



PRODUCT STANDARD
TURBINES AND COMPRESSORS
HYDERABAD

TC-6-2691

REV No.: **00**

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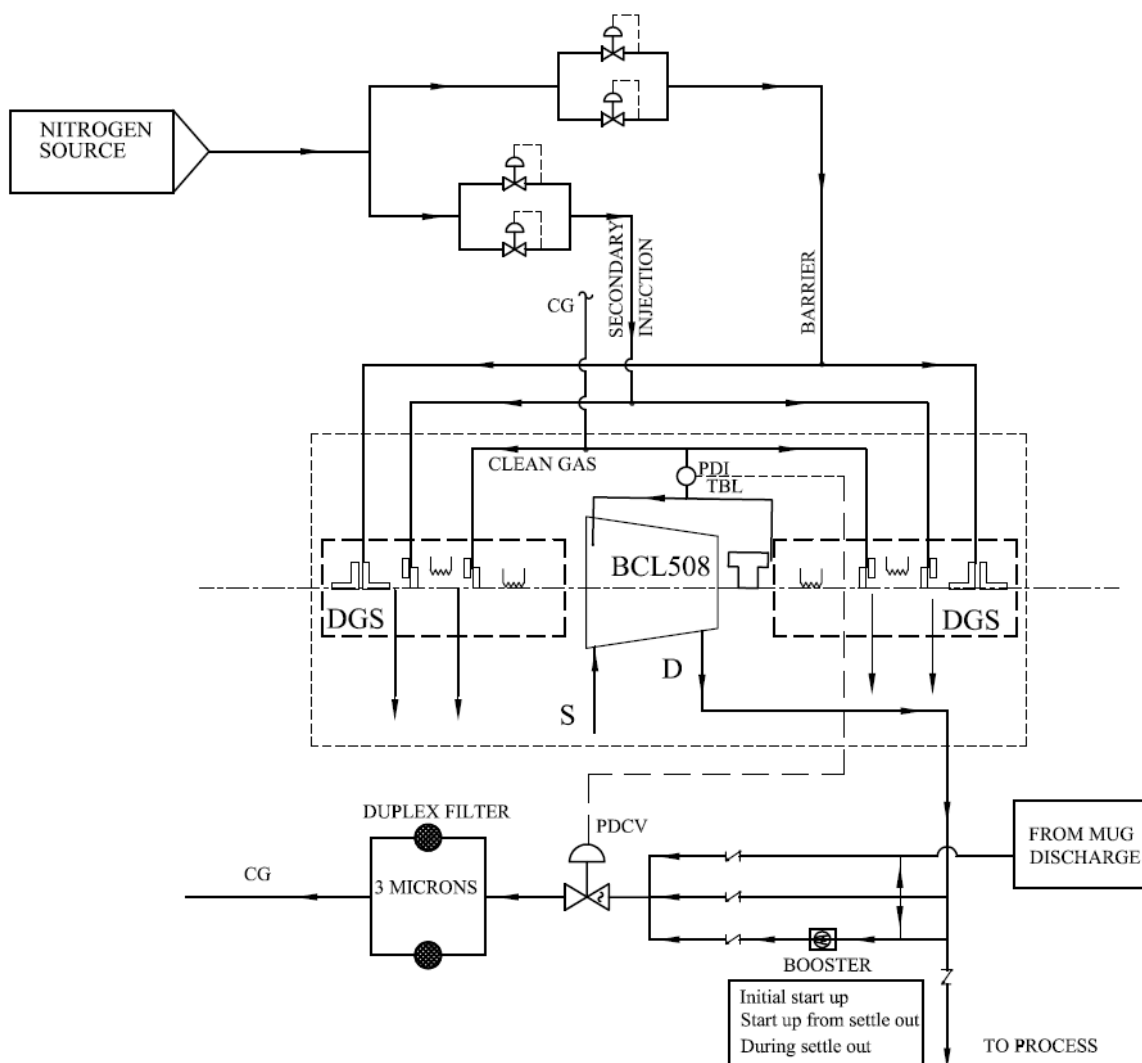
JOB SPECIFICATION OF DRY GAS SEAL

PROJECT: M/s HRRL VGO (ST+ BCL 508)

1. GENERAL SPECIFICATION:

For general details of dry gas seals, please refer General Specification No.TC52357
For Seal Shaft and Housing Dimensions, please refer Specification No.TC52508

2. SCHEMATIC OF GAS SEAL SYSTEM



For a detailed scheme, refer to Seal gas P&ID as provided in Dry Gas Seal skid specification.

Scope of supply of supporting seal gas system (along with filter skid) is covered under a separate specification vide TC55450

Rev. No.	Revisions	Prepared	Approved	Date
00	Refer to record of revisions	R NAGARAJU	YVRL	18.07.2020

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3. SEAL PROCUREMENT DETAILS 3.1 DRY GAS SEAL CONFIGURATION SINGLE [] DOUBLE [] TANDEM [X] TRIPLE [] 3.2 DRY GAS SEAL TYPE: UNIDIRECTIONAL [] BIDIRECTIONAL [X] 3.3 INTERMEDIATE LABYRINTH: Yes / No 3.4 BARRIER SEAL: CARBON RING TERTIARY [X] LABYRINTH SEAL [] 3.5 SEAL CODE DESCRIPTION: <table border="1"> <thead> <tr> <th>Var</th> <th>Description</th> <th>BHEL Matl code</th> </tr> </thead> <tbody> <tr> <td>01</td> <td>Tandem type Bi directional Dry Gas Seal (Φ132) with Barrier seal</td> <td>TC9762691016</td> </tr> <tr> <td>02</td> <td>DGS Assy/Dis Assy. Fixture(Φ132)</td> <td>TC9762691024</td> </tr> </tbody> </table> 4. SEAL HOUSING & SHAFT DIMENSIONS Please refer Var No 11 (DGS DIA 132 BCL400/A & BCL500 SERIES for END MOUNTED BEARING DESIGN) for Seal housing and shaft dimensions. All the interface assembly parts including outer closing cover with its pin, "O" rings, tolerance strips (as applicable), keys, locating/ anti-rotation pins, circlips etc. are in vendor scope. The outer closing cover shall be provided with the milled projections as shown in the sketch to facilitate free oil drain. The dimensions indicated in the sketch shall be strictly adhered to.					Var	Description	BHEL Matl code	01	Tandem type Bi directional Dry Gas Seal (Φ132) with Barrier seal	TC9762691016	02	DGS Assy/Dis Assy. Fixture(Φ132)	TC9762691024
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5. SEAL DESIGN INPUTS									
5.1. DATA FOR SEAL DESIGN									
OPERATING CONDITION		Op_Case-1 SOR	Op_Case-1 EOR	#Design case-1 SOR	Op_Case-2 SOR	Op_Case-2 EOR	S/U_N2_6 KSCG	S/U_H2_2 2KSCG	
PARAMETER DESCRIPTION									
Gas Composition		As per annexure-1							
Mol. wt.		4.54	5.73	4.54	4.78	6.11	28.010	2.02	
Pr. in the Seal gas line upstream of filter (kg/cm2-a)		81.7	85.7	81.7	81.7	85.8	14.5	25.3	
Temp in Seal gas Line upstream of filter (°C)		97	102	98	98	103	139	51	
Clean gas pressure (downstream of DPCV) (kg/cm2-a)		63.1	63.1	63.1	63.1	63.1	7.9	23.9	
Clean gas temperature (downstream of DPCV) (°C)		97	102	98	98	103	139	51	
Total clean gas leaking into Compr. through end labyrinth seals (both ends) Downstream of DPCV (into Compressor)	NOR (Kg/hr)	596	666	595	611	687	494	262	
	NOR (Am3/hr)	65	59	65	64	57	78	149	
	Max (Kg/hr)	895	1000	894	917	1032	741	394	
	Max (Am3/hr)	98	88	98	96	85	117	224	
Shaft Speed(rpm)		8426	8110	9337	8242	7880	6200	7000	
OPERATING CONDITION		Op_C1 SOR_T D	Op_C1 EOR_T D	DES_C1 SOR_T D	Op_C2 SOR_T D	Op_C2 EOR_T D	S/U_N2_4 .5KSCG	S/U_H2_2 0KSCG	
PARAMETER DESCRIPTION									
Gas Composition		As per annexure-1							
Mol. wt.		4.54	5.73	4.54	4.78	6.11	28.010	2.02	
Pr. in the Average Seal gas line upstream of filter (kg/cm2-a)		81.7	85.7	81.7	81.7	85.8	11.1	24.1	
Temp in Seal gas Line upstream of filter (°C)		97	102	98	98	103	141	56	
Clean gas pressure (downstream of DPCV) (kg/cm2-a)		63.1	63.1	63.1	63.1	63.1	6.4	21.9	
Clean gas temperature (downstream of DPCV) (°C)		97	102	97	98	103	141	56	
Total clean gas leaking into Compr. through end labyrinth seals (both ends) Downstream of DPCV (into Compressor)	NOR (Kg/hr)	596	666	596	611	687	441	249	
	NOR (Am3/hr)	65	59	65	64	57	86	157	
	Max (Kg/hr)	895	1000	895	917	1032	662	374	
	Max (Am3/hr)	98	88	98	96	85	130	236	
Shaft Speed(rpm)		8295	8031	8295	8110	7805	6500	8500	

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System settling out press.(kg/cm ² -g)	71.86
Rated Speed (rpm)	9337
Min. mechanical design pressure for DGS	102 kg/cm ² g
Mechanical design temperature for DGS	Min → 3.4 °C Max. Operating Temp. → 139 °C Max. Allowable Temp. → 160 °C
Back Pressure in Primary vent	Nor → 0.1kg/cm ² -g / Max → 1.7kg/cm ² -g

- # Performance Guarantee case is **Design CASE1_SOR**
- Rated Speed is 9337 RPM
- Maximum Continuous Speed(MCS) is 9804 RPM
- Minimum Speed is 6069 RPM
- Trip Speed is 10784 RPM
- Slow roll requirement: Not applicable/However, there will be tilting operation with 4 strokes per minute wherein each stroke rotation is 60 deg.

5.2. AMBIENT CONDITIONS

Temperature	:	Min → 3.4 °C Nor → 28 °C Max → 48.2 °C
Relative Humidity	:	Min → 3 Nor → 45 Max → 100

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5.3. GAS COMPOSITION FOR VARIOUS CONTINUOUS OPERATING CONDITIONS: The gas composition for all the above operating conditions is furnished at Annexure-1																																																					
5.4. SEALING GAS <table border="1"> <tr> <td rowspan="3">Primary Seal</td> <td>For Normal Operation</td> <td>Dry and filtered process gas from Compressor discharge/Nitrogen/Sweet Gas</td> </tr> <tr> <td>During Startup</td> <td>Seal Gas (process gas / Nitrogen) from Seal Gas Booster / Make up Gas Compressor Discharge(MUG)/N2 for N2 startup</td> </tr> <tr> <td>During Settle Down Startup from Settle Down</td> <td>Process gas from Seal Gas Booster / Make up Gas Compressor Discharge(MUG)</td> </tr> <tr> <td>Secondary Seal</td> <td colspan="2">Nitrogen / Plugged</td> </tr> <tr> <td>Barrier Seal</td> <td colspan="2">Nitrogen / Instrument Air</td> </tr> </table>							Primary Seal	For Normal Operation	Dry and filtered process gas from Compressor discharge/ Nitrogen / Sweet Gas	During Startup	Seal Gas (process gas / Nitrogen) from Seal Gas Booster / Make up Gas Compressor Discharge(MUG)/N2 for N2 startup	During Settle Down Startup from Settle Down	Process gas from Seal Gas Booster / Make up Gas Compressor Discharge(MUG)	Secondary Seal	Nitrogen / Plugged		Barrier Seal	Nitrogen / Instrument Air																																			
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5.5 Site Utility Data of the Seal Gas: <table border="1"> <thead> <tr> <th>Gas</th> <th>Parameter</th> <th>Min</th> <th>Nor</th> <th>Max</th> <th>Mech. Design</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Nitrogen</td> <td>Pressure Kg/Cm² g</td> <td>4.5</td> <td>6</td> <td>7</td> <td>10.5</td> </tr> <tr> <td>Temperature °C</td> <td></td> <td>40</td> <td></td> <td>65</td> </tr> <tr> <td rowspan="2">Sweet Gas</td> <td>Pressure Kg/Cm² g</td> <td colspan="4" rowspan="2">NA</td> </tr> <tr> <td>Temperature °C</td> </tr> <tr> <td rowspan="2">Instrument Air</td> <td>Pressure Kg/Cm² g</td> <td colspan="4" rowspan="2">NA</td> </tr> <tr> <td>Temperature °C</td> </tr> <tr> <td rowspan="3">MUG Compressor</td> <td>Disch. Pressure Kg/Cm² g</td> <td colspan="4">84.8</td> </tr> <tr> <td>Disch. Temperature °C</td> <td colspan="4">129</td> </tr> <tr> <td>Max.Oil Carryover</td> <td colspan="4">100 ppm</td> </tr> </tbody> </table>							Gas	Parameter	Min	Nor	Max	Mech. Design	Nitrogen	Pressure Kg/Cm ² g	4.5	6	7	10.5	Temperature °C		40		65	Sweet Gas	Pressure Kg/Cm ² g	NA				Temperature °C	Instrument Air	Pressure Kg/Cm ² g	NA				Temperature °C	MUG Compressor	Disch. Pressure Kg/Cm ² g	84.8				Disch. Temperature °C	129				Max.Oil Carryover	100 ppm			
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6. SPECIAL POINTS

- 6.1 During catalyst sulfiding operation, the H₂S content in the recycle gas may increase to 2.0% mol. Material selection to be in accordance with NACE MR0175.
- 6.2 Process gas may contain traces of NH₃ and entrained MDEA. Avoid copper or copper alloys for the seal parts in contact with process gas.
- 6.3 Make up gas compressor (which is reciprocating oil lubricated type compressor) is used to make-up the H₂ in closed recycle loop on continuous basis. Please note that maximum of 100 ppm of lube oil carryover in the process gas, due to the above. Dry gas seals and system shall be designed suitably.
- 6.4 MRT with dry gas seals is not applicable as per Clause 53 of TC52357. However, Supplier to confirm to provide assistance for assembly/disassembly – 2 visits for a period of 3 days each for each casing – **at shop**.

7. Warranty

This clause overrides the Clause.26 of TC52357.

All equipment/goods supplied shall be warranted for 12 months from the date of commissioning or upto 31st December 2023 whichever is earlier.

Replaced/repared equipment /material will be warranted for 12 months from the date of repair /replacement or 31st December 2024 whichever is earlier.

8. Applicable Standards / Codes

- 8.1. BHEL General Specification No. TC52357
- 8.2. BHEL Housing Dimension Specification No. TC52508
- 8.3. API 617 – 7th edition
- 8.4. API 614 – 5th edition
- 8.5. NACE MR0103/MR0175

ANNEXURE - 1
GAS COMPOSITION

(Gas Analysis)

123	Gas analysis #	Design Conditions:						
124	■ Mol % □ Wt%							
125	Constituent MW		OP_Case1_SOR Design_Case1_SOR DES_C1_SOR_TD OP_C1_SOR_TD	OP_Case1_EOR OP_C1_EOR_TD	OP_Case2_SOR OP_C2_SOR_TD	OP_Case2_EOR OP_C2_EOR_TD	S/U_N2_6KSCG S/U_N2_4.5KSCG	S/U_H2_22KSCG S/U_H2_20KSCG
126	Air	28.968	0.00	0.00	0.00	0.00	0.00	0.00
127	Oxygen	32.000	0.00	0.00	0.00	0.00	0.00	0.00
128	Nitrogen	28.018	0.00	0.00	0.00	0.00	100.00	0.00
	Water	18.018	0.38	0.38	0.39	0.39	0.00	0.00
129	CO	28.010	0.00	0.00	0.00	0.00	0.00	0.00
130	CO ₂	44.010	0.00	0.00	0.00	0.00	0.00	0.00
131	H ₂ S	34.078	0.000	0.000	0.000	0.000	0.00	0.00
132	Hydrogen	2.016	88.237	82.718	87.123	80.418	0.00	100.00
133	Methane	16.042	7.81	12.23	8.40	13.19	0.00	0.00
134	Ethylene	28.052	0.00	0.00	0.00	0.00	0.00	0.00
135	Ethane	30.068	2.05	3.21	2.43	3.80	0.00	0.00
136	Propylene	42.078	0.00	0.00	0.00	0.00	0.00	0.00
137	Propane	44.094	0.93	1.24	1.06	1.42	0.00	0.00
138	1 Butene	56.108	0.00	0.00	0.00	0.00	0.00	0.00
139	i-Butane	58.120	0.19	0.24	0.20	0.27	0.00	0.00
140	n-Butane	58.124	0.16	0.21	0.18	0.23	0.00	0.00
141	Cyclopentane	70.135	0.00	0.00	0.00	0.00	0.00	0.00
142	Cyclopentene	68.120	0.00	0.00	0.00	0.00	0.00	0.00
143	1,3-Pentadiene	68.120	0.00	0.00	0.00	0.00	0.00	0.00
144	1 Pentene	70.135	0.00	0.00	0.00	0.00	0.00	0.00
145	i-Pentane	72.148	0.00	0.00	0.00	0.00	0.00	0.00
146	n-Pentane	72.148	0.00	0.00	0.00	0.00	0.00	0.00
147	n-Hexane	86.179	0.243	0.312	0.217	0.282	0.00	0.00
148	Pentane plus		0.00	0.00	0.00	0.00	0.00	0.00
149	Pentylene		0.00	0.00	0.00	0.00	0.00	0.00
150	Total		100.00	0.00	0.00	0.00	100.00	100.00
151	Avg.Mol.		4.54	5.73	4.78	6.11	28.013	2.016

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