

2.25 क्रोमियम - 1मालीब्डेनम स्टील प्लेटों का
मानक विनिर्देशन

STANDARD SPECIFICATION FOR
2.25 Cr. - 1 Mo STEEL PLATES

2	12.04.04	REVISED AND REISSUED AS STD. SPEC.	<i>[Signature]</i> DNN	<i>[Signature]</i> AKM	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
1	05.01.01	REVISED AND REISSUED AS STD. SPEC.	DNN	AKM	CRMN	MI	
0	01.03.96	ISSUED AS STANDARD SPECIFICATION	DNN	CRMN	VC	AS	
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman	Approved by

Abbreviations:

ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing Materials
ACC	Accelerated Cooling Cycle
EIL	Engineers India Limited
EN	European Standard
IBR	Indian Boiler Regulations
ISR	Intermediate Stress Relieving
mm	Millimeter
N	Normalised
PWHT	Post Weld Heat Treatment
T	Tempered

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1.0 SCOPE

This specification covers additional and supplementary requirements of SA-387 / SA-387M Gr.22 Cl.2 (ASME Sec.II Latest) plates intended primarily for pressure vessels/heat exchangers with operating temperature exceeding 375 °C in hydrogen service.

2.0 GENERAL

- 2.1 The tolerance on thickness of steel plates shall be positive only.
- 2.2 Final rolling shall be lengthwise.
- 2.3 Reconditioning, repair of plates by welding shall not be permitted. Surface conditions shall meet requirements of EN 10163 (Part:2) Class A Subclass 3.

3.0 SUPPLEMENTARY TECHNICAL REQUIREMENTS

- 3.1 The steel shall be made by electric furnace or basic oxygen process and shall be vacuum degassed.
- 3.2 Plates shall be supplied in Normalised and Tempered condition (N+T). Alternatively accelerated cooling from an austenitizing temperature by liquid quenching followed by tempering is also acceptable (N + ACC. + T).
- 3.3 The tensile strength at room temperature shall not exceed 7030 Kg/cm².
- 3.4 Certified chemical analysis shall be carried out on heat as well as on product. In addition to chemical analysis required by applicable material specification, analysis of Ni, Cu, As, Sn, and Sb shall be reported. However, Copper and Nickel content shall be limited to 0.20% (max.) and 0.30% (max.) respectively. Material shall have a 'J' factor, as defined as $(Si + Mn) \times (P + Sn) \times 10^4$ less than or equal to 100, where the concentration of elements are in percent.
- 3.5 The material shall have an austenitic grain size 5 (Five) or finer as determined by the method of ASTM E 112.

3.6 Ultrasonic examination of plates

Plates of all thicknesses shall be ultrasonically tested after specified heat treatment as per SA-578 / SA- 578M with an acceptance standard of Level-B.

3.7 Simulated Heat Treatment on Test Coupons

All test specimens representative of heat treated (N+T) / (N+ACC+T) plates shall be subjected to simulated heat treatments. Simulated heat treatments shall include all heat treatments involved during fabrication of the equipment. This shall include PWHT of the equipment plus two additional PWHT cycle (one for shop repair and one for future) including all intermediate heat treatments (ISR). Simulated heat treatment shall be conducted on the test coupons before the specified mechanical tests like tensile, bend, impact tests etc. All tests shall be carried out with minimum PWHT condition and maximum PWHT condition including all ISR. These details shall be recorded on test certificates clearly indicating all heat cycle conditions. Simulated heat treatments shall be decided by fabricator based on fabrication technique employed.

- 3.7.1 Impact tests (Charpy V-Notch) shall be carried out at minus 18 °C with 55J average value for three specimens and with no single specimen below 48J. The orientation of test specimen shall be transverse to the direction of final rolling.

- 3.8 a) Impact energy versus temperature (transition) curves shall be developed for each heat of plate.
- i) A minimum of eight sets of three impact tests of completely heat treated material with minimum PWHT condition and maximum PWHT condition including all ISR shall be performed for each curve. Sample location shall be as specified in ASME code.
- ii) The eight sets of impact test shall be performed at different temperature but shall include minus 18 °C. The generated transition curve shall clearly define the transition zone and the upper shelf. The maximum test temperature shall correspond to the upper shelf energy level.
- b) Step cool tests shall be performed on completely heat treated material with minimum PWHT condition and maximum PWHT condition including all ISR from each heat of plate.
- i) Step cooling shall be in accordance with the following temperatures, holding times and cooling rates to the next lower temperature:

Temperature ° C	Holding time Hrs.	Cooling rate to the next temperature °C/hr
593	1	5.6
538	15	5.6
524	24	5.6
496	60	2.8
468	100	27.8
315	-	air cooling

- ii) Impact test of each step cooled sample shall be performed and transition curve shall be developed following the procedure outlined in clause 3.8(a) above.
- c) Acceptance criteria for materials shall be in accordance with the following:

$$vTr 55 + 3.0 \times \Delta vTr 55_{sc} \leq 10 \text{ } ^\circ\text{C}$$

Where $vTr 55$ = Charpy V notch 55J impact energy transition temperature of completely heat treated specimens before step cooling.

$\Delta vTr 55_{sc}$ = The shift in Charpy V notch 55J impact energy transition temperature after step cooling tests.

3.9 Bend test as per supplementary requirement S 14 of SA-20 / SA-20M.

3.10 Hardness of plates shall not exceed 225 BHN.

3.11 Additional tests

Following additional tests shall be applicable, if specified in Material Requisition:

- a. High temperature tension test for each heat as per S7 of SA-20 / SA- 20M at temperature specified in Material Requisition with maximum PWHT condition including all ISR. Test results shall also be furnished in the test certificates.

- b. Through-thickness tension test for plates 25 mm and above in thickness shall be conducted with frequency and test procedure as per SA-770 / SA-770M with maximum PWHT condition including all ISR and determination of reduction of area as per SA-370. Minimum reduction area shall not be less than 35%. Test results shall also be furnished in the test certificates.

4.0 CERTIFIED DOCUMENTS

The supplier shall furnish 6 copies of the certificates/documents inclusive of all the following tests required as per specification, duly certified by the Inspecting Authority before shipment of plates. The actual values obtained shall be recorded in the test certificates/documents. Material certificates shall conform to DIN 50049 Type 3.1B/ EN 10204 Type 3.1B.

- a. Chemical Analysis
- b. Mechanical Tests
- c. Additional Tests (if specified in the requisition)
- d. Data of heat treatment i.e. initial temperature including heat rate soaking temperature soaking time /cooling rate, etc.
- e. Simulated Heat Treatment of Mechanical Test Coupons (S3 of SA-20 / SA-20M)
- f. Ultrasonic Examination (S 12 of SA-20 / SA-20M)
- g. Certification as per IBR (if specified in the requisition).
- h. Charpy V-notch impact tests (S5 of SA-20 / SA-20M)
- i. Impact - temperature transition curves and acceptance criteria.
- j. Bend test (S14 of SA-20/ SA-20M)

5.0 PAINTING

No painting of any kind is permitted on the steel plates except stencil marking. However, steel plates shall be carefully protected and packed against any damage during transit and shall be of sea-worthy condition.

6.0 INSPECTION AUTHORITY

Material test certificates duly certified by mill's Quality Control Department are acceptable. However, if third party inspection is specified in requisition, all test certificates and documents shall be duly certified by the third party.