



TD-106. – 2 Rev. No. : 00 Form No. :		<div></div> <div>PRODUCT STANDARD HYDERABAD GT ENGINEERING</div>		<div>Prod. Std. No. : GT51616</div> <div>Rev. No. 05</div> <div>Page : 1 of 8</div>	
<div><div>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.</div><div><div><div><div>GAS TURBINE STARTING SYSTEM (Fr-9E)</div><div>1.0 DESCRIPTION</div><div>1.1 This applies to a hydraulic torque converter assembly, i.e. torque converter and auxiliary equipment which in conjunction with a suitable motive power source, will be used to crank and start a BHEL Heavy Duty Gas Turbine.</div><div>2.0 APPLICABLE DOCUMENTS:</div><div>2.1 The following specification/ ordering sheet of the issue in effect on date of invitation for bids or request for proposal form a part of this specification.</div><div>2.2 Specification and Standards</div><div>2.2.1. Gas Turbine Department Lube Oil specification GT10198 or GE Spec. GEK28143A (equivalent to ISO VG32 oil).</div><div>2.2.2. Stainless Steel Tubing Spec. HY10793 or AISI 304/UNS S30400.</div><div>2.2.3. Welding Practices, GT54031 or GE spec P8A–AG1.</div><div>2.2.4. Welding Practices, Piping GT54160 or GE Spec. P8A–AG3.</div><div>2.2.5. PAINTING: All components are to be painted as per painting scheme 1RZ₃+V₆+V₇ as mentioned at clause 6.6 of Spec. GT10112. Color shade is light gray (shade No.631of BIS:5) as mentioned at clause 3.2 of spec GT10112 (or) “Light Gray C 705”of M/s Carboline, St. Louis, Missouri, USA.</div><div>3.0 REQUEST FOR COPIES:</div><div>3.1 Request for copies of BHEL specifications of Product Standards should be addressed to the Purchase department and mailed to the address shown on the purchase order.</div><div>4.0 REQUIREMENTS</div><div>4.1 DESIGN</div><div>4.1.1. Mounting: Unless otherwise specified, all components of the hydraulic torque converter assembly will mount as a single unit and will incorporate base mounting features suitable for direct bolt down to the Gas Turbine structure. Shaft centerline height of the assembly will be 606.5mm (608.6mm shaft centerline height minus 3.1mm allowance for shimming). Additionally, there shall only be four bolt down locations for the assembly.</div><div>4.1.2. Input Shaft: Connection will be via a flexible coupling from the power source (electric motor, see-section 4.1.5).</div><div>4.1.3. Output Shaft: Connection from the torque converter assembly to the accessory gear will be via, a flexible coupling. See section 4.1.8 for starting system output shaft torque and speeds.</div><div>4.1.4. Shaft Rotation: Rotation of the output shaft, looking into the output shaft of the torque converter assembly, is to be clockwise. Input shaft rotation, looking from output end to input end, shall be counter clockwise.</div><div>4.1.5. Motive Power Source: Standard motive power shall be provided by BHEL in the form of an electric motor, 4 pole, 6600 VAC, 50 Hz.</div></div></div></div></div>					
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4.1.6. Operating Fluid:
Lightweight turbine oil or fire resistant lubricant (refer item 2.1.1) from the gas turbine lube system. Fluid temperature will range from 40⁰ F minimum to 190⁰ F maximum. Fluid supply pressure and available flow rate shall be 100 GPM at 25 PSIG during start-up 10 GPM at 25 PSIG during normal gas turbine operation.

4.1.7. Seals, Packing, Gaskets, etc.:
Any used in the construction of the torque converter assembly must be compatible with the operating fluid(s) specified.

4.1.8. Converter input/output Torque:
Shall be fully adjustable to satisfy turbine speed variations required. The required torque points listed on the table below shall be met.

Operation	Required Torque Kg.m (Ft.Lb)	Required Output Speed (RPM)
Breakaway	7900 (58000)	0
Purge (33% Speed)	964 (7000)	1000
Firing (12% Speed)	310 (1500)	360
Acceleration	661+ (4800+)	1500
Self – Sustaining Speed	0	1950
Slow Roll / Cool Down	1653 (12000)	6~7

4.1.9. Torque Curves:
Maximum input and minimum output shaft torques shall be provided by the torque converter assembly manufacturer.

4.1.10. Slow-Roll Capability:
The torque converter assembly shall include a turning gear to slow-roll the gas turbine for cooling and borescope inspection purposes. The turning gear shall have a required minimum torque of 2480 Kg-m with maximum continuous torque at 6 to 7 RPM (see section 4.1.8). There shall also be the capability to add operation under DC power.

4.1.10.1. Slow-Roll Turning Gear Motor shall be a 25 HP, 415 VAC, 50 Hz, 1500 RPM motor. Junction Box shall be suitable for an Al cable of 35 mm² section, and terminated on terminal blocks.

4.1.10.2. DC Emergency Turning Gear Motor/Remote Borescope Option shall be included. The motor shall have the following requirements: 3+ HP (1.6 Kg-m continuous torque, 125± 20 VDC, 1750 RPM, 40⁰ C ambient, 1.0 SF, Class F insulation, compound wound, C-Face without feet, vertical mount DE down, no drip cover, double shaft extension Class 1 Group D Div.2 explosion proof, and a 3/8” drilled and tapped hole in mounting base to accommodate protective earth strap on the AC motor. Junction Box shall be suitable for on Al cable of 35 mm² section, and terminated on terminal blocks.


4.1.10.3. No protective earth strap hole required.


4.1.10.4. Add a 3/8” drilled and tapped hole in mounting base to accommodate protective earth strap.


4.1.11. Auxiliary Equipment:
All auxiliary equipment which may be required to enable the torque converter to meet performance specifications shall be identified and included in all proposals and/or quotations. Any such auxiliary equipment supplied as a part of the torque converter assembly must completely satisfy the applicable requirements. Any such equipment which is not supplied shall be identified as such, and listed with full requirements of the item.


4.1.12. Instrumentation and Special Control Components


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Ref. Doc 351A9070		<div><div>4.1.12.1. <u>Electrical Components:</u></div><div>All electrical devices shall be third party approved for operation in a Class 1, Group D, Div. 2 environment and for a tropical environment. All DC electrical devices shall also be 125 VDC</div><div>4.1.12.2. <u>Instrumentation:</u></div><div>Inlet and casing pressure gauges shall be provided. Pressure gauges shall be provided in dual units of PSIG and Kg/cm2. All pressure gauges shall have isolation values and test ports</div><div>4.1.12.3. <u>Piping Connections:</u></div><div>All external pipe connections shall be either standard flange connections, or pipe threads which shall accept American Standard Pipe.</div><div>4.2 <u>System Considerations: See section 4.1</u></div><div>4.3 <u>Performance</u></div><div>4.4.1. <u>Rated Performance:</u></div><div>Rated performance shall meet or exceed limits set forth in section 4.1.8.</div><div>4.4.2. <u>Transient Performance:</u></div><div>Torque converter assembly shall remain operable and sheet rated performance after experiencing 20 percent output shaft over speed.</div><div>4.4 <u>Environment</u></div><div>4.4.1. <u>Ambient:</u></div><div>Ambient operating temperatures are from +40⁰ F to +180⁰ F.</div><div>4.4.2. <u>Degree of Enclosure:</u></div><div>Starting systems will be in a completely enclosed compartment. Protection from precipitation is not required.</div><div>4.4.3. <u>Elevation:</u></div><div>Maximum operation elevation is 7000 feet.</div><div>4.5 <u>Reliability, Design Life, Maintainability, and Safety</u></div><div>4.5.1. <u>Reliability:</u></div><div>The torque converter assembly shall provide a minimum of 1000 consecutive trouble-free starts.</div><div>4.5.2. <u>Design Life:</u></div><div>The torque converter assembly (auxiliary equipment included) shall be designed for 20,000 hours of continuous uninterrupted operation. It shall have 10 years of useful life based on a maximum of 350, 20 minute starts per year.</div><div>4.5.3. <u>Maintainability:</u></div><div>Information regarding maintenance, special tools, and spare parts shall be provided by the manufacturer.</div><div>4.5.4. <u>Safety:</u></div></div>			

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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.		<p>The vendor shall assess the safety of his/her product and shall advise BHEL, in writing, of all warnings and instructions which, in the opinion of the vendor, are necessary to preclude occurrence of hazardous conditions or to define and minimize risk of potentially hazardous conditions. A hazardous condition is defined as one which may cause personnel injury or death due to the installation, operation, failure, servicing, repair or disposal of the vendor product.</p> <p>4.6 <u>Materials:</u> Materials selected shall be compatible with the requirements of this specification and, in addition, should be chosen for qualities associated with long life and resistance to corrosion, wear and other forms of deterioration.</p> <p>4.7 <u>Physical Requirements</u></p> <p>4.7.1. <u>Dimensions and Weight:</u></p> <p>Size and weight of this system shall be consistent with the torque and power rating of the equipment supplied. The length of the assembly from input shaft end to output shaft end shall not exceed 2286mm (90inches) and overall length shall not exceed 2540mm (100inches). See section 4.1.1. Supplier drawings shall list assembly weight and show location of assembly center of gravity. Lifting eye bolts shall be shouldered eye bolts placed on spot faces.</p> <p>4.7.2. <u>Cleanliness and workmanship:</u></p> <p>All parts, components and assemblies shall be thoroughly cleaned prior to and after assembly and test, including removal of all loose, spattered, excess soldering or welding materials, rosin, weld flash, metal chips or any foreign matter, burns and sharp edges.</p> <p>4.7.2.1. <u>Openings:</u></p> <p>All openings are to be securely covered against entry of foreign materials after cleaning and before shipment.</p> <p>4.7.2.2. <u>Workmanship:</u></p> <p>Workmanship shall be done in a manner resulting in full compliance with the requirements of this specification.</p> <p>4.7.2.3. <u>Nameplate and Product Markings:</u></p> <p>Equipment supplied shall be identified by Equipment Serial No. BHEL Material Code, Vendor model No. BHEL PO No, Vendor's job No. etc., necessary for easy material identification & Vendor approachability.</p> <p>5.0 <u>QUALITY ASSURANCE PROVISIONS</u></p> <p>5.1 <u>Responsibility for Tests and Inspections:</u></p> <p>Unless otherwise specified by the ordering sheet, drawing or purchase order, the supplier is responsible for the performance of all test and inspection requirements. Except as otherwise specified the supplier may utilize his/ her own facilities or any commercial laboratory acceptable to the Gas Turbine Department. BHEL, in addition, reserves the right to perform any of the required inspection or tests where such inspections and tests are considered necessary to assure that the item supplied conforms to the requirements of this specification.</p> <p>5.2 <u>Qualification Inspection and Test Requirements:</u></p> <p>In order to indicate conformity with and to qualify the unit design for acceptance by BHEL, prototype test shall be performed. The test particulars, i.e. parameters and data requirements, will be identified by Sourcing Quality and GT Design Engineering Departments.</p>		
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<div><div>COPYRIGHT AND CONFIDENTIAL</div><div>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.</div></div> <div><div>5.3 <u>Production inspection and Tests:</u></div><div>Every production unit shall be given a standard commercial test at rated, input speed and power to confirm overall mechanical integrity and minimum guaranteed torque. Vibration levels to be measured at starting means bearing caps, shall not exceed 0.381mm (0.0015") peak-to-peak in any direction. Evidence of satisfactory test performance shall be provided.</div><div>6.0 <u>PREPARATION FOR DELIVERY</u></div><div>6.1 <u>Preservation, Packaging and packing</u></div><div>6.1.1. Preservation</div><div>Preservation shall be accomplished in accordance with acceptable commercial practices for domestic or foreign shipments.</div><div>6.1.2. Packaging:</div><div>Packaging shall be accomplished in accordance with acceptable commercial practices for domestic or foreign shipments.</div><div>6.1.3. Packing:</div><div>Packing shall be accomplished in accordance with acceptable commercial practices for domestic or foreign shipments. The vendor shall make shipment using the minimum number of shipping containers consistent with the requirements of safe transit, available modes of transportation and routing. It shall be the vendor's responsibility to determine that packing as done is adequate to assure that all equipment shall arrive at destination in an undamaged condition and ready for intended use.</div><div>6.2 <u>Marking:</u></div><div>See purchase order</div><div>6.3 <u>Shipment:</u></div><div>Approval to ship must be obtained from applicable Purchasing Unit either by MAIL/FAX/TELEX call or telegram. If shipment will be short, the Purchasing approval of all shortage items must be obtained prior to shipment. At the time of shipment, two copies of the packing list and shortage list, with promised shipping dates if applicable, must be air mailed to the applicable Purchasing Unit as noted on the purchase order.</div><div>7.0 <u>DATA REQUIREMENTS</u></div><div>7.1 All manufacturer drawings and document requirements for this design shall be ordered by purchase order.</div><div>7.2 The manufacturer shall make no changes to approved drawings without the approval of the procuring activity of the BHEL Gas Turbine Engineering. The approval of drawings in no way relieves the manufacturer of responsibility for meeting the requirements of the Specifications or Ordering Drawings.</div><div>7.3 Those documents required for approval prior to the start of manufacture shall be so indicated by an asterisk (*).</div><div>7.4 The following indicated with an "X" the required drawings and documents to be furnished by the Supplier.</div><div><table><tr><td>_____</td><td>DIS-100</td><td>Design Drawings/Documents</td></tr><tr><td>—X—</td><td>DIS-102</td><td>Assembly Drawing</td></tr><tr><td>—X—</td><td>DIS-103</td><td>Detailed/Assembly-Drawing</td></tr><tr><td>_____</td><td>DIS-105</td><td>Detail Part Drawing</td></tr><tr><td>_____</td><td>DIS-106</td><td>Purchased Part Drawing</td></tr><tr><td>—X—</td><td>DIS-107</td><td>Equipment Part Drawing</td></tr><tr><td>_____</td><td>DIS-108</td><td>Modification Drawings</td></tr></table></div></div> <tr><td colspan="2">Ref. Doc</td><td colspan="6">351A9070</td></tr>								_____	DIS-100	Design Drawings/Documents	—X—	DIS-102	Assembly Drawing	—X—	DIS-103	Detailed/Assembly-Drawing	_____	DIS-105	Detail Part Drawing	_____	DIS-106	Purchased Part Drawing	—X—	DIS-107	Equipment Part Drawing	_____	DIS-108	Modification Drawings	Ref. Doc		351A9070					
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8.0 TRANSMITTAL REQUIREMENTS 8.1 Transmittal Instructions for this design documentation shall be identified by the purchase order. 8.2 Complete outline information including the mechanical outline, footprint, cable entrance/exit locations, lifting provisions, weight and CG shall be provided three (3) weeks after receipt of order or inquiry.																																		
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		VAR No.	GE Part No.	Description	Material Code	Wt. (Kgs)	Remarks
		01	351A9070P002 + 354A1415P001 + 354A1415P002	GT starting system without DC Turning gear motor and with couplings.	GT9751616018	~4225.00	Coupling specs are GT51625, var 01 & GT51625 var 02
		02	351A9070P001 + 354A1415P001 + 354A1415P002	GT starting system with DC Turning gear motor with couplings.	GT9751616026	~4250.00	With DC Turning Gear Motor as per 4.1.10.2 OWSA var 01.
		03	351A9070P001	GT starting system		~4100.00	Same as var 01, but without couplings
		04	351A9070P002	GT starting system		~4125.00	Same as var 03, except 4.1.10.2
		05	351A9070P003	GT starting system		~4125.00	Same as var 04, except 4.1.10.3
		06	351A9070P004	GT starting system		~4100.00	Same as var 03, except 4.1.10.4
		07	351A9070P001 + 354A1415P001 + 354A1415P001	GT starting system with DC Turning gear motor with couplings.	GT9751616077	~4260.00	AC Motor rated for 380V OWSA Var02
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		Rev.No.	Date	Revision Details	Revised	Approved
		00	20.08.1996	First Made	KGR	KRMR
		01	15.01.1997	Detailed Spec Made	KGD	KRMR
		02	18.03.1998	Details Of Painting Added At Clause 2.1.5	VSH	KRMR
		03	25.03.1999	Clause 4.3 Modified In Line with GE Recommendation	HK	KRMR
		04	03.11.2009	Var 07 ADDED	AJH	BSN
		05	10.12.2020	Retyped. Generally Revised.	ART	VSH
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