

Minimum Technical Qualifications Required for supplying Forged Short Circuit Ring of material High conductivity (98 % IACS) forging -ANNEALED as per BHEL specification no. AA19801 for Rate Contract for IMM and LEM Division

Ref no: AME/MTQ/SCRING/OI

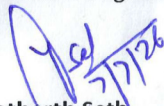
Date: 06..07.2026

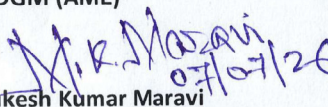
Following are the mandatory requirements. Offers of vendors not meeting these requirements will not be considered.

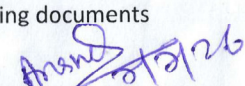
S. N	Description of pre-qualification requirement	Supporting Documents required	Complied (Yes / No)																											
1.	Only OEMs / manufacturers are eligible.	Vendor shall confirm that vendor is original manufacturer of the tendered item.																												
2	Vendor must have executed at least three POs of short circuit ring forgings - Annealed of material high conductivity (98% 'ACS). The forgings are classified in two categories as per below :- Category (1) SC ring OD < 1000mm Category (2) Sc Rin OD 1000≤OD≤1500mm # Please Refer Note-1.	a) The vendor has to furnish details of Minimum 3 POs of short circuit ring supplied and executed successfully in last 5 years from <u>Tender opening date</u>. The details shall be furnished as below: <table><tr><th rowspan="2">Short Circuit ring (Forging)</th><th rowspan="2">High conductivity (98 % IACS) forging Annealed</th><th colspan="3">Dimension (in mm)</th><th rowspan="2">Name of Customer / Year of supply/P O no etc</th></tr><tr><th>OD</th><th>ID</th><th>TK</th></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> Out of three POs as per above, at least one PO should be as per Case 1 or Case 2 :- Case 1:- When the Vendor is quoting only for Category (1) At least One PO of SC ring having OD 800 mm (min) is mandatory. OR Case 2:- When the Vendor is quoting for Category (2) or both the categories At least One PO of SC ring having OD 1200 mm (min) is mandatory. b) This should be accompanied by Self-declaration (seal signed by authorized signatory on Company's letter head) giving purchase order reference, purchase order date, customer name, quantity supplied and supply date along with proof of supply , acceptance of material by customer [customer material receipt no. / CRAC no. / SRV no. etc] Test certificate of short circuit ring for all the three cases must be submitted with offer.	Short Circuit ring (Forging)	High conductivity (98 % IACS) forging Annealed	Dimension (in mm)			Name of Customer / Year of supply/P O no etc	OD	ID	TK																			
Short Circuit ring (Forging)	High conductivity (98 % IACS) forging Annealed	Dimension (in mm)			Name of Customer / Year of supply/P O no etc																									
		OD	ID	TK																										

3	(a) Vendor must have in-house manufacturing facility to manufacture short circuit ring forging of material high conductivity (98% IACS) Forging Annealed as per the BHEL ordering drawing and specification no. AA19801 (latest version) (b) Vendor to submit detailed manufacturing plan with details of raw material, in process and final inspection	(A) Details of in-house manufacturing facilities are to be submitted with offer. Supplier to give Self declaration (seal signed by authorized signatory on Company's letter head) mentioning list of relevant manufacturing facilities owned by the manufacturer. (B) Manufacturing process plan to be submitted by vendor.	
4	a) The Manufacturer, preferably should have in-house testing facilities to conduct tests as per BHEL specification no. AA19801 and QA Plan QA/MT/BOI/007 Rev.03. b) If any facility of particular testing is not available in-house, then Manufacturer to Outsource labs/firms for testing. c) Each S.C. ring shall be tested for Mechanical and NDT tests as per BHEL specification no.AA19801 and QA Plan QA/MT/BOI/007 Rev.03. UT testing procedure to be followed as per BHEL spec AM54155. Supplier to conduct tests on each ring.	a) Self-declaration (seal signed by authorized signatory on Company's letter head) giving details of in-house testing facilities. Test certificates shall cover chemical composition, mechanical properties, dimensional report, non destructive test reports etc. Testing shall be witnessed by BHEL / BHEL approved TPI as per QA/MT/BOI/007 Rev.03. b) In case of outsourcing of testing, vendor to agree to test in government/international accreditation agency approved labs. c) Acceptance in this regard to be given by supplier.	
5	Vendor to confirm supply shall be as per BHEL enquiry drawing and specification.		

NOTE:- 1 If the vendor has already supplied the above mentioned item or similar item fulfilling the criteria for Clause No. **2** to BHEL Bhopal within past 5 years (calculated from the Tender Opening Date), then only the PO /SRV reference shall suffice against requirement of Supporting documents mentioned against Clause no. **2** above.


Yatharth Seth
Sr.DGM (AME)


Mukesh Kumar Maravi
AGM (AME & ISE)


Anand Kr Modi
Sr Manager (AME)

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm.)

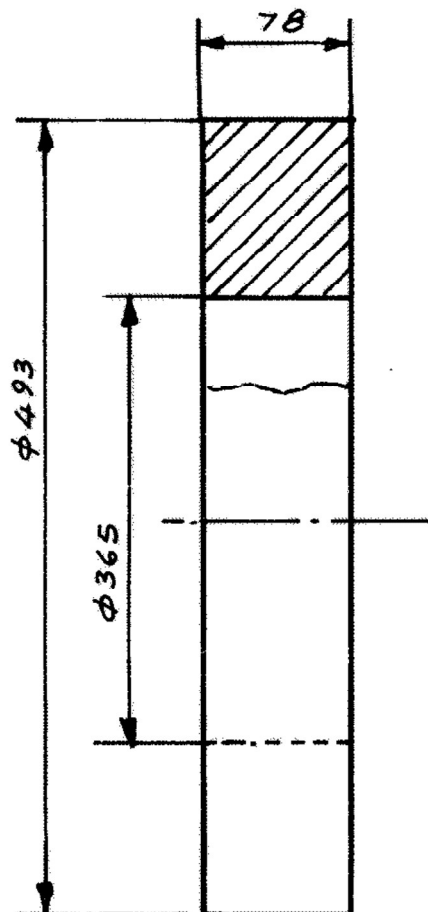
THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.	REV.	DATE	ALTD. - K.N.P.	CHKD. - J.K.	APPD. - M.K.M.	REV.	DATE	ALTD. - L.D.V. -sd-	CHKD. - A.K.B. -sd-	APPD. - A.K.B. -sd-	ADDITIONAL INFORMATION					
	03	08.06.13				02	25.05.02				W.O. 408737421-02					
	STYLE NO. ADDED, DRAWING REDRAWN.						DRG. UPDATED & REDRAWN.						STATUS OF DRAWING			
													DISTRIBUTION OF PRINTS AME - 1 , PLM - 3 TCX(PLM) - 1 ,			
TECHENICAL REQUIREMENTS :- - RING TO BE MACHINED ALL OVER FINISH $\nabla^{3.2}$. - EACH RING TO BE ULTRASONICALLY TESTED AS PER AM 54155. STYLE NO. :- BP9304323959																
REF. DRG. NO.			001	S.C. RING (ORDERING)				AA19801				50.0				
	REMARKS	ITEM NO.	DESCRIPTION				MATL. CODE		A	UNIT	UNIT WT.					
SIGN & DATE								MATL. SPECN.		C		QTY.				
INVENTORY NO.			BHARAT HEAVY ELECTRICALS LTD. BHOPAL				DRN	NAME	SIGN.	DATE	NO. OF ITEM					
							CHD	P.K.S.	-sd-	21.11.84						
							APPD	N.K.J.	-sd-	21.11.84						
DEPT. AME		UNTOL DIMS GR.				SCALE	WEIGHT(KG.)	REF. TO ASSY. DRG.		ITEM NO.		NO. OF ITEM				
CODE 404						NTS				-						
TITLE							DRAWING NO.				REV.					
S.C. RING (ORDERING)							44028045009				03					
							SHEET NO. 01		NO. OF SHEETS 01							

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

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REV.	DATE	ALTERED	REV.	DATE	ALTERED (SPV)	ADDITIONAL INFORMATION
		CHECKED	01	04/6/99	CHECKED	42197A407 11.21
			ST. NO. BP 930432 2901 WAS 900432290			STATUS OF DRAWING
						DISTRIBUTION AME-1 TEX(1MM)-1 OF PRINTS IMM-3



ST. NO. BP 9304322901

NOTE :- ULTRASONIC TESTING TO AM 54155.

✓ ALLOVER.

REF. DRG. NO.

SIGN. & DATE

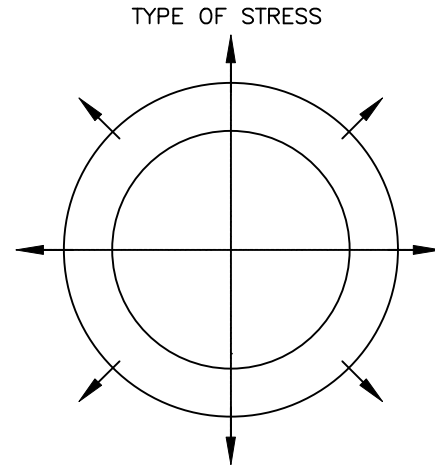
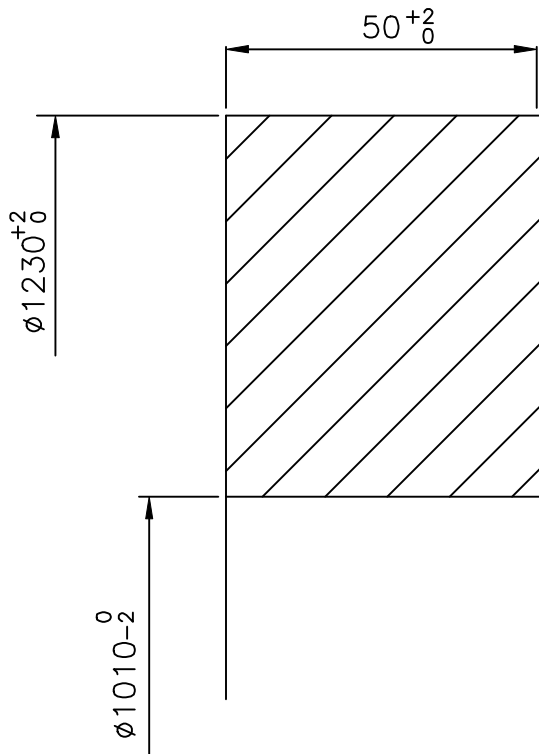
INVENTORY NO.

OXYGEN FREE COPPER.		001	S.C. RING.		BOUGHT OUT A419801		60	
65	REMARKS	75	25	27	29	58	59	34
			ITEM NO.	DESCRIPTION			STD.	34
								45
								55
								56-57
								58
								UNIT WT.
								66
								QTY.
								71
28 → CARD TYPE-3			28 → CARD TYPE-1			28 → CARD TYPE-2		
BHARAT HEAVY ELECTRICALS LTD. BHOPAL					DRN.	NAME	SIGN.	DATE
					CHD.	R.M.S/VKJ	23.4.93	23.4.93
					APPD.	VRG-Moorthy	27/4/93	27/4/93
DEPT.	GRADE OF	SCALE	WEIGHT (Kg)	REF. TO ASSY. DRG.	ITEM NO.	75	77	
AME	UN.TOL.	NTS						
CODE	DIM. C/M							
404								
TITLE				1	3	DRAWING NO.		
S.C. RING FORGED				CARD CODE		44028045151		
						22		
						23		
						24		
						REV.		
						01		
						SHEET NO. 01		
						NO. OF SHEETS 01		

FIRST ANGLE PROJECTION				(ALL DIMENSIONS ARE IN mm)			
REV.	DATE	ALTERED		REV.	DATE	ALTERED	
		CHECKED				CHECKED	
				ADDITIONAL INFORMATION			
				W.O. 48045A421-11 MPC BARR			
				STATUS OF DRAWING			
				DISTRIBUTION OF PRINTS OC-1, PLM-3 TEX(PLM)-1			
TECHNICAL REQUIREMENTS- 1. EACH RING TO BE ULTRASONICALLY TESTED AS PER AM54155. 2. OXYGEN CONTENT TO BE LIMITED TO 50 PPM.							
REF. Dwg. No.		001		S.C.RING (ORDERING)		217.0	
REMARKS		ITEM No.		DESCRIPTION		AA19801	
CARD TYPE 3		CARD TYPE 1		CARD TYPE 2		CARD TYPE 4	
Bharat Heavy Electricals Ltd. Bhopal		NAME		DATE		11.11.08	
L.PATEL		RPG		11.11.08		11.11.08	
DEPT. AME		SCALE		WEIGHT (Kg)		REF. TO APPR. Dwg.	
CODE 404		N.T.S		217.0		ITEM No. 75 77	
TITLE		DRAWING No.		REV.		00	
S.C. RING (ORDERING)		44028045598		SHEET No. 01		No. OF SHEETS 01	

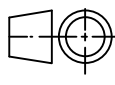
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REV.	DATE	ALTERED	REV.	DATE	ALTERED	ADDITIONAL INFORMATION
		CHECKED			CHECKED	
						W.O. 48214A421-11/21/31 W.O. 48215A421-11/21/31
						STATUS OF DRAWING
						DISTRIBUTION OF PRINTS OC-1, TEX-3



TECHNICAL REQUIREMENTS-

1. EACH RING TO BE ULTRASONICALLY TESTED AS PER AM54155.

REF. DRG. No. 44028047018			001	S.C.RING (FORGING)				172.0									
				AA19801													
SIGN & DATE	65	REMARKS	75	25	27	29	DESCRIPTION	58	59	34	MATL. CODE	45	55	56	58	UNIT WT.	65
					ITEM No.				STD.	46	MATL. SPECN.	54	57	UNIT	66	QTY.	71
SIGN & DATE	CARD TYPE 3		28	28		CARD TYPE 1		28		CARD TYPE 2							
			BHARAT HEAVY ELECTRICALS LTD.				BHOPAL		DRN	NAME VINAY		SIGN 		DATE 06.05.19			
INVENTORY No.									CHD								
									APPD	MHN				06.05.19			
INVENTORY No.	DEPT.	AME	GRADE			SCALE	N.T.S		WEIGHT (Kg.)	172.0		REF. TO ASSY. DRG.				ITEM No.	75 77
	CODE	404	OF UN. TOL. DIM. C/M/F													No. OF ITEMS	
INVENTORY No.	TITLE								1	3	7	DRAWING No.		22	23	24	REV.
	S.C. RING (FORGING)								CARD CODE			44028047140		00			
												SHEET No. 01		No. OF SHEETS 01			

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

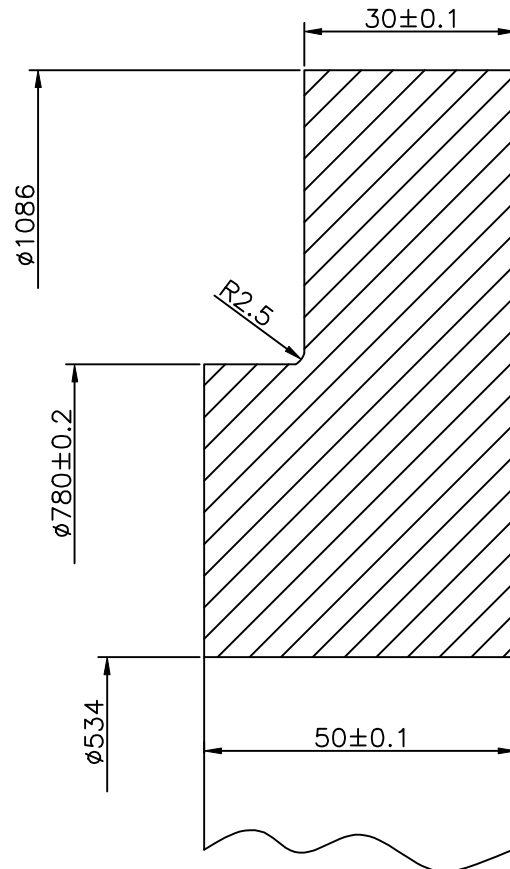
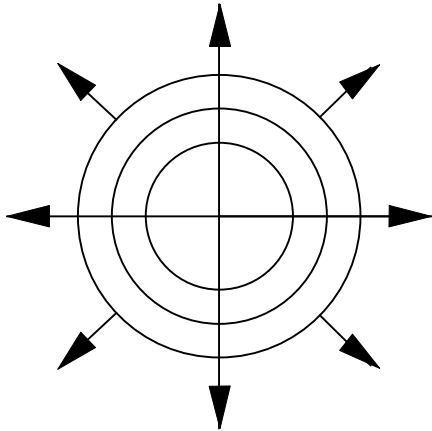
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REV.	DATE	ALTERED	REV.	DATE	ALTERED	ADDITIONAL INFORMATION STANDARD (1DL7650)	
		CHECKED			CHECKED		
		APPROVED			APPROVED		
						STATUS OF DRAWING	U
						DISTRIBUTION OF PRINTS	O.C. - 1 GTG(EM)-1 PLM - 3

TECH. REQUIRMENTS :-

- 1 RING TO BE MACHINED ALL OVER FINISH $3.2/\sqrt{\quad}$
- 2 EACH RING TO BE ULTRASONICALLY TESTED AS PER AM 54155.

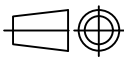
TYPE OF LOADING/STRESS

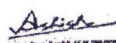


4 403 81 45 002
REF. DRG. NO.

SIGN. & DATE

INVENTORY NO.

B.O.	001	S.C.RING (ORDERING)		34	45	58	312.5	65
65	75	25	27	29	58	59	46	54
REMARKS	ITEM NO.	DESCRIPTION			STD	MATL. CODE	54	55
						MATL. SPCN.	56	57
28 → CARD TYPE-3		28 → CARD TYPE-1			28 → CARD TYPE-2			
					NAME		SIGN	DATE
					DRN	Y.M.	<i>Yogesh</i>	31.03.24
					CKD	VP		31.03.24
					APPD	VP	<i>Yogesh</i>	31.03.24
DEPT AME	UNTOL.DIMS. GR.		SCALE NTS	WEIGHT (K.G.)	REF. TO ASSY. DRG.		ITEM NO.	NO. OF ITEM
CODE 404				232.5				
TITLE					DRAWING NO.		REV.	
S.C.RING (ORDERING)					4 403 81 45 016		00	
					SHT. No. 01		NO. OF SHT. 01	

 BHARAT HEAVY ELECTRICAL LIMITED, BHOPAL QUALITY CONTROL- MOTOR GROUP QUALITY PLAN FOR FORGED SHORT CIRCUITING RING FOR SQUIRREL CAGE INDUCTION MOTORS Page 1 of 2										
Customer		BHEL, Bhopal		QAP No. QA/MT/BOI/007		Rev. No.03		LEGEND		
Material description		Forged short circuiting ring for squirrel cage induction motors		Date: 12/02/2018				RR: Record Review TPIA: Third party inspection agency		
Specification		Spec no.AA19801 and PO/Drawing				W: Witness				
Sr. No	Stage	Characteristics	Method	Reference Document	Acceptance Criteria	Extent of check	Record of format	Inspection by	Mode of inspection	Remarks
1.	Raw material									
1.1		a)Chemical Composition b) Oxygen content	Spectra Analysis Spectra Analysis	AA-19801 Drawing/If not called in drg then AA019801	AA-19801 Drawing/If not called in drg then AA019801	1 No./ Heat 1 No./Heat	Supplier TC Test Report	Third party Inspection Agency/BHEL	Record Review Record Review	Stock shall be verified by inspector. (Test lab should be NABL accredited)
2.	In-process inspection									
2.1	Heat Treatment	Heat Treatment	Verification of HT chart	As per vendor process doc	As per vendor process doc	Per cycle	H.T.Chart	-do-	Record Review	(Check calibration status of temp Recorder) (Thermocouple)
2.2	Identification of test sample	Sample Identification	Test piece shall be heat treated simultaneously with forging in same heat. Heat No. should be clearly hard punched both on forging and sample. Two test pieces (one for TPIA witnessing and one for testing at BHEL Bhopal) shall be identified by TPIA.Both the test pieces shall be marked with PO no, Heat no., TPIA Stamp. Size of each test piece shall be 25 x 250 mm long						Witness	
2.3	Testing on sample (Electrical mechanical)	1.Tensile 2.Hardness 3.Conductivity	IS 1608:2005 IS1500 ASME E 1004,IS 613	AA 19801 AA 19801 AA 19801	AA 19801 AA 19801 AA 19801	Per heat / HT batch Per heat / HT batch Per heat / HT batch	Test certificate Test certificate Test certificate	-do- -do- -do-	Witness	Check calibration status of testing equipment (calibrated by NABL accredited lab.) For conductivity test meter. OEM calibration certificate is acceptable
 Prepared by  Approved by										

BHARAT HEAVY ELECTRICAL LIMITED, BHOPAL QUALITY CONTROL- MOTOR GROUP QUALITY PLAN FOR FORGED SHORT CIRCUITING RING FOR SQUIRREL CAGE INDUCTION MOTORS Page 2 of 2										
Customer		BHEL, Bhopal			QAP No. QA/MT/BOI/007		Rev. No.03		LEGEND	
Material description		Forged short circuiting ring for squirrel cage induction motors			Date: 12/02/2018				RR: Record Review TPIA: Third party Inspection agency	
Specification		Spec no.AA19801 and PO/Drawing					W: Witness			
Sr. No	Stage	Characteristics	Method	Reference Document	Acceptance Criteria	Extent of check	Record of format	Inspection by	Mode of inspection	Remarks
3	Final Inspection									
3.1	Nondestructive testing	a.Ultrasonic Testing in proof machined stage	As per BHEL Std AM 54155	AM 54155	AM 54155	100%	Test Certificate	TPIA/BHEL	Witness	Shall be tested by NDT level-II report shall be signed with seal & certificate No.
3.2	Dimensions & visual inspection in proof machined condition	Dimension Surface Finish	Measurement /visual	BHEL Drawing	BHEL Drawing (Dimension & surface finish)	100%	Inspection report	-do-	Witness	
3.3	Dispatch	Visual inspection/ packing & marking	Drawing /packing Instruction	AA 19801	AA 19801	100%	Inspection report	-do-	Review	Second test sample identified by TPIA shall be sent along with the int for testing at BHEL works. Each SC ring shall be wrapped by protective covering layer (thick polythene sheet/bituminized jute cloth) and packed in wooden box. Wooden box should be marked with Supplier name, PO no, item Description.
3.4	Vendor Identification	1. Vendor name 2. PO no. 3. Heat no. 4. Sl. no. 5. Drg no. 6. Spec no.	Hard Punch	PD/Drg.	PO/Drg.	100%	--	TPIA	Witness	Hard Punch Identification to be done on one face
3.5	Document submission duly verified by TPIA	1. Source raw material TC. 2. Heat treatment graph with PO no & batch no. 3. Test report in line with format in AA19801 4. NDT report 5. Final dimension and visual report. 6. Third party inspection report (apptd by BHEL) report								
 Prepared by Approved by										



PRODUCT STANDARD
AME BHOPAL

AM 54155

PAGE 1 OF 3

REVISION - 03

ULTRASONIC TESTING AND
ACCEPTANCE NORMS FOR
FORGED S.C. RINGS.

1. SCOPE: THIS STANDARD COVERS THE ULTRASONIC TESTING PROCEDURE FOR THE MACHINED FORGED COPPER SHORT CIRCUIT RINGS USED IN SQUIRREL CAGE INDUCTION MOTOR.
2. SURFACE CONDITION: THE SURFACE-CONDITION OF THE MACHINED FORGING SHALL HAVE A SURFACE FINISH OF 6.25 MICRON, OR BETTER.
3. EQUIPMENT: THE ULTRASONIC EQUIPMENT SHALL BE SUITABLE FOR OPERATING AT FREQUENCIES WITHIN THE RANGE OF 0.5 MHz TO 6.0 MHz.
4. TESTING METHOD: THE IMPULSE ECHO METHOD SHALL BE USED USING NORMAL BEAM PROBES OF 10mm DIA IN FREQUENCY RANGE 1-4 MHz GENERALLY 2 MHz LONGITUDINAL 10mm DIA PROBE SHALL BE USED.
5. SCANNING: THE TEST TO BE CARRIED OUT BY SCANNING FROM BOTH THE FACES AND O.D. GIVING SUFFICIENT OVERLAP, SO THAT NO AREA IS LEFT UNCOVERED.

CONTD. ...

1 COMPLETE STD. REVISED. DISTRIBUTION NO

2 CLAUSE 7.1.3 - 20% WAS 80%
3 CLAUSE 7.1.2 DELETED

AME
IMM

	NAME	SIGN	DATE
PREPARED	OC		13.03.94
CHECKED	VKJ		15.03.94
APPROVED	PB		16.03.94

REVISIONS

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PRODUCT STANDARD

AME BHOPAL

AM 54155

PAGE 2 OF 3

REVISION - 03

6. CALIBRATION: TIME BASE OF THE EQUIPMENT SHALL BE CALIBRATED TO ACCOMODATE, IN GENERAL, TWO BACK ECHOS ON THE SCREEN.

7. SENSITIVITY: SETTING:—TESTING SHALL BE CARRIED OUT IN TWO STAGES FOR TESTABILITY DETERMINATION AND FLAW—DETECTION AS FOLLOWS.

7.1 TESTABILITY DETERMINATION:

7.1.1 FIRST BACK WALL ECHO SHALL BE ADJUSTED TO 80% OF FULL SCREEN HEIGHT.

7.1.2 ~~GAIN SHALL BE INCREASED BY 12dB AND SCANNING SHALL BE CARRIED OUT AT THIS GAIN LEVEL THROUGHOUT THE AREA OF THE S.C.RING.~~

7.1.3 GRASS INDICATION/NOISE—LEVEL SHALL NOT BE MORE THAN 20% F.S.H.

7.2 FLAW DETECTION:

7.2.1 FIRST BACK WALL ECHO SHALL BE ADJUSTED TO 80% OF FULL SCREEN HEIGHT.

7.2.2 GAIN SHALL BE INCREASED BY 6dB AND SCANNING SHALL BE CARRIED OUT AT THIS LEVEL THROUGHOUT THE AREA OF THE S.C.RING.

7.2.3 ANY FLAW—INDICATION SHALL NOT EXCEED 80% F.S.H. AT THIS GAIN SETTING.

CONTD. ...'

REVISIONS	NO.	DESCRIPTION	DATE	NAME	SIGN	DATE
1		COMPLETE STD. REVISED.		AME		
2		CLAUSE 7.1.3-20% WAS 80%.		IMM		
3		CLAUSE 7.1.2 DELETED O.C.B.				
				PREPARED	OC	13.03.94
				CHECKED	VKJ	15.03.94
				APPROVED	PS	16.03.94



PRODUCT STANDARD

AME BHOPAL

AM 54155

PAGE 3 OF 3

REVISION - 03

8.0 ACCEPTANCE STANDARD

THE FOLLOWING INDICATION SHALL BE UNACCEPTABLE

- 8.1 INDICATIONS INTERPRETTED AS CRACKS, SEAMS, FLAKES AND LAPS.
- 8.2 GRASS INDICATIONS/NOISE-LEVEL EXCEEDING THE LIMIT AS MENTIONED IN 7.1.3.
- 8.3 FLAW INDICATIONS EXCEEDING THE LIMIT AS MENTIONED IN 7.2.3.

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1. COMPLETE STD. REVISED. DISTRIBUTION NO.

AME
IMM

1
3

2. CLAUSE 7.1.3-20% WAS 80% *20%*

3. CLAUSE 7.1.2 DELETED D.P. 9 *20%*

PREPARED	PLANET	SIGN	DATE
OK		<i>15/03/94</i>	13.03.94
CHECKED	VPJ	<i>15/03/94</i>	15.03.94
APPROVED	PB	<i>16/03/94</i>	16.03.94



CORPORATE PURCHASING SPECIFICATION

AA19801

Rev No. 04

PAGE 1 of 4

HIGH CODUCTIVITY (98% IACS) FORGINGS-ANNEALED

1.0 GENERAL

This specification governs the quality requirements of High Conductivity (98% IACS) Copper Forgings, for sizes 6 mm and above and with oxygen content of 400 ppm max. (controlled oxygen).

2.0 APPLICATION

For short circuiting rings of squirrel cage induction machines.

3.0 CONDITION OF DELIVERY

Forged and Annealed.

4.0 COMPLIANCE WITH NATIONAL STANDARDS

The material shall comply with the requirements of the following national standard with additional requirement of oxygen content of 400 ppm max. and also meet the requirements of this specification.

IS: 6912 – 2005: Copper and Copper Alloys Forging Stock and Forging - Specification

Gr. ETP Condition: O

Oxygen Content – 400 ppm max.

5.0 DIMENSIONS AND TOLERANCES

5.1 Dimensions

The dimensions of the forgings shall be in accordance with the drawings supplied with BHEL order.

5.2 Tolerances

5.2.1 Rough Forged

Thickness and outside diameter +3%, -0%

Internal diameter -3%, +0%

5.2.2 Rough Machined

As stated in BHEL order/drawing.

5.2.3 Rolled and Punched

Thickness ± 0.254 mm

Revisions:
Clause 26.5.4 of MOM of MRC-NFM+HE

APPROVED:
INTERPLANT MATERIAL RATIONALISATION
COMMITTEE – MRC(NFM+HE)

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5.2.4 Inside and Outside Diameter

Over, mm	Up to and including, mm	Tolerance, ± mm
--	305	± 0.13
305	610	± 0.25
610	--	± 0.38

6.0 FREEDOM FROM DEFECTS

The forgings shall be free from defects such as inclusions, hard spots, cracks etc., which may adversely affect the machining, electrical conductivity and utility of forgings.

7.0 MANUFACTURE

High conductivity copper rings shall be forged or rolled and punched to shape without any welding or joining.

8.0 HEAT TREATMENT

The forgings shall be supplied in annealed condition and the test bars, representative of these forgings, shall also undergo the same heat treatment.

9.0 CHEMICAL COMPOSITION

The chemical composition of the material when analyzed in accordance with IS: 440 or any other conventional/instrumental methods shall be as follows:

Element	Percent	
	Min	Max
Copper	99.90	--
*Bismuth	--	0.0010
*Lead	--	0.005
*Total all impurities (excluding silver)	--	0.03
Oxygen	--	0.04

*Note: These elements need not be determined when the material supplied conforms with mechanical and electrical properties specified in this specification. However, the supplier shall ensure that the composition of the material lies within the limits specified above.



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10.0 TEST SAMPLES

- 10.1** One sample per heat per consignment shall be taken for chemical, mechanical and electrical tests.
- 10.2** Test samples shall be provided from each batch of forgings, or from the forging stock from which the forging has been made. They shall be of sufficient length to provide the tensile test piece. It may be forged to a cross-section approximately 2/3 of the original cross-section and shall be heat treated, simultaneously with and similar to the forging it represents.
- 10.3** Electrical resistivity measurement and tensile testing shall be performed on each sample.

11.0 PROPERTIES

11.1 Mechanical properties

11.1.1 Tensile

The material when tested in accordance with IS: 1608 shall have the following properties, for sizes 6 mm and above.

Tensile strength : 210 N/mm², minimum.

11.1.2 Hardness – Brinell

The material, when tested in accordance with IS: 1500 shall show a hardness of 40 HB minimum.

NOTE: Hardness test shall be conducted only when tensile test cannot be performed.

11.2 Electrical Properties

11.2.1 Electrical Conductivity

The electrical conductivity of the forging shall not be less than 98% IACS, at 20°C, when tested by Eddy current probe method as per ASTM E1004

Note: Refer IS: 613, for temperature correction factor.

11.3 ADDITIONAL TESTS

If specified in the order/drawing, the forgings shall be subjected to the following tests.

- 1) Radiographic test.
- 2) Ultrasonic test.

12.0 REPAIR OF FORGINGS

The forgings shall not be repaired unless permission in writing has been obtained previously from the BHEL.

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13.0 TEST CERTIFICATES

Unless otherwise stated, five copies of test certificates shall be supplied along with each consignment.

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

The test certificate shall bear the following information:

AA19801, Rev-04: HIGH CODUCTIVITY (98% IACS) FORGINGS-ANNEALED

BHEL Order No.

Manufacturer's/Supplier's Name:

Lot/Batch No.

Drawing No.

Quantity supplied

Test results for clause 5.0, 9.0, and 11.0.

14.0 PACKING AND MARKING

Forgings shall be suitably packed to prevent corrosion and damage during transit. Machined surface shall be properly protected with anti-corrosive compounds.

Each forging shall be legibly marked with the following information:

AA19801, Rev-04: HIGH CODUCTIVITY (98% IACS) FORGINGS-ANNEALED

BHEL Order No.

Manufacturer's/Supplier's Name:

Lot/Batch No.

Drawing No.

Quantity supplied

15.0 REFERRED STADARDS (Latest Publications including Amendments)

- 1) IS: 440
- 2) IS: 1608
- 3) IS: 1500
- 4) IS: 613
- 5) ASTM E1004