

## Mars® 220

### Mars® 220: Medium Hardness Armor (440 HB) for blast protection

Mars® 220 is a protection steel dedicated to vehicle structures for protection against mines and IED. It offers optimal mechanical characteristics in terms of hardness (440 HB), toughness, and ductility for resistance against blast and fragments, while keeping an excellent workability, especially bending and welding, for building specific vehicle profiles used for blast protection (example: V-shaped floor).

#### PROPERTIES

#### STANDARDS

##### INDUSTEEL: Mars® 220

Mars® 220 satisfies requirements of following specifications:

- > France                      **NF A36-800-1 THD 1**
- > Germany                    **TL 2350-0000-Quality O**
- > U.K.                         **Def Stan 95-24 Class 3A (420-480HB)**
- > USA                         **MIL-DTL-12560 Class 4a (420-470HB)**

#### CHEMICAL ANALYSIS - WEIGHT%

	C	S	P	Si	Mn	Ni	Cr	Mo
4 to 50 mm (.16" to 2")	≤ .22	≤ .005	≤ .015	≤ .5	≤ 1.5	≤ 2	≤ 1	≤ .6
>50 to 80 mm (2" to 3.15")	≤ .24	≤ .005	≤ .015	≤ .5	≤ 1.5	≤ 5	≤ 2	≤ .6

#### MECHANICAL PROPERTIES

	Delivery conditions	Hardness	Yield Strength		UTS		Elongation	Charpy KV* -40 ° Transversal to rolling direction	
		HB	MPa	ksi	MPa	ksi	5d(%)	J	ft.lbs
4 to 50 mm (.16" to 2")	Guarantees	420-470	≥1100	≥ 160	≥ 1250	≥ 181	≥ 10	≥ 27	≥ 20
	Typical values	440	1150	167	1450	210	13	48	35
>50 to 80 mm (2" to 3.15")	Guarantees	≥400	≥800	≥116	≥1300	≥189	≥10	≥20	≥15

\* Standard specimen: 10 x 10 mm

#### HEAT TREATMENT

Mars® 220 is quenched and tempered at low temperature (≤200°C/390°F) for thicknesses up to 50mm. For special purpose like heavy vehicles underbelly it receives a special heat treatment.

## IN SERVICE CONDITIONS

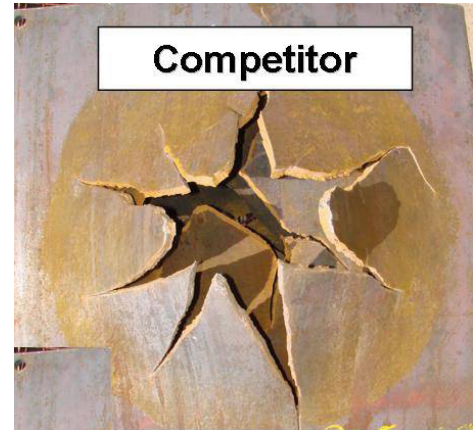
### BALLISTIC PROPERTIES

Mars® 220 steel grade has been designed for high resistance against mines (blast effects).

Against kinetic projectiles, Mars® 220 steel has a ballistic behavior between Mars® 190 (< 400 HB) and Mars® 240 (500HB).



Mars® 220 sample th15 mm (.6") after blast test (classified results)



Competitor steel sample th15 mm (.6") after similar blast test (classified results)

## DELIVERY CONDITIONS

### SIZES AND TOLERANCES

Mars® 220 can be supplied as standard size plates or tailor made mill plates or formed parts (cf: Parts-kit offer)

#### Sizes

Thicknesses	4.0 - 50 mm (.15" - 2")
On request: 51 to 80 mm (>2" to 3.15")	
Width	≤ 2500 mm (98")
Length	≤ 8100 mm ( 318")

For other sizes, please contact us.

#### Thickness tolerances (quarto plates)

(Possibility of tighter tolerances on request)

Thickness		Tolerance for width ≤ 2000 mm (≤ 79")		Tolerance for 2000 < width ≤ 2500 mm (79" < w ≤ 98")	
mm	inch	mm	inch	mm	inch
≤ 12	≤ .47	0,8	.03	1	.04
> 12 to 20	≤ .47 to .79	1	.04	1.2	.047
> 20 to 35	≤ .79 to 1.38	1.2	.047	1.4	.055
> 35 to 50	≤ 1.38 to 1.97	1.6	.063	1.8	.071

#### Tight thickness tolerances (cut-to-length plates)

Thickness		Width		Tolerance
mm	in	mm	in	mm (in)
4 ≤ th < 7,8	0.16 < th < 0.28	2000	78.74	-0/+0,4 mm (-0/+0.016)
7,8 ≤ th < 10,8	0.28 ≤ th < 0.39	2000	78.74	-0/+0,5 mm (-0/+0.020)

#### Flatness

Our product are delivered with a guaranteed flatness ≤ 3mm/m (1/8" in every 40").  
95% of plates are delivered with a typical flatness ≤ 1.5 mm/m (1/16" in every 40").

## DELIVERY CONDITIONS

### PARTS - KIT OFFER

Mars® 220 is also supplied as cut parts by laser or oxygaz/ dry plasma (depending on thickness) up to finished complex parts and kits (formed, welded, machined, painted options...)

*Please contact us for your specific projects*



*Formed and machined part in Mars® 220 thickness above 70 mm (2.80") manufactured by Industeel*

## PLATE PROCESSING

For all information concerning machining, thermal cutting, forming or welding, see our userguide for Mars® protection steels.

As a general rule, when using Mars® protection steel, the increased mechanical characteristics of this material must be taken into account.

It is crucial to wear appropriate individual safety equipment and to equip machines with collective protection.

## YOUR CONTACT

**Damien Delorme**

**Tel. +33 3 85 80 50 37**

*damien.delorme@arcelormittal.com*

<http://industeel.arcelormittal.com>

**Industeel France**

*Le Creusot Plant*

*56 rue Clemenceau*

*F-71202 Le Creusot Cedex*

Technical data and information are to the best of our knowledge at the time of printing. However, they may be subject to some slight variations due to our ongoing research programme on protection 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.