Industeel

ArcelorMittal

MARS® 240

High hardness steel (500 HB) for ballistic protection

MARS® 240 is a high-hardness steel (500HB) with optimal compromise ballistic resistance properties and workability for applications:
- very light weight vehicle structures to medium vehicles
- add on armour, removable all thicknesses and all applications
- boxes, containers, shelters, storage tanks, door frames...

Standards

INDUSTEEL : MARS® 240

MARS® 240 satisfies requirements from specifications :

→ France	NF A 36-800-TDH 2
→ Germany	TL 2350-000 Quality Z
→ UK	DEF STAN 95-24 Class 3
→ US	MIL DTL 46100 RevE

Chemical analysis - Weight %

C	S	P	Si	Mn	Ni	Cr	Mo
≤ .30	≤ .002	≤ .010	≤ .4	≤ 1	≤ 1.8	≤ 1.6	≤ .6

Chemical composition depends on thickness range (particularly on Ni and Cr contents) and, possibly, on customer's specification

Mechanical properties

as supplied	Hardness	Yield Strength		UTS		Elongation	Charpy V-40° Transversal to rolling direction	
	HB	MPa	*KSI*	MPa	*KSI*	5d(%)	J	*ft.lbs*
Minimum values	477-534	≥ 1100	≥ *160*	≥ 1600	≥ *232*	≥ 9	≥ 16	≥ *12*
Typical values	495	1300	*195*	1700	*250*	12	28	*21*

Heat treatment

MARS® 240 is quenched and tempered at low temperature (≤200°C / 390°F)

Ballistic properties

Généralities

Threat	V_o (m/s)	Distance (m)	Obliquity	Thickness for protection	
				mm	inch
.357 Magnum FMJ	430 ±10	5	0°	2,3	*.09*
.44 Magnum FMJ	440 ±10	5	0°	2,8	*.11*
7.62mm PS x 39 M43	720 ±10	10	0°	4,0	*.16*
5.56mm SS109 (M855) x 45	950 ±10	10	0°	6,7	*.26*
5.56mmSS92 (M193) x 45	980 ±10	10	0°	9,8	*.39*
7.62mm ordinary x 51 (.30 ball x 51)	830 ±10	10 100	0° 0°	6,0 5,2	*.24* *.20*
7.62mm P80 x 51 (.30 AP x 51)	830 ±10	30 30 100 100	0° 30° 30° 45°	15,0 7,5 6,5 5,0	.59 .30 .26 .20
12,7mm P Mle 47 x 99 (.50 AP x 99)	875 ±10	100 100 200 500	0° 30° 45° 30°	24,5 15 11 11	*.96* *.59* *.43* *.43*

According to 4569 STANAG / AEP-55 / Volume 1 / Edition C / Version 1 (April 2014)

Level	KE Threat		Required thickness for protection (mm)	
	Calibre and projectile type	V proof (±20m/s)	MARS®240	
3	7.62 mm x 51 AP WC (8.4g core)	930	21,5 (.846")	**21.5 (.846")**
	7.62mm x 54 API B32 (10g core)	854	-	
2	7.62mm x 39 API BZ (7.8g core)	695	12,5 (.492")	
1	7.62mm x 51 NATO (9.7g)	833	6,2 (.244")	**9.3 (.366")**
	5.56mm x 45 NATO SS109 (4g)	900	6,3 (.248")	
	5.56 x 45M 193 Ball (3.56 g)	937	9,3 (.366")	

Processing

Cutting

Standard thermal cutting techniques (oxygas, dry plasma or laser) can be used without any pre-heating for thicknesses up to 20mm *(.8")*

For higher thicknesses, pre-and post-heating at 150°C (*300°F*) are recommended.

Remarks : Industeel can supply directly cut parts with very tight tolerances sizes, in view of their direct utilization or integration in assembly lines.
Holes can be realized by laser up to a diameter equal to half thickness (example : a 3 mm (*.118"*) diameter hole in a 6 mm (*.24"*) thickness plate).
→ Please, contact us for any information (see item parts-kits option)

Forming

Cold bending part (mandrel radius =3t)
MARS® 240 - 4.7mm (.18") thick

→ *Cold Forming*
The rough-cut edges (oxycutting or shearing) are trimmed and ground prior to forming.

Thickness (mm-inch)	Bending line // Rolling direction	Bending line ⊥ Rolling direction
< 8 mm (.30")	R = 8 x th	R = 6 x th
From 8 (.30") to ≤ 16 mm (.65")	R = 9 x th	R = 7 x th
> 16 mm (.65")	Contact us	

R = Minimum mandrel radius - Th = Thickness of plate - Ve opening recommended : (Rx2) + (3xth)

Remarks :
Getting from a great experience in cold forming armour steels, Industeel can supply directly cold bending parts with mandrell radius up to 3 thicknesses.

→ *Hot Forming*
No problem at 900/950°C (*1650-1740°F*) . After hot forming, a complete quality heat treatment (Q+T) must be made.
Remarks
Industeel can supply directly hot forming parts.

→ Please contact us for any complementary information concerning hot or cold forming - see § Parts, Kit offer).

Welding

MARS® 240 can be weld assembled without any pre-heating or stress-relieving up to 20mm (.8"). For thicknesses ≥ 20mm (.8") we recommend a pre and post heating at 150-200°C (300-390°F). Edges of cut parts or plates must be ground to remove any traces of oxide or surface defects. In case of tightened assemblies, the processes used must lead to an austeno-ferritic alloy weld deposit. Electric arc welding using 20-10-3 austeno-ferritic welding rod with basic coating is recommended for this purpose.

MIG welding using wire type 18-8 Mo can also be performed.

Following precautionary steps warrant quality of the joints
→ Be sure that plate temperature is not below 10°C *(50°F)*. Oven-drying of the welding rods.
→ Ignition on an overlength rather than on the joint itself.
→ Short arc to optimize the protection of the welding-rod coating.

Laser cut and welded parts
MARS® 240 - 4,7mm (.19")

Remarks : Industeel can supply directly welded parts with great sizes tolerances precision.
Please contact us for any information
(see item parts-kits option)

Sizes and Tolerances

Sizes

MARS® 240 can be supplied as tailor made mill plates, or standard sizes plates.

Thicknesses	2,5 - 50mm (*.1" - 2"*)
On request : above 50mm (2") up to 150mm (6")	
Width	≤ 2500 mm (*98"*)
Length	≤ 8100 mm (*318"*)

Tolerances on thickness

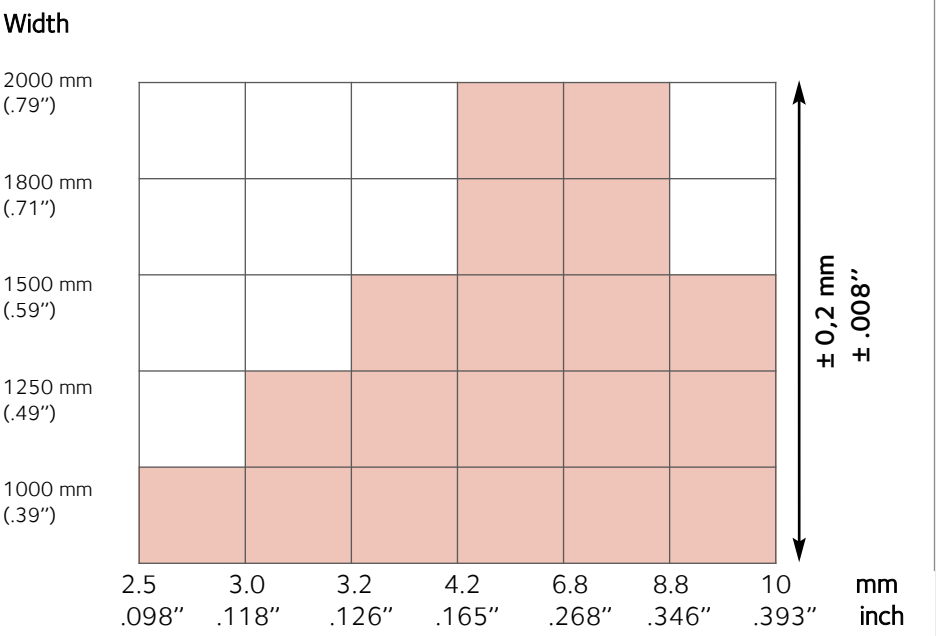
(Possibility of lower tolerances on request)

Thickness		Tolerance for width ≤ 2000mm (≤ 79")		Tolerance for 2000 < width ≤ 2500mm (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*

Flatness

Our products are delivered as standard with a flatness less than or equal to 3mm/m (1/8" in every 40").

Tight tolerances



Parts - Kit offer

MARS® 240 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

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.

For any information

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