

## Mars® 240

### 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...

#### PROPERTIES

#### STANDARDS

##### INDUSTEEL: Mars® 240

Mars® 240 satisfies requirements of following specifications:

- > France                      **NF A 36-800-TDH 2**
- > Germany                   **TL 2350-000 Quality Z**
- > U.K.                         **DEF STAN 95-24 Class 3**
- > USA                         **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 5d(%)	Charpy V -40° Transversal to rolling direction	
	HB	MPa	ksi	MPa	ksi		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).

## IN SERVICE CONDITIONS

### BALLISTIC PROPERTIES

#### Generalities

Threat	V <sub>o</sub> (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
7.62 mm PS x 39 M43	720 ±10	10	0°	4.0	.16
5.56 mm SS109 (M855)x45	950 ±10	10	0°	6.7	.26
5.56 mm SS92 (M193) x 45	980 ±10	10	0°	9.8	.39
7.62 mm ordinary x 51 (.30 bail x 51)	830 ±10	10	0°	6.0	.24
		100	0°	5.2	.20
7.62 mm P80 x 51 (.30 AP x 51)	830 ±10	30	0°	15.0	.59
		30	30°	7.5	.30
		100	30°	6.5	.26
		100	45°	5.0	.20
12.7 mm P Mle 47 x 99 (.50 AP x 99)	875 ± 10	100	0°	24.5	.96
		100	30°	15	.59
		200	45°	11	.43
		500	30°	11	.43

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

Level	KE Threat		Required thickness for protection (mm-inches)	
	Calibre and projectile type	V proof (±20 m/s)	Mars®240	
3	7.62 mm x 51 AP WC (8.4 g core)	930	21.5 (.846")	21.5 (.846")
	7.62 mm x 54 API B32 (10 g core)	854	-	
2	7.62 mm x 39 API BZ (7.8 g core)	695	12.5 (.492")	
1	7.62 mm x 51 NATO (9.7 g)	833	6.2 (.244")	9.3 (.366")
	5.56 mm x 45 NATO SS109 (4 g)	900	6.3 (.248")	
	5.56 x45M 193 Bail (3.56 g)	937	9.3 (.366")	

## DELIVERY CONDITIONS

### SIZES AND TOLERANCES

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

#### Sizes

Thicknesses	2.5 - 50 mm (.7" - 2")
On request	above 50 mm (2") up to 150 mm (6")
Width	≤ 2500 mm (98")
Length	≤ 8100 mm (318")

For other sizes, please contact us.

#### Tolerances on thickness

(Possibility of tighter tolerances on request)

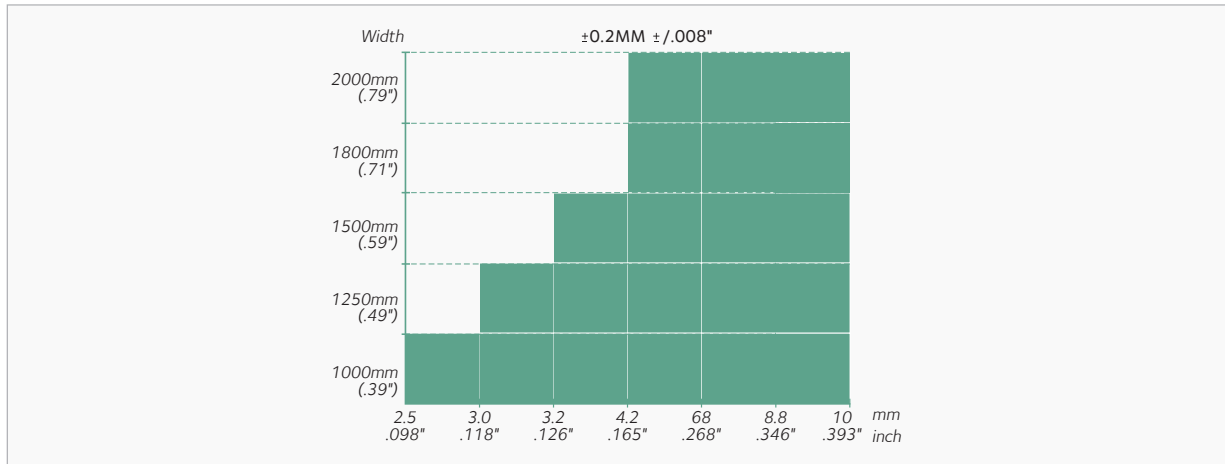
Thickness		Tolerance for width ≤ 2000 mm (≤ 79")		Tolerance for 2000 < width ≤ 2500 mm (79" < w ≤ 98")	
		mm	inch	mm	inch
≤ 12	≤ .47	0.8	.03	1	.04
> 12 to 20	> .47 to .79	1	.04	1.2	.047
> 20 to 35	> .79 to 1.38	1.2	.047	1.4	.055
> 35 to 50	> 1.38 to 1.97	1.6	.063	1.8	.071

#### Flatness

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

## DELIVERY CONDITIONS

### Tight thickness 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*

## PLATE PROCESSING

### CUTTING

Standard thermal cutting techniques (oxygas, dry plasma or laser) can be used without any pre-heating for thicknesses up to 20 mm (.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 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 t	R = 6 x t
From 8 (.30") to ≤ 16 mm (.65")	R = 9 x t	R = 7 x t
> 16 mm (.65")	Contact us	

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

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.

*Cold bendied part (mandrel radius = 3t)  
Mars® 240 - 4.7 mm (.18") thick*

#### 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 formed 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 20 mm (.8"). For thicknesses  $\geq 20$  mm (.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 austenoferritic welding rod with basic coating is recommended for this purpose.

MIG welding using wire type 18-8Mo can also be performed. Following precautionary steps warrant quality of the joints :

- > Be sure that plate temperature is not below 15°C (60°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 weldingrod coating

Remarks: Industeel can supply directly welded parts with great sizes tolerances precision.

Please contact us for any information (see item parts-kits option)



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

## YOUR CONTACTS

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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.