



**PLANT PURCHASING
SPECIFICATION
HYDERABAD**

HY10663

Rev. No. 05

PAGE 1 OF 5

ALLOY STEEL BARS FOR HIGH TEMPERATURE SERVICE – H & T
(GR: 25 Cr Mo 4)

1.0 GENERAL:

This specification governs the quality requirements of alloy steel bars of grade 25 Cr Mo 4 in hardened and tempered condition.

2.0 APPLICATION :

For the manufacture of high temperature fasteners for steam turbines.

3.0 CONDITION OF DELIVERY :

The bars shall be supplied in hot rolled/forged and hardened and tempered condition.

4.0 COMPLIANCE WITH STANDARDS:

The material shall comply with DIN: 10269-1999 GR: 25 Cr Mo 4 : Heat resisting and highly heat resisting materials for bolts and nuts with the following additional / specific requirements.

5.0 DIMENSIONS AND TOLERANCES:

5.1 Dimensions: The sizes shall be as specified in the order. Unless otherwise specified, the bars shall be supplied in random lengths of 3 to 6 metres or in multiples with maximum of 10% shorts down to 1 metre.

Forged bars shall be supplied in lengths of 1.5 to 3.0 metres.

5.2 Tolerance:

5.2.1 Hot rolled bars: The bars shall not vary from specified diameter or distance across flats by more than $\pm 2\frac{1}{2}$ %.

5.2.2 Forged bars: The tolerance on the forged bars shall be as follows:

Revisions: Modified Cl. 5.0, 6.0, 10.0.			Issued : STANDARDS ENGINEERING DEPARTMENT		
Rev.No. 05	Amd. No.	Reaffirmed	Prepared: STDS.ENG., MATLS.ENG.	Approved: AGM (ENGG.)	Dt.of 1st Issue
Dt. FEB. 2006	Dt.	Year:			JUL. 1982

Diameter, mm

Tolerance, mm

> 50 to 125	+ 6.0
>125 to 175	+ 8.0
>175 ---	+ 12.5

Note: (FOR HOT ROLLED & FORGED BARS)

Insignificant surface defects in the form of dent and ripple marks are permissible provided their depth does not exceed half the tolerances on each size.

6.0 MANUFACTURE:

Steel shall be made by basic electric process and subsequently vacuum degassed. If any other process is employed, it shall be to mutual agreement between the supplier and BHEL.

Note: Raw material like ingots/blooms/billets required for forgings should be procured from BHEL approved sources alongwith test certificate.

7.0 HEAT TREATMENT:

7.1 The heat treatment cycle shall be as follows:

Hardening at 840-880°C Cool in oil or water.

Tempering at 540°C-680°C for min. 2 hrs and cool in air slowly to minimize residual stresses.

7.2 If the bars need be straightened after heat treatment, the bars shall be stress relieved, after straightening operation, at 30°C below the actual tempering temperature.

The actual heat treatment cycle followed shall be reported in test certificate.

8.0 FREEDOM FROM DEFECTS:

The bars shall be straight, sound and free from internal and surface defects viz., cracks, piping, scabs, laps, hairline cracks etc. The bars shall be free from twists and bends.

9.0 FINISH:

9.1 The surface of the bars shall be smooth without any laps, rolled in scales etc. Dents, roll marks and scratches are permitted provided their depth does not exceed half the tolerance limits specified in Cl.5.0.

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



**PLANT PURCHASING
SPECIFICATION
HYDERABAD**

HY10663

Rev. No. 05

PAGE 3 OF 5

10.0 SELECTION OF TEST SAMPLES:

10.1 Chemical Analysis: Each melt shall be analysed for chemical composition.

10.2 Mechanical Tests:

One sample per lot, comprising of bars of same size, melt and heat treatment batch shall be taken for mechanical testing. For bars of diameter more than 160 mm the supplier has the option of reducing the diameter to 160 mm by forging or machining and then test it as per Cl. 12.0 of this specification to achieve the required properties of 160 mm dia. ruling section.

11.0 CHEMICAL COMPOSITION:

The chemical analysis of the material shall be as follows:

Element (%)		C	Si	Mn	Cr	Mo	P	S
Melt Analysis	min .	0.22	--	0.60	0.90	0.15	-	-
	max.	0.29	0.40	0.90	1.20	0.30	0.035	0.035
Permissible variation in product Analysis		± 0.02	±0.03	±0.04	±0.05	±0.04	+0.005	+0.005

12.0 MECHANICAL PROPERTIES

The Mechanical properties of the material shall be as follows:

Specimen	Limiting ruling Section (mm)	Tensile Strength N/mm ²	0.2% Proof stress, min N/mm ²	Elongation % min (l=5d)	Reduction in area % min	Impact strength, min (ISO-V Specimen) J
Longitudinal	≤ 100	600-750	440	18	60	60
	> 100		420			45
	≤ 160					

NOTE: 1) The tensile test shall be carried out according to IS:1608 or any reputed National Standard.

2) The charpy impact test shall be carried out according to IS:1757, or any reputed National Standard. The test shall be performed on ISO - V Specimen of size 10x10x55mm with a 2 mm V-Notch.

HY10663	PLANT PURCHASING SPECIFICATION HYDERABAD	
Rev. No. 05		
PAGE 4 OF 5		

The minimum impact value specified above is the average of 3 specimens from a single location. Only one value of the three can be below the specified minimum, but in no case below 2/3rd of the same. All the three values shall be reported.

13.0 RETESTS:

- 13.1** If any of the test specimen fails to meet the requirements specified in cl 12, the sample bar from which the test specimen was cut shall be rejected and two further sample bars from the same lot shall be taken for retest.
- 13.2** If the retests also fail, manufacturer is at liberty to heat-treat the bars in question. However, not more than two re-heat treatments are allowed. Re-tempering is not considered as reheat treatment.
- 13.3** If after re-heat treatment, the mechanical properties are not complied with, the entire lot shall be rejected.

14.0 ULTRASONIC TEST:

All bars above 50mm dia shall be ultrasonically tested according to the latest ASTM:A388 (BHEL Standard AA0850118), to ensure freedom from defects.

The following defects (Category 2 of AA0850118) shall be unacceptable.

- i) Cracks, flacks, seams and laps.
- ii) Defects giving indications larger than that from a 4mm diameter equivalent flaw.
- iii) Groups of defects with maximum indication less than that from a 4mm diameter equivalent flaw which can not be seperated at testing sensitivity if the back echo is reduced to less than 50%.
- iv) Defects giving indications of 2 to 4mm diameter equivalent flaw seperated by a distance less than four times the size of the larger of the adjacent flaws.

15.0 INSPECTION AT SUPPLIER'S WORKS:

The representative of BHEL shall have free access to the supplier's works at all times during the execution of the order, to satisfy himself that the material is produced as per the quality requirements of this specification. All reasonable facilities shall be extended to him, free of charge. He may also witness the sampling, testing and marking called for in this specification.



**PLANT PURCHASING
SPECIFICATION
HYDERABAD**

HY10663

Rev. No. 05

PAGE 5 OF 5

16.0 TEST CERTIFICATES:

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

- a) Specification No: HY 10663 / Rev. 05
- b) BHEL order No
- c) Size
- d) Name of the Supplier
- e) Process of steel manufacture & bars.
- f) Melt No.
- g) Heat Treatment details and batch No.
- h) Results of chemical analysis and mechanical tests.
- i) Results of ultrasonic tests.

16.2 The test certificate shall be signed by the chief of Quality/Chief Metallurgist of the supplier and BHEL representative.

17.0 PACKING AND MARKING:

17.1 Marking: All bars with cross-sectional dimension greater than 50mm shall be stamped with the melt number, specification number and supplier's trade mark on both the end faces of the bars.

Bars of sectional dimension 50mm and below shall be bundled as per each size and metal lable bearing the following information shall be securely attached to each bundle.

- a) BHEL Specification No. HY 10663
- b) BHEL Order No.
- c) Melt No. & Heat Treatment batch No.
- d) Size & Weight
- e) Supplier's trade mark.

17.2 Packing: The bars shall be suitably packed to prevent corrosion and damage during transit.

18.0 REJECTION:

In the event of any material proving defective during the course of further processing or testing, such material shall be rejected and the supplier shall make immediate arrangements to replace the same free of cost.