicle for non-fluorescent particles or as recommended by the manufacturer. Concentration checks shall be made at least every eight hours.

8.2.2. WET PARTICLE CONTAMINATION:

Both fluorescent and non-fluorescent suspensions shall be checked periodically for contaminants such as dirt, scale, oil, lint, loose fluorescent pigment, water (in the case of oil suspensions), and particle agglomerates which can adversely affect the performance of the magnetic particle examination process. The test for contamination shall be performed at least once per week.

8.2.2.1. Carrier Contamination:

For fluorescent baths, the liquid directly above the precipitate should be examined with fluorescent excitation light. The liquid will have a little fluorescence. Its color can be compared with a freshly made-up sample using the same materials or with an unused sample from the original bath that was retained for this purpose. If the "used" sample is noticeably more fluorescent than the comparison standard, the bath shall be replaced.

8.2.2.2. Particle Contamination.

The graduated portion of the tube shall be examined under fluorescent excitation light if the bath is fluorescent and under visible light (for both fluorescent and non-fluorescent particles) for striations or bands, differences in color or appearance. Bands or striations may indicate contamination. If the total volume of the contaminates, including bands or striations exceeds 30% of the volume magnetic particles, or if the liquid is noticeably fluorescent, the bath shall be replaced.

Note: In any case, color of particles used shall have adequate contrast with the surface being examined.

9. EXAMINATION:

9.1 EXAMINATION COVERAGE:

All examinations shall be conducted with sufficient field overlap to ensure 100% coverage at the required sensitivity.

9.2 MINIMUM LIGHT INTENSITY:

9.2.1. Visible Light Intensity

9.2.1.1. The examination area and the accumulation of magnetic particles shall be observed under adequate lighting. An intensity of 1076 lux is adequate. The minimum light intensity shall be 100 fc (1076 lux). The light intensity, natural or supplemental white light source, shall be measured with a white light meter prior to the evaluation of indications or a verified light source shall be used. Verification of light sources is required to be demonstrated only one time, documented, and maintained on file.

All following activity shall be done under the illumination of 100 watt 230V incandescent bulb at a minimum distance of 25 cms from test part for ensuring 1076 Lux light intensity at test part surface.

9.2.2. Black Light (UV-A Light)

9.2.2.1. Black light intensity at the examination surface shall be not less than 1000 micro watt/ cm^2 at a distance of 15 inch.

9.2.2.2. The black light intensity shall be measured at least once in every 8 hrs. and whenever the work station is changed. The UV-A and White Light Meter should be calibrated once in One year.

9.2.2.3. With fluorescent particles, the examination is performed in a darkened area. The Intensity of Ambient visible light in the darkened area shall not exceed 2 fc or 21.5 lux.

9.2.2.4. The examiner shall be in the darkened area for at least 5 minutes prior to performing the examination for eye adaptation. The examiner shall not wear glasses with permanent Tint or Photo Chromic (light sensitive) lenses which change colour in Sunlight.

9.2.2.5. The black light shall be warmed up for a minimum period of 5 minutes prior to use or measurement of the intensity.

Lux meter/Light meter shall be calibrated at least once a year or whenever a meter has been repaired. If meters have not been in use for one year or more, calibration shall be done before being used.

For selection of other light sources vs maximum distances permitted refer Exhibit 1.

9.3 DIRECTION OF MAGNETIZATION:

Two separate examinations shall be performed on each area. During second examination, the lines of magnetic flux shall be approximately perpendicular to those used in the first examination.

10. METHOD OF EXAMINATION:

Examination shall be made by continuous method.

10.1 Dry continuous magnetization method:

The magnetizing current remains on while the examination medium (Brick red Dry particle) is being applied and while the excess of the examination medium is being removed.

10.2 Wet continuous magnetization method:

The magnetizing current shall be turned on after the particles have been applied. Flow of particles shall stop with the application of current. Wet particles applied from aerosol spray cans/pump sprayers may be applied before and/or during magnetizing current application.

11. TECHNIQUES:

11.1 PROD TECHNIQUE:

11.1.1. Magnetizing Procedure:

The prod electrodes are pressed firmly against the surface in the area to be examined. In order to avoid arcing, a remote control switch shall be built into the prod handles, to permit the current to be turned on after the prods have been properly positioned and to be turned off before they are removed. The prods tips shall be kept dressed and cleaned to make satisfactory electrical contact.

11.1.2. Magnetizing Current and Prod Spacing:

Single-phase (half-wave rectified) current HWDC shall be used. The current shall be 100 to 125amps per inch of prod spacing for sections 0.75 inch thick or greater. For sections less than 0.75 inch thick the current shall be 90 to 110 amps per inch of prod spacing. Prod spacing shall not exceed 8 inches and shall not be less than 3 inches.

11.2 YOKE TECHNIQUE:

11.2.1. This technique is primarily intended to cover the region between the poles. The pole spacing shall be between 100 mm to 150 mm. In order to ensure that the region of interest gets 100 % coverage, every region (or segment of the test area, divided according to the pole spacing), shall be tested twice such that the pole space displacements are mutually perpendicular in the former and later cases. For example, in the case of the weld, the pole space orientation can be 45 Deg. and 135 Deg. Respectively with respect to the weld center line orientation, in the first and second attempts.

11.2.2. Pie-Shaped Magnetic Particle Field Indicator shall be used to ensure field adequacy as well as direction of field. It shall be positioned on the surface to be examined with copper-plated side away from the inspected surface.

Suitable field strength is indicated by formation of clearly defined lines of magnetic particles across the copper face of the indicator when the magnetic particles are applied simultaneously with the magnetizing force. When a clearly defined line of particles are not formed in the desired direction, the magnetizing technique shall be changed as needed.

11.3 For inspection of components of Gr 91 material including Gr C12A, prod technique shall not be used. This shall be inspected by Yoke technique using Dry or Wet method.

12. METHOD OF PARTICLE APPLICATION AND EXCESS PARTICLE REMOVAL:

12.1 DRY PARTICLES:

12.1.1. The dry particles shall be applied in such a manner that a light uniform dust-like coating settles on the surface of the area being examined. The application technique shall be such that the particles are suspended in air and reaches the examination surface in a uniform cloud with a minimum force, using hand powder applicators (squeeze bulb) or specially designed mechanical blower or by a spray nozzle.

12.1.2. Dry particles shall not be applied to a wet surface nor when there is excessive wind. The particles shall not be applied by pouring, throwing, or spreading with fingers.

12.1.3. Any excess powder shall be removed while the magnetization current is on and shall be with a gentle air stream by a blower or squeeze bulb without removing or disturbing particles attracted by a leakage field that may prove to be a relevant indication.

12.2 WET PARTICLES:

12.2.1. The application of wet particles involves the bathing of the area to be examined, by spraying or flowing during the application of magnetizing current.

12.2.2. Two or more shots shall be applied, but the last shot shall be applied while the bath still remains on the area to be examined and after the particle flow has been stopped. Care shall be taken to cut off the bath application before

removing the magnetic field, to prevent high-velocity particle flow that may wash away or remove fine or weakly held indications.

13. INTERPRETATION AND EVALUATION :

(a) All indications shall be evaluated in terms of the acceptance standards of the referencing Code Section.
(b) Discontinuities on or near the surface are indicated by retention of the examination medium. However, localized surface irregularities due to machining marks or other surface conditions may produce false indications.
(c) Broad areas of particle accumulation, which might mask indications from discontinuities, are prohibited, and such areas shall be cleaned and reexamined.

All indications shall be evaluated by a NDE Level II or NDE Level III in terms of the acceptance standard of ASME SEC VIII DIV 1, ASME SEC VIII DIV 2, ASME SEC I, ASME B31.1, NBIC NB 23 current Edition.

14. REPORTING :

Interpretation and evaluation shall be reported in the Proforma appended in Exhibit-2.

15. POST-EXAMINATION CLEANING :

The examination surface shall be wiped clean using cloth / cotton waste.

16. DEMAGNETIZATION :

No demagnetization is required unless specifically required by customer. When required one of the following methods (ref. SE-709-95 for detail techniques) shall be used**.**

- Withdrawing from AC coil.
- Decreasing alternating current.
- Demagnetizing with yokes.

17. RECORDS :

All the reports of Magnetic particle test shall be preserved till MDR signed**.**

18. ACCEPTANCE STANDARDS:

(Ref: ASME SEC I, ASME SEC VIII Div 1 & Div 2 Edition 2019)

All surfaces to be examined shall be free of

- Relevant Linear indications
- Relevant rounded indications greater than 5 mm.
- Four or more relevant rounded indications in a line separated by 1.5 mm or less edge to edge.

Notes: Any indication believed to be non relevant shall be confirmed by re-examination using same method or other non destructive examination method and/or by surface conditioning.

1. **Relevant indications**: Indications having any dimension greater than 1.5 mm.
2. **Linear indications:** Relevant Indications having length greater than three times the width.
3. **Rounded indications:** Relevant indications having circular or elliptical shape with a length equal to or less than three times its width**.**

(For other Codes such as ASME B31.1, NBIC NB23 refer respective current Edition)

ISSUE NO.: 2

PROCEDURE FOR LIQUID PENETRANT EXAMINATION

Issue No	Rev No	Date of Revision	Brief Records of Revision
1	0	02-02-2015	First Edition
1	1	11-04-2017	Cl no. 3,5,13 revised as per ASME Sec V Edition 2015
2	1	25-04-2018	Cl no. 3,5,6.2,6.4,6.6,7.2.4,7.3,10,15 revised as per ASME Sec V Edition 2017
2	2	15-05-2020	Cl no. 3.1,3.2,6.2,14 revised and Cl no.1,6.1,6.4,8 modified as per ASME Sec V Edition 2019.

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1. SCOPE:

This Procedure shall be used for the detection of open surface discontinuities in welds, plates, and forgings etc., used in Pressure Vessels., Heat Exchangers, Boilers and parts thereof by visible Liquid Penetrant Examination using solvent removable process for ferrous and non-ferrous materials.

2. POLICY:

2.1. The Liquid Penetrant Examination shall be carried out either as per one of the procedures enumerated in the following pages which are verified and found to be in accordance with ASME SEC V or as per any other applicable referencing code sections and specifications.

2.2. Only personnel qualified in accordance with BHEL HPVP NDE Written Practice shall carry out any Liquid Penetrant examination.

3. APPLICABLE STANDARDS:

3.1 ASME SEC V Edition 2019.

3.2 Construction code sections ASME Sec I, ASME Sec VIII Div 1, ASME Sec VIII Div 2 Edition 2019, ASME B31.1 Edition 2018, NBIC NB 23 Edition 2019, SNT-TC-1A Edition 2016 & ASME SEC V Edition 2019 Art.1.

4. SYSTEM:

All Liquid Penetrant Examination procedures shall be amended and approved as required by NDE Level III taking into consideration of

4.1. Experience gained in various examination procedures.

4.2. Recommendation of Audit Teams.

4.3. Referencing Code sections.

5. WRITTEN PROCEDURE REQUIREMENTS: (As per ASME Sec V Article 6 T-621)

Liquid Penetrant examination shall be performed in accordance with a written procedure, which shall as a minimum contain the essential and non-essential variable as mentioned in the table below. The written procedure shall establish a single value, or range of values, for requirement.

Table T-621.1
Requirements of a Liquid Penetrant Examination Procedure

Requirement	Essential Variable	Nonessential Variable
Identification of and any change in type or family group of penetrant materials including developers, emulsifiers, etc.	X	...
Surface preparation (finishing and cleaning, including type of cleaning solvent)	X	...
Method of applying penetrant	X	...
Method of removing excess surface penetrant	X	...
Hydrophilic or lipophilic emulsifier concentration and dwell time in dip tanks and agitation time for hydrophilic emulsifiers	X	...
Hydrophilic emulsifier concentration in spray applications	X	...
Method of applying developer	X	...
Minimum and maximum time periods between steps and drying aids	X	...
Decrease in penetrant dwell time	X	...
Increase in developer dwell time (Interpretation Time)	X	...
Minimum light intensity	X	...
Surface temperature outside 40°F to 125°F (5°C to 52°C) or as previously qualified	X	...
Performance demonstration, when required	X	...
Personnel qualification requirements	...	X
Materials, shapes, or sizes to be examined and the extent of examination	...	X
Post-examination cleaning technique	...	X

Any change of requirement specified as an essential variable mentioned above shall require requalification of the written procedure.

6. METHOD OF EXAMINATION:

6.1. IDENTIFICATION OF PENETRANT EXAMINATION MATERIALS:

6.1.1. PRADEEP/PMC/MAGNAFLUX brands of PT chemicals be used. Other brands may also be used with the approval of NDE Level-III.

6.1.2. Refer certification of contaminant content for all liquid penetrant materials used.

6.1.3. Ensure manufacturers batch numbers, on the penetrant material containers and Certificate mentioned above are same.

6.2. **MINIMUM LIGHT INTENSITY:**

All following activity shall be done under the illumination of 100 watt 230V incandescent bulb at a maximum distance of 25 cms from test part for ensuring 1076 Lux light intensity at test part surface.

6.3. **SURFACE PREPARATION (FINISHING AND CLEANING, INCLUDING TYPE OF CLEANING SOLVENT) (As per ASME Sec V Edition 2019Article 6 T-642)**

This procedure applies to below mentioned surface preparations.

6.3.1. As welded
6.3.2. As ground
6.3.3. As machined /As Forged/As Plates

6.3.4. SURFACE CLEANING:

6.3.4.1. Ensure Surface examined and all adjacent areas within 1" shall be free of scale, welding flux, weld spatter.
6.3.4.2. Use Organic solvent - Cleaner mentioned above to remove oil, and other extraneous matter.
6.3.4.3. Wait for a minimum of 3 minutes for evaporation of cleaning solvent used above.

6.4. **SURFACE TEMPERATURE (As per ASME Sec V Edition 2019 Article 6 T-652)**

Ensure that the temperature of the penetrant and the surface of the part to be subjected to penetrant testing is between 5 to 52 deg centigrade. For examination between 5- 10 deg Centigrade, the minimum Penetrant dwell time shall be two times than that established for testing between 10 to 52 deg Centigrade.

6.5. **METHOD OF APPLYING PENETRANT**

Use brush or spray for application of penetrant to the surface of the part.

6.6. **PENETRATION (DWELL) TIME**

6.6.1. Allow penetrant on the weld surface for minimum 5 minutes and maximum 10 for welds & Casts.

6.6.2. Allow penetrant on the surface for minimum 10 minutes and maximum 15 minutes and for plates & forgings.

Note: Ensure that penetrant is not dried during dwell time.

6.7. **METHOD OF REMOVING EXCESS SURFACE PENETRANT**

6.7.1. After completion of penetration (dwell) time remove any penetrant remaining on the surface using clean, dry, and lint free cloth.

6.7.2. Remove the remaining traces of penetrant on the weld surface by wiping the surface with clean, lint- free material lightly moistened with the solvent remover. Complete this step within 10 minutes after start of excess penetrant removal.

6.7.3. Do not flush the weld surface with cleaning solvent for removal of excess penetrant.

6.8. **DRYING AFTER EXCESS PENETRANT REMOVAL (AS PER ASME SEC V ARTICLE 6 T-674)**

Wait for a maximum of 2 minutes for evaporation of cleaning solvent used above for Excess Penetrant Removal.

6.9. **METHOD OF APPLYING DEVELOPER**

Apply Developer using aerosol can spray after above step. (i.e. Drying After Excess Penetrant Removal). Maximum time for Developer application is 5 min.

6.10. **DEVELOPER DWELL TIME (INTERPRETATION TIME)**

6.10.1. Developing time for final interpretation begins immediately after developer coating is dry.

6.10.2. Wait for a minimum of 2 minutes after developer spray for developer coating to dry.

6.10.3. Observe closely during application of developer to aid in characterization of indications developed.

6.10.4. Final interpretation shall be made within 10 to 20 min after developer coating is dry.

6.11. **MINIMUM AND MAXIMUM TIME PERIODS BETWEEN STEPS AND DRYING AIDS**

6.11.1. Minimum time between surface cleaning and application of penetrant 3 minutes. Maximum No limit.

6.11.2. Minimum/Maximum time between application of penetrant and start of excess Penetrant removal 5/10 minutes for welds and 10/15 minutes for plates and forgings.

6.11.3. Maximum time between excess penetrant removal and application of Developer 10 minutes.

6.11.4. Final interpretation time minimum 10 and maximum 20 minutes after developer coating is dry.

7. PERSONNEL QUALIFICATION REQUIREMENTS

Personnel qualified and certified to NDE Level III in PT shall demonstrate this procedure to the satisfaction of AI. Application of this procedure on jobs shall be by personnel qualified and certified to NDE Level II / NDE Level III in PT as per the Written Practice.

8. MATERIALS, SHAPES, OR SIZES TO BE EXAMINED AND THE EXTENT OF EXAMINATION

This procedure is applicable to welds, plates, forgings of all shapes and sizes for ferrous and non ferrous materials. The extent of examination shall be as per referred specification or test plan.

9. POST EXAMINATION CLEANING TECHNIQUE:

Using cloth or cotton waste Post-examination cleaning shall be done as soon as practical after Evaluation and Documentation.

10. GENERAL REQUIREMENTS:

10.1. If the surface to be examined is large enough to complete examination within the above established times the examination shall be performed in increments.

10.2. Ensure bleed-out from large indications does not alter the examination results during interpretation time.

10.3. Any change of requirement specified as an essential variable in para 5 shall require requalification of this written procedure.

11. EVALUATION:

All indications shall be evaluated in terms of the acceptance standards Referred below.

12. DOCUMENTATION (AS PER ASME SEC V EDITION 2019ARTICLE 6 T-690):

Recording of Indications shall be done in Liquid Penetrant Examination Requisition cum report format referred in Exhibit 2.

12.1. Non rejectable Indications: Non rejectable indications shall be recorded as specified by the referencing Code Section.

12.2. Rejectable Indications: Rejectable indications shall be recorded.
As a minimum, the type of indications (linear or rounded), location and extent (length or diameter or aligned) shall be recorded.

13. RECORDS:

All the reports of Liquid Penetrant Examination shall be preserved till MDR signed.

14. ACCEPTANCE STANDARDS FOR LIQUID PENETRANT EXAMINATION:

REF: ASME SEC I, ASME SEC VIII Div 1 & Div 2 Edition 2019.

All surfaces to be examined shall be free of

1. Relevant linear indications.
2. Relevant rounded indications greater than 3/16 inch (5mm).

3. Four or more relevant rounded indications in a line separated 1/16 inch (1.5mm) or less (edge to edge).

Notes:

- Only indications with major dimensions greater than 1/16 inch (1.5 mm) shall be considered relevant.
- A linear indication is one having a length greater than three times the width.
- A rounded indication is one of circular or elliptical shape with the lengthy equal to or less than three times the width.
- Any questionable or doubtful indications shall be reexamined to determine whether or not they are relevant.

(For other Codes such as ASME B31.1, NBIC NB23 refer respective current Edition)