



PLANT PURCHASING SPECIFICATION HYDERABAD

HY10995

Rev. No.06

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STAINLESS STEEL BARS, ANNEALED (GR: V X 12 Cr 13)

1.0 GENERAL:

This specification governs the quality requirements of stainless steel bars of grade VX 12 Cr 13, in annealed condition.

2.0 APPLICATION:

These bars are used for the manufacture of open upset forgings meant for welded type impellers of centrifugal compressors.

3.0 CONDITION OF DELIVERY:

All rolled/forged bars shall be supplied in annealed and rough turned condition.

4.0 COMPLIANCE WITH NATIONAL/INTERNATIONAL STANDARDS:

The bars shall in general comply with UNI-6900, X 12 Cr 13, with the following specific/additional requirements.

5.0 DIMENSIONS AND TOLERANCES :

5.1 Dimensions: The dimensions shall be as specified in the order. Unless otherwise specified in the order, the hot rolled bars shall be supplied in random lengths of 3 to 6 meters with a maximum of 10% shorts down to 1 meter. Forged bars shall be supplied in random lengths of 1.5 to 3.0 meters in rough turned condition.

5.2 Tolerances: The tolerances on cross sectional dimension shall be as follows:

The diameter of the bars shall not be more than +2.0mm of the ordered size.

6.0 MANUFACTURE :

6.1 The steel used shall be fully killed and shall be manufactured by basic electric process. The steel shall subsequently Vacuum degassed (under an atmospheric pr. of 2 torr. max) followed by refining through ESR process.

6.2 In place of vacuum degassing & ESR process, VAR process may be followed.

6.3 Any other process of steel melting and refining shall be mutually agreed upon.

Revisions: Modified Cl. 5.0, 6.0, 7.0, 11.2 and 12.0 and added Cl.14.0

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6.4 The actual Hydrogen gas content shall be analyzed in molten metal after vacuum degassing /VAR process and shall be reported. Hydrogen content shall be less than 2.0 ppm.

6.5 Rolled or forged bars shall be manufactured after giving sufficient reduction to each ingot ensuring that the cast structure is completely broken into fine grain structure. The reduction ratio shall not be less than 4:1 from ingots.

6.6 The material as per this specification shall be supplied by the manufacturers who are having complete in-house steel melting, refining, hot rolling/forging/blooming/etc., heat treatment and testing facilities.

7.0 HEAT TREATMENT :

Bars shall be supplied in annealed condition. However, test samples shall be subjected to the following suggested heat treatment.

Hardening: Heating to 970 – 1000 ° C, Soaking for sufficient period followed by quenching in oil.

Tempering: Heating to not less than 600 ° C, soaking for 1.5 times the soaking time during hardening followed by cooling in air.

The details of actual heat treatment cycle followed by the supplier shall be furnished in the test report.

8.0 SURFACE FINISH:

The edges of bars shall be cut square by sawing or shearing and no crop ends shall be permissible.

9.0 CHEMICAL COMPOSITION:

The steel shall conform to the following Chemical Composition:

Element		C	Si	Mn	Cr	Ni	S	P	S+P	H ₂ ppm
Ladle Analysis	Min.	0.09	-	-	11.5			-	-	-
	Max.	0.15	1.00	1.00	14.00	1.00	0.020	0.020	0.035	2.0
Permissible variation in product Analysis		±0.01	+0.05	+0.03	±0.15	+0.03	+0.003	+0.003	-	-

Note:

Cr equivalent shall be less than 8.4

(Cr.-eq. = Cr +2Si +1.5Mo +5V +5.5Al -Ni -5Mn -30C -25N)



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10.0 TEST SAMPLES:

10.1 One test sample for chemical analysis shall be taken from a bar representing each melt.

10.2 Test samples selected from each size of the bars in a lot belonging to same melt shall be heat treated according to clause 7.0, before mechanical testing. (Supplier has got the option of upsetting the test coupon to further 1.5 reduction ratio before heat treatment for the bars of sizes above 200 mm diameter).

11.0 MECHANICAL PROPERTIES:

11.1 Test samples shall be taken from heat treated test coupon in tangential direction for each melt of bars more than 150 mm dia. / size. For bars of dia. /size up to 150mm (inclusive), the properties can be tested in longitudinal direction on heat treated samples.

11.2 The following properties shall be achieved. The values obtained shall be reported in test certificate

Tensile Strength N/mm ²	0.2% Proof Stress, N/mm ² Min.	% Elongation L=5.65 √So min.	Impact Strength, Min (2mm - V notch)J at room temperature
930 max	640-740	14	25 (J)

Note:1) Tensile test shall be performed as per IS :1608 or any reputed National Standard.

2) The minimum Impact strength value specified above is the average of three samples at the same location. Only one value can be lower than the specified minimum value, but in no case lower than 2/3rd of the specified minimum value. All the three value shall be reported.

11.3 **Hardness Test:** 10% of the bars or 10 bars minimum (whichever is higher) in annealed condition shall be tested for hardness. Hardness shall be less than 207 BHN. The hardness values for the tested bars shall be reported in test certificate.

12.0 NON-DESTRUCTIVE TEST:

The material shall be tested for non-destructive testing in dispatch condition (final machined condition)

12.1 **Ultrasonic test:** The bars shall be subjected to ultrasonic testing as per BHEL Standard AA 0850118 and acceptance norm shall be category 1 of AA0850118.

12.2 **Magnetic particle test:** All the forgings shall be subjected to magnetic particle inspection as per ASTM:E709. Cracks are not acceptable.

13.0 NON METALLIC INCLUSIONS:

The inclusion contents of the steel shall not be greater than class-2 (thin series) and 0.5 thick series as per ASTM: E45, Plate I for inclusion type A, B, C & D.

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14.0 RETESTS:

If any of the selected test samples (after heat treatment) fails to meet the specified requirements due to some mechanical reasons, another specimen may be taken. In the event of failure due to heat treatment, not more than two reheat treatments may be carried out. However, re-tempering is not considered as reheat treatment.

15.0 ADDITIONAL REQUIREMENTS FOR FIRST TIME SUPPLIES:

A comprehensive Manufacturing Process Plan (MPP) and Quality Plan including additional requirements (if any) duly approved by BHEL are mandatory before placement of order on a vendor who has not supplied the same material in the past.

The MPP shall include the stage wise detailed Manufacturing process (with control parameters at each stage) and Testing Plan (MTP) indicating the steel melting processes, ingot dimensions, forging process, forging ratio, heat treatment plan, sketches showing test sample locations and stages of inspection etc.

No process parameter changes are permitted without written approval of BHEL for subsequent supplies once the MPP referred above is frozen.

BHEL may incorporate additional tests in the purchase order depending upon review of the capabilities / experience of the new vendor during first time supplies of this material to BHEL.

16.0 INSPECTION AT SUPPLIER'S WORKS:

16.1 BHEL representative shall have free entry and access to all areas where the manufacture of the bars is carried out. All reasonable facilities shall be extended to him including labour wherever necessary.

16.2 BHEL representative shall be given sufficient advance intimation to witness the various processes, tests, etc. Punching and identification of test coupons and forging and execution of various tests shall be done in presence of BHEL representative.

17.0 TEST CERTIFICATE:

Five copies of test certificates giving the following details shall be furnished.

- a) BHEL specification No: HY 10995 / Rev.06
- b) BHEL Order No.
- c) Size.
- d) Melt No. (Along with process of steel melting/refining).
- e) Results of chemical analysis along with the H₂ content report.
- e) Results of Mechanical Tests.
- f) Results of hardness test on bars.
- g) Results of NDT.
- h) Inclusion content of steel.
- i) Details of heat treatments (on both the test bar and the material)

The test certificate shall be signed by the chief of Inspection /Chief Metallurgist of the firm and duly signed by BHEL nominated inspector.



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18.0 MARKING AND PACKING:

18.1 The following details shall be legibly stamped on each bar on one of the end face.

- a) HY 10995 Rev.06
- b) Manufacturer's Mark.
- c) Melt No. /size.
- d) BHEL Inspector's stamp.

18.2 The bars shall be suitably protected from damage during transport.

19.0 REJECTION AND REPLACEMENT:

In the event of the bar material 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 material at his own cost and the rejected bars shall be returned after all the commercial conditions are satisfied.