Mars® 550

Very-High Hardness Armor.

Mars® 550 is a very-high-hardness (typical 550 HBW) protection steel for lightweight armor applications such as :

- Very light to medium-weight vehicles structures
- Add-on armour of any thickness for usage up to heavy tanks.
- Boxes, containers, shelters, reservoirs, door frames, etc.

It is specially suitable for applications where the weight of a high-hardness armor is not acceptable but the workshop implementation doesn't allow the use of an ultra-high-hardness armor

Properties

Standards

Mars® 550 can be ordered according to the following standards: **NF A36-800 THD3 or MIL-DTL-46186**

Chemical composition - Ladle analysis - Max weight %

C	S	P	Si	Mn	Ni
0.35	0.002	0.010	1.0	1.2	1.6
Cr	**Mo**	**CE [1)]**			
0.6	0.6	0.77			

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	YS	UTS	Elongation	Charpy KV [2)] @-40°C standard 10 x 10 specimen [3)]	
	HBW	MPa	MPa	5d (%)	J	ft.lbs
Guarantees	530 - 570	≥ 1300	≥ 1700	≥ 8	≥ 18	≥ 13
Typical Values	550	1450	1800	11	24	18

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 65061 / 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 testing levels ASTM A578/A578M level C / EN 10160 Class S_3/E_4

In service conditions

Ballistic properties

Mars®550 exceeds the ballistic performance requirements of MIL-DTL-46186A.
See our table of recommended minimum thicknesses for common protection levels.
Ballistic test to be performed upon request.

Plate processing

Cutting

Mars® 550 can be cut either by abrasive waterjet, laser or plasma.

Bending

Mars® 550 offers ability to cold forming but as other protection steels must be used with caution. The elastic energy stored during forming may lead to rupture or shifting. It is essential to maintain a safety distance and not situate oneself in front of the plate while it is being formed. It is crucial to wear appropriate individual safety equipment and to equip machines with collective protection. The capacity of the machine and tools must be suitable information on bending loads in relation to tools, plate thickness and steel strength.
The most important parameter when bending are the use of a correct punch radius. Please contact us if you need assistance.

General recommendations :

- Minimal recommended temperature: 15°C
- Ensure that there are no obvious defects, especially on edges. Ideally, plate edges in the bending area should be ground smooth and rounded prior to operation.
- Die edges must remain clean, smooth, and ideally lubricated.
- Perform preliminary trials on prototypes and form the first pieces with low speed recommandation.
- Make sure that there is enough room in the die for the chosen punch together with the workpiece :
  Die width > punch diameter + 3 x thickness

Grade	Thickness mm (inch)	Mandrel Radius		Width of the die
		//	⊥	
Mars® 550	< 8 (0.315)	5t	5t	Die width > 2 x radius + 3 x thickness
	8 to 16 (0.315 to 0.63)	6t	6t	

Welding

Mars® 550 can be welded using common welding processes. Like the other protection steels, it can be sensitive to cold cracking in the heat affected zone of a weld. The best results can be obtained by :

- Make sure that the steel is at least at room temperature (≈20 °C). For thicknesses highter than 25mm, the steel must be preheated at a temperature maximum of 100°C (maximal temperature acceptable by plate to preserve mechanical proprieties).
- Clean the weld joint area, removing potential sources of hydrogen: rust, scale, moisture, grease, ...
- Using low hydrogen welding methods and consumables (filler material hydrogen content HD ≤ 5 ml/100 g).
- Preferably use MAG welding and a welding sequence that is designed to minimize residual stresses.
- Austenitic consumables must be used. The recommended stainless austenitic consumables are of type AWS 307.

Delivery conditions

Heat treatment

Mars® 550 is quenched and tempered at low temperature (< 180°C).
Air hardened version is auto-tempering which is specially adapted to hot forming

Surface properties

According to MIL-DTL-12560 or EN 10163 class B - subclass 3.
Shot blasting and weldable primer application can be performed upon request.

Sizes and tolerances

Mars® 550 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	5 - 16 mm (.197" - .630")			2.5 – 10.0 mm (.157" - .393")
Thickness Tolerances	Th	For width ≤ 2000 mm	For width ≤ 2400 mm	
	≥ 5 to ≤ 12 > 12 to 16	0/+0.8 0/+1.0	0/+0.8 0/+1.2	≥ 4.0 to ≤ 7.8 :-0/+0.4 > 7.8 to ≤ 10.0 :-0/+0.5
Width*	1500 - 2500 mm (39" - 137")			1500 - 2000 mm (39" - 78")
Lenght	1600 - 8100 mm (47" - 319")			1800 - 8100 mm (71" - 319")
Shape, length, and width tolerances as per EN 10029				

* Depending on plate thickness

Flatness

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

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