

**STRUCTURAL STEEL PLATE, 100 KSI (690 MPA), SUBSEA  
COMPATIBLE, WITH QUALITY REQUIREMENTS INCLUDED**

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E	1310111	17-DEC-2018	Luksetich, George	Lohne, Orjan Fossmark	RELEASED

**Summary:**

This document specifies the minimum requirements for hot formed, quenched and tempered plates in accordance with EN 10025-6 - S690QL. Thickness 4-150mm. The material is not generally suited for welding. In case welding is planned, personnel from Materials Engineering must always be consulted in advance. This material is not suitable for direct exposure to sour service.

Revised by: Finn Thorstensen

## 1.0 Scope

This Material Specification outlines the requirements for quenched and tempered high strength plates, according to EN 10025-6 – S690QL. The document gives the requirements for raw material only.

The material is not specified for sour service according to NACE MR0175/ISO-15156.

The material is not generally suited for welding. In case welding is planned, personnel from Materials Engineering must always be consulted in advance.

These requirements are FMC's minimum requirements. The EN standards should always be referred to for requirements.

Some of the requirements in this Material Specification are identical with those in the standard, but are included for the sake of completeness.

## 2.0 Reference Specifications

EN 10025-6:2004	Hot rolled products of structural steels – Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition
EN 10025-1:2004	Hot rolled products of structural steels – Part 1: General technical delivery conditions
EN 10204	Metallic Products - Types of Inspection Documents

## 3.0 Manufacturing process

The manufacturing process shall be in accordance with EN 10025-6.

### 3.1 Melting

The steels shall be made by the basic oxygen or basic electric arc furnace process. All steels shall be fully killed and shall have a fine grain structure containing nitrogen binding elements in amounts sufficient to bind the nitrogen. In addition the steel shall be vacuum degassed or ladle refined.

### 3.2 Delivery condition

The product shall be quenched and tempered (QT). Thickness 4-150 mm.

## 4.0 Chemistry requirements

The ladle and product analysis shall comply with Table 1. All values are maximum values unless otherwise noted. The deliberate addition of any other elements than those listed in Table 1 is not permitted.

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

	Ladle (wt%)	Product (wt%)
Carbon	0.20	0.22
Silicon	0.80	0.86
Manganese	1.70	1.80
Phosphorus	0.020	0.025
Sulfur	0.010	0.012
Nitrogen	0.015	0.016
Boron	0.0050	0.0060
Chromium	1.50	1.60
Copper	0.50	0.55
Molybdenum	0.70	0.74
Niobium	0.06	0.07
Nickel	2.0	2.1
Titanium	0.05	0.07
Vanadium	0.12	0.14
Zirconium	0.15	0.17
Aluminum (minimum)	0.018	0.013
CEV	Thickness <50 mm:	0.60
	Thickness >50 and <100 mm:	0.77
	Thickness >100 and <150 mm:	0.83

Carbon Equivalence (CEV) shall be calculated using the following equation

$$\%C + \frac{\%Mn}{6} + \frac{(\%Cr + \%Mo + \%V)}{5} + \frac{(\%Ni + \%Cu)}{15}$$

## 5.0 Metallurgical Testing

Mechanical testing shall be done in as-delivered condition for each nominal wall thickness. Frequency of testing, preparation and location of samples and test pieces shall be in accordance with EN 10025-6.

## 5.1 Mechanical Testing

Tensile testing shall be performed according to requirements in EN 10002-1 and EN 10025-6. The Materials shall meet the mechanical requirements listed in table 2.

Table 2: Mechanical Requirements (All values are a minimum unless otherwise noted)

	<b>Thickness &gt;3 mm and &lt;50 mm</b>	<b>Thickness &gt;50 mm and &lt;100 mm</b>	<b>Thickness &gt;100 mm and &lt;150 mm</b>
Tensile Strength, (Rm)	770 – 940 MPa (111.7 - 136.3 ksi)	760 – 930 MPa (110.2 - 134.9 ksi)	710 – 900 MPa (103 - 130.5 ksi)
0.2% Proof Stress, (Rp 0,2)	690 MPa (100.1 ksi)	650 MPa (94.6 ksi)	630 MPa (91.4 ksi)
Elongation, L0 = 5,65 √S0, minimum <sup>1</sup>	Transverse: 14%	Transverse: 14%	Transverse: 14%
Hardness - plate surface, maximum	333 HBW (35HRC)	333 HBW (35HRC)	333 HBW (35HRC)
<sup>1</sup> L0 = gauge length, S0 = specimen diameter			

## 5.2 Impact Testing

Charpy V-notch impact testing shall be performed in accordance with requirements in EN 10045-1 and EN 10025-6.

For plate thickness > 40 mm longitudinal test specimens shall be sampled from the 1/4 t position.

Table 3: Impact Energy Requirements

Test Temperature	-40°C (- 40 °F)
Impact Energy (average), min	42 J (31 ft-lb)
Impact Energy (single), min	30 J (22ft-lb)

## **6.0 Non-Destructive Evaluation**

### **6.1 Volumetric Inspection**

Plates with wall thickness > 6 mm shall be subject to ultrasonic testing in accordance with EN 10160, acceptance criteria S1 / E1.

## **7.0 Surface Properties**

The surface condition shall be in accordance with EN 10025-6.

## **8.0 Tolerances**

The tolerances shall be in accordance with EN 10025-6.

## **9.0 Certification**

Documentation that is in compliance with EN 10204 type 3.1 inspection certificates shall be supplied provided to FMC 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.