STRUCTURAL STEEL, 51 KSI (355 MPA), PLATES, ANGLES, CHANNELS AND OTHER LOW CARBON STEEL MILL SHAPES

Rev	Reason of Change	Date	Made By	Reviewed By	Approved By	Status
0	------	08-09-2015	Pankaj Kumar	R.K. Sharma	D.P. Raturi	Released
1	Note added in chemical requirement for bars for Sulpher contents	07-11-2016	M. Namchu	A. Semwal	K. K. Dhiman	Released

Summary:

This Specification covers the requirements for carbon steels in yield strength class 51 ksi yield (355 MPa) to be used for structural fabrications such as tree frames and miscellaneous structures. Materials include plates, beams, channels, angles, T sections, Z sections, bars, and hollows.

1.0 Scope

This specification covers the requirements for carbon steel with yield strength class 51 ksi (355 MPa) to be used for structural fabrications such as tree frames and other miscellaneous components.

This specification details the minimum requirements for hot finished carbon steel to be used in fabricated structures. Materials include plates, beams, channels, angles, bars, tubes, among others. Equivalent or higher grades may be used by the supplier provided they meet the requirements of this specification.

2.0 Melting

The steels shall be made by the basic oxygen or basic electric arc furnace process. All steels shall be fully killed and made to fine grain practice.

3.0 Chemistry Requirements

The chemistry shall be in accordance with Table 1.

Table 1: Chemical Composition (All are maximums unless otherwise noted)

Elements	Wt. Percentage (%)
Carbon	0.24
Manganese	1.70
Phosphorous	0.035
Sulfur[1]	0.030
Vanadium + Niobium	0.12
CE	0.45

[1] For bars the maximum Sulphur content may be 0.040% provided the component is not to be welded and the chemical composition is reported with a minimum 0.0020% Ca.

The carbon equivalent (CE) shall be calculated using the following equation:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

4.0 Heat Treatment

Material shall be supplied in the normalized/normalized rolled (+N) or as rolled (AR). Alternative heat treatment conditions are acceptable provided the mechanical properties after PWHT have been documented to maintain pre-weld base material properties.

5.0 Metallurgical Testing

5.1 Mechanical Properties

Mechanical testing shall be performed according to ASTM A370 or ISO 6892-1 (EN 10002-1). The mechanical properties shall comply with Table 2.

Table 2: Required Mechanical Requirements. (All are minimums unless otherwise noted)

Tensile strength$_1$ Rm MPa (ksi)	**Minimum yield strength$_1$ ReH MPa (ksi)**					**Minimum Elongation 5,65√S0 (4√S0) %**
t ≤ 100 mm (t ≤ 4 in)	**t ≤ 16 mm (t ≤ 5/8 in)**	**16 < t ≤ 40 mm (5/8 < t ≤ 1 1/2 in)**	**40 < t ≤ 63 mm (1 1/2 < t ≤ 2 1/2 in)**	**63 < t ≤ 80 mm (2 1/2 < t ≤ 3 1/8 in)**	**80 < t ≤ 100 mm (3 1/8 < t ≤ 4 in)**	**t ≤ 100 mm (t ≤ 4 in)**
470-630	355 (51	345 (50)	335 (49)	325 (47)	315 (46)	20
[1]For larger thickness, refer to applicable standard.						

5.2 Impact Testing

Charpy V-notch testing shall be performed according to ASTM E23 or ISO 148-1 (EN 10045-1). The material shall meet the requirements of Table 3.

Table 3: Impact Energy Requirement

Test temperature	-4 ^{o}F (-20 ^{o}C)
Impact Energy (average), min	20 ft-lb (27 J)
Impact Energy (single), min	14 ft-lb (18J)

6.0 Repair

Repair by welding is not acceptable.

7.0 Certification

Documentation that is in compliance with EN 10204 type 3.1 inspection certificates shall be supplied provided with each shipment of material. This type of certificate requires the supplier to provide test results for all requirements listed in specifications that are attached to the part report.

8.0 Applicable Grades

The following list of typical industry specifications and grades may be used as reference specifications for purchasing, but do not necessarily meet all requirements of this specification. The requirements of this specification shall be the valid requirements.

API 5L X52	Seamless or Seam Welded Carbon Steel Pipes
DIN 17121 Grade ST52-3	Seamless Tubes
API 2H Grade 50 API 2MT-1 API 2W Grade 50 API 2Y Grade 50 ASTM A656 Grade 60 ASTM A633 Grades C and D ASTM A737 Grade B	Plates
ASTM A618	Structural Tubings
EN 10219	Cold Formed Tubulars
EN 10210 S355NH	Hot Finished Tubulars
BS 7191 Grade 355EM EN 10225 Grade S355G1 + N	Hot Finished Seamless Tubulars
ASTM A131 Grade DH36/EH36 BS 4360-50D BS 4360-50DD CSA G40.21 (04) 50WT - CAT2 DIN 17100 Grade ST52-3 N EN 10025 Grade S355J2G3 EN 10113 Grade S355NL or ML EN 10155 Grade S355J2G1W NFA 35-501 Grade 36.4 NORSOK M-120 Y04, Y05, Y06, Y07, Y20, or Y25	All Shapes