Industeel

ArcelorMittal

Steel Solutions
for protection applications

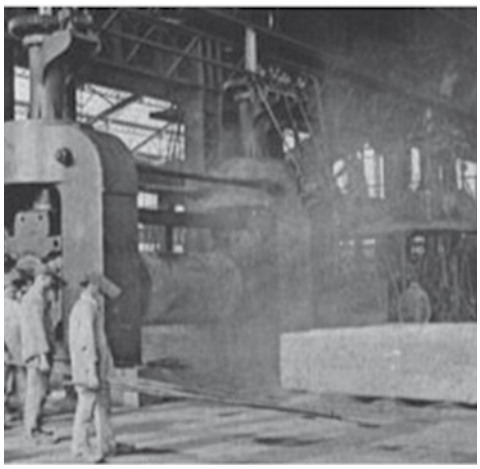
Our Business

Leading supplier of high quality steels

Subsidiary of ArcelorMittal, Industeel is specialized in the production of hot rolled steel plates, ingots and formed pieces in the largest dimensional range.

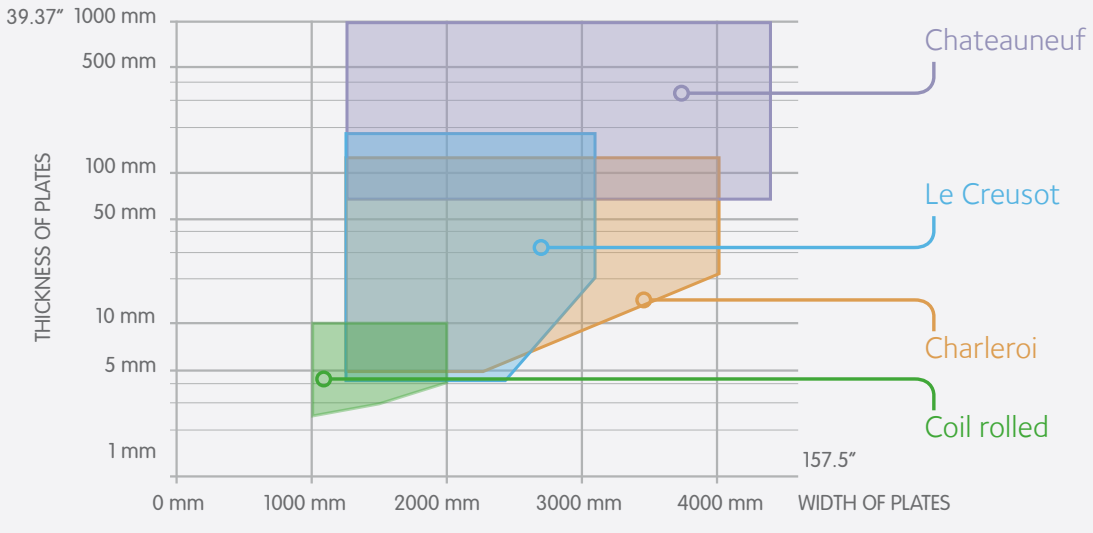
Specialized in carbon and stainless steels, Industeel offers a complete range of high quality steel grades designed to meet the most severe specifications.

Rolling mill of Le Creusot early 20th century



Rolling mill today

The largest dimensional range of plates



For all other dimensions, please consult

Our strengths

First-class producer of ballistic protection steel plates

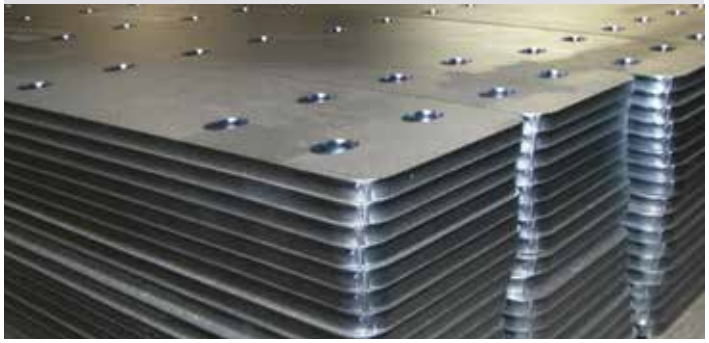
Industeel specificities and advantages in protection steels manufacturing

QUIET PLATES

Thanks to our efficient and soft process quenching, eliminating residual stress, we guarantee quiet plates with:

- No deformation during and after cutting
- Low residual magnetism

Pile of cut parts MARS® thickness 6 mm



FLATNESS

Our unique quenching press machine gives excellent results in terms of guaranteed flatness (95% plates < 1.5 mm/m):

- Easier welding
- Better integration

Pile of flat MARS® plates thickness 4 mm

TIGHT TOLERANCES

In addition to quarto plates, Industeel offers a wide range of coils (up to 10 mm) with thight tolerances (+/- 0.2 mm) thus allowing weight reduction.

Thickness Control

Our added value

Innovative Steel Solutions for protection applications

Innovation

We design new solutions to respond to specific requirements with innovative and added-value products.

Our Research and Development Center works in cooperation with recognized institutes and organizations (dynamic tests, blast trials, ...) to develop new grades and anticipate future requirements.

Technical Assistance

Our team can support you in the integration of our steel solutions (heat treatments, machining, bending, welding...).

Trials

We have the experience and know-how to design ballistic solutions and perform conventional ballistic trials (with all the main accredited ballistic tests centers).

Taylor barrel of R&D center

Tekken standard welding on protection steel

Drilling trials

Our services

More than a mother plate supplier

Parts or kits

Experienced team of ballistic experts dedicated to provide you with the best service from the very beginning of your project up to successful completion.

Our complete offer:

- Plates from quarto plates or coils
- Parts for target application with holes or attachments for handling
- Laser cut parts
- Cold or hot bended parts
- Laser welded pieces
- V shape floors, underbelly formed parts
- Specific perforated material

Stock of plates

All you need to start your project on time:

Our stock:

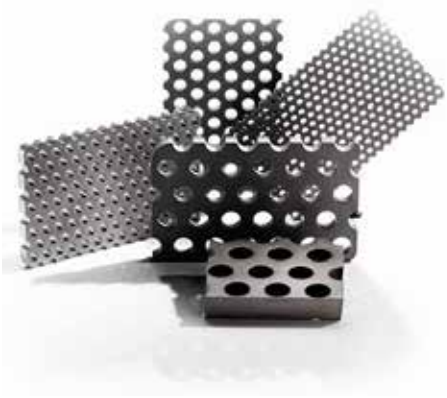
- Various protection steel grades (Mars® 190, 220, 240, 300, 600) available in a wide range of thicknesses
- Samples, prototype parts are also available with short delivery time

Specific painted sample

«KIT» Steel solution

Sample with fitting holes

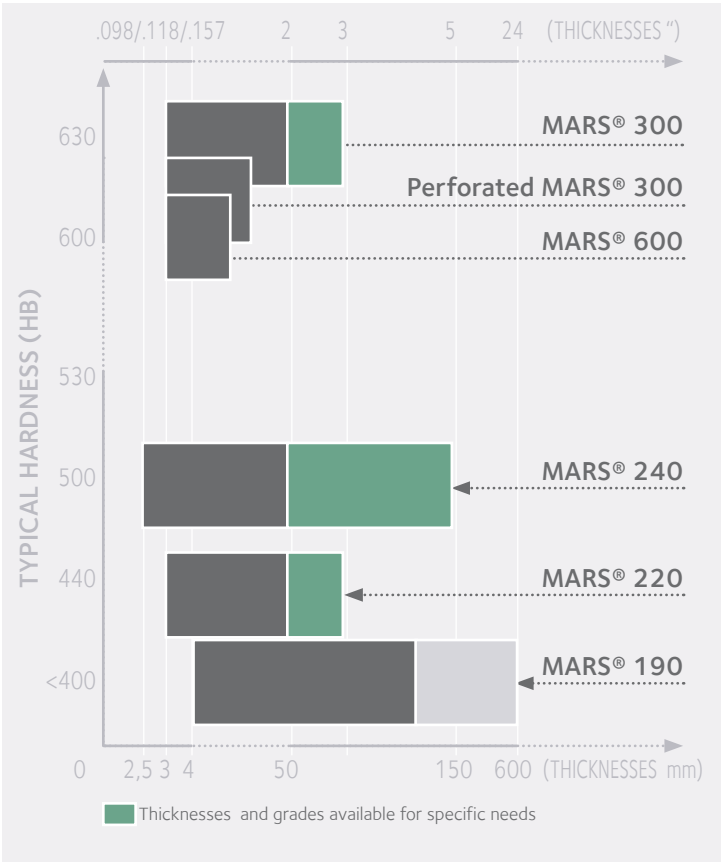
Perforated samples



Our high quality steel solutions for protection applications

STANDARD LEVELS		MARS® 190	MARS® 220	MARS® 240	MARS® 300	PERFO. MARS® 300	MICRO PER-FO. MARS® 300	MARS® 600	DOUBLE OR MULTI-LAYERS MARS®
Civil EN 1522 Standard	FB3-FB4			★★★				★★	
	FB5-FB6	★	★	★★	★★		★	★★★	★
	FB7	★	★	★	★★★		★	★★★	★★
Military Stanag 4569 (AEP 55)	KE 1 & 2	★	★	★★	★★★		★	★★★	★★
	KE 3	★	★	★	★★		★★	★★	★★★
	KE 4					★★★			★★★
	20 FSP	★★★	★★	★	★	★★★	★	★★	★★★
	Mines - IED	★★	★★★	★★	★★	★★	★	★★★	★★★

Hardness – Key factor



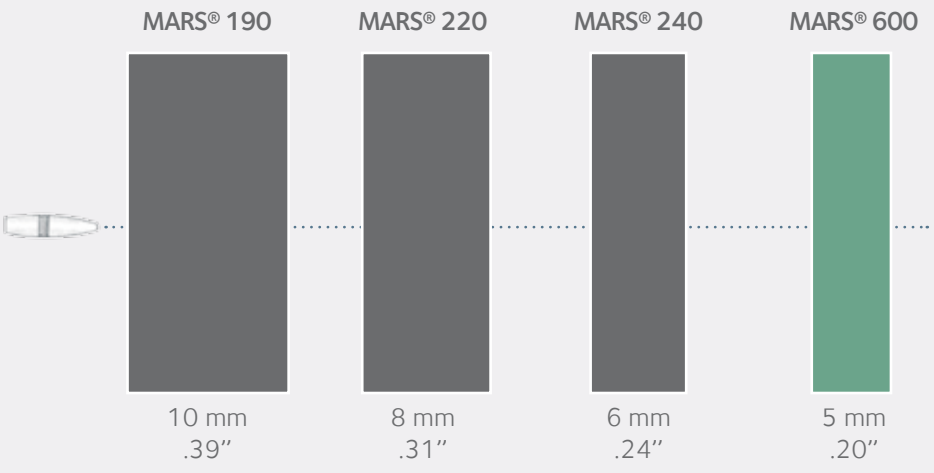
Multi-hit ballistic test for civil applications

Ballistic properties

Impact sectional view on thick plate

Used as solid plate stand alone

7.62 x 51 Ball ammunition
Obliquity 0° Nato
Distance 10 m (33”)
Required thicknesses for protection



Rolled Homogeneous Armor MARS® 190 for targets

ADVANTAGES

Reproducibility

- From one heat to another for each specified grade
- From one target to another in a production line

Homogeneity

- Throughout whole thickness and independently of the thickness
- Over the whole surface of the production line plate and from one plate to another

Compactness

In compliance with most stringent specifications

- ASTM A578
- EN 10160 class S3 and E4

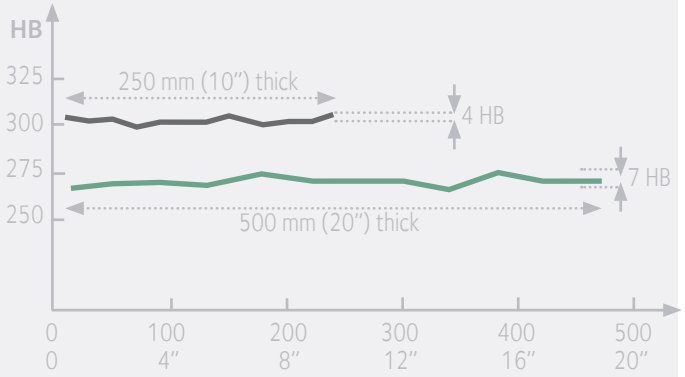
STANDARDS

NF A36-800-1 CLA (France)
MIL-DTL-12560 Class 3 (USA)
TL 2350-0001 (Germany)
Def Stan 95-13 (UK)

Ballistic acceptance testing of MARS® 190 thickness 100 mm

Brinell measure through the thick MARS® 190 plates

Homogeneity in thick Mars® 190 plates



METALLURGICAL PROPERTIES
• Low alloyed steel with 0.25% C & Ni-Cr-Mo- V • Hardness < 400 HB • Quenched & Tempered at high temperature

MECHANICAL PROPERTIES TYPICAL VALUES*				
HB	YS (MPa)	TS (MPa)	E%	KV T-40°C (J)
240 to 400	600 to 900	800 to 1000	12 to 20	30 to 80

(*) = can be adapted as per customer requirement.

PROCESSING TYPICAL GENERALITIES
More details in our protection userguide

THICKNESS RANGE
13 to 600 mm

WIDTH
Up to 3300 mm

Rolled Homogeneous Armor

Applications 240 - 400 HB

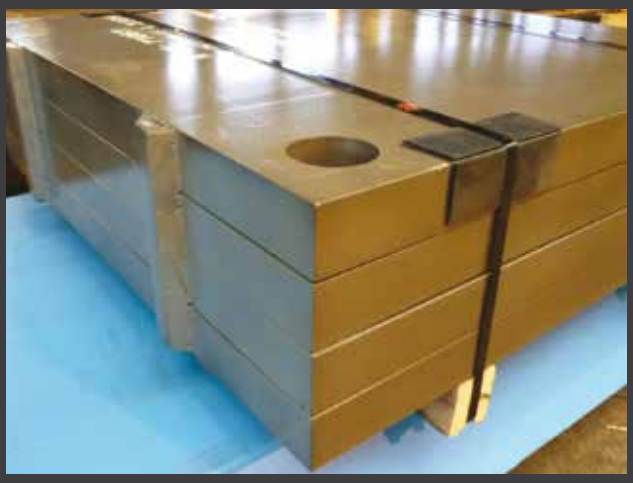
MARS® 190 for targets is the reference used for analysis, control of munitions performances and for their qualification.

Strict respect of metallurgical properties in all required thicknesses is followed.

Ballistic acceptance testing of medium calibers

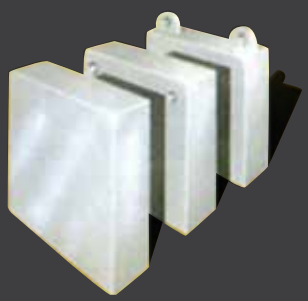
APDSFS threat used on MARS® 190 for targets

EXAMPLES OF APPLICATIONS



Piling of 4 plates of 80 mm of Mars® 190

- Exceptional range of thickness from 13 up to 600 mm
- Heavy thicknesses can avoid piling of medium thicknesses and eliminate contact layer reactions during projectile penetration
- Delivery in plates, parts with holes or attachments for handling



Rolled Homogeneous Armor MARS® 190

ADVANTAGES

Easy processing (for a wide range of thicknesses), while keeping good and multipurpose ballistic properties for any kind of threat

Adapted metallurgical properties according to specific requirements (chemical composition, hardness range, thickness range...)

Excellent homogeneity and reproducibility

Available in different classes:

- Class 1: for structure with maximum resistance to penetration of armor piercing munitions
- Class 2: for floors with maximum resistance to high rates of shock loading

STANDARDS

NF A36-800-1 CLA (France)
MIL-DTL-12560 Class 1 - 2 (USA)
TL 2350-0000 - Quality G – L- K – H (Germany)
Def Stan 95-24 - Class 1 & 2 (UK)

Welded assemblies...

METALLURGICAL PROPERTIES
• Low alloyed steel with 0.25% C & Ni-Cr-Mo- V • Hardness < 400 HB • Quenched & Tempered at high temperature

MECHANICAL PROPERTIES TYPICAL VALUES					
	HB	YS (MPa)	TS (MPa)	E%	KV T-40°C (J)
Class 1	240 to 400	600 to 900	800 to 1000	12 to 20	30 to 80
Class 2	300	700	900	15	70

PROCESSING TYPICAL GENERALITIES
More details in our protection userguide

THICKNESS RANGE	
Class 1	Class 2
5,5 to 150 mm	5,5 to 50 mm

MAXIMUM WIDTH	
Class 1	Class 2
Up to 3300 mm	

MARS® 190 plates in workshop

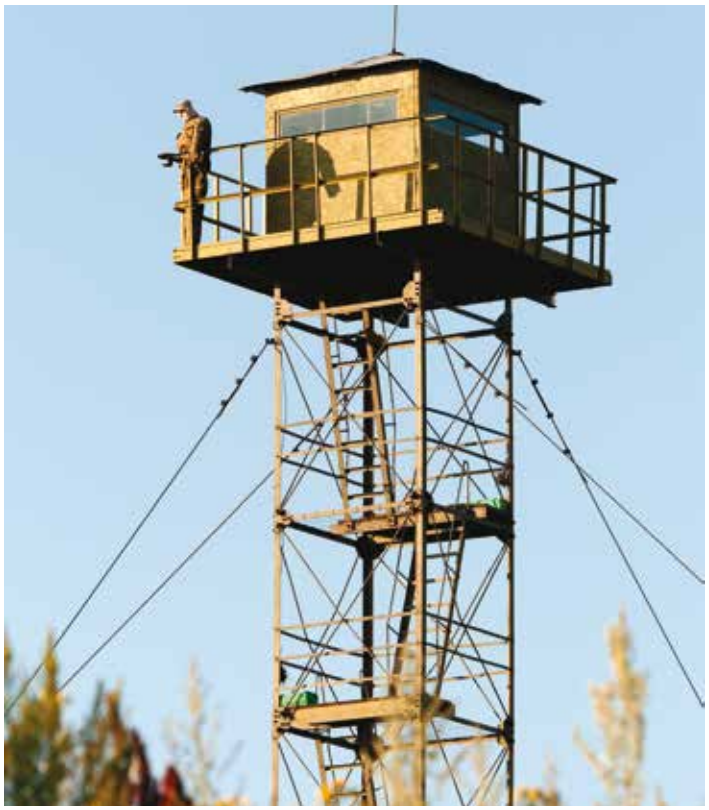
Rolled Homogeneous Armor

Applications 240 - 400 HB

MARS® 190 ability to meet all technical requirements makes it a material of choice in the most advanced and modern projects, both medium and heavy vehicles, ships and frigates constructions.

Frigate

Observation post



EXAMPLES OF APPLICATIONS

Example of Mars® 190 integration

- Medium and heavy tank structures
- Floors for all kinds of vehicles
- Ship and frigate construction
- Observation posts, buildings

Medium Hard Armor (MHA)
MARS® 220

ADVANTAGES

Optimal ballistic protection against mines and IED thanks to its excellent hardness, toughness and ductility properties

Excellent workability particularly bending and welding for building complex designs used for blast protection. (V shape floor)

Available in two versions

- For floors and undersides of light and medium vehicles from 4 to 50 mm
- For underbelly of heavy vehicle, from 20 to 80 mm

STANDARDS

NF A36-800-1 THD1 (France)
MIL-DTL-12560 Class 4a (USA)
TL 2350-0000 - Quality O (Germany)
Def Stan 95-24 - Class 3a (UK)

MARS® 220 thick plate for heavy vehicle underbelly

METALLURGICAL PROPERTIES	
	• Hardness 400 to 480 HB
From 4 to 50 mm	• Quenched & Tempered at low temperature • Low alloyed steel with 0.19 % C & Ni
From 20 to 80 mm	• Low alloyed steel with 0.22 % C & Ni-Cr • Special heat treatment

MECHANICAL PROPERTIES TYPICAL VALUES					
	HB	YS (MPa)	TS (MPa)	E%	KV T-40°C (J)
From 4 to 50 mm	440	1150	1450	13	48
From 20 to 80 mm	400	>800	>1300	>9	

PROCESSING TYPICAL GENERALITIES
More details in our protection userguide

THICKNESS RANGE
From 4 to 80 mm

MAXIMUM WIDTH
2500 mm

MARS® 220 thick under belly plates for heavy vehicle floor

Medium Hard Armor (MHA)

Applications 440 HB

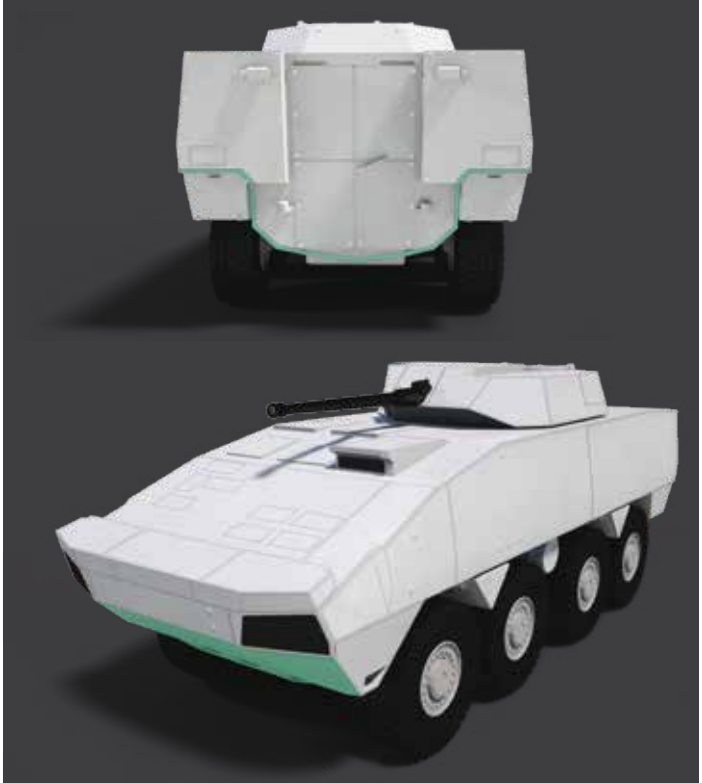
MARS® 220 has been qualified by the military as preferred material due to its remarkable resistance to blast during testing on prototypes.

Floors structure from light vehicles up to heavy tanks, add-on armour plates to upgrade existing floor, Mars® 220 replies easily to any undersides configurations.

Blast mines

Tank floor

EXAMPLES OF APPLICATIONS



Example of MARS® 220 integration

- Blast and IED protection
- V shape floors for light and medium vehicles
- Bottom sides of medium vehicles
- Underbelly for heavy tank
- Add-on armor on existing floor

High Hard Armor (HHA)
MARS® 240

ADVANTAGES

Well balanced solution between workability and weight saving used in military and civil applications

Tight tolerances (+/-0.2 mm) from very thin thickness 2.5 mm up to medium thickness

Excellent flatness and homogeneity, Mars®240 sheets are delivered with a guaranteed flatness of 3 mm/m and uniformity of mechanical properties throughout the material

Specific civil levels (FB5 & FB6), special grade (S) has been developed to meet civil market needs

STANDARDS

NF A36-800-1 THD2 (France)
MIL-DTL-46 100 (USA)
TL 2350-0000 - Quality Z (Germany)
Def Stan 95-24 - Class 3 (UK)

METALLURGICAL PROPERTIES	
	• Hardness 477 to 534 HB • Quenched & Tempered at low temperature
MARS® 240	• Low alloyed steel with 0.28 % C & Ni-Cr-Mo

MECHANICAL PROPERTIES TYPICAL VALUES					
	HB	YS (MPa)	TS (MPa)	E%	KV T-40°C (J)
MARS® 240	495	1300	1700	12	28

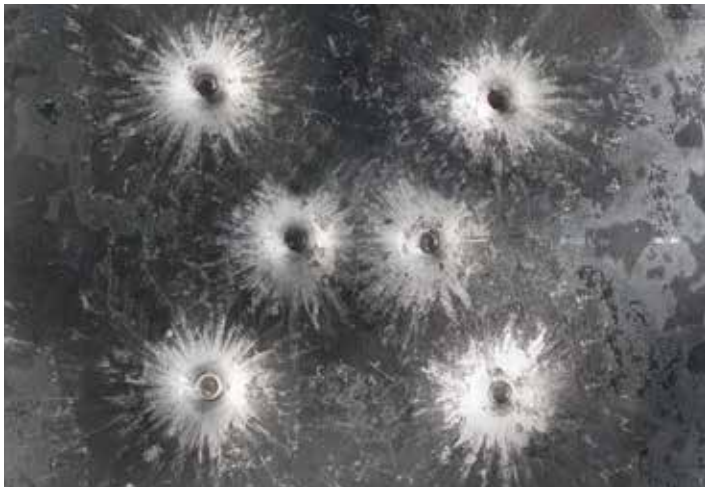
PROCESSING TYPICAL GENERALITIES
More details in our protection userguide

THICKNESS RANGE
2.5 to 50 mm in current fabrication > 50 up to 150 mm for specific needs

MAXIMUM WIDTH
2500 mm

Explosive reactive armor boxes in MARS® 240 starting from 2.5 mm

Mars® 240 - 2.8 mm - .44 Magnum - 436 m/s



High Hard Armor (HHA)

Applications 500 HB

Excellent flatness, quiet material (no spring back during cutting) make MARS® 240 a perfect 500 HB solution for all welded constructions. Tight tolerances allow weight saving, offering the lightest solution for a given level of protection.

MARS® 240 thin hull welded

MARS® 240 used for civil application

EXAMPLES OF APPLICATIONS

Add-on armor bent parts in MARS® 240 fitted on vehicles

- Light & medium vehicle structures
- Trucks, cabins, vans structures
- Kit parts for vehicles in civil application
- Add-on armor kits
- Window frames

Ultra High Hard Armor (UHA)
MARS® 300

ADVANTAGES

> 600 HB ballistical efficient material

Exceptional performances in penetration resistance making it the best solution for weight saving

Easy integration in multi materials and composite solutions with its incredible flatness of better than 3 mm/m

Available in two classes:

- Class 1 (605 HB) replying to current UHA specifications
- Class 2 (630 HB), replying to ultimate standard used by leading experts

STANDARDS

- NF A36-800-1 class THD 4 & 5 (France)
- MIL-DTL-32332 Class 1 & 2 (USA)
- TL 2350-0000 - Quality T (Germany)
- Def Stan 95-24 - Class 5 (UK)

Add-on armor bolted

METALLURGICAL PROPERTIES

- Low alloyed steel with 0.50% C & Ni-Mo
- Hardness 578 to 655 HB
- Quenched & Tempered at low temperature

MECHANICAL PROPERTIES TYPICAL VALUES

	HB	YS (MPa)	TS (MPa)	E%	KV T-40°C (J)	CE*
Class 1	605	1500	2200	9	12	≤0.83
Class 2	630	1600	2300	7	9	

PROCESSING TYPICAL GENERALITIES

More details in our protection userguide

THICKNESS RANGE

3 to 50 mm in current fabrication
> 50 up to 80 mm for specific needs

MAXIMUM WIDTH

2500 mm

* CE = C + [Mn/6] + [(Cr+Mo+V)/5] + [(Ni+Cu)/15]

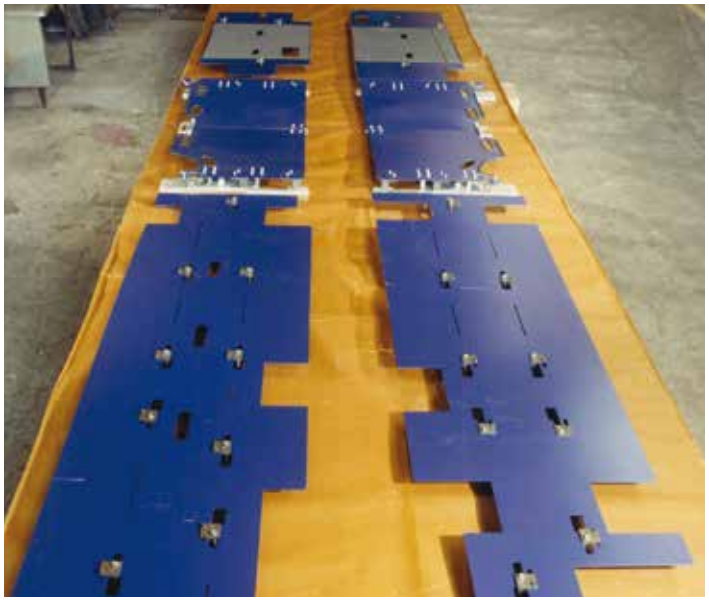
Ultra High Hard Armor (UHA)

Applications > 600 HB

Mainly in thin plates (typical thickness of 6 mm) from which more than 10000 big size parts have been laser cut, ready to be fitted on vehicles.

Mars® 300 is a MUST for high tech and light solutions.

Helicopter parts



Truck cabin in MARS® 300 (fitted parts)

EXAMPLES OF APPLICATIONS

Example of Mars® 300 integration

- Flat kits parts for whole vehicles
- Add-on armor
- Front layer of composite solutions
- Heavy armor for MBT protection

Ultra High Hard Armor (UHA)
MARS® 300 Perforated

ADVANTAGES

For the same level of protection, perforated Mars® 300 is a lightweight solution equivalent to composite solution like ceramic with a much better multi-hit capability and casier possibility of integration

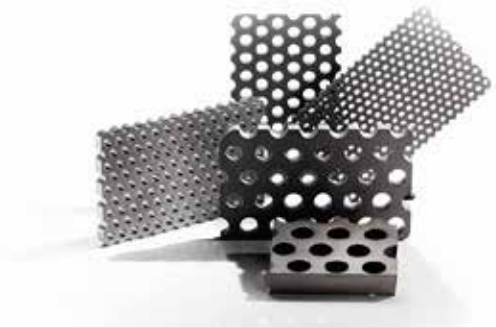
630 HB material without loss or heat affected zone from holes drilling operation

Macro and micro perforated concepts where configurations of holes are defined to meet maximum efficiency in terms of caliber ammunition and obliquity of impacts

STANDARDS

NF A-36-800-1 THD 4 & 5 (France)
MIL-DTL-32332 Class 1 & 2 (USA)
TL 2350-0000 - Quality T (Germany)
Def Stan 95-24 - Class 5 (UK)

Perforated MARS® 300 configurations examples



METALLURGICAL PROPERTIES

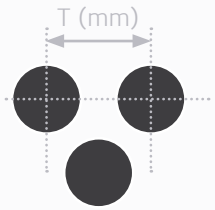
- Low alloyed steel with 0.50 % C & Ni-Mo
- Hardness 578 to 655 HB
- Quenched & Tempered at low temperature

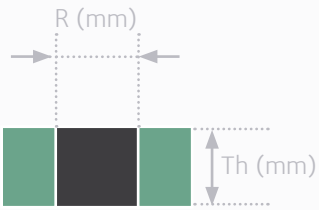
MECHANICAL PROPERTIES TYPICAL VALUES

630 HB

KIT PART FOR TRUCK ROOF

Cylindrical holes pattern





PROCESSING TYPICAL GENERALITIES

More details in our protection userguide

THICKNESS RANGE

3 to 15 mm

MAXIMUM WIDTH

1600 mm

STANDARD

R ≥ Thickness with T ≥ (R x 1.5)

MICROPERFORATED

R < Thickness with R ≥ (Thickness x 0.5)

Ultra High Hard Armor (UHA)

Applications 630 HB

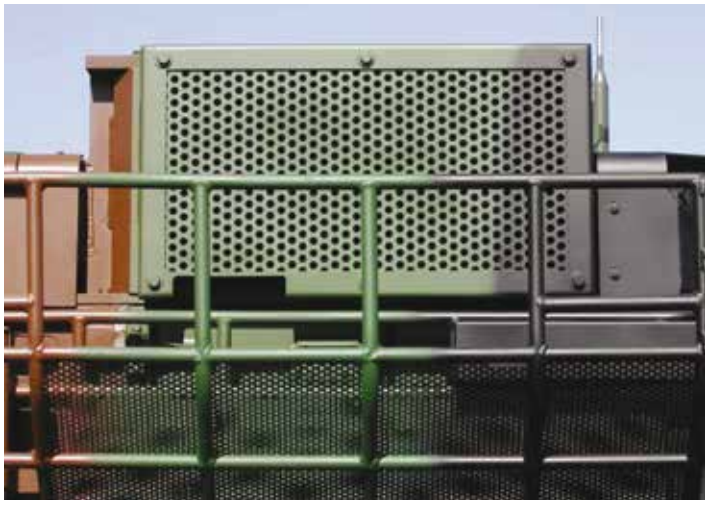
Projectiles broke on impact against the ultra high hard Mars® 300, losing their efficiency and ability to damage the protected structure.

Perforated MARS® 300 kits are mainly used for light and medium vehicles to improve their protection from a STANAG level 2 to STANAG level 4.

Perforated MARS® 300 is also used as ventilation grille (engine, cabin).

APC upgraded by bolting perforated MARS® 300 panels

Perforated MARS® 300 as ventilation grille



EXAMPLES OF APPLICATIONS

Example of Perforated Mars® 300 integration

- Add-on armor on light and medium vehicles
- Kit parts or pieces for specific parts of all vehicles
- Ventilation grilles for all range of vehicles

Ultra High Hard Armor (UHA)
MARS® 600

ADVANTAGES

New metallurgical concept combining 600 HB hardness level with excellent ductility and toughness close to a 500 HB material. Ultra high hard armor steel with very high ballistic performances and integration possibilities

First multipurpose 600 HB with an impressive ballistic behavior in terms of deformation capacity, resistance to multi-impacts and and best in its class workability (mainly bending)

STANDARDS

NF A36- 800-1 class THD 4 (France)
MIL-DTL-32332 Class 1 (USA)
TL 2350-0000 - Quality T (Germany)
Def Stan 95-24 - Class 5 (UK)

METALLURGICAL PROPERTIES
• Low alloyed steel with 0.43 % C & Ni-Mo • Hardness 578 to 655 HB • Quenched & Tempered at low temperature

MECHANICAL PROPERTIES TYPICAL VALUES					
HB	YS (MPa)	TS (MPa)	E%	KV T-40°C (J)	CE*
601	1450	2150	10	23	≤ 0.77

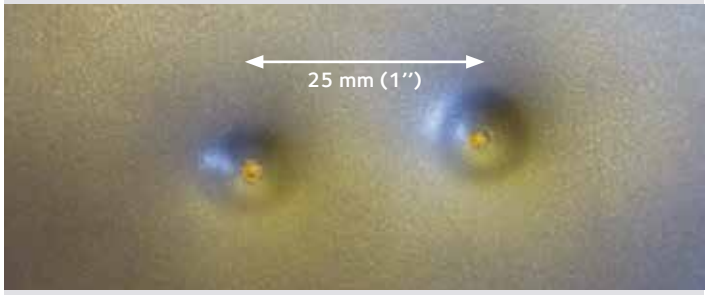
PROCESSING TYPICAL GENERALITIES
More details in our protection userguide

THICKNESS RANGE
3 to 15 mm - Extension possible

MAXIMUM WIDTH
2500 mm

* CE = C + [Mn/6] + [(Cr+Mo+V)/5] + [(Ni+Cu)/15]

MARS® 600 thickness 5 mm - EN 1522 FB6



MARS® 600 thickness 8.7 mm

Cold bent part

Mars® 600 cold bending operations

Ultra High Hard Armor (UHA)

Applications 600 HB

Mars® 600 is the material of the future that is changing designs of military programs: light weight solution and possible use as a structure. Its great properties offer limitless usage possibilities.

What users say about MARS®600:

> *« MARS® 600 is not a 600 HB standard, it is MARS® 600 »*
> (France – 10-2014)

> *« We have never seen such multi hit capability for a 600 HB »*
> (Switzerland – 03-2014)

> *« MARS® 600 is a new solution that we have not until now had »*
> (Germany – 07-2014)

MARS® 600 used for VBCI vehicle (Nexter)

EXAMPLES OF APPLICATIONS

Example of MARS® 600 integration

- Light & medium modern vehicle structures
- Cold formed parts for light and medium vehicles
- Solid add-on armor with space
- Front layer of composite solutions
- Insert for individual protection

Where to find our steels

From our production sites

1- INDUSTEEL BELGIUM
266, rue de Châtelet
Marchienne-au-Pont
BELGIUM 6030
Tel: + 32 71 44 16 99

2- INDUSTEEL FRANCE
Le Creusot plant
56, rue Clémenceau - BP 19
F - 71201 LE CREUSOT Cedex
Tel : + 33 3 85 80 53 02

3- Châteauneuf plant
BP 368 Châteauneuf
42803 RIVE-DE-GIER Cedex
Tel : + 33 4 77 75 21 41

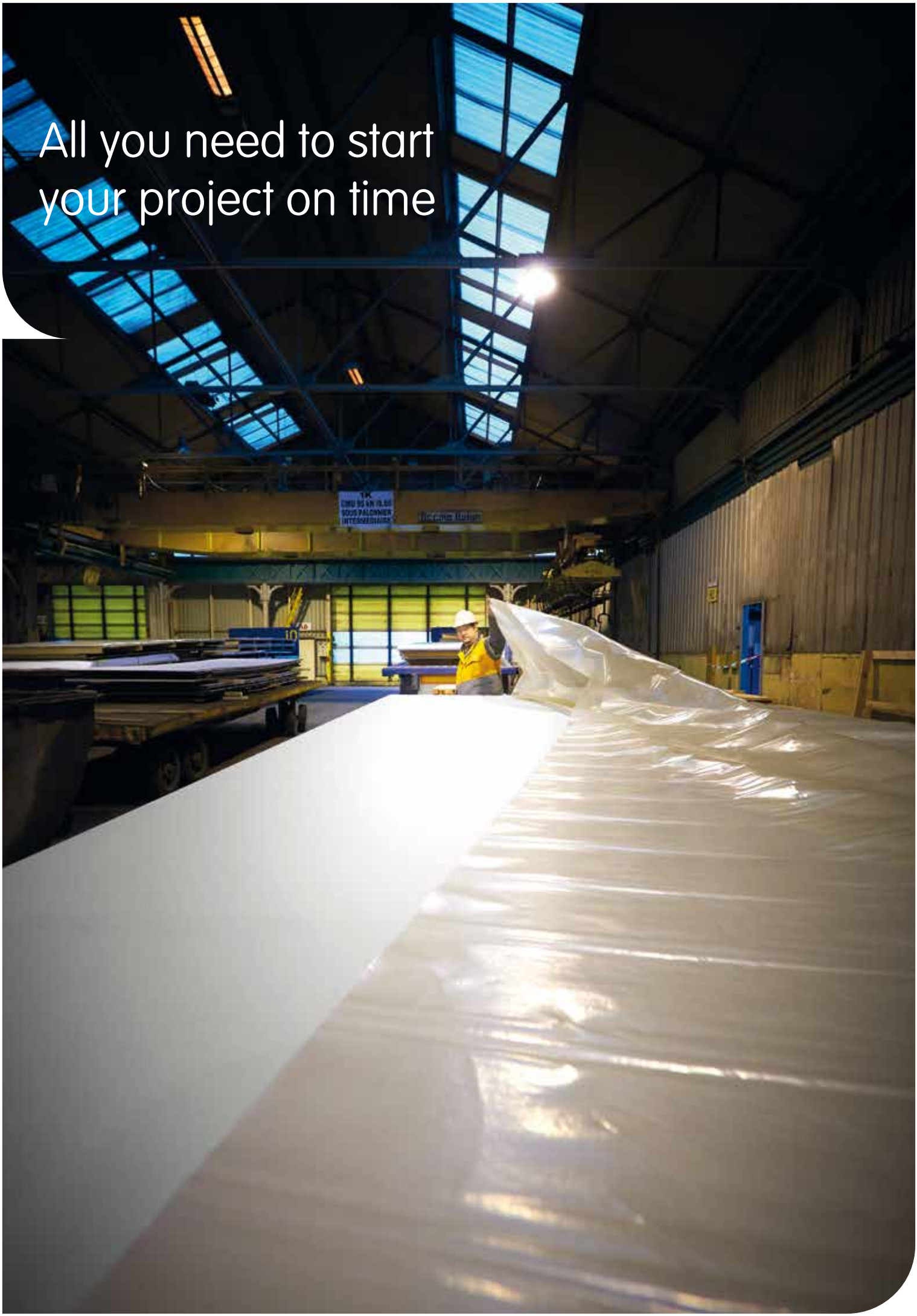
From our Mars® distributors

4- ARCELORMITTAL
Dubaï Steel Trading co.
Jebel Ali, South Zone
PO Box 8386
Dubaï
UNITED ARAB EMIRATES
Tel: +971 4.803.6666

5- Culture Special Steel Pte. Ltd.
20 Pioneer Cres # 07-05, West Park Bizcentral
628555 Singapore
SINGAPORE
Tel: +65 6694 3313

From our 40 sales agencies worldwide

http://industeel.arcelormittal.com



All you need to start your project on time

ArcelorMittal

For more information

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http://industeel.arcelormittal.com

Makheia – Juin 2017

transforming
tomorrow