

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

**QA Plan for casting/ rough machined cast components no. : QTM/QAP/VENDOR/13-14/001 Rev.10 Dt.: 28.05.2024**

**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	TP/IA/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>1. For components of TM type 6FRA6068/ 6FXA7059/ HS15250: Casting manufacturer (in-house/ outsourced) shall be RDSO approved class 'A' foundry with valid certification.</li><li>2. For other components: Casting manufacturer (in-house/ outsourced) shall be class 'A' foundry as listed in document no. TM22604 (annexure 1) or shall meet the qualifying criteria as per document no. TM22604 (annexure 1).</li><li>In case of outsourcing, quantity procured by supplier shall be verified from challan/ invoice for meeting the BHEL PO quantity.</li></ul>	<ul style="list-style-type: none"><li>In case of outsourcing: 1. Proof of source of casting to be provided to BHEL</li><li>2. Challan/ invoice to be provided to BHEL</li></ul>

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			TP/Supplier	TP/IA/QC**				
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
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
5	Mechanical Testing	Mechanical properties mentioned in the BHEL specification /drawing	One sample per heat/ per heat treatment	100% TC to be verified	Mechanical testing equipment	As per BHEL drawing/ specification	As per BHEL drawing/specification	

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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) reports above) to be provided to BHEL
			TP/Supplier	TP/IA/QC**				
\$. 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.								
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	1) a) In case order is as per casting drawing: As per BHEL drawing. b) In case order is as per rough m/cd drawing: As per BHEL drawing along with concentricity less than 1mm. c) In case order is from finish machined	Dimensional witness report to be provided to BHEL

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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	TP/IA/QC**				
							drawing: 4(+/-0.5) mm machining allowances on each tool point along with concentricity less than 1mm.	
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/MP/UT)	DP/MP/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/MP/UT) report of 100% components or sampling percentage as mentioned in the BHEL drawing / specification shall be submitted along with consignment.

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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	TP/IA/QC**				
			100% (MPI) or Sampling percentage as mentioned in the BHEL drawing / specification	20% (MPI)				Radiography report & films of 5% components or sampling percentage as mentioned in BHEL drawing / specification shall be submitted. Report issuing inspector shall be ISNT/ASNT level-II in respective NDT test and reports shall be duly signed & stamped by inspector.
10	Non Destructive Tests (NDT) (Radiography)	Radiography tests as mentioned in the BHEL drawing/ specification	5% (Radiography) or Sampling percentage as mentioned in the BHEL drawing/ specification/ PO (whichever is higher. Subject to minimum 01 no./ set.	Witness & Verification of radiography report & films for correlation with components  Note: In case of suspension tube & steel ventilators, TP/IA/BHEL QC to identify the cast/rough machined suspension tube/steel ventilator serial nos. (embossed on casting) for	NDT equipment	As per BHEL drawing/ specification	As per BHEL drawing/ specification	Radiography report & films of 5% 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.

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Sl. No. Name of the process

Parameters for inspection

Quantum of check\*  
TP/Supplier TPIA/QC\*\*

Mode of inspection/ equipment used

Drawing No./Spec./ Std.

Acceptance norms\*\*\*

from supplier (See note 1) Note: In case of suspension tube & steel ventilator, radiography report & films shall be submitted during casting/ rough machining stage to BHEL for verification & approval.

radiography test. Radiography report & films during casting/ rough machining stage of suspension tube/steel ventilator (identified by TPIA/BHEL QC) shall be provided to BHEL for verification & approval.

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. 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.

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Sr. Manager  
BHEL/BPL/ QNDT/26

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			TP/Supplier	TP/IA/QC**				
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	-
12	Paint (Visual, Dry paint thickness and Adhesion test)	Inorganic ethyl zinc silicate primer paint (specification AA56113) on cast surfaces	100%	100% (Visual) & 10% per lot (DFT and adhesion test)	Visual and Instruments	As per relevant BHEL drawing/ specification TM94217 (latest revision)	As per relevant BHEL drawing/ specification TM94217	Report to be submitted for: • Visual • DFT • Adhesion
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:

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- 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 filment in any job),





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

Ref.: TM12545 Rev. 09 Dt.28.05.2024

**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***	Requirement from supplier
			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	\$-Inspection of 3D CMM checking shall be done Either by RDSO or TPI(A(supplier to confirm before call booking)) in case of TM 6FR46068 bearing components only And for others inspection shall be done by agency as mentioned in PO.
	B) Other dimensions	B) 100%	C) 20% (Min.)	3D CMM / Gauges & Instruments	As per relevant BHEL Drawing	As per relevant BHEL Drawing		

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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				
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.

Notes:

- 1) All test records, dimensional reports (3D CMM & MANUAL) checked & reviewed by TP, 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 QC. (e.g : If lot size is 2 then minimum one no is to be checked).
- 5) (\*\*\*) Sample inspection 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.
- 6) Calibration records of all the measuring machines, instruments, gauges, fixtures etc. used for dimensional measurement shall be duly reviewed by BHEL/BHEL inspection agency before start of inspection.

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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: T P – Task Performer (Supplier), QC – Quality Control (QIX / BHEL appointed inspection agency)

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