1. MATERIAL

a) Specification : ASME {Latest on date of Purchase Order (PO)}:
CS: SA 179, SA 192, SA210 Gr.A1 & Gr.C, SA 106 Gr.B & Gr.C
AS: SA 209 T1, SA 213 T11, T12, T22, T23, T91 &T92

b) Additional Requirement : As listed below (Supplementary to Specification)

c) End Product : For Manufacture of Hot and Cold finished Seamless Steel Tubes / Pipes as per Indian Boiler Regulations (IBR)

d) Material Source : Supply of Alloy Steel grades shall be from IBR approved Creep Resistance Steel makers. The creep testing shall have been done in **National Metallurgical Laboratory** at **Jamshedpur or BHEL corporate R&D** at **Hyderabad** for Indian Manufacturers and Accredited laboratories for foreign Manufacturers.

Creep Property requirements (For Both Indian and Foreign Manufacturers)**:**

Spec. & Grade	Test Duration in Hrs.	Test Temp. in ° C	Stress in MPa (min.)
SA 213 T 11/T12	**1,000**	**550**	**140**
SA 213 T 22	**1,000**	**550**	**160**
SA 213 T 91/92	**10,000**	**600**	**120**

The above values are meant for both Concast and Rolled blooms. Grade wise, one time creep test report using specimen of blooms for the supply condition (as cast / rolled) is to be submitted.

2. CHEMICAL COMPOSITION AND PROCESS OF MANUFACTURE.

Fully Killed, Vacuum de-gassed Bars in Concast or Rolled form. Ladle analysis to suit end product.
Max. Carbon 0.25% for SA 210 A1 and 0.3% for Sa 210 Gr C .Product analysis and maximum trace elements: Al: 0.02%, Cu: 0.25%, Total: 0.5% for CS and 0.3% for AS.SA 213 T12: Silicon : 0.2% min.

3. DIMENSIONS AND TOLERANCES

a) Diameter : 200 mm. + 2.0 mm - 4.0 mm ; Ovality : < 4.0 mm
b) Length : As per Enquiry /Purchase Order.
c) Straightness : Permissible deviation is 2.5 mm / meter or 25 mm on the entire length of the bars which ever is less.
d) End Surface : 3.0 mm from the perpendicular

4. SUPPLY CONDITION:

As Cast / As Rolled.
In every despatch schedule , the lot Quantity shall be atleast 30 MT per Melt / Heat Number.
Each consignment of bloom despatches shall have the quantity bulked melt/Heat wise.

5. FINISH AND REPAIR

Free from mill scales and defects like laps, seams, folds, cracks, undue segregation, piping etc. Repairs by welding is prohibited. The Surface defects can be removed mechanically subject to meeting minimum diameter.

6. NON-DESTRUCTIVE TESTING

Ultrasonic Test: NDE Procedure No.: 13 (Latest) shall be referred for testing and acceptance for Rolled Blooms only.

7. METALLURGICAL TEST:

7.1 MACRO ETCH TEST: (CONCAST & ROLLED BLOOMS)

1) One sample of complete cross-section of a bloom (Bar) for each Heat / Melt Number shall be examined in accordance with ASTM E 381. The reference plates shall be as follows.
a) For the blooms made by Concast Method (Plate – II &III) and
b) For the blooms made by Rolled Method. (Plate I & II).
c) The Macro structure shall be better than or equal to C2 R2 S2 of ASTM E381 (Plate I & II)

2) Injurious defects of any category like Surface cracks, Pipe/center void, Star crack, center unsoundness, Dark center, Pin holes, White bands, Chill structure, and Dendritic structure (strong) - are not allowed.

3) Photo of Macrograph shall be provided along with test certificates per Heat/ Melt.

7.2 MICRO EXAMINATION FOR ROLLED BLOOMS.

The Specimen for Testing shall be taken on longitudinal plane, midway between the center and surface of the material. The 'Inclusion content of the steel," measured as per ASTM E 45 shall not exceed the following.

Classification							
Type 'A"		Type 'B"		Type 'C'		Type 'D	
Thin	Heavy	Thin	Heavy	Thin	heavy	Thin	Heavy
2	1	2	1	2	1	2	1

8.0 MARKING

a) On each bar longitudinal colour coding to be done by paint for entire length by a band of 50.0 mm width and also both End faces.

b) Melt number & Specification shall be paint stenciled with white colour on both the faces.

SA 192	WHITE	SA 209 Gr. T1	BROWN, RED
SA 210 Gr. A1	YELLOW	SA 213 Gr. T11	BROWN, WHITE
SA 210 Gr. C	BLUE	SA 213 Gr. T12	BROWN, YELLOW
SA 106 Gr. B	RED	SA 213 Gr. T22	GREEN, RED
SA 106 Gr. C	BLUE	SA 213 Gr. T23	RED, WHITE
SA 179	GREEN	SA 213 Gr. T91	GREEN, YELLOW
		SA 213 Gr. T92	BROWN, BLUE

9.. INSPECTION AND CERTIFICATION

FOREIGN SUPPLIERS:

a. IBR Well known steel makers:

Product shall be inspected at works and certification shall be IBR Form IV signed by both maker & maker's representative.

b. IBR Approved Steel Makers:

Product shall be inspected at works and certification shall be IBR Form IV countersigned by Inspecting authority approved by IBR for the country of origin. (To be concurred by BHEL before placing PO).

INDIAN SUPPLIERS :

a. IBR Well Known Steel Makers:

Product shall be inspected at works and certification shall be IBR Form IV signed by both maker & maker's representative.

b. IBR Approved Steel Makers:

Product shall be inspected at works and certification shall be IBR Form IV countersigned by Boiler inspectorate / Directorate of respective State.

TC shall essentially contain:

1. BHEL Order No., TDC No. & Test certificate number, Size & Quantity- Heat / Melt No wise
2. Specification and Grade with year of code, Heat Number, Steel & bar making process.
3. Chemistry including trace elements - Ladle and Product analysis.
4. Metallurgical Test results, NDE results with reference and acceptance standards as applicable.
5. Identification Mark on the Product.
6. Photo of Macro Etch Test.

S. Manojikumar Sr.Engr (QA & C)	**A. Natarajan** DGM (QA & C)	**A. Rajendra Prasad** DGM (OP & C & TE)	**N.Karuppusamy** AGM (MM / SSTP)	**R. Dharmar** AGM (QA & C)
Prepared By	Reviewed By			Approved By

Revision Record: rev: 00: Re-numbered and re-written from TDC: E: S: 04//00
Revision Record: rev: 01: Modified: Cl. 1.0, 3.0, 4.0, 7.0, 8.0 & 9.0.
Revision Record rev 02; Modified: Cl 1.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0 & 9.0.
Metallurgical Test introduced .in Cl no 7 instead of Mechanical Test
Revision Record rev 03; Deleted: Cl 3.0(d)
Revision Record: Rev. 04: Modified Cl.: 1.a), 2.0, 3.0 a), c) & 8.0 to included SA 213 T23 & T91 & T92
Revision Record: Rev. 05: Modified Cl.: 1.d), 3.0, 4.0, 8.0 & 9.0 included Cl.3 (d)
Revision Record: Rev. 06: Modified Cl.: 1.a), d), 2.0, 3.0 a), c), 8.0 b), 9.0, & included Creep test requirements for alloy steel

****

MANUAL ULTRASONIC TESTING OF ROUND ROLLED STEEL BLOOMS

Prepared By	Reviewed & Approved By
R.PARAMESHWARAN MANAGER / NDT LEVEL II	R.J.PARDIKAR AGM / NDT Sr. LEVEL III

EFFECTIVE FROM 09-08-2008

1.0 SCOPE:

1.1 This procedure deals with the ultrasonic testing of Round Rolled Steel blooms by contact pulse-echo method .

2.0 REFERENCE

2.1 ASME Section V Article 5

2.2 ASTM A 388

3.0 PERSONNEL QUALIFICATION:

3.1 Personnel performing examinations shall be qualified in accordance with NDE 01 to at least one of the following levels.

1) Operator	**Minimum Level-1**
2) Evaluation / Report issue	**Level-II**

4.0 EQUIPMENT and SEARCH UNIT

4.1 The examination shall be done with an ultrasonic pulse echo system generating frequencies of 1 MHz to 5 MHz and equipped with a stepped gain control of 2 dB.

4.2 Contact testing with manual scanning shall be done with 2 MHz frequency using longitudinal wave Straight beam probe with a crystal size of 20 to 25mm and 35 degree shear wave with crystal dimension 8x9 mm.

5.0 COUPLANT

5.1 Oil or Oil and grease mix shall be used as couplant.

6.0 SURFACE PREPARATION

6.1 The testing can be carried out on the Blooms as drawn condition . The surface shall be free from scales and deep pits and other foreign materials that may interfere with interpretation of test results.

7.0 EQUIPMENT CALIBRATION

7.1 The Screen height linearity and amplitude control linearity shall be performed in accordance with ASME Sec V Article 4 Appendix I, at the beginning of each period of extended use or every 3 months whichever is less.

8.0 PROCEDURE

8.1 CALIBRATION REFLECTORS

8.1.1 STRAIGHT BEAM TESTING

8.1.1.1 For Calibration purpose the mid portion of the bloom shall be taken .

8.1.1.2 The calibration reflector shall be the first back wall echo from the opposite side of a sound area of the bloom.

8.1.1.3 The gain shall be adjusted to get the back wall reflection to 80% of the FSH and this is taken as reference echo (RE)

8.1.2. ANGLE BEAM TESTING

8.1.2.1 For Angle beam, reference block with same curvature and material shall be used with side drilled hole of diameter 2.0 mm at 50 mm depth and the gain shall be adjusted to get a height of 80% of FSH and taken as Reference echo(RE)

8.2 SCANNING

8.2.1 The scanning shall be performed at a gain setting +6dB of the Reference echo(RE).

8.2.2 During inspection, the entire bloom shall be scanned circumferentially through 360 degree.

8.2.3 During inspection, areas showing complete loss of back reflection shall be rechecked to determine whether the loss of back reflection is due to poor coupling and contact.

8.2.5 The rate of probe movement for examination shall be less than 150 mm/sec.

8.2.6 Minimum 10% overlap between successive scanning shall be maintained.

8.3 CALIBRATION CHECK

8.3.1 When any part of the examination system is changed, a calibration check shall be made on the basic reflector at the finish of each examination, every 4 hours during the examination and when examination personnel are changed.

9.0 ACCEPTANCE STANDARD

9.1 Ultrasonic acceptance or rejection criteria for blooms shall be on a realistic appraisal of the end use.

9.2 Any signal greater than 20% of the FSH in the chill depth area shall be identified as defective in normal and angle beam.

9.3.1 For normal beam Central portion being an area of segregation, the defect echo shall be permitted up to 50% of FSH.

****