



CORPORATE PURCHASING SPECIFICATION

AA 106 20

Rev. No. 09

PREFACE SHEET

BOLTING STEEL BARS FOR HIGH TEMPERATURE SERVICE-H & T (Gr: 21CrMoV5-7+QT)

FOR INTERNAL USE ONLY
REMOVE THIS PREFACE SHEET BEFORE ISSUE TO SUPPLIERS

Comparable Standards:

GERMAN : DIN EN 10269-1999
Gr: 21CrMoV5-7 (1.7709)

Suggested / Probable Suppliers and Grades:

As per user plant vendor list

User Plant References:

1. HYDERABAD : HY10665
2. PIPING CENTRE, MADRAS : A 193, B7
3. TIRUCHY : A 193, B7
4. HARIDWAR : HW10673, HW10681

Revisions : As per Email Dt.16.03.2011 from
Shri Vimal Kishore, BHEL Hyderabad.

APPROVED :
INTERPLANT MATERIAL RATIONALISATION
COMMITTEE-MRC (FCF+HTM)

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BOLTING STEEL BARS FOR HIGH TEMPERATURE SERVICE - H & T (Gr.:21CrMoV5-7+QT)

1.0 GENERAL:

This specification governs the quality requirements of 21CrMoV5-7 bolting steel bars in hardened and tempered condition upto 600 mm diameter / size.

2.0 APPLICATION:

For the manufacture of steam turbine bolts, nuts, studs, spindles, bushes and other components operating in the temperature range of 300 - 540⁰ C.

3.0 CONDITION OF DELIVERY:

Hot rolled/Forged and Hardened and Tempered.

The bars shall be supplied with ends square and true. The bars shall be supplied in straight lengths without twists and bends.

4.0 COMPLIANCE WITH NATIONAL STANDARDS:

The material shall comply, in general, with the requirements of the following National standard and also meets the requirements of this specification.

DIN EN 10269-1999 Gr: 21 Cr Mo V 57 :Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties.

5.0 DIMENSIONS AND TOLERANCES:

5.1 Sizes:

Bars shall be supplied to the dimensions specified in BHEL order.

5.1.1 Length:

Unless otherwise specified, hot rolled bars shall be supplied in 3 to 6 metres length or in multiples with maximum of 10 per cent, shorts down to 1 metre.

Forged bars shall be supplied in lengths of 1.5 to 3 metres.

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**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:

<u>Diameter, mm</u>	<u>Tolerance, mm</u>
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 degaussed. 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 bars shall be heat treated as per EN10269 to get the mechanical properties specified as per clause 12.0.

7.2 Following heat treatment is suggested:

Harden at 900-950⁰ C, cooling in the circulated air / oil depending on Cross Section.
Temper at 680 - 720⁰C, minimum 2 hours.

The duration of tempering as well as the controlled cooling rate are to be chosen to achieve minimum residual stress.

7.3 If the bars need straightening after heat treatment, the straightening operation shall be followed by stress relief annealing at 30⁰C below the tempering temperature with slow cooling after the total straightening process.

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 clause 5.0.

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 analysis of the material and the permissible variation in the composition from the specified limits shall be as follows:

Element	Percent for bar dia upto 160mm		Percent for bar dia. 160-600mm		Permissible
	min.	max.	min.	max.	Variation, %
Carbon	0.17	0.25	0.17	0.25	± 0.02
Silicon	-	0.40	0.15	0.35	+ 0.05
Manganese	0.40	0.80	0.35	0.85	± 0.04
Chromium	1.20	1.50	0.90	1.20	± 0.05
Molybdenum	0.55	0.80	0.65	0.80	± 0.05
Vanadium	0.20	0.35	0.25	0.35	± 0.03
Sulphur	--	0.020	--	0.020	+ 0.005
Phosphorus	--	0.020	--	0.020	+ 0.005
Copper	-	0.20	--	0.20	
Tin	-	0.025	--	0.025	
Arsenic	-	0.010	--	0.010	
Antimony	-	0.010	--	0.010	
Aluminium (Total) -		0.03	--	0.015	
Nickel	-	0.60	0.50	0.80	

11.0 TEST SAMPLES:**11.1 CHEMICAL ANALYSIS:**

Each melt shall be analysed for chemical composition.

11.2 MECHANICAL TESTS:

A hardness test is to be carried out to verify the uniformity of the strength within the delivery lot (per melt and heat treatment batch). The test amount shall be 10% of the bars, but not less than 10 bars. In case order is of less than 10 bars, all bars shall be hardness tested. Mechanical properties shall be tested on hardest and softest bar.

The taking of specimens has to be carried out according to EN 10269 with the following exception:

Up to a diameter (d) or an edge length (a,b) > 160 mm, the transverse specimens can be taken (instead of longitudinal specimens).

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12.0 MECHANICAL PROPERTIES:

12.1 Tensile:

When tested in accordance with IS:1608, the test pieces shall show the following properties (values for transverse specimens in brackets):

Property	Bar < 160mm	Bar 160-600mm
Tensile strength, N/mm ²	700-850	700-850
0.2% Proof stress, N/mm ² ,min	550	550
Elongation (1= 5d), % min.	16	16 (13)
Reduction in area, % min.	60	60 (35)
Impact energy (J) *	63	63 (20)
Hardness (HB 30)	210-250	215-260

*** Charpy Impact (ISO - V) Value :**

When tested in accordance with IS : 1757, the piece shall show a minimum average Charpy impact value over three test values as specified above. Only one test value out of the three can be below the specified value but in no case shall be less than two-thirds the minimum specified value. All the 3 test values shall, however, be reported.

The test is applicable for bars of sizes above 16 mm only.

13.0 NON-DESTRUCTIVE TEST:

13.1 Verification inspection of all bars.

13.2 100% Ultrasonic inspection of all bars above 40mm size according to EN 10308 type 1a and 1c table 1). Acceptance criteria are as follows.

- d or (a,b) = 200mm quality class 4
- d or (a,b) = 200mm quality class 3

In general, the decision limit for loss of back wall echo is 3 dB and for the real reflector length max. 10mm.

14.0 RETESTS:

As per EN10021.

15.0 TEST CERTIFICATE:

Three copies of test certificates shall be supplied unless otherwise stated on the order. In addition the supplier shall ensure to enclose one copy of test certificate alongwith their dispatch documents to facilitate quick clearance of material.

The test certificate shall bear the following information:

BHEL references:
 BHEL order No.
 AA 106 20 , Rev.No. 08: Bolting Steel bars for HTS - H & T (Gr.:21CrMoV5-7- QT)

Supplier Referances:
 Supplier's Name
 Heat or Cast No.
 Process of manufacture
 Identification No.
 Particulars of heat treatment & Batch No.



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Results of Tests:

Chemical analysis

Mechanical properties

Ultrasonic test

Results of dimensional inspection

Mill test certificate

The certificate must be signed by the Chief, Inspection Department / Chief Metallurgist of the supplier's plant.

16.0 PACKING AND MARKING:

Bars shall be suitably packed to prevent corrosion and damage during transportation.

Bars over 63 mm diameter shall be individually stamped / painted on one end face with cast number and AA 106 20. Bars of 63 mm diameter and less shall be bundled together and identified by means of a metal label stating the cast number and specification No. AA 106 20 attached to the bundle.

Each package shall, in addition bear the following information:

AA 106 20 : Bolting Steel bars for HTS - H & T (Gr.:21CrMoV57)

BHEL Order No.

Supplier's name and trade mark, if any.

Cast / Batch No.

Identification No.

Size and quantity supplied.

17.0 REFERRED STANDARDS (Latest Publications Including Amendments):

1) DIN 10269

2) IS: 3739

3) IS:1608

4) IS:1757

5) EN 10228-3

6) EN10021

Note: Alternative equivalent standards are acceptable with prior agreement.