



**PLANT PURCHASING
SPECIFICATION
HYDERABAD**

HY10664

REV. NO. 06

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ALLOY STEEL BARS - QUENCHED & TEMPERED

(GR: 42 Cr Mo 4)

1.0 GENERAL:

This specification governs the requirements of alloy steel bars of grade 42 Cr Mo 4 in quenched and tempered condition.

2.0 APPLICATION :

For the manufacture of high tensile and high temperature fasteners and other components requiring high tensile strength coupled with good ductility and resistance to shock and wear.

3.0 CONDITIONS OF DELIVERY :

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

4.0 COMPLIANCE WITH STANDARDS:

This specification complies in general with DIN EN 10083 / 1996, Grade : 42 Cr Mo4.

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 5 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.

Diameter, mm

Tolerance, mm

50 mm to 175 mm

+ 8.0 mm

Above 175 mm

+ 12.5 mm

Revisions:

Modified clause 16.0 to add the results of hardness & NDT tests in test certificate.

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Note: (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 tolerance on each size.

6.0 **MANUFACTURE:**

Method of steel manufacture shall be at the manufacturer's discretion. The steel shall be fully killed..

7.0 **HEAT TREATMENT:**

7.1 The recommended heat treatment cycle shall be as follows:

Hardening : 820° - 860° C followed by water/ oil quenching.

Tempering at 540° - 680° C followed by Air cooling.

The actual heat treatment cycle followed shall be reported in Test Certificate.

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

8.0 **FREEDOM FROM DEFECTS:**

The bars shall be free from Cracks, Scabs, laminations, and other harmful defects.

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 .

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

10.0 **CHEMICAL COMPOSITION:**

The melt analysis of the material shall be as follows:

Element		C	Si	Mn	Cr	Mo	P	S
Melt Analysis	Min .	0.38	-	0.60	0.90	0.15	-	-
	Max.	0.45	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	± 0.03	+ 0.005	+ 0.005

Note : Ni addition upto 0.50% is permitted for improving impact properties.



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11.0 SELECTION OF TEST SAMPLES:

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

11.2 Mechanical Tests:

11.2.1 One sample per lot, comprising of bars of same size, melt and heat treatment batch shall be taken for mechanical testing.

11.3 **Hardness:** Hardness shall be checked for 5% of the bars of same size, melt and heat treatment batch. In any case minimum two bars shall be tested for hardness.

12.0 MECHANICAL PROPERTIES :

The Mechanical properties of the material shall be as follows. For the size ranges upto 160 mm dia the properties given are for longitudinal specimen. For the size range 160 - 250, the properties for both longitudinal and transverse direction are given.

Ruling Section, mm	Tensile Strength N/mm ²	0.2% proof stress, min. N / mm ²	Elongation min. L = 5d	Reduction in area % min.	Notched bar impact strength min. (ISO - V notch) J	Hardness, BHN
Upto 16	1100-1300	900	10	40	--	315 - 375
>16 ≤40	1000-1200	750	11	45	25	285 - 335
>40 ≤100	900-1100	650	12	50	25	245 - 315
>100 ≤160	800-950	550	13	50	25	225 - 275
>160 ≤250 (L)	750-900	500	14	55	25	215 - 245
>160 ≤250 (T)	750-900	500	12	--	27 (DVM 3 mm - U notch)	215 - 245

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 - Specimen of size 10x10x55mm with a 2 mm V-Notch.

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- 3) 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.
- 4) The hardness shall be tested in accordance with IS 1500 or any other equivalent international standard.

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 reheat treat the bars in question. Not more than two reheat treatments are allowed. However, retempering is not considered as reheat treatment.
- 13.3 If after reheat treatment, the mechanical properties are not complied with, the entire lot shall be rejected.

14.0 ULTRASONIC TEST:

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

The following defects (Category 2 of AA 0850118) 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 separated at testing sensitivity if the back echo is reduced to less than 50%.
- iv) Defects giving indications of 2 to 4mm diameter equivalent flaw separated 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.



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16.0 TEST CERTIFICATES:

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

- Specification No. HY10664 Rev. 06
- Material Grade : 42 Cr Mo 4
- BHEL Order No.
- Size
- Melt No.
- Process of manufacture
- Heat Treatment details and batch No.
- Results of chemicals analysis and mechanical properties.
- Results of hardness test.
- NDT tests (if applicable).

17.0 PACKING AND MARKING:

17.1 Marking: All bars with cross sectional dimension greater than 50 mm 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 50 mm and below shall be bundled as per each size and a metal label bearing the following information shall be securely attached to each bundle.

- BHEL Specification No. HY10664 Rev .06
- BHEL Order No.
- Melt No. & Heat Treatment batch No.
- Size & Weight
- Supplier's trade mark.

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

18.0 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 material forging at his own cost and the rejected bars shall be returned after all the commercial conditions are satisfied.