

QA Plan for casting/ rough machined cast components no. : QTM/QAP/VENDOR/13-14/001 Rev.08 Dt.: 02.01.2021

**Part 1: Final inspection of the component before dispatch from vendor works (#)**

Sl. No	Name of the process	Parameters for inspection	Quantum of check*		Mode of inspection/ equipment used	Drawing No./Spec./ Std.	Acceptance norms***	Requirement from supplier (See note 1)
			TP/Supplier	TPIA/QC**				
1	Casting for magnet frame, stator housing, stator chamber DE & NDE, suspension tube, rotor components (commutator hub, commutator 'v' ring, rotor end ring etc.) and bearing assembly components (end shields, wipers, bearing cap/ covers etc.)	Source of casting	100%	100%	Proof of source of casting	-	<ul style="list-style-type: none"> <li>Casting manufacturer (in-house/ outsourced) shall be RDSO approved class 'A' foundry.</li> <li>In case of outsourcing, quantity procured by supplier shall be verified from challan/ invoice for meeting the BHEL PO quantity.</li> </ul>	In case of outsourcing:  1. Proof of source of casting to be provided to BHEL.  2. Challan/ invoice to be provided to BHEL.
2	Heat Treatment	Soaking temperature/ Soaking time	100%	100% TC to be verified	Temperature recorder/ Time temperature charts	Heat treatment requirement as per BHEL specification mentioned in the drawing	Mechanical properties as specified in the BHEL specification	Heat treatment report and graph to be provided to BHEL
3	Shot/Sand blasting	Casting surface finish	100%	20%	Instrument	As per BHEL drawing	Surface finish to be less than 50µm in 100% area except profile transition zone (Ref. IS: 3073)	Report of shot/sand blasting and surface finish to be provided to BHEL

लवकुश मौर्य / L. K. MAURYA  
 अभियंता / Engineer  
 क्यू.टी.एम. प्रभाग / Q.T.M. Division  
 बी.एच.ई.एल., भोपाल / BHEL, BHOPAL

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			TP/Supplier	TPIA/QC**				
4	Melt Analysis	Chemical composition mentioned in the BHEL specification /drawing	One sample per heat/ per heat treatment batch	100% TC to be verified	Spectrometer / Wet analysis method	As per BHEL drawing/ specification	As per BHEL drawing/specification	TC (from casting manufacturer or NABL accredited lab) to be provided to BHEL. Three test samples\$ per heat / per heat treatment batch is to be verified by TPIA (for heat & heat treatment batch punched by supplier matching with test certificate reports above) to be provided to BHEL.
5	Mechanical Testing	Mechanical properties mentioned in the BHEL specification /drawing	One sample per heat/ per heat treatment batch	100% TC to be verified	Mechanical testing equipment	As per BHEL drawing/ specification	As per BHEL drawing/specification	

\$: 1) In case item manufactured is by sand casting, 3 keel blocks (separately cast/integrally cast as per specification) to be supplied.  
 2) In case item manufactured is by investment casting, 3 test pieces of size Ø30 X 260 ±10 to be supplied.

लवकुश मौर्या / L. K. MAURYA  
 अभियंता / Engineer  
 क्यू.टी.एम. प्रभाग / Q.T.M. Division  
 बी.एच.ई.एल., भोपाल / BHEL, BHOPAL

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			TP/Supplier	TP/IA/QC**				
6	Hardness checking on casting	Hardness limit mentioned in the BHEL specification/drawing	20% of components/ Heat treatment batch / Lot	10% of components / Heat treatment batch / Lot	Hardness testing equipment	As per BHEL drawing/specification	As per BHEL drawing/specification	Hardness test report to be provided to BHEL
7	Identification Marking	Identification marking of casting manufacturer by embossing on castings on the location shown in drawing or location may be taken from BHEL Engg. Dept.	100%	100%	Visual	As per BHEL drawing/specification TM12548	Identification marking as per BHEL drawing/specification TM12548	-
8	Dimensional Inspection	Cast dimensions	All drawing dimension of 100% component	All drawing dimension of 10% component	Instrument	As per BHEL drawing	<p>1) a) In case order is as per casting drawing: As per BHEL drawing.</p> <p>b) In case order is as per rough m/cd drawing: As per BHEL drawing along with concentricity less than 1mm.</p> <p>c) In case order is from finish machined drawing: 4(+/-0.5) mm machining allowances on each tool point along with concentricity less than 1mm.</p>	Dimensional witness report to be provided to BHEL

  
 लवकुश मौर्य / L. K. MAURYA  
 अभियंता / Engineer  
 क्यू.टी.एम. प्रभाग / Q.T.M. Division  
 बी.एच.ई.एल. भोपाल / BHEL, BHOPAL


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			TP/Supplier	TPIA/QC**				
8	Dimensional Inspection	Rough machined dimensions	All drawing dimension of 100% component	All drawing dimension of 20% component	Instrument	As per BHEL drawing	2) Centre line on each job should be marked to ensure the cast, rough m/cd dimensions as per the casting, rough m/cd drawing requirement or machining allowance on each tool point of finish machined drawing.	Dimensional witness report to be provided to BHEL
9	Non Destructive Tests (NDT) (DP/MPI/UT)	DP/MPI/UT tests as mentioned in the BHEL drawing/ specification	100% (DP) or Sampling percentage as mentioned in the BHEL drawing / specification	20% (DP)	NDT equipment	As per BHEL drawing/ specification	As per BHEL drawing/ specification	NDT (DP/MPI/UT) report of 100% components or sampling percentage as mentioned in the BHEL drawing / specification shall be submitted along with consignment. Report issuing inspector shall be ISNT/ASNT level-II in respective NDT test and reports shall be duly signed & stamped by inspector.
			100% (UT) or Sampling percentage as mentioned in the BHEL drawing / specification	20% (UT)				
			100% (MPI) or Sampling percentage as mentioned in the BHEL drawing / specification	20% (MPI)				

लवकुश मौर्य / L. K. MAURYA  
अभियंता / Engineer  
क्यू.टी.एम. प्रभाग / Q.T.M. Division  
बी.एच.ई.एल., भोपाल / BHEL, BHOPAL

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			TP/Supplier	TPIA/QC**				
10	Non Destructive Tests (NDT) (Radiography)	Radiography tests as mentioned in the BHEL drawing/ specification	10% (Radiography ) or Sampling percentage as mentioned in the BHEL drawing/ specification/ PO (whichever is higher)	Witness & Verification of radiography report & films for correlation with components  <b>Note:</b> In case of <b>suspension tube &amp; steel ventilators</b> , TPIA/BHEL QC to identify the cast/rough machined suspension tube/steel ventilator serial nos. (embossed on casting) for radiography test. Radiography report & films during casting/ rough machining stage of suspension tube/steel ventilator (identified by	NDT equipment	As per BHEL drawing/ specification	As per BHEL drawing/ specification	Radiography report & films of 10% components or sampling percentage as mentioned in BHEL drawing / specification shall be submitted. Report issuing inspector shall be ISNT/ASNT level-II in radiography and reports shall be duly signed & stamped by inspector.  <b>Note:</b> In case of <b>suspension tube &amp; steel ventilator</b> , radiography report & films shall be submitted during casting/ rough machining

  
 लवकुश मौर्य / L. K. MAURYA  
 अभियंता / Engineer  
 क्यू.टी.एम. प्रभाग / Q.T.M. Division  
 बी.एच.ई.एल., भोपाल / BHEL, BHOPAL

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				TPIA/BHEL QC) shall be provided to BHEL for				
Sl. No	Name of the process	Parameters for inspection	Quantum of check*		Mode of inspection/ equipment used	Drawing No./Spec./ Std.	Acceptance norms***	Requirement from supplier (See note 1)
			TP/Supplier	TPIA/QC**				
10				verification & approval <sup>Ω</sup> .				stage to BHEL for verification & approval <sup>Ω</sup> . Supplier shall also submit filled checklist as per page 3 of radiography process spec. no. BHEL/BPL/ QNDT/26 in compliance of the said spec. along with above.
Note: 1. BHEL reserve the right to carry out radiography test at BHEL Bhopal on randomly selected jobs or jobs for which radiography report & films have been submitted by the supplier for ensuring radiography requirement. 2. <sup>Ω</sup> Delay in supply due to non-clearance of castings/rough-machined castings because of any non-conformity observed in radiography report/films during verification at BHEL shall not be considered as reason for delay in supplies as per PO delivery requirement.								
11	Visual Inspection	Component to be free from any abnormality such as blow hole, pin hole, dent etc.	100%	100%	Visual	As per BHEL drawing/ specification	Free from visual defect	-
	Paint (Visual, Dry paint thickness and	Inorganic ethyl zinc silicate primer paint	100%	100% (Visual) & 10% per lot	Visual and	As per relevant BHEL drawing/	As per relevant BHEL drawing/ specification	Report to be submitted for:

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	Adhesion test)	(specification AA56113) on cast surfaces		(DFT and adhesion test)	Instruments	specification TM94217 (latest revision)	TM94217	<ul style="list-style-type: none"> <li>• Visual</li> <li>• DFT</li> <li>• Adhesion</li> </ul>
Sl. No	Name of the process	Parameters for inspection	Quantum of check*		Mode of inspection/ equipment used	Drawing No./Spec./ Std.	Acceptance norms***	Requirement from supplier (See note 1)
			TP/Supplier	TPIA/QC**				
13	List of Calibration records of used measuring & Testing Equipment's	Calibration due date, accreditation status of master instruments	100%	100%	Verification	-	-	List of Calibration records of measuring and Testing instruments is to be provided to BHEL as per annexure-A.

**Notes:**

- 1) All test records checked by TP, TP/IA/QC (dully signed & sealed) as per above QAP requirement shall be submitted along with consignment.
- 2) Final acceptance will be based on inspection at BHEL, Bhopal.
- 3) (\*) Quantum of inspection shall be in line with QAP unless otherwise mentioned in the drawing.
- 4) (\*\*) Job shall be randomly selected from offered lot, the quantum of check (min. 1 no.) from the offered lot to be checked by TP/IA or QC. (e.g.: If lot size is 2 then minimum one no is to be checked).
- 5) (\*\*\*) Sample inspection of component does not mean that the supplier will not meet drawing & specification requirements in remaining components. In case any defect / non-conformance is observed at any stage (during processing or before and after fitment in any job), the same is liable to be rejected and same shall be replaced immediately by the supplier at BHEL or BHEL Customer site (wherever deficiency is observed) and necessary penal action will be taken as per BHEL norms.

लवकुश मौर्य L. K. MAURYA  
अभियंता / Engineer  
क्यू.टी.एम. प्रभाग / Q.T.M. Division  
बी.एच.ई.एल., भोपाल / BHEL, BHOPAL

**Part II: Requirement of clearance of 1<sup>st</sup> lot from BHEL:**

- 1) First lot of item shall be supplied after meeting all QAP requirements to BHEL Bhopal and supply of subsequent lots shall be undertaken only after clearance of first lot by BHEL Bhopal.
- 2) Vendor has to initiate the supplies as per PO delivery only. Delay in supply of first lot of components or rejection of components due to any non-conformity/ quality deficiency shall not be considered as reason for delay in supply of components in subsequent deliveries as per PO delivery requirement.
- 3) Initial clearance of 1st lot of items does not absolve the supplier from supply of items as per drawing and specification requirement in subsequent lots.

**Meaning of Legends: '#' - Supplier to submit test certificates & reports of above mentioned parameters.**

**Abbreviation:** TPIA –BHEL appointed third Party Inspecting Agency, T P – Task Performer (vendor), QC- Quality Control (QIX / BHEL appointed inspection agency)

Prepared by:	Approved by:	Issued by:
<div> <b>लवकुश मौर्य / L. K. MAURYA</b> <b>OTM</b> अभियंता / Engineer क्यू.टी.एम. प्रभाग / Q.T.M. Division बी.एच.ई.एल., भोपाल / BHEL, BHOPAL</div>	<div><div> <b>मनीष वर्मा / MANISH VERMA</b> <b>TME</b> उप महाप्रबंधक (अभिकल्प) / DGM (Design) टी.एम.ई. विभाग / TME Division बी.एच.ई.एल., भोपाल / BHEL, Bhopal</div><div> <b>राजेश कुमार / RAJESH KUMAR</b> <b>TXM</b> वरि. प्रबंधक / Sr. Manager टी.एक्स.एम. विभाग / TXM Division बी.एच.ई.एल., भोपाल / BHEL, Bhopal</div></div>	<div><div> <b>एम. एल. क. / M. L. K.</b> <b>QTM</b> उप महाप्रबंधक / Dy. Ge. क्यू.टी.एम. प्रभाग / Q.T.M. Division बी.एच.ई.एल., भोपाल / BHEL, BHOPAL</div><div> <b>राहुल टोप्पो / RAHUL DEY</b> <b>QTM</b> प्रबंधक / Manager क्यू.टी.एम. विभाग / QTM Division बी.एच.ई.एल., भोपाल / BHEL, Bhopal</div></div>

**BHARAT HEAVY ELECTRICALS LIMITED, BHOPAL**  
**QUALITY CONTROL TRANSPORTATION**  
**QUALITY ASSURANCE PLAN (QAP)**

Ref.: TM12545 Rev. 07 Dt.06.08.22

QA Plan for fully finished components (with finish dimensions final machined on CNC machines) with mandatory requirement of checking on 3D CMM, supplied on fully finish basis or labour basis

Note: Components to be finished machined on CNC are Stator frame, Bearing assy. components (including end shields), Suspension tube & its assy. components

**Part 1: Final inspection of the component before dispatch from vendor works (#)**

Sl. No.	Name of the Process	Parameters of Inspection	Quantum of Check*		Mode of Inspection/ Equipment used	Drawing No./Spec./Std.	Acceptance Norms***	Remarks
			TP (Supplier)	Inspection Agency **				
1.	Raw material	Applicable only in case order is executed on fully finish basis						
	a. If the raw material is casting.	Applicable QAP No.: QTM/QAP/VENDOR/13-14/001 (latest revision) [Witness & Verification of RT reports & films for correlation with components, only record verification of material testing/checking parameters and verification of 3 test samples (keel blocks separately cast/integrally cast as per specification to be supplied along with consignment.) as per raw material QAP to be done by TPI. No inspection/record verification for cast/rough machined dimensions as per casting QAP.]						
	b. If the raw material is fabrication/ plate.	Applicable QAP No.: QTM/QAP/FABRICATED ITEMS/VENDOR/18-19/01 (latest revision) [Only record verification of testing/checking parameters and verification of TC of plate used for fabrication of component (to be supplied along with consignment) as per raw material QAP to be done by TPI. No inspection/record verification for fabricated/rough machined dimensions as per fabrication QAP.]						
	c. If the raw material is forging.	Applicable QAP No.: QTM/QAP/VENDOR/13-14/002 (latest revision) [Only record verification of testing/checking parameters and verification of 3 test samples to be supplied along with consignment) as per raw material QAP to be done by TPI. No inspection/record verification for forge/rough machined dimensions as per forging QAP.]						
2.	Dimensions	A) Critical to quality (CTQ) dimensions as marked in drawing	A) 100%	A) 20% (Min.)	3D CMM	As per relevant BHEL Drawing	As per relevant BHEL Drawing	\$- In case of TM 6FRA bearing components inspection on 3D-CMM, inspection agency shall be RDSO and for other cases inspection shall be carried out by agency mentioned in PO.
		B) Other dimensions (machined/ un-machined).	B) 100%	B) 20% (Min.)	3D CMM / Gauges & Instruments			
गजेन्द्र सिंह राठी/R.G.S. RATHORE								

गजेन्द्र सिंह राठौर / G.S. RATHORE

उप प्रबंधक / Manager

कच्चा व निर्यात विभाग / QTM Division

बी.एस.एस. भोपाल / BHEL, BHOPAL

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Sl. No.	Name of the Process	Parameters of Inspection	Quantum of Check*		Mode of Inspection/ Equipment used	Drawing No./Spec./Std.	Acceptance Norms***	Requirement from supplier
			TP (Supplier)	Inspection Agency				
3.	Visual Inspection	Free from visual defect.	100%	100%	Visual	-	Component to be free from any abnormality such as blow hole, pin hole, dent etc.	-
4.	Identification marking	Identification marking at machining stage on the location shown in drawing or location may be taken from BHEL Engg. Dept.	100%	10%	Verification	As per relevant BHEL drawing/ specification TM12548	Identification marking as per BHEL drawing/spec. TM12548	-
5.	Paint (Visual, Dry paint thickness and Adhesion test)	Epoxy primer paint (specification AA56113) on um-machined surfaces.	100%	100%(Visual) & 10% per lot (DFT and adhesion test)	Visual and Instruments	As per relevant BHEL Drawing/ specification TM94217 (Latest Rev)	As per relevant BHEL Drawing/ specification TM94217 (Latest Rev)	Report to be submitted for- • Visual • DFT • Adhesion

गजेन्द्र सिंह राठौर/G.S. RATHORE

उप प्रबंधक / Dy. Manager

कच्चा टैंक विभाग / CTKM Division

बी.एच.एल. भोपाल/BHEL, BHOPAL

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			TP (Supplier)	Inspection Agency				
6.	Packing	Packaging suitability for transit & storage	100%	-	Visual	-	-	Each component shall be suitably packed & wrapped to avoid any damage to components during transit and ingress of water. Note: In case any damage to machined surface found during inspection at BHEL, job will be liable to be rejected.

गजेन्द्र सिंह राठी / G.S. RATHORE  
 डि. इन्स्पेक्टर / Manager  
 क्वालिटी मैनेजिंग / QTM Division  
 बीएचएल, भोपाल / BHEL, BHOPAL

## Notes:

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Prepared by:	Approved by:	Issued by:
गजेन्द्र सिंह राठौर / G.S. RATHORE उप प्रबन्धक / Dy. Manager क्यू टी एम विभाग / QTM Division बी.एच.ई.एल. भोपाल / BHEL, BHOPAL <b>QTM</b>	<div> <div> 06/08/22  मनीष  TME  MANISH VERMA  वरिष्ठ उप महाप्रबन्धक (अभि.) / Sr. DGM (Design)  टी.एम.ई. विभाग / TME Division  बी.एच.ई.एल. भोपाल / BHEL, BHOPAL </div> <div> राजेश कुमार  RAJESH KUMAR  ज्येष्ठ प्रबन्धक / Sr. Manager  टी.एक्स.एम. विभाग / TXM Division  बी.एच.ई.एल. भोपाल / BHEL, BHOPAL </div> <div> राहुल टोप्पो  RAHUL TOPPO  प्रबन्धक / Manager  क्यू टी एम विभाग / QTM Division  बी.एच.ई.एल. भोपाल / BHEL, BHOPAL  <b>QTM</b> </div> </div>	गजेन्द्र सिंह राठौर उप प्रबन्धक / Dy. Manager क्यू टी एम विभाग / QTM Division बी.एच.ई.एल. भोपाल / BHEL, BHOPAL <b>QTM</b>