

TD 219
Rev 00**PLANT PURCHASING
SPECIFICATION
HYDERABAD**

HY10697

Rev. No. 00

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ALLOY STEEL BARS (H & T)**(GR: 42 Cr Mo 4) (In line with API 8C)****1.0 GENERAL :**

This specification governs the requirements of alloy steel bars of grade 42 Cr Mo 4 in heat treated condition.

2.0 APPLICATION :

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

3.0 CONDITION OF DELIVERY :

The bars shall be supplied in hot rolled / forged and heat treated condition.

4.0 COMPLIANCE WITH NATIONAL / INTERNATIONAL STANDARDS :

This specification complies in general with DIN EN 10083 / 1996, Grade : 42 Cr Mo4 and also meets requirements of API 4F and 8C. In case of any contradictions between DIN EN 10083 and API 8C, the requirements of API specifications as specified in this specification will be applicable.

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, mmTolerance, mm

50 mm to 175 mm

+ 8.0 mm

Above 175 mm

+ 12.5 mm

Revisions: Revised inline with API 8C (5th Edition)

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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:**

The steel shall be melted in Electric Furnace. 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 a suitable temperature followed by Air cooling to achieve the mechanical properties specified in Cl. 8.3.

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.

Note:

- The heat treatment furnace shall be duly calibrated and the records of calibration shall be maintained.
- The loading of the material in heat treatment furnaces shall be such that the presence of any one part does not adversely affect the heat treatment lot. The temperature and time requirements for heat treatment cycles shall be determined in accordance with this specification. Actual heat treatment temperature and time shall be recorded and heat treatment records shall be traceable to relevant components.

7.0 **FREEDOM FROM DEFECTS :**

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

Repair by welding is not permissible.

8.0 **MATERIAL QUALIFICATION:**

8.1 **SELECTION OF TEST SAMPLES:**

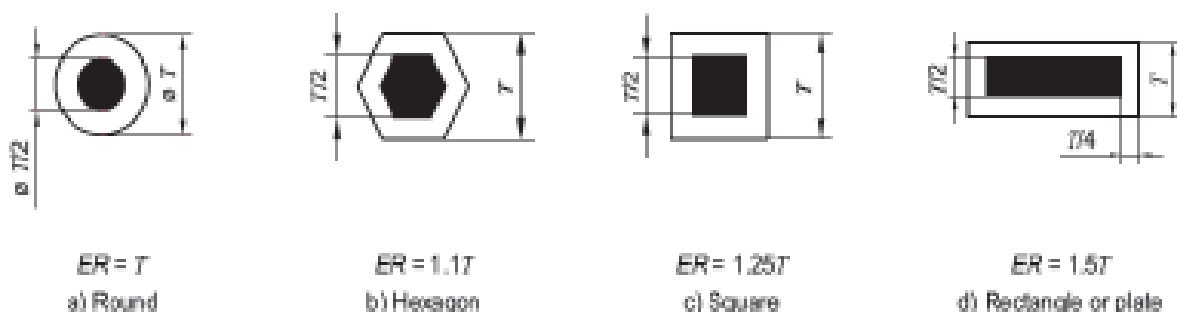
8.1.1 **Chemical Analysis:** Each melt shall be analysed for chemical composition.

8.1.2 **Mechanical Tests:** One sample per lot, comprising of bars of same size, melt and heat treatment batch shall be taken for mechanical testing.

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.

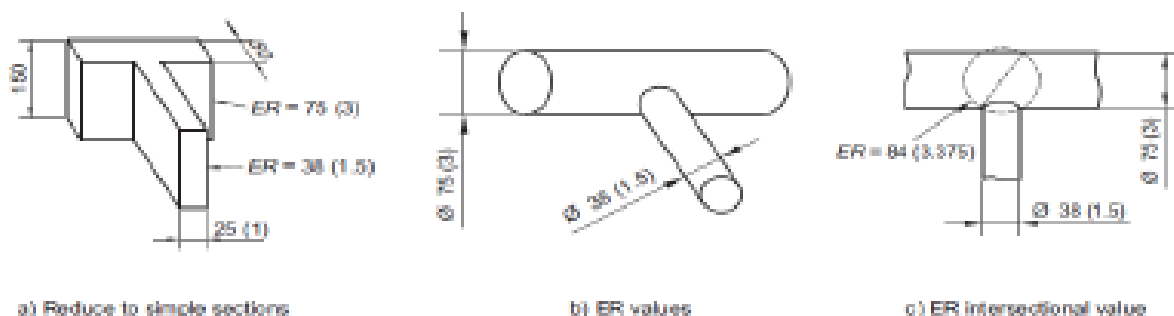
Qualification test coupons shall be either integral with the components they represent or separate from the components or a sacrificial product part. In all cases, the test coupons shall be from the same heat as they qualify, given the same working operations, shall be heat treated with the components.

The below figure shows the basic models for determining the equivalent round which shall be used for determining the size of the qualification test coupon using the equivalent round method for solids.



The following steps (an illustration is shown in the below figure) shall be followed in determining the samples as per the equivalent round method for complex sections.

- Reduce the component to simple section.
- Convert each section to an equivalent round.
- Calculate the diagonal through the circle that would circumscribe the intersection of the equivalent round value.
- Use the maximum equivalent round value, whether for a single section or an intersection as the Equivalent round of the complex section.



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8.2 CHEMICAL COMPOSITION & TOLERANCES:

The melt analysis of the steel shall be as follows:

Element		C	Si	Mn	Cr	Mo	S	P
Melt	% Min.	0.38	-	0.60	0.90	0.15	-	-
Analysis	% Max.	0.45	0.40	0.90	1.20	0.30	0.020	0.020
Tolerance		±0.02	±0.03	±0.04	±0.05	±0.03	+0.005	+0.005

Note: a) Sulfur and phosphorous contents are in line with PSL2 requirements of API 8C

b) Ni addition up to 0.50% is permitted for improving impact properties.

8.3 MECHANICAL PROPERTIES :

The test pieces shall have the following mechanical properties.

Ruling Section, mm	Tensile Strength N/mm ²	0.2% proof stress, min. N / mm ²	Elongation min. L = 4d	Elongation min. L = 5d	Reduction in area % min.	Notched bar impact strength min. (ISO - V notch) J	Hardness, BHN
Upto 16	1100-1300	900	14	12	40	42	315 - 375
>16 40	1000-1200	750	17	15	45	42	285 - 335
>40 100	900-1100	650	17	15	50	42	245 - 315
>100 160	800-950	550	17	15	50	42	225 - 275
>160 250 (L)	750-900	500	20	18	55	42	215 - 245
>160 250 (T)	750-900	500	20	18	--	42	215 - 245

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- The tensile test shall be carried out according to ASTM A370 or any reputed national standard.
- 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.
- The hardness shall be tested in accordance with IS 1500 or any other equivalent international standard.

The impact values indicated above are average of 3 values. All the 3 values shall be reported. No individual value (out of three specimens) shall be less than 32 J

8.4 ADJUSTMENT FACTOR FOR SUB SIZE IMPACT SPECIMENS:

The impact test to be carried using full size test pieces (Size of 10 mm x 10 mm x 55 mm) if the thickness permits. If it is necessary for sub size test pieces to be used, the acceptance criteria for impact values shall be those stated above but multiplied by the appropriate adjustment factor as shown in the below table. Sub size test pieces of width less than 5 mm shall not be used.

Specimen dimension in mm	Adjustment factor
10.0 x 7.5	0.833
10.0 x 5.00	0.667

8.5 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.

- Cracks, flacks, seams and laps.
- Defects giving indications larger than that from a 4mm diameter equivalent flaw.
- 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%.
- 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.

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9.0 RETESTS:

- 9.1 If any of the test specimen fails to meet the requirements specified in d.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
- 9.2 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.
- e)
- 9.3 If after reheat treatment, the mechanical properties are not complied with, the entire lot shall be rejected.

10.0 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.

11.0 TEST CERTIFICATES:

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

- a) Specification No. HY10697 Rev. 00
- b) Material Grade : 42 Cr Mo 4
- c) BHEL Order No.
- d) Size
- e) Melt No.
- f) Process of manufacture
- g) Heat Treatment details and batch No.
- h) Results of chemicals analysis and mechanical properties.
- i) Results of hardness test.
- j) NDT tests.



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12.0 PACKING AND MARKING:

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.

- i) BHEL Specification No. HY10697 Rev .00
- ii) BHEL Order No.
- iii) Melt No. & Heat Treatment batch No.
- iv) Size & Weight
- v) Supplier's trade mark.

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

13.0 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.