

**Technical Qualification Requirements for supplying Rough Turned Shaft Forgings (Steel)
as per BHEL Drawing / Size and Material Specification for Rate Contract**

Ref. No.: AME/TQR/RTSHAFT/RC/Rev.01

Original issue Date: 03-07-2026

Revision date : 31-8-26

Following requirements are mandatory. Offers of vendors not meeting these requirements will not be considered.

1. Only OEMs / manufacturers are eligible. Vendor confirms that he is original manufacturer of the tendered item.
2. The design features, dimensions and material of construction shall be strictly as per BHEL drawing, QAP and specifications as per bid document.
3. Rough Turned Shaft Forgings must be manufactured from steel produced by the open hearth, electric or such other processes. The steel shall be "Fully killed". The minimum reduction ratio of forging shall be 4:1.
4. Manufacturing / testing facility assessment may be carried out at vendor works by BHEL, if required.

S. No.	Description of Requirement	Supporting Documents Required																		
5.	<u>Supply Experience:</u> Vendor must have at least 3 years of experience (calculated from tender opening date) of manufacturing and supply of at least 25 nos steel shaft forgings. <i>For example</i>, vendor has to provide AT LEAST one proof of supply from year 2020, 2021, 2022, 2023 etc or of any older date to establish 3 years' experience . In total, vendor has to give proof of supply of at least 25 nos steel shaft forgings.	Purchase order/ s copies AND Proof of supply like Invoice / CRAC / Test Certificate / Delivery challan etc. Note: In case supply experience to BHEL Bhopal is available, then only PO number is sufficient. The relevant POs should meet the required experience criteria laid down in column on left side. However, in case of non-supply or rejection of shaft, such POs will not be considered																		
	<table><tr><th>Enq. It.</th><th>Shaft Diameter Range (in mm)</th><th colspan="2">Experience required (Shaft major dia in mm)</th></tr><tr><td>#01</td><td>130 ≤ D ≤ 200</td><td>At least 01 no shaft dia ≥ 200</td><td>Remaining at least 24 nos shafts have to be at least 130 mm dia</td></tr><tr><td>#02</td><td>210 ≤ D ≤ 290</td><td>At least 01 no shaft dia ≥ 290</td><td rowspan="3">Remaining at least 24 nos have to be at least 210 mm dia</td></tr><tr><td>#03</td><td>300 ≤ D ≤ 350</td><td>At least 01 no shaft dia ≥ 350</td></tr><tr><td>#04</td><td>360 ≤ D ≤ 440</td><td>At least 01 no shaft dia ≥ 440</td></tr></table>		Enq. It.	Shaft Diameter Range (in mm)	Experience required (Shaft major dia in mm)		#01	130 ≤ D ≤ 200	At least 01 no shaft dia ≥ 200	Remaining at least 24 nos shafts have to be at least 130 mm dia	#02	210 ≤ D ≤ 290	At least 01 no shaft dia ≥ 290	Remaining at least 24 nos have to be at least 210 mm dia	#03	300 ≤ D ≤ 350	At least 01 no shaft dia ≥ 350	#04	360 ≤ D ≤ 440	At least 01 no shaft dia ≥ 440
	Enq. It.		Shaft Diameter Range (in mm)	Experience required (Shaft major dia in mm)																
	#01		130 ≤ D ≤ 200	At least 01 no shaft dia ≥ 200	Remaining at least 24 nos shafts have to be at least 130 mm dia															
	#02		210 ≤ D ≤ 290	At least 01 no shaft dia ≥ 290	Remaining at least 24 nos have to be at least 210 mm dia															
	#03		300 ≤ D ≤ 350	At least 01 no shaft dia ≥ 350																
#04	360 ≤ D ≤ 440	At least 01 no shaft dia ≥ 440																		
Qualification will be established/ judged for each item individually.																				
6.	a) Vendor must have in-house forging and heat treatment facilities to manufacture Rough Turned Shaft forgings as per BHEL drawing and material specification. Outsourcing of any of these processes is not acceptable.	(a) Details of in-house manufacturing facilities																		

The bidder hereby confirms compliance to all the above clauses of technical qualification requirements

Sign and Seal of Bidder

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	(b) If raw material like ingots / blooms / billets is being sourced from outside sources, vendor has to provide details of the supplier(s) with their manufacturing facility.	(b) If raw material like ingots / blooms / billets are being sourced from outside, vendor to provide at least 01 PO copy OR at least 01 TC of the raw material.
7a	The manufacturer should have testing facilities (either inhouse or outsourced) to conduct tests as per applicable BHEL QA Plan and specification as per bid document. All the testing equipment used should be calibrated by NABL/ equivalent national/ international accreditation agency.	Vendor to provide details / list of in-house testing facilities
7b	If the test facility for conducting one or all of the tests is outsourced, then vendor has to test in NABL/ Government/ national / international accredited testing agency.	Vendor to confirm (Yes/ No)



Mukul Anhalani, Sr Manager (AME)

Nidhi Gupta, Sr. DGM (AME)



Mukesh Kumar Maravi, AGM (AME, ISE)



The bidder hereby confirms compliance to all the above clauses of technical qualification requirements

Sign and Seal of Bidder



PLANT PURCHASING SPECIFICATION BHOPAL

BP 19388

Rev. No. 11

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SUPERSEDES
BP 19388 Rev.10

MANGANESE STEEL FORGINGS - NORMALIZED

1. GENERAL:

This specification governs the quality of Manganese Steel Forgings- Normalized.

2. APPLICATION:

Shafts –Weldable – for Motors.

3. CONDITION OF DELIVERY :

Normalized Rough Machining of the forgings shall be carried out, unless otherwise specified on the order / drawings.

4. COMPLIANCE WITH NATIONAL STANDARDS:

There is no Indian Standard covering this type of material. This Specification is broadly based on M/s Siemens Germany specification SN 40261 July – 1995 Gr.20 Mn 5N.

5. DIMENSIONS AND TOLERANCES :

The dimensions & tolerances shall be as specified on the order / drawing. Where ever these are not specified, forgings shall be supplied as per agreement between the purchaser & the supplier.

6. MANUFACTURE :

Forgings shall be manufactured from steel produced by the open hearth, electric or such other process as may be agreed to between the purchaser and the supplier.

The steel shall be fully killed.

Sufficient discard shall be made from each ingot to ensure freedom from pipe, segregation and other defects.

The amount of hot working and finishing temperature shall be such as to ensure complete soundness and adequate uniformity of structure and mechanical properties after heat treatment. The Forgings shall not be overheated.

The minimum reduction ratio when Forgings are made out of ingots shall be 4:1

Revision :

Clause 10 updated.

Issued by :

STANDARDS AND MATERIALS GROUP
TECHNICAL SERVICES DEPARTMENT

Rev. 11

Date : 13.04.2024

Date of first Issue : Sept'1984



PLANT PURCHASING SPECIFICATION BHOPAL

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7. HEAT TREATMENT :

Forgings shall be normalized at suitable temperature to attain the mechanical properties specified.

8. FINISH : As mentioned in the drawing.

9. FREEDOM FROM DEFECTS :

Forgings shall be free from defects such as cracks, flakes, seams, segregation, non-metallic inclusions and other defects which may affect the utility of the forgings.

10. CHEMICAL COMPOSITION :

The ladle analysis of the steel and permissible variation in the composition of the forging from the analysis shall be as follows :-

Element	Percent		Permissible Variation Percent
	Min.	Max.	
Carbon	0.17	0.23	± 0.02
Silicon	-	0.60	+ 0.03
Manganese	1.00	1.50	± 0.05
Sulphur	-	0.035	+ 0.005
Phosphorus	-	0.035	+0.005

Note:1) Elements not quoted above shall not be added to the steel, other than for the purpose of finishing the heat and shall not exceed the following limits.

Element	Percent Max.
Nickel	0.30
Chromium	0.30
Copper	0.25
Molybdenum	0.15
Vanadium	0.05
Tin	0.05
Aluminium (Total)	0.50

- 2) Chemistry of the steel is to be adjusted in such a way that Carbon equivalent when calculated from the formula given below should not exceed 0.48%

$$\text{Carbon Equivalent} = C + \frac{\text{Mn}}{6} + \frac{\text{Cr} + \text{Mo} + \text{V}}{5} + \frac{\text{Ni} + \text{Cu}}{15}$$

11 TEST SAMPLE:

- 11.1 Unless otherwise specified on the order / drawing, test samples shall be taken from each heat and each heat treatment batch. Test samples should be cut from the heat treated forgings by cold process only and shall receive no further heat treatment.



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Test samples shall be taken from locations indicated on the drawing, leaving enough material, if required, for testing at purchaser's end, integral with the forgings.

Test samples shall be cylindrical or rectangular in shape & cut at a distance of One-third radius or one – sixth diagonal from the outer surface.

12. MECHANICAL PROPERTIES :

The test pieces, after being heat treated as per clause 7, shall show the following properties :

Only Longitudinal tests shall be conducted unless otherwise specified in the Drawing /Purchase Indent.

When it is not possible to test the material by a Standard Longitudinal test piece, material taken in the Tangential or Transverse direction must meet the properties specified in clause 12.1 & clause 12.2 below.

12.1 Tensile Strength :

When tested in accordance with IS:1608, the test pieces shall show the following properties.

Shaft Dia mm		Tensile Strength	Yield Strength	% Elongation on 5.65√So Gauge Length Min.		
Over	Upto	N/mm ²	N/mm ² , Min.	L	T	Q
-	250	490-640	295	22	19	15
250	600	490-640	275	21	18	14

'L' = Longitudinal, 'T' = Tangential, 'Q' = Transverse – Test Samples.

12.2 Impact Value :

When tested, in accordance with IS : 1757 (Charpy Impact V-Notch) the test pieces shall show the following Charpy values (Average of 3 samples) on specimens at Room Temperature.

Longitudinal - 48 Joules Min.
Tangential - 34 Joules Min.
Transverse - 24 Joules Min.

12.3 HARDNESS (BRINELL) :

When tested in accordance with IS:1500 the material shall show a Brinell Hardness of 140 to 200 HB.

13. NON – DESTRUCTIVE TESTING :

The forgings shall be subjected to the Non-Destructive Testing procedure laid down in BHEL Corporate Standard AA 085 01 18. The Ultrasonic Testing of Steel Forgings, and the Acceptance norms shall be as mentioned below :



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1. Defect size admissibility shall be :

- A) In outer region of shaft i.e. between 75 & 100% of the radius, Category -1 of AA0850118.
- B) In the region of 25% to 75% of radius, Category-2 of AA0850118.
- C) In the inner region of shaft i.e. between 0 & 25% of the radius Category-3 of AA0850118.

- 2. The minimum distance between two adjacent faults should be at least 10 times of the larger Fault for all regions.
- 3. Reduction of back wall echo to less than 50% is not acceptable for all regions.

14. INSPECTION AT SUPPLIER'S WORKS :

Test and inspection are to be conducted in the presence of the customer's representative.

The representative shall have free access at all times while the Work on the contract is being performed, to all parts of the manufacture's works. The supplier shall offer the purchaser's representative all reasonable facilities, without charge, to satisfy the latter, that the material is being furnished in accordance with this specification.

The supplier shall prepare and provide necessary test specimens for testing to be carried out at his premises. If facilities are not available at his works, the supplier shall make necessary arrangement for carrying out the prescribed tests elsewhere.

15. TEST CERTIFICATES :

Three copies of test certificates including one transparent copy shall be supplied unless otherwise stated on the order, in the Test Certificate Format annexed to this specification (Annexure-1).

16. PACKING AND MARKING :

Forgings shall be suitably packed to prevent corrosion and damage during transit.

Machined surface shall be properly protected with a rust preventive (hard film) having a protection period of one year.

Each package of forging (When supplied separately) shall be legibly marked with the following information.

BP 19388 : Manganese Steel Forgings – Normalized

Our Order No. / Drawing No / PF No.

Batch No.

Weight

Supplier's Name



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ANNEXURE – I RECOMMENDED TEST CERTIFICATE FORMAT FOR FORGINGS

SUPPLIER'S NAME AND ADDRESS TEST CERTIFICATE FOR FORGINGS									
1 Customer :					9 Reduction Ratio	Ingot to Bloom Bloom to Blank			
2 TC No. & Date					10. Batch No.				
3 PO No. :					11. Heat / Melt No.				
4 Process of Melting Ingot					12. Spec.No.				
5 Deoxidization Process					13. Test Bar Size & Nos.				
6 Forging Method :					14. Supplier of the ingot /billet/ Bloom and TC reference.				
7 BHEL's Reference for Approval of Bloom									
8 Discard : Top _____ % Bottom _____ %									
15. FORGINGS COVERED BY TEST CERTIFICATE									
S.No.	Drawing No. & item No			Description			Quantity & Weight		
16. CHEMICAL COMPOSITION (PERCENT)									
Element	C	Si	Mn	S	P				
As Per Min.									
Spec. Max.									
Actual Values									
17. HEAT TREATMENT (TO be accompanied by Recorder Chart, Whenever called for)									
Condition	Heating Rate °C/hr	Temp. °C		Soaking Hrs	Time.	Cooling Rate, °C/hr	Cooling Medium		
18. MECHANICAL PROPERTIES									
	T.S. N/m ²	Y.S. 0.5/0.2% Proof N/mm ²	% Elongation 5.65√So GL	% R.A. Min	Hardness BHN (Min. 3 values)	Impact Value Joules	Bend Test		
							Angle Of bend	Dia of Mandrel	Result
As Per Min Spec Max									
Actual Values									
19. Surface finish (When called for in the order /drg)									
20. DIMENSIONAL INSPECTION									
21. NON –DESTRUCTIVE TESTS									
Nature of Test	Acceptance level	Instrument used		Range	Results	Any other details			
Ultrasonic									
Radiographic									
Dye penetration / Magnetic Particle									
22. METALLOGRAPHIC EXAMINATION (To be conducted if called for and photo micrographics to be attached along with a report)									
Location of Sample	Etchant used	Magnification	Constituent observed	Relative %					
Microstructure	Macroetch	Inclusion Rating							
23. OTHER TESTS IF ANY (MICROSCOPIC, SULPHUR PRINTS, ETC)									
24. IDENTIFICATION OF FORGINGS AS PER PURCHASE SPEC									
We hereby certify that the items mentioned above have been tested and inspected in our presence and are found to be in accordance with drawings, specification and purchase order									
SIGNATURE, NAME OF SEAL OF THE INSPECTING OFFICER					SIGNATURE, NAME & SEAL OF THE CHIEF OF QUALITY CONTROL/ CHIEF METALLURGIST OF THE				
DATE SUPPLIER					DATE :				
INSTRUCTIONS									
a) Details of all heat treatment processes carried out should be furnished sequentially in 17.									
b) Test certificates are to be furnished as per Purchase order and specification, in A4 size preferably in transparent paper.									
c) All the entries including signature should be in block colour ink.									
d) If testing is done by outside agencies, the original TCs shall be furnished.									
e) The actual TC may run into more than one A4 size paper, if needed, to needed, to facilitate filling up of details.									

STANDARD MANUFACTURING QUALITY PLAN FOR ROUGH TURN SHAFT (FORGED)											
		QP. NO.: QA/MT/BOI/003 REV NO: 10 DATE: 09/06/2023							P- Perform, R-Report Review, W- Witness, V-Vendor, B-BHEL/TPIA		
PAGE : 1 of 2											
SL NO	STAGE	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY		REMARKS
									V	B	
1.	RAW MATERIAL -INGOT	Chemical Analysis (ladle)	Major	Chemical	Sample/heat	Specification / Drawing/PO	Specification/ Drawing/PO	TC	P	R	
2.	REDUCTION RATIO	a) Ingot to Bloom b) Bloom to Blank	Major	Dimension	100%	Specification / Drawing/PO	Specification/ Drawing/PO	TC	P	W	Dimensions of ingot & final forged shaft before start of machining shall be witness for RR calculation.
3.	NORMALIZING	Heat Treatment Chart	Major	Review of Chart	100%	Manufacturer Standard	Manufacturer Standard	TC	P	R	
4.	BLACK STAGE	a)Mechanical Properties- (i)longitudinal direction & transverse direction - Tensile Strength, Elongation, Yield Strength, Impact (ii)Hardness	Major	Mechanical	1 Sample/heat	Specification / Drawing/PO	Specification/ Drawing/PO	TC	P	W	On Sample identified (Seal & Stamped) by BHEL/TPIA -Dia. 170mm and above, tests is also to be performed in transverse direction in addition to longitudinal direction.
		b) Chemical Properties	Major	Chemical	1 Sample/heat	Specification / Drawing/PO	Specification/ Drawing/PO	TC	P	W	On Sample identified (Seal & Stamped) by BHEL/TPIA
		c) Visual check for impressions marks of forging process	Major	Visual	100%	Specification / Drawing/PO	Specification/ Drawing/PO	TC	P	W	

STANDARD MANUFACTURING QUALITY PLAN FOR ROUGH TURN SHAFT (FORGED) QP. NO.: QA/MT/BOI/003 REV NO: 10 DATE: 09/06/2023 P- Perform, R-Report Review, W- Witness, V-Vendor, B-BHEL/TPIA											
										PAGE : 2 of 2	
SL NO	STAGE	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY		REMARKS
									V	B	
		d) <u>Visual check</u> Free from cracks, flakes and non-metallic inclusions	Major	Visual	100%	Specification / Drawing/PO	Specification/ Drawing/PO	TC	P	W	
5	Rough Turned Shaft	Ultrasonic Test	Major	NDT	100%	Specification / Drawing/PO	Specification/ Drawing/PO	TC	P	W	
		All dimensions as per PO/ Drawing	Major	Measurement	100%	PO/ Drawing	PO/ Drawing	TC	P	W	Vendor shall supply 30 mm extra length (in addition to drawing / PO length) on each finished shaft forgings for random sample selection & testing at BHEL Bhopal
6.	Dispatch	Visual inspection/ Packing & marking	Major	Physical/Visual	100%	Manufacturer Standard	Manufacturer Standard	TC	P	R	
7.	Identification on shaft (Both Face of shaft forgings)	1. Vendor Name, 2. PO no. 3. Heat no. 4. Serial no./Forge No. 5. Drg no/size 6. Spec no.	Major	Physical/Visual	100%	BHEL Spec as per Drawing /PO	BHEL Spec as per Drawing /PO	TC	P	W	Marking by hard punch on both faces

Prepared & Reviewed by

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Approved by

एच.ए.टोपो / F.A. TOPPO
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		BHARAT HEAVY ELECTRICALS LIMITED <u>ITEM CLEARANCE CHECKLIST FOR TPIA/QIX</u>		
Ref : QEM/LEM/2024/A Date:- 13-06-2023		SRV No. –		
		PO NO. –		
		INVOICE DETAILS -		
		ITEM DESCRIPTION –		
		BOI QAP -		
SL.No.	CHECK POINT	TYPE OF CHECK	Page No.	REMARKS
1.	Chemical Analysis of Ingot Raw material	REVIEWED		
2.	Ingot size	WITNESSED		
3.	Forged shaft size (In Black stage)	WITNESSED		
4.	Reduction Ratio calculation	REVIEWED		
5.	Mechanical & Chemical properties in Black stage (Identified stamped sample)	WITNESSED		
6.	Visual check in black stage for impression marks of forging process, free from cracks, flakes & non-metallic inclusions	WITNESSED		
7.	UT & Dimensions of RT shaft	WITNESSED		
8.	Identification on both side face of shaft i.e. vendor name, PO No., Heat No., Forge No., Serial No., Drg. No., Size & Spec. No.	WITNESSED		
9.	Dispatch (Visual inspection/packing & marking)	REVIEWED		
10.	Inspector Name and mobile no.	To be Filled		
11.	TPI agency and validity period	To be Filled		

Discrepancy report if any –

Checked by