



PRODUCT STANDARD
TURBINES AND COMPRESSORS
HYDERABAD

TC-6-2635

REV No.: **00**

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JOB SPECIFICATION OF DRY GAS SEAL

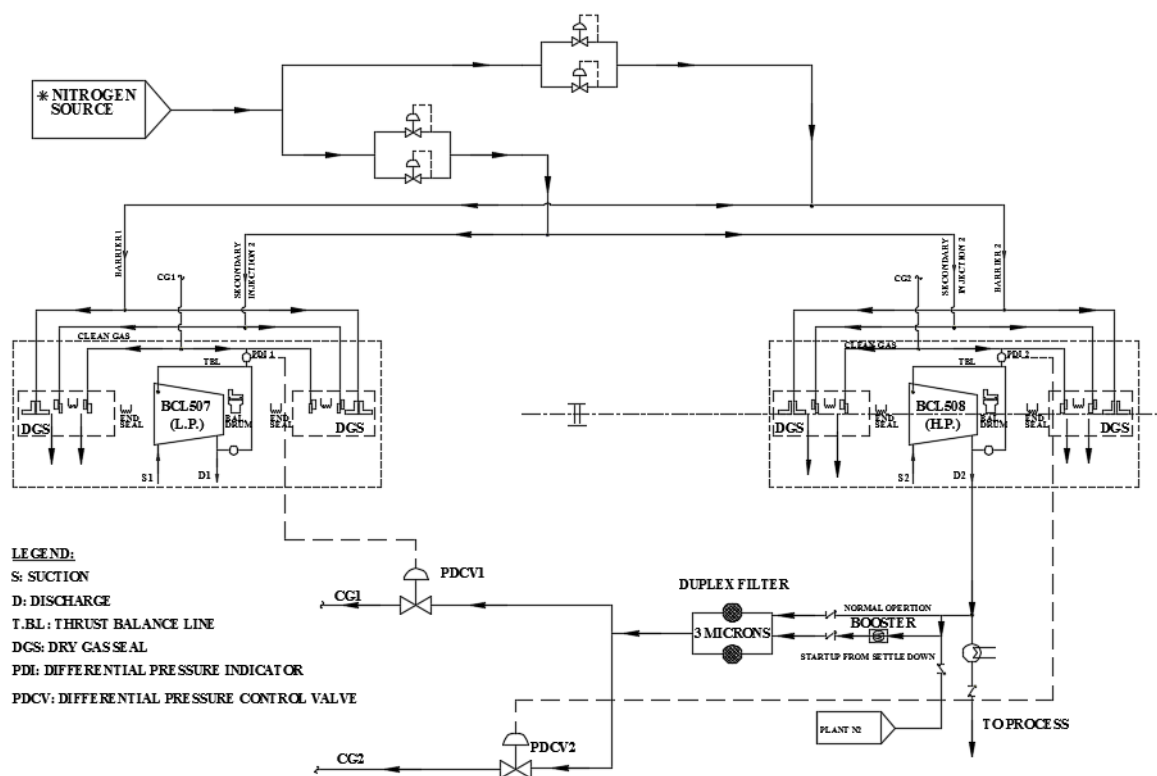
Project: M/s BPCL KRL NET GAS BS VI MS BLOCK

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
01	Refer to record of revisions	KVS	YVRL	02.05.2016

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				PAGE 2 OF 8									
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company. 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" style="width: 100%;"> <thead> <tr> <th>Var</th> <th>Description</th> <th>BHEL Material code</th> </tr> </thead> <tbody> <tr> <td>01</td> <td>Tandem type Bi directional Dry Gas Seal (Φ150) with Barrier seal</td> <td>TC9762635019</td> </tr> <tr> <td>02</td> <td>DGS Assy/Dis Assy. Fixture (Φ150)</td> <td>TC9762635027</td> </tr> </tbody> </table> 4. SEAL HOUSING & SHAFT DIMENSIONS Please refer TC52508 Var. No.6 (DGS dia 150 BCL/MCL 500 series) 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 Material code	01	Tandem type Bi directional Dry Gas Seal (Φ150) with Barrier seal	TC9762635019	02	DGS Assy/Dis Assy. Fixture (Φ150)	TC9762635027
Var	Description	BHEL Material code											
01	Tandem type Bi directional Dry Gas Seal (Φ150) with Barrier seal	TC9762635019											
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5. SEAL DESIGN INPUTS

5.1. DATA FOR SEAL DESIGN

OPERATING CONDITION		RATED1	NORMAL1	RATED2	NORMA L2	NORMAL3	ALT1	TURND OWN1	TURND OWN2
PARAMETER DESCRIPTION									
Gas Composition		As per annexure-1							
Mol. wt.		6.50	6.50	5.70	6.70	6.30	5.70	5.70	6.50
Pr. in the Average Seal gas line upstream of filter (kg/cm ² -a)		26.5	26.4	26.3	26.4	26.3	26.3	26.1	26.1
Temp in Seal gas Line upstream of filter (°C)		108.2	109.4	113.1	111.7	114.0	114.6	116.0	111.5
Clean gas pressure (downstream of DPCV1) (kg/cm ² -a)		7.37	7.28	7.08	7.07	6.97	6.99	7.02	7.35
Clean gas temperature (downstream of DPCV1) (°C)		108.2	109.4	113.1	111.7	114.0	114.6	116.0	111.5
Clean gas pressure (downstream of DPCV2) (kg/cm ² -a)		14.70	14.55	14.45	14.29	14.18	14.44	14.48	14.67
Clean gas temperature (downstream of DPCV2) (°C)		108.2	109.4	113.1	111.7	114.0	114.6	116.0	111.5
Total clean gas leaking into Compr. through end labyrinth seals (both ends) Downstream of DPCV1 (into LP Compressor)	NOR (Kg/hr)	201	199	183	198	190	181	181	199
	NOR (Am ³ /hr)	136	136	148	136	142	149	149	136
	Max (Kg/hr)	301	299	274	298	286	272	272	299
	Max (Am ³ /hr)	203	205	222	205	214	224	224	204
Shaft Speed(rpm)		9347	9168	9424	8960	9197	9303	9048	8416
Total clean gas leaking into Compr. through end labyrinth seals (both ends) Downstream of DPCV2 (into HP Compressor)	NOR (Kg/hr)	287	285	264	285	275	264	264	285
	NOR (Am ³ /hr)	97	98	105	97	101	105	106	97
	Max (Kg/hr)	430	427	397	428	413	396	396	428
	Max (Am ³ /hr)	146	146	158	146	152	158	158	146
Shaft Speed(rpm)		9347	9168	9424	8960	9197	9303	9048	8416
System settling out press.(kg/cm ² -g)		7.5 for LP and 16.1 for HP							
Rated Speed (rpm)		9424							
Min. mechanical design pressure for DGS (kg/cm ² -g)		43 kg/cm ² -g							
Mechanical design temperature for DGS		Min → 0 °C Max → 150 °C							
Back Pressure in Primary vent		Nor → 0.2kg/cm ² -g / Max → 1.7kg/cm ² -g							

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- Performance Guarantee case is RATED1
- Rated Speed is 9424 RPM
- Maximum Continuous Speed(MCS) is 9895 RPM
- Minimum Speed is 6597 RPM
- Trip Speed is 9895 RPM
- Slow roll requirement: NA

5.2. AMBIENT CONDITIONS

Temperature	:	Min → 20 °C Nor 35°C Max → 38°C
Relative Humidity	:	Min. Nor. % Max. 95% @38 °C

5.3. GAS COMPOSITION FOR VARIOUS CONTINUOUS OPERATING CONDITIONS:

1. Process gas composition: Annexure-1

5.4. SEALING GAS

Primary Seal	For Normal operation - HP Compressor Discharge	Dry and filtered process gas from Makeup/HP Compressor Discharge/ Nitrogen /Sweet Gas				
	During starting	Seal gas (Process) from seal gas Booster				
	During Settle down	Seal gas (Process) from seal gas Booster				
Secondary Seal		Nitrogen / Plugged				
Barrier Seal		Nitrogen / Instrument Air				
Gas		Parameter	Min	Nor	Max	Mech.Design
Nitrogen	Pressure Kg/Cm ² g		4.0	6.0	7.0	10.5
	Temperature °C		Amb	Amb	65	65
Sweet Gas	Pressure Kg/Cm ² g		NA			
	Temperature °C					
Instrument Air	Pressure Kg/Cm ² g		NA			
	Temperature °C					



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6. Special Notes

1. Dry gas seal vendor shall submit written confirmation in their letterhead for the following:
 - a. The spare seal (not installed in casing) shall be suitable for use without any refurbishment for at least 5 years from the date of supply. Vendor shall provide necessary storage conditions to comply with the above.
 - b. If the spare seals are not used at all before 5 years and if the vendor's design standard practice is calling for any refurbishment / revalidation / requalification, after 5 years but before 10 years period vendor shall accept to refurbish the spare seals free of charge for one time to the end customer.
 - c. If the spare seals are used before 5 years, the above Part-b is not applicable.
2. Dry gas seals shall be used for mechanical run test. Vendor to specify the precautions for same. Vacuum inside the compressor is typically $-0.8 \text{ kg/cm}^2\text{-g}$.
3. The Maximum depressurization rate is $2.5 \text{ kg/cm}^2\text{-g/min}$. Vendor to select the materials suitably.

4. Applicable Standards / Codes

- a. BHEL General Specification No. TC52357
- b. BHEL Housing Dimension Specification No. TC52508, Var.06
- c. API 617 – 7th edition
- d. API 614 – 5th edition
- e. Material shall be NACE MR0103 applicable



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ANNEXURE – 1

GAS COMPOSITION

OPERATING CONDITIONS (Continued)								
Gas analysis □ Mol % □		1 st Stg/ Normal1	2 nd Stg/ Normal1	1 st Stg/ Rated1	2 nd Stg/ Rated1	1 st Stg/ Rated1	2 nd Stg/ Rated1	REMARKS
		Design Case 1	Design Case 1	Design Case 1	Design Case 1	Rich Case (No TGR)	Rich Case (No TGR)	
Constituent	MW							
Air	28.966							
Oxygen	32.000							
Nitrogen	28.016							
Water Vapor	18.016	Trace	Trace	Trace	Trace	Trace	Trace	
CO	28.010							
CO ₂	44.010							
H ₂ S	34.076	*	*	*	*	*	*	* 2 ppm
Hydrogen	2.016	86.62	88.33	86.62	88.33	89.92	91.84	
Methane	16.042	3.25	3.31	3.25	3.31	1.70	1.73	
Ethylene	28.052							
Ethane	30.068	3.10	3.14	3.10	3.10	1.74	1.76	
Propylene	42.078							
Propane	44.094	2.06	2.06	2.06	2.06	1.54	1.55	
i-butane	58.120	0.53	0.52	0.53	0.52	0.53	0.51	
n-butane	58.120	0.74	0.72	0.74	0.72	0.76	0.73	
i-pentane	72.146	0.40	0.36	0.40	0.36	0.39	0.34	
n-pentane	72.146	0.22	0.19	0.22	0.19	0.2	0.17	
Hexane		3.09	1.38	3.09	1.38	3.22	1.36	
Hydrogen Chloride		Trace	Trace	Trace	Trace	Trace	Trace	
Total		100	100	100	100	100	100	
Avg. Mol. Wt.		8.2	6.5	8.2	6.5	7.5	5.7	

		ALTERNATE CONDITIONS					
Gas analysis ☐ Mol % ☐		1 st Stg/ Normal2	2 nd Stg/ Normal2	1 st Stg/ Normal3	2 nd Stg/ Normal3	1 st Stg/ Alt. 1	2 nd Stg/ Alt. 1
		Design Case 2	Design Case 2	Rich Case	Rich Case	Rich Case (No TGR)	Rich Case (No TGR)
Constituent	MW						
Air	28.966						
Oxygen	32.000						
Nitrogen	28.016						
Water Vapor	18.016	Trace	Trace	Trace	Trace	Trace	Trace
CO	28.010						
CO ₂	44.010						
H ₂ S	34.076	*	*	*	*	*	*
Hydrogen	2.016	86.24	87.99	87.60	89.41	89.92	91.84
Methane	16.042	3.13	3.19	2.72	2.77	1.70	1.73
Ethylene	28.052						
Ethane	30.068	3.02	3.06	2.66	2.70	1.74	1.76
Propylene	42.078						
Propane	44.094	2.48	2.48	2.12	2.13	1.54	1.55
i-butane	58.120	0.59	0.58	0.51	0.49	0.53	0.51
n-butane	58.120	0.83	0.79	0.71	0.68	0.76	0.73
i-pentane	72.146	0.40	0.36	0.36	0.32	0.39	0.34
n-pentane	72.146	0.22	0.19	0.19	0.16	0.20	0.17
Hexane Plus		3.11	1.37	3.12	1.33	3.22	1.36
Hydrogen Chloride		Trace	Trace	Trace	Trace	Trace	Trace
Total		100	100	100	100	100	100
Avg. Mol. Wt.		8.4	6.7	8.0	6.3	7.5	5.7

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		ALTERNATE CONDITIONS			
Gas analysis □ Mol % □		1 st Stg/ Turndown1	2 nd Stg/ Turndown1	1 st Stg/ Turndown2	2 nd Stg/ Turndown2
		Rich Case (No TGR)	Rich Case (No TGR)	Design Case 1	Design Case 1
Constituent	MW				
Air	28.966				
Oxygen	32.000				
Nitrogen	28.016				
Water Vapor	18.016	Trace	Trace	Trace	Trace
CO	28.010				
CO ₂	44.010				
H ₂ S	34.076	*	*	*	*
Hydrogen	2.016	89.92	91.84	86.62	88.33
Methane	16.042	1.70	1.73	3.25	3.31
Ethylene	28.052				
Ethane	30.068	1.74	1.76	3.10	3.14
Propylene	42.078				
Propane	44.094	1.54	1.55	2.06	2.06
i-butane	58.120	0.53	0.51	0.53	0.52
n-butane	58.120	0.76	0.73	0.74	0.72
i-pentane	72.146	0.39	0.34	0.40	0.36
n-pentane	72.146	0.20	0.17	0.22	0.19
Hexane Plus		3.22	1.36	3.09	1.38
Hydrogen Chloride		Trace	Trace	Trace	Trace
Total		100	100	100	100
Avg. Mol. Wt.		7.5	5.7	8.2	6.5

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