NON MAGNETIC ALLOY STEEL FORGINGS FOR RETAINING RINGS

GR: X 8 CR Mn N 1818K

1.0 GENERAL:

This specification governs the quality requirements of magnetic steel forging grade: x 8 Cr Mn N 1818K.

2.0 APPLICATION:

For non-magnetic end retaining rings in Turbogenerators.

3.0 CONDITION OF DELIVERY

The forging shall be supplied in heat treated, cold expanded and rough machined condition to the relevant drawing.

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

There is no Indian Standard covering this material. This specification is based on TLV-9385 of M/s Siemens AG. Germany.

5.0 DIMENSIONS AND TOLERANCES:

Forging shall have dimensions and tolerances as per ordering drawing.

6.0 MANUFACTURE:

The steel for forging shall be made by Electrio Slag Remelting (ESR) process or any other processes agreed between the supplier and BHEL. Sufficient discard shall be made from each end of the ingot to ensure freedom from piping and undue segragation.

The forging shall receive its hot mechanical work under a press of ample power. The forging shall be cold expanded below 300°C. Hot-cold forming and age hardening permissible.

7.0 HEAT TREAMENT:

The forging shall be solution treated before cold expansion and stress-relieved at 340-360°C for minimum 5 hrs. after cold expansion.

8.0 FINISH:

The surface finish of the forging shall be as per the ordering drawing.

9.0 FREEDOM FROM DEFECTS:

The forging shall be free from cracks, flakes, clusters of fine inclusions and other harmful defects.

10.0 CHEMICAL COMPOSITION:

The melt analysis of the steel shall be as given below:

Element	C	Si	Mn	P	S	Cr	N	Al	Ti	V
Min.(%)	-	-	17.5	-	-	17.5	0.50	-	-	-
Max.(%)	0.10	0.80	20.0	0.050	0.015	20.0	-	0.025	<0.10	0.15

11.0 TEST SAMPLES:

Tangential and radial test samples are to be taken out from the test rings as shown on the ordering drawing. The testing shall be conducted on test pieces cut from segments positioned at 180° apart on the test rings as shown on the drawing. Test samples shall be cut after stress relief annealing.

12.0 MECHANICAL PROPERTIES:

12.1 Mechanical properties on tangential test specimens at room temperatures are given in table 1 for various strength grades. However, the specific strength grade shall be mentioned in the drawing.

Strength Grade	0.2% Proof Stress N/mm^2 min.	Elongation % min.	Reduction in area % min.	Charpy Impact strength (ISO-V) J min.
1.	500	39	62	135
2.	550	37	61	130
3.	600	35	60	125
4	650	32	59	120
5.	700	30	58	110
6.	750	28	57	105
7.	800	26	55	100
8.	850	24	55	95
9.	900	22	54	90

10.	950	20	54	80
11.	1000	18	54	80
12.	1050	18	53	80
13.	1100	17	53	78
14.	1150	16	53	78
15.	1170	15	52	78
16.	1200	14	52	75
17.	1230	14	51	75
18.	1250	13	50	70
19.	1300	12	50	70

NOTE:- Actual 0.2% Proof Stress values can be higher than specified by not more than 150 N/mm² for strength grades upto 17 (inclusive) and not more than 100N/mm² for strength grades 18 onwards

12.2 Mechanical properties on the radial specimens shall be as follows:

The retaining rings having 0.2% Proof Stress ≥ 750 N/mm² in tangential direction and the wall thickness 60mm.

a) 0.2% proof stress = 0.7 x 0.2% proof stress (tangential specified) min (Radial)

b) Elongation (Radial) : $\frac{\text{Elongation (rad. actual)}}{\text{Elongation (tang. Actual)}} = 0.50$ min

c) Reduction in area (Radial) : $\frac{\text{Reduction in area (rad. actual)}}{\text{Reduction in area (tang. Actual)}} = 0.50$ min

d) Chary impact energy (Radial) = 40 j min. (ISO-Vnotch)

Note: 1. Tensile test shall be conducted in accordance with IS:1608 or any reputed national standard.

2. Chary impact test shall be conducted in accordance with IS:1757 or any reputed national standard on 3 ISO-Vnotch samples. The minimum impact strength indicated is average of 3 specimen values. However, one of the three values can be permitted below minimum specified value, but in no case shall be below 2/3rd of the specified minimum. All the three values shall be reported in Test Certificate.

3. In case, reduced ductility values attained. Then the proof is to be produced by the manufacturer that the reason for this is purely due to local impurities which has no effect on the required properties.

4. The remainder test material shall be parted off and supplied along with the forging. This material shall be punched as shown in drawing with identification number and BHEL representative's stamp. The peripheral location of the test rings shall be clearly shown through marking on forging and test rings.

13.0 NON-DESTRUCTIVE TESTS:

13.1 Ultrasonic Test: The forging shall be subjected to ultrasonic examination over the 100% of the surface area as per pulse echo method at 2MHz and 1MHz with 45° angular probe.

DGS Method is to used forinturuption of the indicationsThe scanning shall be

a) In radial direction

b) 2 x in circumferential direction direction at <45° perpendicular to the ring surface

c) 2 x in axial direction at <45° perpendicular to the ring surface.

Acceptable randomly distributed individual equivalent defect size is 2 mm dia over a registering length of ≤20 mm. Registering length is that at the ends of which the indications fall back from 2 mm to a limiting value of 1.6 mm. The following indications shall be recorded and informed to BHEL for their approval.

a) All indications with a equivalent reflector size ≥1.6 mm Dai.

b) All individual flaw indication with attenuated back wall echo of >6 dB

c) All randomly distributed individual equivalent defect sizes of 1.6 Dai

d) All indications with line form or surface form both spread as well as local agglomerations, irrespectiveof the size of individual indications that are contained in agglomerations.

13.2 Dye Penetrate Test: All the surfaces of the forging shall be examined by Dye Penetrate Test. No cracks are permitted.

14.0 NON-MAGNETIC PROPERTIES:

The permeability test shall be carried out as per ASTM A342 (the latest edition) and permeability at 100 oresteds shall be 1.10 max.

15.0 INSPECTION AT SUPPLIER'S WORKS:

BHEL representative shall have free access to all parts of the supplier's works connected with the manufacture of the material ordered and shall be at liberty to inspect the manufacture at any stage. All the reasonable facilities shall be provided to the representative including labour to satisfy himself that the forging are made to this specification. The supplier shall inform BHEL representative in advance after heat treatment and rough machining of the forging to witness the various tests. BHEL representative shall be present during cutting and marking of the test rings.

16.0 IDENTIFICATION NUMBER:

An identification number shall be given for each forging in purchase order. The number shall be stamped on the front side of the forging and surrounded by oil colour.

17.0 TEST CERTIFICATE:

17.1 Three copies of test certificate including one transparent copy shall be supplied.

Test certificate shall have the following details.

a) HY 19372 Rev.01
b) Identification No. as per cl.16 and Order No.
c) Name on a drawing No. of the Forgings.
d) Melt No.
e) Details of melt analysis and method of steel melting.
f) Details of heat treatment with charts.
g) Actual results of ultrasonic testing furnishing details such as sensitivity, probe Dai, frequency and direction of probing.
h) Results of dye penetrant test.
i) Results of mechanical test
j) Results of magnetic permeability test.

17.2 The test certificate shall be signed by the chief of inspection/chief metallurgist of the supplier/s works.

18.0 PACKING AND MARKING:

18.1 Packing: The forging shall be suitably packed to withstand for an indifinite time of exposure to all climatic condition without developing any external and internal defects. The forging shall be properly protected.

18.2 Marking: The following details shall be punched clearly on each forging at the location shown in the drawing and the same shall be encircled by paint.

a) HY 19372 Rev.01.
b) BHEL Order No.
c) Melt No.
d) Forging Identification No.
e) Drawing No.
f) BHEL Inspection Representative's Stamp.

19.0 REJECTION AND REPLACEMENT:

In the event of the forging proving defective in the course of further processing at BHEL, the same shall be rejected notwithstanding any previous acceptance. The supplier shall replace the rejected forging shall be returned after all the commercial conditions are satisfied.