

Mars® Protection steels

Mars® 650

Ultra-High-Hardness Armor with maximum resistance to penetration

Mars® 650 is a ultra-high-hard (typical 650 HBW) protection steel offering uncompromising ballistic resistance performance, for use as add-on armor.

Properties

Standards

Mars® 650 can be ordered according to the following standard: **NF A36-800 THD5**
MIL-DTL-32332

Chemical composition - Ladle analysis - Max weight %

C	S	P	Si	Mn	Ni	Cr	Mo	B	CE ¹⁾
0.55	0.002	0.010	1.0	0.7	2.4	0.4	0.5	0.003	0.83

1) Carbon equivalence per ASTM A6/A6M, i.e. : $CE = C + [Mn/6] + [(Cr + Mo + V)/5] + [(Ni + Cu)/15]$

Mechanical Properties (in both directions)

	Hardness	Charpy KV ²⁾ @-40°C standard 10 x 10 specimen ³⁾	
	HBW	J	ft.lbs
Guarantees	≥ 577	≥ 8	≥ 6
Typical values	650	9	7

2) Average of 3 tests. Single value min 70% of specified average.

3) For nominal thicknesses under 11mm, sub-size specimens are used. The specified minimum value is then proportional to the specimen cross section.

Brinell hardness test according to relevant standard (EN ISO 6506-1 / ASTM E10/E110), on each plate and in two places, one at each end of a diagonal, on a milled surface 0,5 to 1mm below plate surface.

Charpy Impact test according to relevant standard (EN ISO 148-1 / ASTM E23) on each heat and thickness from 6mm. Ultrasonic test is performed according to standard requirements or upon special agreement up to EN 10160 Class S₃ /E₄.

In service conditions

Ballistic properties

See our table of recommended minimum thicknesses for common protection levels.

Ballistic test to be performed upon request.

Plate processing

Cutting

Mars® 650 can be cut either by abrasive waterjet, laser or plasma.

Delivery conditions

Heat treatment

Mars® 650 is quenched and tempered at high temperature ($\leq 180^{\circ}\text{C}$).

Surface properties

According to MIL-DTL-32332 or EN 10163 class B - subclass 3.

Shot blasting and weldable primer application can be performed upon request.

Sizes and tolerances

Mars® 650 can be supplied as quarto plates or cut-to-length sheets (from hot strip mill) in standard sizes or tailor made dimensions.

	Quarto plates			Cut-to-length sheets
Thicknesses	4.0 – 16 mm (.157" – .787")			2.8 – 10.0 mm (.098" – .393")
Thickness	Th	For width ≤ 2000 mm	For width ≤ 2400 mm	
	≥ 4 to ≤ 12 > 12 to 20	0/+0.8 0/+1.0	0/+0.8 0/+1.2	≥ 2.5 to ≤ 8.5 : -0/+0.4 > 8.5 to ≤ 10.0 : -0/+0.5
Width*	1500 – 2500 mm (39" – 98")			1500 – 2000 mm (39" – 78")
Lenght	1600 – 8100 mm (63" – 319")			1800 – 8100 mm (71" – 319")
Shape, length, and width tolerances as per MIL-DTL-32332 or EN 10029				

* Depending on plate thickness

Flatness

Maximum flatness deviation is 3 mm/m (when measured according to EN 10029).

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Technical data and information are to the best of our knowledge at the time of editing. However, they may be subject to some slight variations due to our ongoing research programme on steels. Therefore, we suggest that information be verified at time of enquiry or order. Furthermore, in service, real conditions are specific for each application. The data presented here are only for the purpose of description, and considered as guarantees when written formal approval has been delivered by our company. Further information may be obtained from the address opposite.