



PRODUCT STANDARD

HYDERABAD

Prod. Std. No. GT 10127

Rev. No. 02

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ACCEPTANCE REQUIREMENTS . - COMPRESSOR WHEELS - LAST STAGE MS5001/2

AND LOW TEMPERATURE STAGES ($\leq 650F$) FOR "EC", "F", "G" AND "H"

TECHNOLOGY MACHINE DESIGNS

1. SCOPE

1.1 This specification provides the engineering requirements for Gas Turbine Compressor Wheel Forgings. It supplements the general requirements for rotating forgings that are specified in Process Specification GT 10047 and it must be used with GT 10047 and the material specification called for on the respective forging drawing.

1.2 This specification is applicable to the following compressor wheel forgings as follows:

<u>Identity</u>	<u>Material Specification</u>
MS5001 - 16th Stg.	HY 19460 (B50A420-B12)
MS5002A, B-15th Stg.	HY 19460 (B50A420-B12)
MS6001FA, 1-13 Stgs.	— B50A818-A12
MS7001EC, 1 & 2 Stgs.	— B50A818-A11
MS7001EC, 3-14 Stgs.	— B50A818-A12
MS7001F & FA, 1-14 Stgs.	— B50A818-A12
MS7001FB, 1-12 Stgs.	— B50A818-A12
MS7001G&H, 5-11 Stgs.	— B50A818-C12
MS9001F & FA, 1 & 2 Stgs.	— B50A818-A11
MS9001F & FA, 3-14 Stgs.	— B50A818-A12
MS9001EC, 1 & 2 Stgs.	— B50A818-A11
MS9001EC, 3-14 Stgs.	— B50A818-A12
MS9001G & H, 5-11 Stgs.	— B50A818-C12

1.3 Parts other than those specifically set forth above (Ref. Para. 1.2) which are ordered to the requirements of this specification should be referred promptly to **Gas Turbines Engineering for** clarification/resolution.

1.4 Unless otherwise specified, the requirements of this specification are applicable to all materials (Ref. Para. 1.2).

2. APPLICABLE DOCUMENTS

2.1 The documents contained in process specification GT 10047, Section 2, apply to this specification.

3. DEFINITIONS

3.1 The definitions contained in process specification GT 10047 Section 3 apply to this specification.

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Revisions :

Refer to record of revisions :

Prepared :


P . R . P / SCS

Approved :



S . S . R


Date :

10/09/03


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<p style="text-align: center;">COPYRIGHT AND CONFIDENTIAL</p> <p style="text-align: center;">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>		<p>4.1.2.4 <u>Macro Cross-Section</u> - When a complete cut-up destructive qualification procedure is specified, an axial-radial cross-section of the qualification forgings shall be etched and photographs shall be taken to reveal grain flow and chemical segregation (Figure 1). Etch in accordance to Process Specification GT 10185.</p> <p>4.1.2.5 <u>Hardness Survey</u> - When a complete cut-up destructive qualification procedure is specified, a hardness survey shall be made on the face of the axial-radial cross-section cut. and there must be a sufficient number of test positions to accurately reflect hardness; therefore tensile strength uniformity. In addition, a surface hardness survey must be performed per Para. 4.2.2.3.</p> <p>4.1.2.6 The microstructure and the grain size shall be determined for a sample obtained from all of the specified Qualification Forging testing locations, Table I and Figure I. The grain size shall be determined per specification ASTM E112 and the cleanliness rating per specification ASTM E45. The microphotographs shall be at 100X after etching with a 2 percent Nital solution. All metallographic examination results must meet the requirements of the appropriate material specification and they shall be contained in the Qualification Program Report.</p> <p>4.1.2.7 <u>Production/Part Chemical Composition</u> - The chemical composition must be determined for the bore location and carbon check analyses for all of the other testing locations. All results shall be contained in the Qualification Program Report.</p> <p>4.1.3 In order for the forging supplier to achieve qualification status for a specific forging, capability must be demonstrated for the consistent development of all BHEL required mechanical properties and material qualities. Important for the proof of capability is the production of a forging that exhibits the properties and qualities that are expected with the applied processing operations. A part of this expectation of capability is the development of characteristics that are similar to those that are developed in the same or similar forgings produced by other current forging suppliers. It follows that simply producing a forging that just meets the minimum requirements does not earn a supplier qualification status.</p>					
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<p style="text-align: center;">COPYRIGHT AND CONFIDENTIAL</p> <p style="text-align: center;">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>		<p>After a forging supplier achieves qualification status, this status might be extended to apply to other forgings that present the same or lesser degrees of difficulty during manufacture. Decisions regarding the expansion of qualification status to forgings will be made by Turbine Materials and Process Engineering.</p> <p>Production status, i.e. the authority to proceed with production forgings shall be given by Gas Turbine Engineering.</p> <p>4.1.4 After the Purchaser has given process qualification to the Forging Supplier the manufacturing process will be considered "FROZEN" and deviations from it will be allowed only if written permission from Materials & Processes Engineering has been obtained.</p> <p>4.2 <u>Forging Supplier Production Wheels</u></p> <p>4.2.1 <u>Manufacture</u></p> <p>The maximum number of forgings in a furnace heat treatment batch will depend on the Supplier's austenitizing and/or tempering furnaces. This information and the typical positioning of the compressor wheel forgings in the different furnaces must be submitted in the appropriate Supplier Manufacturing Process Plan (MPP), or must be documented in a Supplier's standard manufacturing practices instruction.</p> <p>Additional information to be reported in the MPP or contained in the standard Manufacturing Practices Instruction is the method of positioning each forging or a number of forgings in the water tank during the quenching operation.</p> <p>4.2.2 <u>Testing and Evaluation</u></p> <p>4.2.2.1 Test specimens must be obtained from the bore test position in each forging. Table I - Part B lists the required mechanical properties that must be determined and be reported in the Forging Supplier Certificate of Test.</p> <p>4.2.2.2 <u>Purchaser Test Material</u></p> <p>The test rings shall be retained by the Supplier in accordance with GT 10047.</p>								
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<p align="center">TABLE I</p> <p align="center">REQUIRED MECHANICAL PROPERTIES TESTING¹⁾ (REFER TO FIGURE 1)</p> <p>A. Qualification Wheel Testing</p> <table border="1"> <thead> <tr> <th rowspan="2">Test Ring Location</th> <th rowspan="2">R.T. Tensile (KSI)</th> <th colspan="2">Charpy V-Notch</th> </tr> <tr> <th>FATT(2) (°F)</th> <th>Fibrosity at Test Temperature of -75F Percent)</th> </tr> </thead> <tbody> <tr> <td>B Ring</td> <td>1X</td> <td>1X</td> <td>2X</td> </tr> <tr> <td>R</td> <td>2X (0 & 180)</td> <td>1X</td> <td>2X</td> </tr> <tr> <td>MR</td> <td>1X</td> <td>1X</td> <td>--</td> </tr> <tr> <td>MB</td> <td>1X</td> <td>1X</td> <td>--</td> </tr> <tr> <td>BB</td> <td>1X</td> <td>1X</td> <td>2X</td> </tr> </tbody> </table>					Test Ring Location	R.T. Tensile (KSI)	Charpy V-Notch		FATT(2) (°F)	Fibrosity at Test Temperature of -75F Percent)	B Ring	1X	1X	2X	R	2X (0 & 180)	1X	2X	MR	1X	1X	--	MB	1X	1X	--	BB	1X	1X	2X
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B. Production Wheel Testing

Test Ring Location	R.T. Tensile (KSI)	Elevated Temp.(3)* Tensile (KSI)	Charpy V-Notch Fibrosity at Temp. of -75 ⁰ F (-59.4 ⁰ C) (Percent)
B Ring	1X	1X	2X

- (1) All specimens must be in the tangential (circumferential) direction. The Charpy V-notch specimens must have the root of the notch parallel with the centerline of the forging and the notch opening facing the bore.
- (2) The FATT must be estimated from a minimum of four specimens tested at different temperatures. The test temperatures must be selected in a manner that will result in high probability that two test temperatures are above the FATT at 50 percent and two test temperatures are below.
- (3) MS-5001 and 5002, **HY 19460** last stage compressor wheel forgings will have the elevated temperature tensile test performed at 200F, (**93.3⁰ C**) and the MS7FA and MS9FA 14th stage, B50A818 compressor wheel forgings will have the elevated temperature tensile test performed at 350°F (**176.7⁰ C**)
- (4) Hardness testing is required for all qualification and production forgings and it must respectively be performed per Paras. 4.1.2.5 and 4.2.2.



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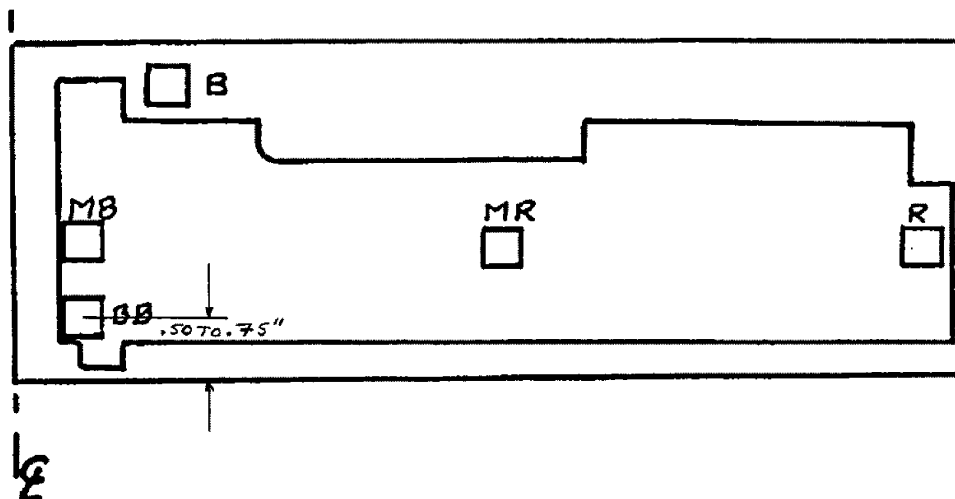
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FIGURE 1

MECHANICAL PROPERTIES TESTING LOCATIONS



♦ Refer to Para. 4.1.2.1.


- (1) Specimens MB and BB - The test specimen centers must be 12.7 to 19.05 (0.5" to 0.75") from the bore surface. In addition, Specimens BB must be 12.7 to 19.05 (0.5" to 0.75") below the as-heat treated radial-circumferential surface.
- (2) Specimens R, MR and MB - The test specimen centers must be located at the forging's mid height or mid thickness. In addition, Specimen MR must be located at the forging's mid radius and specimen R must be 12.7 to 19.05 (0.5" to 0.75") from the as-heat treated outer diameter.
- (3) Specimen B - 19.05 x 19.05 mm (.75" x .75") Nominal Cross Section Ring - The center of the bore ring must be 12.7 to 19.05 (0.5" to 0.75") below the as-heat treated radial circumferential surface
- (4) All test specimen locations and orientations within the as-heated forging envelope must be accurately defined and documented in the qualification report.

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	02	1.7.21	Generic Rev	CNK	KDG
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