SPECIFICATION FOR SEAL GAS BOOSTER

IOCL-GUJARAT REFINERY SYN GAS PROJECT

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1.0 **SCOPE**

This specification defines the scope of supply for a seal gas booster (s) that shall be used to ensure seal gas flow to centrifugal compressor dry seals during compressor start-up or when compressor is in pressurized shutdown.

The seal gas booster (s) is realized as pneumatic driven, reciprocating (single or double acting) compressor. The booster (s) shall be suitable for horizontal or vertical mounting.

2.0 **TECHNICAL DATA: Refer clause 22.**

3.0 **TECHNICAL REQUIREMENTS**

3.1 The booster shall be suitable for operation of minimum 2000 hrs without any maintenance required.

3.2 The seal gas booster(s) shall be suitable for instant start-up without any lead time.

3.3 The booster material shall be SS316L as a minimum.

3.4 The booster shall be supplied in completely assembled condition. BHEL shall connect the gas inlet & outlet lines, instrument connection. Vendor to inform accessories required (like air filter & regulator, SOV) etc. to be supplied by purchaser.

3.5 All the sizing, material selection, design etc. shall be in line with ASME standard for pressure equipment.

4.0 **SPARES REQUIREMENT**

4.1 Commissioning spares required for commissioning the offered equipment as per vendor recommendation for all pneumatic equipment shall be included in Vendor's scope of supply along with the main equipment. Vendor to submit a list of such spares required along with the offer.

4.2 Mandatory spares shall be as follows to be included in vendor's scope of supply. The word "TYPE" means the make, model no, range, size/length, rating, material as applicable.

4.2.1 Pneumatic actuated booster:

- Pneumatic circuit spares (as applicable): all wear & tear parts and seals including:
- Pneumatic cylinder-01 no
- Air filter reducer-01 no
- Snubber-01 no
- Pneumatic distributor-01 no

4.2.2 Process side Booster spares: 01 set of all wear & tear parts and seals including:

- -gaskets
- -seals
- -o-rings
- -check valve

4.2.3 Special tools kits & tackles: as per vendor recommendation.

5.0 **H_2 SERVICE REQUIREMENTS**

The wetted parts of booster shall be compliant to attached IOCL H2 service requirements (Doc no: 44AC9100-4000-D.02-0001-A4).

6.0 **DESIGN STANDARDS (AS APPLICABLE)**

6.1 European directive no 94/9/EC (ATEX)

6.2 European directive no 97/23/EC (PED)

6.3 ASME VIII Div. 1

6.4 ANSI B16.34

6.5 NACE MR0103 / MR0175

6.6 Gas Hazardous area classification: IEC Zone-1, Gas group II C, T3.

7.0 **PIPING REQUIREMENTS**

7.1 Piping Interface connections

Description	Type
Process gas inlet	1" NPTF or higher
Process gas outlet	1" NPTF or higher
Vent / drain	½" NPTF or higher
Instrument air inlet	½" NPTF or higher

7.2 All the materials in contact with gas inlet / outlet and vent shall be of SS316L or equivalent forging /casting materials.

7.3 All the materials in instrument airline shall be SS316L piping / tubing.

7.4 All Butt-welded joints shall be TIG welded and the welds shall be 100% radio graphed.

7.5 All the vent/ drain holes, if any shall be plugged with threaded plugs/caps.

8.0 **DOCUMENTATION REQUIREMENTS**

8.1 Along with technical offer, arranged in this sequence only:

8.1.1 Booster technical details.
8.1.2 Booster Performance / operation graphs / curves.
8.1.3 Booster Data sheets.
8.1.4 Instrument air consumption.
8.1.5 Recommended spares list along with special tools (if any).
8.1.6 Signed & stamped copy of this specification.
8.1.7 Filled in Check List.
8.1.8 Filled in PTR.
8.1.9 Filled in Deviation Format.
8.1.10 Filled in Price Schedule marked 'QUOTED' for each item.
8.1.11 Filled in Logistic Certificate.

8.2 Within 2 weeks of Placement of Order / LOI: Vendor shall submit following for approval for the documents as mentioned below within 2 weeks of Placement of PO /LOI:

8.2.1 General Arrangement drawing of seal gas booster giving overall dimensions. It shall show location / disposition of various equipment / Instruments on the booster and location of customer termination connection.
8.2.2 Bill of Material of all the equipment, instruments, components etc. The Bill of Material should clearly show the make and model of each component, which are subjected to BHEL / CUSTOMER approval.
8.2.3 Booster Data sheets.
8.2.4 Instrument datasheets.
8.2.5 Booster Performance / operation graphs / curves.
8.2.6 Quality assurance plan.
8.2.7 Spares list.

8.3 Final Documentation: Vendor shall furnish the following:

8.3.1 Documents mentioned 8.2.1 above.
8.3.2 Instruction, Service and Maintenance manual
8.3.3 Test and Inspection reports : 3 copies.
8.3.4 Guarantee Certificates : 3 copies.
8.3.5 Photographs for all views : 2 sets (In DVD, the digital photos shall be provided).

9.0 **EQUIPMENT QUALIFICATION CRITERIA (EQC)**

Seal Gas Booster shall be identical in frame size and identical or validly similar in terms of **application (seal gas supply to compressor seals),** Type of drive, inlet and discharge pressures, inlet temperatures, flow, number and materials etc. as compared to **at least two units designed, manufactured, tested and supplied from the proposed manufacturing plant in last fifteen years**

at least one of these units shall have been operating satisfactorily in the field for at least 8000 hours without any major problems as on the date of issue of enquiry.
Vendor shall furnish complete reference list / details (Proven track record) along with the offer. These details shall include Plant name, year of commissioning, number of operating hours completed and name of contact person(s) etc. for the seal gas booster similar to one being offered.

10.0 PROVEN TRACK RECORD

Vendor shall submit filled in PTR as per EQC listed in above clause.

11.0 INSPECTION AND TESTING REQUIREMENTS

All the equipment shall be subject to inspection and witness tests by Third Party Inspection agency. The schedule of quality checks shall be furnished by the vendor in the quality plan which is subject to the approval of BHEL. The minimum shall be as indicated in below table.

Quality Plan

Sl. No.	Description	Type of check Quantum of check 100%	Ref. Documents	Type of Inspection	Agency
1	Assembly of Booster	- Location of equipment - Correctness of flow Schematics - Overall dimensions	- Approved GA drawing	Physical check	Lloyd's / DNV / BV / TUV etc.
2	Welding (if applicable)	Type	Manufacturing drawings.	-Review of Radiograph certificate -Welding efficiency of 1	
3	Booster	- Material Certification	-BHEL/ CUSTOMER Specification - Approved drgs / docs.	Verification of test report / certificate	
4	Gas leak test	- Leakage with **HELIUM**	--Do--	Witness	
5	Name Plates	- Correctness	--Do--	Physical check	
6	Performance test	-performance	Booster shall be tested to verify pressure & flow parameters	Witness	

12.0 MARKING AND SHIPPING

12.1 Name plates: The Individual components shall be provided with Nameplates giving important details like make, model etc. Each component shall be provided with stainless steel Tag plates duly punching Tag Nos. as applicable on it.

12.2 Preparation for Shipment:

12.2.1 Equipment shall be suitably prepared for shipment. The preparation shall make the equipment suitable for 6 months of outdoor storage from the date of shipment.

12.2.2 Seal gas booster assembly shall be marked with details like, drawing no, job number, PO No. etc. at a convenient location.

12.2.3 Lifting Points and lifting lugs shall be clearly identified.

12.2.4 All Loose supplied items like flanges, nut-bolt, gaskets etc. if any, shall be listed out separately in the packing list.

12.2.5 Adequate amount of silica gel or equivalent shall be provided in the box before dispatch for the removal of moisture till installation.

12.2.6 All safety instructions for storage and handling shall be indicated on external surface of the box.

13.0 **DEVIATIONS**

Bidder shall submit duly filled deviation format along with technical offer, otherwise, it will be presumed that there are no deviations from this specification. Offer without this deviation list will not be evaluated & shall be considered for rejection. If, there are no deviations, bidder shall submit signed copy of deviation format, mentioning "No Deviations".

14.0 **GUARANTEE**

Refer ITB documents.

15.0 **TENDER EVALUATION CRITERIA**

15.1 The total price for the complete package i.e. Main System, Mandatory spares, Supervision of erection & commissioning charges shall be considered for L1 evaluation.

15.2 Duly signed & stamped un-priced price schedule and unit prices shall be submitted along with technical offer by bidder as a token of concurrence that all items are quoted without which the offer will not be evaluated. For unpriced bid bidder to fill 'Quoted' for each item and submit (refer PRICE SCHEDULE format).

16.0 **TENDER REJECTION**

Non-compliance to inclusion of any the following documents with technical offer shall lead to rejection of the bids.

16.1 Filled in Check List not included.

16.2 Filled in PTR not included.

16.3 Filled in Deviation Format not included.

16.4 Filled in Price Schedule marked 'QUOTED' for each item not included.

16.5 Filled in Logistic Certificate not included.

17.0 **SPECIAL NOTES**

17.1 Vendor shall confirm that the bill of material furnished along with offer is only indicative and the final BOM, which shall be furnished during detailed Engineering (after order placement) for the approval of BHEL. The additional items, if any required at later stage for complying BHEL specification or for the satisfactory working of the seal gas booster shall be supplied by vendor without any price/delivery implications

17.2 Vendor should bring out in his offer clause wise deviations if any, with respect to proposed supply along with price adder for withdrawing the deviation to comply with specification. Failure to highlight the same will be construed as acceptance on the part of the vendor to meet the requirement of this specification totally.

17.3 Vendor shall provide the relevant technical information and supporting documents whenever asked for by the customer/ consultant.

17.4 Vendor to clearly bring out any additional requirements, which are essential for proper functioning of the Seal Gas Booster. This shall be included in the offer.

18.0 **Check List**

(To be filled by the vendor and submitted along with the offer without which offer will not be considered)

Sl. No	Description	Vendor Confirmation (Yes/No)
1	Booster technical details, catalog included.	
2	Booster Performance / operation graphs / curves included.	
3	Booster Data sheets included.	
4	Instrument air consumption included.	
5	Commissioning spares list included. (As per vendor recommendation)	
6	Mandatory spares list included.	
7	Special tools (if any) included.	
8	Signed & stamped copy of this specification included.	
9	Filled in Check List included.	
10	Filled in PTR included.	
11	Filled in Deviation Format included.	
12	Filled in Price Schedule marked 'QUOTED' for each item included.	
13	Filled in Logistic Certificate included.	

VENDOR SIGNATURE WITH SEAL

19.0 **PTR Format**

19.1 Name of the Bidder

19.2 Whether manufacturer & supplier:

19.3 Whether System Integrator & Supplier:

19.4 Name of Packager:

Sl.No	PTR Requirement	Ref-1	Ref-2	Ref-3	Ref-4
1	Description of item as manufactured & Supplied/ engineered (identify bidder's scope of work)				
2	Plant / Purchaser's name, address, Tel no, Fax no, email and contact person				
3	Application (seal gas supply to compressor seals)				
4	Type of drive,				
5	Inlet and discharge pressures, flow				
6	Material				
7	Make & model no of the booster supplied.				
8	Date of order placed				
9	Contractual completion date				
10	Actual completion date/ month & year of commissioning				
11	Number of operating hours completed				
12	Reasons of delay if any				
13	Details of major break down till date.				

VENDOR SIGNATURE WITH SEAL

Vendor to furnish the complete exhaustive reference list separately for our review.

20.0 **Deviation Format**

Sl.No	Clause No. of Specification	Deviation	Reason for deviation	Deviation category	
				Product/design limitation	Optimization

VENDOR SIGNATURE WITH SEAL

21.0 **Logistic support certificate:**

CERTIFICATE FOR LOGISTIC SUPPORT

(TO BE SIGNED BY **VENDOR'S PRINCIPAL** (Original equipment manufacturer)
CORPORATE LEVEL SIGNATORY ON COMPANY LETTERHEAD)

I, ON BEHALF OF M/s, ---------- CONFIRM THAT THE SEAL GAS BOOSTER QUOTED BY M/s ----------FOR <PROJECT NAME OF BHEL / BHEL CUSTOMER> (INDIA) SHALL CONTINUED TO BE SUPPORTED BY US AND QUOTED SYSTEM SHALL NOT BE WITHDRAWN FROM "INDIAN" MARKET AS A MATTER OF CORPORATE POLICY.

I, FURTHER CONFIRM THAT IN CASE OF PLACEMENT OF ORDER ON US, <BHEL / BHEL CUSTOMER> (INDIA) SHALL BE SUPPORTED IN PROVIDING BACK-UP ENGINEERING, MAINTENANCE SUPPORT AND SPARE PART SUPPORT FOR A PERIOD OF NOT LESS THAN TEN (10) YEARS FROM THE DATE OF PLACEMENT OF ORDER.

(SIGNATURE WITH SEAL)

CERTIFICATE FOR LOGISTIC SUPPORT

(TO BE SIGNED BY **VENDOR'S CORPORATE** (Bidder for the enquiry) LEVEL SIGNATORY ON COMPANY LETTERHEAD)

I, ON BEHALF OF M/s ----------CONFIRM THAT THE SEAL GAS BOOSTER QUOTED BY US FOR <PROJECT NAME OF BHEL / BHEL CUSTOMER> (INDIA), SHALL CONTINUE TO BE SUPPORTED BY US AND OUR PRINCIPAL M/S ----------

I, FURTHER CONFIRM THAT IN CASE OF PLACEMENT OF ORDER ON US WE SHALL CONTINUE TO SUPPORT M/S <BHEL / BHEL CUSTOMER> (INDIA) IN PROVIDING BACK-UP ENGINEERING, MAINTENANCE SUPPORT AND SPARE PART SUPPORT FOR A PERIOD OF NOT LESS THAN TEN (10) YEARS FROM THE DATE OF PLACEMENT OF ORDER.

(SIGNATURE WITH SEAL)

CERTIFICATE FOR LOGISTIC SUPPORT

(TO BE SIGNED BY "Bidders **VENDOR" CORPORATE** LEVEL SIGNATORY ON COMPANY LETTERHEAD)

Applicable for all major sub-systems bought-out by the bidder

I, ON BEHALF OF M/s, ---------- CONFIRM THAT THE ---------- QUOTED BY THROUGH M/S---------- FOR <PROJECT NAME OF BHEL / BHEL CUSTOMER> (INDIA), SHALLCONTINUE TO BE SUPPORTED BY US AND OUR PRINCIPAL M/S ----------

I, FURTHER CONFIRM THAT IN CASE OF PLACEMENT OF ORDER ON US, WE SHALL CONTINUE TO SUPPORT M/S <BHEL / BHEL CUSTOMER> (INDIA) IN PROVIDING BACK-UP ENGINEERING, MAINTENANCE SUPPORT AND SPARE PART SUPPORT FOR A PERIOD OF NOT LESS THAN TEN (10) YEARS FROM THE DATE OF PLACEMENT OF ORDER.

(SIGNATURE WITH SEAL)

22.0 PROJECT SPECIFIC BOOSTER TECHNICAL DATA & PRICE SCHEDULE:

22.1 PROJECT SPECIFIC TECHNICAL DATA FOR SEAL GAS BOOSTER-MCA1064:

22.1.1 **Utility**: Instrument Air (for pneumatic drive)

SL NO	PARAMETER	MIN	NOR	MAX	MECH. DESIGN
a	Pressure (kg/cm^{2}g)	3.5	5.2	7.0	10.5
b	Temperature (°C)	35	40	40	65

22.1.2 **Design conditions-Process (MCA1064)**

SL NO	PARAMETER	VALUE
a	Design Pressure	31.3 kg/cm2g
b	Maximum Working Temperature	150 °C
c	Gas leak test Pressure (HELIUM)	46.95 kg/cm2g

22.1.3 **Operating conditions (MCA1064):**

SL NO	**PARAMETER**	**VALUE**		
a	**Operating case**	**Case-1**	**Case-2**	**Case-3**
b	Inlet Pressure (Kg/Cm2(g))	12	18	5
c	Inlet Temperature (deg C)	91	91	40
d	Gas Mol Wt. (Refer Gas Composition)	8.63 (HC)	8.63 (HC)	28.016 (nitrogen)
e	Flow (ACM^3/Hr)-required	8	8	8
f	Pressure increase (ΔP required, Kg/Cm2)	2	2	2
g	QTY of Booster (vendor to indicate)			
h	Maximum Flow (ACM^3/Hr) possibe with selected single booster			
i	Maximum Flow (Kg/Hr) possibe with selected single booster			

*** For all operating cases, vendor to inform the maximum gas flow possible from selected booster.**

22.2 **PRICE SCHEDULE: : SEAL GAS BOOSTER**

22.2.1 **Offer ref no.:**

22.2.2 **Offer date:**

22.2.3 **Enquiry ref. no:**

22.2.4 **Enquiry date:**

Sl.No.	DESCRIPTION	RFQ Qty	Booster Qty per set	Unit Price	Total Price
1	SEAL GAS BOOSTER-MCA1062 (TC9765442092) along with commissioning spares / special tools (as per vendor recommendation clause 4.1 & 4.2.3)				
2	Seal Gas Booster spares-MCA1062 (TC9765442106) as listed in clause 4.2.1 & 4.2.2		--		
3	Additional price to withdraw the deviations if any taken by vendor for respective clause of BHEL specification.	Clause wise			
4	Total Price for L1 Evaluation • 1+2				

Notes:

i. Any additional requirements, which are essential for proper functioning of the seal gas booster but not indicated in specification, are included in the offer.

ii. Vendor shall submit UNIT PRICE for all spare items for the booster.

VENDOR SIGNATURE WITH SEAL

ANNEXURE A : SPECIAL REQUIREMENTS FOR HYDROGEN SERVICE

These requirements are applicable in addition to the requirements specified in the Piping Material Specification.

1.0 **GENERAL**

Vendor's quality plan shall include the special quality checks and inspection requirements for these services.

For operating temperatures below 230℃, materials shall be of carbon steel to the appropriate specifications

For operating temperatures of 230℃ and above, materials shall be selected on the basis of Nelson Curves of API Publication No. 941 (Steels for hydrogen service at elevated temperatures and pressures in petroleum refineries and petrochemical plants).

Impact test & normalizing of CS/AS materials shall be as mentioned in the code.

All flanged facing of flanges and valves shall have concentric serrations.

1.1 PIPE, FLANGES AND FITTINGS

1.1.1 Method of manufacture

A. FOR CS LINES WITH HYDROGEN SERVICE UPTO 204℃

All CS pipes, fittings and flanges having wall thickness 9.53mm and above, shall be normalized. Cold drawn pipes and fittings shall be normalized after the final cold draw pass for all thickness. The normalizing heat treatment shall be a separate heating operation and not a part of hot forming operation.

B FOR CS LINES WITH HYDROGEN SERVICE ABOVE 204℃

All CS pipes, fittings and flanges shall be normalized and tempered. Cold drawn pipes and fittings shall be normalized after the final cold draw pass for all thickness. The normalizing heat treatment shall be a separate heating operation and not a part of hot forming operation.

All Alloy Steel (Cr.-Mo) pipes, forgings and fittings shall be normalized and tempered. The normalizing and tempering shall be a separate heating operation and not a part of hot forming operation. The maximum room temperature tensile strength shall be 100,000 psi.
In addition, details given by process licensor's requirements shall be met.

1.1.2 Post Weld Heat Treatment

A FOR CS LINES WITH HYDROGEN SERVICE UPTO 204℃

All carbon steel pipes and fittings having wall thickness 19 mm and above shall be post weld heat-treated.

B FOR CS LINES WITH HYDROGEN SERVICE ABOVE 204℃

All carbon steel shall be post weld heat-treated.

All alloy steel (Cr-Mo) pipes and fittings shall be post weld heat treated irrespective of type or thickness of weld.
All austenitic stainless steel grades shall be solution annealed after welding. 100% radiography of welded joints shall be done both before and after PWHT

1.1.3 Ferrite No. Test

For all austenitic stainless steel, the weld deposit shall be checked for ferrite content. A ferrite No. (FN) not less than 3% and not more than 10% is required to avoid sigma phase embrittlement during heat treatment. FN shall be determined by Ferrite scope prior to post-to-post weld heat treatment.

1.1.4 Impact Test

For all carbon steel and alloy steel pipes, flanges and fittings with the wall thickness over 20 mm, Charpy-V Notch impact testing shall be carried out in accordance with paragraph UG-84 of ASME Section VIII, Div-1 for weld metal and base metal from the thickest item per heat of material and per heat treating batch. Impact test

specimen shall be in complete heat-treated condition and in accordance with ASTM A370.impact energies at 0°c shall be average greater than 27 J (20 ft-lb) per set of 3 specimens, with a minimum of 19J (15 ft-lb).
If welding is used in manufacture, impact test of Heat Affected Zone (HAZ) and welds metal shall also be carried out.
In addition, details given by process licensor's requirements shall be met.

1.1.5 Hardness

For carbon steel pipes and fittings, hardness of weld and HAZ shall be limited to 200BHN(Max). For alloy pipes and fittings, hardness of weld and HAZ shall be limited to 225BHN(Max).

1.1.6 Radiography

All girth welded joints (longitudinal and circumferential) shall be 100% radiographed in accordance with UW-51 of ASME section VIII Div-1 and ASME Section V.

1.1.7 Valves

All valves castings shall be radiographic quality.

All cast valves flanges & bodies with flange rating of class 900 or greater shall be examined in accordance with paragraphs 7.2 through 7.5 of Appendix-7 of ASME SEC-VIII DIV-1, regardless of casting quality factor.
Only Normalized and Tempered material shall be used in the following specifications:

Castings A216 Gr. WCB, A217 Gr.WC1, A217 Gr.WC4, A217 Gr.WC5, A217 Gr.WC6, A217 Gr.WC9, A217 Gr.C5, A217 Gr.C12

Forgings A105, A182 Gr. F11 Cl.2

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

Test Duration in Minutes					
NOMINAL SIZE	**PRESSURE CLASS**				
	UPTO 300	600	800 & 900	1500	2500
Upto 2.00"	3	6	9	12	12
3.00" to 6.00"	6	9	12	15	18
8.00" to 16.0"	9	9	12	15	18
18.0" to 24.0"	9	12	15	18	21

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

CS & AS Valves :

Bend test and Magnetic Particle inspection of the entire surface of body and bonnet casting shall be in accordance with ASTM A217. Supplementary requirement S3 & S4 evaluation of magnetic particle, inspection shall be in accordance with MSS-SP-53 except that no linear discontinuities shall be allowed.
The Brinell hardness of heat treated casting shall not exceed 200 BHN for carbon steel & 225 for alloy steel.

Repair of defective casting shall be outlined in writing to the purchaser before repair starts. Repair method to be approved prior to welding.
Casting shall be preheated to a minimum of 400ºF prior to welding and all CS and Chromium-Molybdenum alloys shall be post weld heat treated after welding is complete. Stress relieving is essential for welds.

Carbon steel shall be normalised and alloy steels shall be normalised & tempered. Dye Penetrant test of welds shall be in accordance with ASTM B165 Procedure B-2. Interpretation as per Appendix-8 of ASME-VIII Div.1.
The tensile stress for AS shall be less than 100,000 psi.

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

SS Valves :

Casting and test bar shall be heat treated together. Valve casting shall be in solution heat treated and pickled condition.
Critical body and bonnet casing section typically defined by ASME B16.34 shall be radiographed and shall meet ASTM E446 (up to 2" thick) Category A,B & CA Level 2, Category CB, OC & CD Level 3, Category D,B & F Level 0. For wall thickness 2" to 4.5" comparable plates of ASTM E186 shall be used. ASTM E94 and ASTM E142 shall be used for recommended practice & controlling quality of radiography as guide. The entire surface of all castings shall be dye-penetrant inspected after pickling.
Welds repair shall be 100% radiographed and evaluated in accordance with paragraph 344.5 of ASME B31.3 with a minimum casting quality factor of 0.95. Dye Penetration test shall be as per ASTM E165 Procedure B-2, Interpretation as per Appendix-8 of ASME-VIII Div.1.

ANNEXURE B: SPECIAL REQUIREMENTS FOR OXYGEN SERVICE

These requirements are applicable in addition to the requirements specified in the design basis.

1.0 MATERIAL

i). Pipes shall be seamless, or mill welded.

ii). All valves shall have Monel trims.

iii). All pipes, fittings, flanges, gaskets and valves (and their components including packing, bonnet gasket, bolting etc.) shall be cleaned, degreased & packed for "OXYGEN SERVICE".

iv). Valves stem packing shall consist of Braided OR Glass Filled Teflon.

v). All Gaskets including valve bonnet gasket shall be SS Spirally wound with Teflon.

vi). All Gaskets Spiral Wound SS 304 with Teflon shall be identified with metal tab.

2.0 DESIGN

i). Piping shall be arranged to avoid abrupt change in direction and to minimize impingement or turbulence.

ii). Reducing flanges shall not be used. where reduced size branches are required the branch line shall be equal to header size, and the reducer shall be located away from intersection.

iii). Half Couplings shall be used for pressure connections, vents, drains, sample points & thermowells.

iv). Oxygen lines shall be run away from other hydrocarbon lines in the plant and supported on shoe support for all sizes.

v). All joints shall only be BW joints. No SW or threaded joints is permitted.

3.0 CLEANING

i). Fabricated components shall be internally cleaned and degreased to completely remove grease, oil, scale, dirt and other foreign matter and thoroughly flushed and dried. Cleaning components and methods used shall be such as to result in a system suitable for safe handling of oxygen.

ii). All oxygen lines shall be grounded.

ANNEXURE C : PROCEDURE FOR PICKLING

These requirements are applicable in addition to the requirements specified in the Piping Material Specification. Vendor should follow the pickling procedure at their shop as per ASTM A380 (Latest) as a guideline. Brief sequence of operation as given below for SS pipes, fittings, flanges (segments) & valves for SS Gr.321 & SS Gr.316L.

1.0 The objective of chemical cleaning is to remove all extraneous matter, dirt, dust, grease, oil welding slag. Loose rust, oxide scales that may be present on the SS piping to avoid the contamination by way of iron pick up.

2.0 SEQUENCE OF OPERATION

Cleaning of segments shall be carried out in the following sequence.

a. Flushing with the demineralised water to remove dirt, dust, loose rust and foreign matter.

b. Degreasing

c. Acid cleaning

d. Final rinsing and drying

3.0 CHEMICALS

3.1 Caustic potash rayon grade or technical confirming to IS-6831 (latest edition).

3.2 Nitric acid technical grade conforming to IS:264 (latest edition).

3.3 Hydrofluoric acid conforming to ASTM or equivalent. In any case, purity should not be less than 50% HF by wt.

3.4 DM water/chloride free water (chloride level 50 ppm) should be used for flushing and rinsing operation.

4.0 PICKLING OPERATION

4.1 All the fittings, flanges and piping requiring pickling should be flushed with DM water/ chloride free water (chloride up to 50PPM) to remove all extraneous matter, dirt and dust etc.

4.2 After flushing, degreasing shall be carried out in a pickling bath to remove grease, oil and organic coating if any. Degreasing solution shall be potassium hydroxide of concentration 50 gm/litre (100% purity basis). Temperature of solution during pickling shall be 50-55 deg.C. for duration of about 1 hr.

4.3 After degreasing, above segments should be rinsed with above quality of water. Rinsing should be continued till the neutral PH is obtained.

4.4 After step 3, above segments shall be pickled with acid mixture of Nitric acid (HNO_3) and Hydrofluoric acid (HF). Composition of pickling solution should be 10% concentrated HNO_3 by volume (On 100% purity basis) and 0.5% concentrated. HF by volume (on 100% purity basis). Pickling solution can be prepared at room temperature and for a duration of 15-30 minutes. However exact concentration of acid mixture and duration shall depend on cleaning of the above segments based on visual inspection.

4.5 After pickling, above segments should be rinsed with chloride free water.

4.6 Finally dry all the segments by clean dry air.

5.0 PRESERVATION

After the pickling and drying, these segments should be preserved in clean and dry condition to prevent entry of moisture, dust or dirt.

6.0 TEST COUPONS

7.5 cm x. 5.0 cm x 2 mm cleaned and dried test coupons (duplicate) of AISI-321 and 316L shall be exposed to the acid mixture cleaning solution in the tank for the duration of the cleaning operation and weight loss determined. The corrosion rate shall be less than 10 mpy. If excessive corrosion is experienced concentration of HF shall be reduced to get acceptable corrosion rate.

NOTE:

1. Pickling solution can be prepared in suitable bath & cleaning of above segments can be done by dipping or immersion method. Separate bath should be used for each operation.

2. After acid pickling above segments should be visually inspected and the surfaces should be clean, not over etched dry, free from rust and passivated. The visual observation shall be recorded. If the surfaces are not satisfactorily cleaned, then pickling solution concentration and duration shall be accordingly adjusted to obtain clean surface.