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.

For all other dimensions, please consult Chateauneuf, Le Creusot, Charleroi or Coil rolled.
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

FLATNESS

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

TIGHT TOLERANCES

In addition to quarto plates, Industeel offers a wide range of coils (up to 10 mm) with tight tolerances (+/- 0.2 mm) thus allowing weight reduction.
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).
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
Our high quality steel solutions for protection applications

<table>
<thead>
<tr>
<th>STANDARD LEVELS</th>
<th>MARS® 190</th>
<th>MARS® 220</th>
<th>MARS® 240</th>
<th>MARS® 300</th>
<th>PERFO. MARS® 300</th>
<th>MICRO PERFO. MARS® 300</th>
<th>MARS® 600</th>
<th>DOUBLE OR MULTI-LAYERS MARS®</th>
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<tbody>
<tr>
<td>Civil EN 1522 Standard</td>
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<td>FB3-FB4</td>
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<td>★★</td>
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<td>FB5-FB6</td>
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<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>■</td>
<td>★</td>
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<td>FB7</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>★</td>
<td>■</td>
<td>★</td>
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<td>Military Stanag 4569 (AEP 55)</td>
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<td>★★</td>
<td>■</td>
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<td>KE 3</td>
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<tr>
<td>20 FSP</td>
<td>★★</td>
<td>★★</td>
<td>★</td>
<td>★</td>
<td>★★</td>
<td>■</td>
<td>★</td>
<td></td>
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<tr>
<td>Mines – IED</td>
<td>★★</td>
<td>★★</td>
<td>★★</td>
<td>★★</td>
<td>★★</td>
<td>■</td>
<td>★★</td>
<td></td>
</tr>
</tbody>
</table>

Hardness – Key factor

- MARS® 190
- MARS® 220
- MARS® 240
- MARS® 300
- MARS® 600

Thicknoses and grades available for specific needs

Multi-hit ballistic test for civil applications
Ballistic properties

Used as solid plate stand alone
7.62 x 51 Ball ammunition
Obliquity 0° Nato
Distance 10 m (33’’)
Required thicknesses for protection

- **MarS® 240**
  - 6 mm
  - .24”

- **MarS® 220**
  - 8 mm
  - .31”

- **MarS® 190**
  - 10 mm
  - .39”

- **MarS® 600**
  - 5 mm
  - .20”

Impact sectional view on thick plate.
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)

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*

<table>
<thead>
<tr>
<th>HB</th>
<th>YS (MPa)</th>
<th>TS (MPa)</th>
<th>E%</th>
<th>KV T-40°C (J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>240</td>
<td>600</td>
<td>800</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>400</td>
<td>900</td>
<td>1000</td>
<td>20</td>
<td>80</td>
</tr>
</tbody>
</table>

(*) = 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.

- 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

Examples of Applications
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)

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**MECHANICAL PROPERTIES TYPICAL VALUES**

<table>
<thead>
<tr>
<th></th>
<th>HB (MPa)</th>
<th>YS (MPa)</th>
<th>TS (MPa)</th>
<th>E%</th>
<th>KV T-40°C (J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>240 to 400</td>
<td>600 to 900</td>
<td>800 to 1000</td>
<td>12 to 20</td>
<td>30 to 80</td>
</tr>
<tr>
<td>Class 2</td>
<td>300</td>
<td>700</td>
<td>900</td>
<td>15</td>
<td>70</td>
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</tbody>
</table>

**MEETALLURGICAL PROPERTIES**

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

**PROCESSING TYPICAL GENERALITIES**

More details in our protection userguide

**THICKNESS RANGE**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>5,5 to 150 mm</td>
</tr>
<tr>
<td>Class 2</td>
<td>5,5 to 50 mm</td>
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</tbody>
</table>

**MAXIMUM WIDTH**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>Up to 3300 mm</td>
</tr>
<tr>
<td>Class 2</td>
<td></td>
</tr>
</tbody>
</table>
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.

- 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)

**METALLURGICAL PROPERTIES**

- Hardness 400 to 480 HB

| Thickness range | Condition                                      | Material                                      | Standards
|-----------------|------------------------------------------------|-----------------------------------------------|------------
| From 4 to 50 mm | Quenched & Tempered at low temperature         | Low alloyed steel with 0.19 % C & Ni         | Class 4a   |
| From 20 to 80 mm| Low alloyed steel with 0.22 % C & Ni-Cr        | Special heat treatment                        | Class 3a   |

**MECHANICAL PROPERTIES TYPICAL VALUES**

- HB | YS (MPa) | TS (MPa) | E% | KV T-40°C (J)

| Thickness range | 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
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 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**

<table>
<thead>
<tr>
<th></th>
<th>HB</th>
<th>YS (MPa)</th>
<th>TS (MPa)</th>
<th>E%</th>
<th>KV T-40°C (J)</th>
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<td>MARS® 240</td>
<td>495</td>
<td>1300</td>
<td>1700</td>
<td>12</td>
<td>28</td>
</tr>
</tbody>
</table>

**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.

- 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)

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

<table>
<thead>
<tr>
<th>Class</th>
<th>HB</th>
<th>YS (MPa)</th>
<th>TS (MPa)</th>
<th>E%</th>
<th>KV T-40°C (J)</th>
<th>CE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>605</td>
<td>1500</td>
<td>2200</td>
<td>9</td>
<td>12</td>
<td>≤0.83</td>
</tr>
<tr>
<td>Class 2</td>
<td>630</td>
<td>1600</td>
<td>2300</td>
<td>7</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

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.
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 easier 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)

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).

- 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 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)

MECHANICAL PROPERTIES TYPICAL VALUES

<table>
<thead>
<tr>
<th>HB (MPa)</th>
<th>YS (MPa)</th>
<th>TS (MPa)</th>
<th>E%</th>
<th>KV T-40°C (J)</th>
<th>CE*</th>
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</thead>
<tbody>
<tr>
<td>601</td>
<td>1450</td>
<td>2150</td>
<td>10</td>
<td>23</td>
<td>≤ 0.77</td>
</tr>
</tbody>
</table>

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

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]
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)

• 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
Dubai Steel Trading co.
Jebel Ali, South Zone
PO Box 8386
Dubai
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
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Fax : + 33 3 85 80 55 00
Tel : + 33 3 85 80 51 55
Fax : + 33 3 85 80 55 00

Industeel France
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FRANCE

Industeel Belgium
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B - 6030 CHARLEROI BELGIUM

http://industeel.arcelormittal.com

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