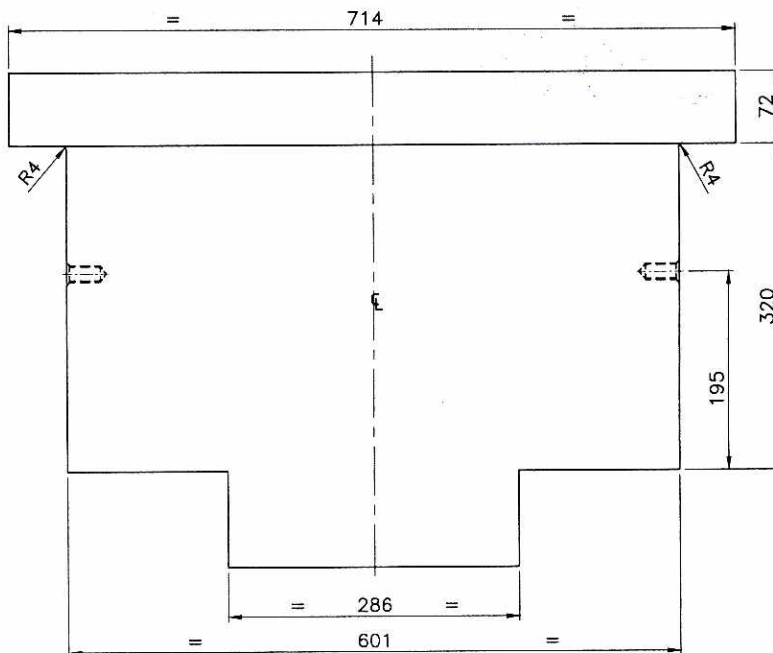


FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 3 253 02 07701



P.F.NO. TO BE
STAMPED HERE

2 HOLES DRILL & TAP M16x33 DEEP
C'SK 28x90° FOR LIFTING PURPOSE.

TECHNICAL REQUIREMENTS:-

1. FORGINGS SHALL BE SUPPLIED IN ACCORDANCE WITH CONDITION LAID DOWN IN DRG. NO. 3 253 02 01400.
2. THE END PLATES ARE TO BE ROUGH MACHINED TO DIMENSION SHOWN MACHINING TOLERANCE ± 0.3
3. MAX. ROUGHNESS OF MACHINED SURFACE SHALL NOT BE WORSE THAN 6.3 MICRONS EXCEPT WHERE OTHERWISE STATED.
4. P.F. NOS TO BE STAMPED IN 6 MM SIZE AS BELOW
 - A. FOR 48 NOS. (UNIT-1) USE P.F. NO. 310240 TO 310287
 - B. FOR 48 NOS. (UNIT-2) USE P.F. NO. 310288 TO 310335
 - C. FOR 48 NOS. (UNIT-3) USE P.F. NO. 310336 TO 310383
 - D. FOR 48 NOS. (UNIT-4) USE P.F. NO. 310384 TO 310431
 - E. FOR 04 NOS. (SPARE) USE P.F. NO. 310432 TO 310435
5. EACH FORGING SHALL BE TESTED ULTRASONICALLY IN ACCORDANCE WITH CORPORATE STANDARD AA 0850118 TO ENSURE FREEDOM FROM INTERNAL DEFECTS. THE NORMS OF ACCEPTANCE SHALL BE AS PER CATEGORY-2 OF THE ABOVE STANDARD.
6. ALL SURFACES SHALL BE PARALLEL & SQUARE.

EXPORT

1

59	64	65	75	78	79	25	27	29	58	59	60	77	29	31	34	45	54	68	77	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
VAR00			REMARKS			VAR. NO.			ITEM NO.			DESCRIPTION			DRAWING NO.			MATL. CODE			UNIT WT.(Kg)			QTY.			ZONE												
28 → CARD TYPE-3										28 → CARD TYPE-1										28 → CARD TYPE-2																			
ADDITIONAL INFORMATION W.O. 38202 TO 38205-X-231-53										HGS 860/210-24D ARUN-III HEP/SAPDC_NEPAL																													
STATUS OF DRAWING 'U'										TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT																													
DISTRIBUTION OF PRINTS										DRN										VINEET																			
HGE-2 HGM-2 FWM-2 TEX-1										Bharat Heavy Electricals Ltd. Bhopal										I.Y./J.J.																			
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QUALITY ASSURANCE DEPARTMENT

QA PLAN FOR: FORGINGS
QA PLAN NO: QSP/HG/104

DATE: 13/10/1993

PI NO: 240380726
REVISION: 01

SHEET 1 of 2
DATE: 14/01/2016

SL. NO.	COMPONENT/ASSY/ OPERATION	CHARACTERISTICS	CLASS	TYPE	QUANTUM OF CHECK	REF. DOC.	RECORD FORMAT	INSPECTION AGENCY	REMARKS
1.0	Forging stock (ingot or bloom)	a) Material certification	Major	Review	100%	Spec/ Drawing	TC	Supplier/BHEL/ Customer	
		b) Material identification	Major	Review	100%	Spec/ Drawing	TC	Supplier/BHEL/ Customer	
1.2	Forging	a) Visual and process checks	Major	Review	100%	Approved forging process	Supplier QC record	Supplier/BHEL/ Customer	
		b) Heat treatment	Critical	Heat treatment	100%	Spec	TC	Supplier/BHEL/ Customer	
		c) Marking of test samples as per drawing	Major	Review	100%	Drawing	Supplier QC record	Supplier/BHEL/ Customer	
		d) Chemical analysis	Major	Chem	Sample	Spec	TC	Supplier/BHEL/ Customer	
		e) Mechanical analysis	Major	Mech	Sample	Spec	TC	Supplier/BHEL/ Customer	
		f) Ensure proof marking for availability of machining allowance	Major	Dimensional	100%	Drawing	Supplier QC record	Supplier/BHEL/ Customer	
		g) Marking of PF nos., etc. before rough machining	Major	Review	100%	Drawing	Supplier QC record	Supplier/BHEL/ Customer	
		h) Visual & dimensional checks of rough machined forgings	Major	Visual/ Dimensional	100%	Drawing	Supplier QC record	Supplier/BHEL/ Customer	

PREPARED BY: -SD-

CHECKED BY: -SD-

APPROVED BY: -SD-

DATE: 13/10/1993

REVISION 01: 1) "Important note" has been added. 2) The "Type" field was blank for 1.2 c) & 1.2 g). 3) The "Record format" field was blank for Sl. No. 1.2 c). 4) The format has been updated.

PREPARED BY: Krishna C Bandaru 14/01/2016

CHECKED BY: Ritesh Gajbhiye 14/01/2016

APPROVED BY: Krishna C Bandaru 14/01/2016

DATE: 14/01/2016

कृष्णा चै. बंडारु
KRISHNA C BANDARU
वरि अभियंता (अधिकृत्य) / Sr. Engineer (D)
एच.जी.ई. प्रभाग / HGE Division
बी.एच.ई.एल., भोपाल / BHEL, BHOPAL

रितेश गजभिये / RITESH GAJBHIYE
वरि प्रबंधक (अधिकृत्य) / Sr. Manager (D)
एच.जी.ई. प्रभाग / HGE Division
बी.एच.ई.एल., भोपाल / BHEL, BHOPAL



QUALITY ASSURANCE DEPARTMENT

QA PLAN FOR: FORGINGS

QA PLAN NO: QSP/HG/104

DATE: 13/10/1993

PI NO: 240380726
REVISION: 01

SHEET 1 of 2

DATE: 14/01/2016

SL. NO.	COMPONENT/ASSY/ OPERATION	CHARACTERISTICS	CLASS	TYPE	QUANTUM OF CHECK	REF. DOC.	RECORD FORMAT	INSPECTION AGENCY	REMARKS
		i) UT on forging and boroscopic examination	Major	NDT	100%	Drawing	TC	Supplier/BHEL/ Customer	
		j) Final marking of PF nos., heat nos., identification, etc.	Major	Review	100%	Drawing	TC	Supplier/BHEL/ Customer	
		k) Painting, preservation, and packing	Major	Review	100%	Drawing	TC	Supplier/BHEL/ Customer	

ABBREVIATIONS: NDT - Non Destructive Testing, Mech - Mechanical, Chem - Chemical, Elec - Electrical, Spec - Specification, TC - Test Certificate, QC - Quality Control

IMPORTANT NOTE: Some of the above-mentioned tests may be witnessed by the customer. This shall be intimated at a later date.

PREPARED BY: -SD-

CHECKED BY: -SD-

APPROVED BY: -SD-

DATE: 13/10/1993

REVISION 01: 1) "Important note" has been added. 2) The "Type" field was blank for 1.2 c) & 1.2 g). 3) The "Record format" field was blank for Sl. No. 1.2 c). 4) The format has been updated.

PREPARED BY: Krishna C Bandaru 14/01/2016CHECKED BY: Ritesh Gajbiye 14/01/16APPROVED BY: Krishna C Bandaru

DATE: 14/01/2016

कृष्णा चै. बंडारु
KRISHNA C BANDARU
वरि अभियंता (अभिकल्प) / Sr. Engineer (D)
एच.जी.ई. प्रभाग / HGE Division
बी.एच.ई.एल., भोपाल / BHEL, BHOPAL

रितेश गजभिये / RITESH GAJBHIYE
वरि प्रबंधक (अभिकल्प) / Sr. Manager (D)
एच.जी.ई. प्रभाग / HGE Division
बी.एच.ई.एल., भोपाल / BHEL, BHOPAL



(8)

		भारत हेवी इलेक्ट्रिकल्स		SPECIFICATION OF ALLOY STEEL FORGINGS-HARDENED AND TEMPERED FOR HYDROGENERATOR		HG 06004 Rev. 01 PAGE 1 OF 7	
गोपनीय एवं अधिकार सुरक्षित इस प्रपत्र पर दी गई जानकारी भारत हेवी इलेक्ट्रिकल्स लिमिटेड की संपत्ति है इसे प्रत्यक्ष या अप्रत्यक्ष रूप से कम्पनी के हितों को नुकसान पहुँचाने के लिए कदापि उपयोग नहीं किया जावे ALLOY STEEL FORGINGS - HARDENED AND TEMPERED 1. GENERAL : This specification governs the quality of forged alloy steel forgings in Hardened & Tempered Condition. 2. APPLICATION : Pole end plates, shafts and other components for generators. 3. CONDITION OF DELIVERY : Forged, Hardened & Tempered in the "rough machined" condition. Forgings shall be commercially straight. 4. COMPLIANCE WITH BHEL / NATIONAL STANDARDS : There is no Indian Standard covering this type of material. 5. DIMENSIONS AND TOLERANCES : The dimensions and tolerances shall be as specified on the order/drawing, and shall not exceed these dimensions. A tolerance of 3 mm for finish has been provided in specifying the rough turned dimensions. Any forging which is bent to interfere with its finishing to desired sizes shall be rejected. 6. MANUFACTURES : Forgings shall be manufactured from steel produced by the open-hearth, electric or such other process as may be agreed to between the BHEL 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. Forgings shall not be over heated.							
		Rev.01 Date: 29/09/2016 - Ref. of BHEL standard BP19389 is removed from Sr. No. 4 - Sr. No.11 ,Mechanical Properties UTS, elongation & Hardness updated ANUPAM KUMAR P.CHAUDHURI 29/09/16 29/9/2016 29/9/16		हाइड्रोजेनरेटर इंजीनियरिंग विभाग भारत हेवी इलेक्ट्रिकल्स लिमिटेड			
				तैयारकर्ता -Sd- ANUPAM KUMAR	अनुमोदनकर्ता -Sd- P.CHAUDHURI	जारी करने की दिनांक 14-07-2008	

(7)

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

The coupling or driven end of the shaft shall be indicated on the drawing. These ends shall correspond to the bottom of the ingot.

7. HEAT TREATMENT :

After forging and rough turning, the forgings shall be hardened & tempered. Forgings shall be free from uneven internal stresses, and shall have homogeneous grain structure.

Details of heat treatment shall be furnished to BHEL as and when called for.

8. FREEDOM FROM DEFECTS :

The forging shall be homogeneous, free from excessive hardness, slag spots, sand seams, blow holes, clinks, cracks or other imperfections.

9. CHEMICAL COMPOSITION :

The chemical composition of the material based on melt analysis shall comply with the following requirement.

Element	% Minimum	% Maximum
Carbon	0.19	0.25
Manganese	0.60	1.00
Silicon	-	0.35
Sulphur	-	0.03
Phosphorus	-	0.03
Nickel	0.35	0.75
Chromium	0.35	0.65
Molybdenum	0.15	0.25

Note : Carbon equivalent shall not be exceed 0.50 percent when calculated from the formula given below :

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

10. TEST SAMPLES :

10.1 Unless otherwise specified on the order/drawing, test samples shall be taken from each cast 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 forging.

10.2 When integral test pieces are not called for and it is not possible to destroy the forgings, separate test samples as mentioned on the order/drawing shall be provided from the blooms and billets from which the forgings are made. They shall be forged to the ruling section of the main forgings and shall be heat treated similarly and simultaneously with the forgings they represent.

10.3 Test samples shall be cylindrical in shape.

(a) Longitudinal / Radial test piece shall be taken from one end of the forging.
Radial test piece may be taken from economic considerations.

(b) Tangential test piece shall be taken from other end of the forging.

(c) Test piece diameter shall be 10mm for HG 06004 min.
(as per IS-1608:1995, amd. No. 1, May 2002, table 5).

Test piece shall be cut as below :

(i) For solid forgings: at a distance of one-third radius or one-sixth diagonal from the outer surface.

(ii) For hollow forgings: midway between the inner and outer surface of the wall thickness.

11. MECHANICAL PROPERTIES : (Longitudinal)

The test pieces, shall show the following properties for all ruling sections. Test methods are specified below :

10.1 Tensile test : IS : 1608

10.2 Hardness test (Brinell) : IS : 1500

10.3 Mechanical properties

i)	Tensile strength (in any direction)	- 620 N/mm ² Min
ii)	Yield strength (in any direction)	- 462 N/mm ² Min
iii)	Elongation 5.65 " so gauge length long / Radial - 16 % min	
		Tangential - 16% min
iv)	Reduction in area	- 40% min.
v)	Hardness (Brinell) for reference only	190-260

Note: For an indication of the general quality of the steel, the broken test pieces shall show a fracture of uniform silky appearance free from granular black or brilliant specks, though this would not be criteria for rejection.

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12. MAGNETIC PROPERTIES: (For information only).

Magnetic Field Strength (H) A/m	Magnetic Induction (B) Minimum Tesla or Wb/m ²
3400	1.39
6200	1.55
10400	1.70
14800	1.76

One sample of size Ø 13 x 50 shall be taken from the each P.F. and shall be submitted to BHEL for testing for B/H-Magnetisation properties, irrespective of whether supplier has got facilities or not for the same.

13. NON-DESTRUCTIVE TESTING (OPTIONAL) :

When stated on the order/drawing, the forgings shall be ultrasonically tested to BHEL Corporate Standard AA 085 0101 for shafts and to AA 085 01 18 for other forgings. Acceptance Standard shall comply with category class mentioned in the standards & called for on the order/drawing.

Boroscopic test for central hole in case of shaft forging shall be carried out to AA 0850101 before application of antirust compound.

14. TEST CERTIFICATES :

Three copies of test certificates shall be supplied unless otherwise stated on the order. In addition, the supplier shall ensure to enclose one copy of the test certificate along with their dispatch documents to facilitate quick clearance of the material.

The following details shall be furnished in the test certificate

- i) Reduction Ratio.
- ii) Dimensional Inspection.
- iii) Details of heat treatment.
- iv) Chemical composition including trace elements.
- v) Results of mechanical tests.
- vi) Results of ultrasonic test.
- viii) Microstructure examination report.

In addition, the supplier shall ensure to enclose one copy of the test certificate along with their dispatch document to facilitate quick clearance of material.

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 BHOPAL	TECHNICAL PRE-QUALIFICATION REQUIREMENTS (T-PQR)	DOC. NO. : HGG-1830 DATE: 19-03-2019 REV. - 00 PAGE 1 OF 1
	HYDRO GENERATOR ENGINEERING DIVISION	

Technical Pre-Qualification Requirements (T-PQR) for pole end plate forging for hydro-generators.

S. No.	Description of pre-qualification requirement	Vendor Response	
		Complied/N ot complied	Supporting Documents required to accept compliance
1	Only forging manufacturer will qualify. Distributors/ stocker/ trader are not qualified.		Certificate of being original manufacturer
2	Compliance to attached product standard HG06004 REV-01 and quality plan QSP/HG/104 REV-01.		Confirmation required.
3	Forging shall be supplied according to Drawing 32530207701 REV-00.		Compliance required.
4	Company to be ISO-9001 certified.		Valid ISO-9001 certificate.
5	T.C. of pole end plate forging will be furnished.		Confirmation required.
6	The company should have experience of supply of similar forging with at least 3 supplies of 5000 kg each (minimum total weight) having individual forging weight between 150-250 kg.		Copy of PO /completion certificate / invoice to be submitted.
7	Vendors who finally qualified in technical PQR have to apply for registration in BHEL vendor directory. (if not registered, for OEM as well as Indian Partner). Directory details: PMD NO.: AEM03, MATERIAL CATEGORY: 193100, ITEM NO.: 04		Confirmation required.

Note:

1. Compliance to above Pre-qualification requirements are mandatory. In absence of compliance of above requirements vendor PQ application is liable to be rejected.
2. BHEL has right to verify information/ confirmation furnished, by asking additional documents proofs etc.

Ila Yadav
Sr. Design Engr/HGE

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(D.K. Chandrakas)

(A. Dixit)