Opportunities of High Strength Steel

High Strength Low Alloy

- HSLA steels provide a good balance between strength, formability and weldability
- Tata Steel’s HSLA range is branded as Ympress
Hot Rolled – typical product series

Yield strength [MPa]

Elongation [%]

Update

Series:
§ HSLA: S315MC - S960MC
§ Structural Steel" S235 – S355
§ 22MnB5, 26MnB5, 30MnB5, 34MnB5
§ XPF series
§ FB590HR. CP800HR
§ High Carbons C15E-C67
§ Die-quenched boron steel HQ1500HR (22MnB5)
§ Wear grades (AR400-600)

Special chemistries not shown: Boron steels, linepipe, high carbon and case hardening steels, steel for pressure vessels and gas cylinders.
XPF…. a breakthrough in chassis lightweight potential
Heat-treatable steels overview

other elements (sum of total\(^1\))

- case hardening steels
- unalloyed tempering steels
- alloyed tempering steels MnB
- alloyed tempering steels Cr/Mo or Cr
- high-carbon steels
- spring steels

Part of current TSE wide strip portfolio (\(\star\) UK, \(\star\) MLE).

1. Sum of maximum specified levels in Si, Cr, Mo, Ni and V.
Cold rolled typical products

Yield strength

Update

Automotive influences
• AHSS:
  • DP800
  • DP1000

Other influences
• Enamelling grades for Domestic Appliances producers
Metallic coated – typical products

Yield strength [MPa]

-5 0 5 10 15 20 25 30 35 40 45

Elongation [%]

100 200 300 400 500 600 700 800 900 1.000

-5 0 5 10 15 20 25 30 35 40 45

Automotive (advanced) high strength steels

Other
- Very high surface requirements for automotive outer parts
Typical steel mill upgrades to support market requirements
(i.e. weight reduction, CO2 emissions etc)

§ Higher strength and thus higher alloyed steels, are hard to produce:
- Casters not equipped to produce high quality High Strength Steel grades
- The rolling facilities are limited in strength for the required dimensional windows
- Coating facilities to be updated for surface quality and coating ability
Products and services that support your company’s growth

- Steel processing expertise to build your business
  - One-stop supplier for steel manufacturing/processing
  - Plasma cutting, 2D profiling, press braking, decoiling, small and heavy fabrication
- Simpler steel supply chain
- Can reduce processing at your site
- Reduces need for in-house processing assets
- Enables you to focus on your core business
Checking all processing steps

- Decoiling
- Laser cutting
- Bending
- Welding
- Painting and assembly
**XPF 800**

**Value proposition**
- **For...** The Automotive Chassis and Suspension market
- **Our...** XPF800
- **Offers...** considerable (10-20%) weight reduction potential
- **Compared to** high strength hot-rolled HSLA and AHSS products
- **Because...** of its combined high formability (min 16%) and edge ductility (min 70% HEC)
- **As validated by...** internal component studies and customer evaluation.

**Comparison with International Standards**

**Available dimensions**

**Application areas**

**Other key properties**
- **Good weldability performance due to low CEV**
- **Good fatigue strength performance**
- **Lower product variation than multi-phased steels**
# HR dry HSLA – product range

## Dimensional capability for steel produced in the Netherlands

<table>
<thead>
<tr>
<th>Thickness</th>
<th>Max. width</th>
</tr>
</thead>
<tbody>
<tr>
<td>From - up to</td>
<td>S315MC</td>
</tr>
<tr>
<td>1.49 - 1.50</td>
<td>1170</td>
</tr>
<tr>
<td>1.50 - 1.53</td>
<td>1180</td>
</tr>
<tr>
<td>1.53 - 1.57</td>
<td>1210</td>
</tr>
<tr>
<td>1.67 - 1.60</td>
<td>1220</td>
</tr>
<tr>
<td>1.60 - 1.70</td>
<td>1280</td>
</tr>
<tr>
<td>1.70 - 1.80</td>
<td>1370</td>
</tr>
<tr>
<td>1.80 - 1.90</td>
<td>1440</td>
</tr>
<tr>
<td>1.90 - 2.00</td>
<td>1520</td>
</tr>
<tr>
<td>2.00 - 2.20</td>
<td>1590</td>
</tr>
<tr>
<td>2.20 - 2.40</td>
<td>1730</td>
</tr>
<tr>
<td>2.40 - 2.60</td>
<td>1810</td>
</tr>
<tr>
<td>2.60 - 2.80</td>
<td>1860</td>
</tr>
<tr>
<td>2.80 - 3.00</td>
<td>1860</td>
</tr>
<tr>
<td>3.00 - 3.20</td>
<td>1930</td>
</tr>
<tr>
<td>3.20 - 3.50</td>
<td>2070</td>
</tr>
<tr>
<td>3.50 - 3.65</td>
<td>2070</td>
</tr>
<tr>
<td>3.65 - 4.00</td>
<td>2070</td>
</tr>
<tr>
<td>4.00 - 4.40</td>
<td>2070</td>
</tr>
<tr>
<td>4.40 - 5.00</td>
<td>2070</td>
</tr>
<tr>
<td>5.00 - 5.60</td>
<td>2070</td>
</tr>
<tr>
<td>5.60 - 6.00</td>
<td>2070</td>
</tr>
<tr>
<td>6.00 - 7.50</td>
<td>2070</td>
</tr>
<tr>
<td>7.50 - 9.00</td>
<td>2070</td>
</tr>
<tr>
<td>9.00 - 10.00</td>
<td>2070</td>
</tr>
<tr>
<td>10.00 - 12.00</td>
<td>2070</td>
</tr>
<tr>
<td>12.00 - 15.00</td>
<td>2070</td>
</tr>
</tbody>
</table>
| The minimum width is 590mm except for S700MC where the minimum width is 1030mm.

Please contact us regarding the availability of S700MC with thickness less than 3.0mm.

---

**For thicknesses from 2.0mm to 9.0mm, in S500MC, the minimum width is 710mm.**

---

HSLA Laser grades

**Guarantees**

- Homogeneous material
- Imperfection free surface
- Very tight tolerances on mechanical properties
- Very tight tolerances on dimensions (1/2 EN or better)
- Flatness guarantee after laser cutting

**Processing benefits**

- **Bending**
  - Predictable bend behaviour due to tight tolerances
- **Laser cutting**
  - High cutting speed
  - Low machine downtime
  - Little lift of material from grid-frame
- **Welding**
  - Consistent properties create predictive weld behaviour
  - Tight tolerances allow for automated welding
### HR-dry: structural steels

#### Dimensional capability for steel produced in the Netherlands – non-pickled

*Dimensions in mm.*

<table>
<thead>
<tr>
<th>Thickness</th>
<th>Max. width</th>
</tr>
</thead>
<tbody>
<tr>
<td>From - up to $S185$</td>
<td>$S235JR$</td>
</tr>
<tr>
<td>1.47 - 1.49</td>
<td>1300</td>
</tr>
<tr>
<td>1.49 - 1.50</td>
<td>1320</td>
</tr>
<tr>
<td>1.50 - 1.53</td>
<td>1330</td>
</tr>
<tr>
<td>1.53 - 1.57</td>
<td>1350</td>
</tr>
<tr>
<td>1.57 - 1.60</td>
<td>1360</td>
</tr>
<tr>
<td>1.60 - 1.70</td>
<td>1410</td>
</tr>
<tr>
<td>1.70 - 1.80</td>
<td>1450</td>
</tr>
<tr>
<td>1.80 - 2.00</td>
<td>1550</td>
</tr>
<tr>
<td>2.00 - 2.20</td>
<td>1700</td>
</tr>
<tr>
<td>2.20 - 2.40</td>
<td>1820</td>
</tr>
<tr>
<td>2.40 - 2.60</td>
<td>1920</td>
</tr>
<tr>
<td>2.60 - 2.70</td>
<td>2030</td>
</tr>
<tr>
<td>2.70 - 2.80</td>
<td>2070</td>
</tr>
<tr>
<td>2.80 - 3.00</td>
<td>2070</td>
</tr>
<tr>
<td>3.00 - 3.20</td>
<td>2070</td>
</tr>
<tr>
<td>3.20 - 3.50</td>
<td>2070</td>
</tr>
<tr>
<td>3.50 - 3.65</td>
<td>2070</td>
</tr>
<tr>
<td>3.65 - 4.00</td>
<td>2070</td>
</tr>
<tr>
<td>4.00 - 4.40</td>
<td>2070</td>
</tr>
<tr>
<td>4.40 - 12.70</td>
<td>2070</td>
</tr>
</tbody>
</table>

All grades are available in the as-rolled (+AR) and normalized rolling (+N) and suitable for cold rolling (C) conditions. The minimum width is 1000mm for thicknesses over 12.7mm. The minimum width is 900mm for all other thicknesses.

1) $S235J2$ available for thicknesses ≤ 12.7mm.
2) $S275JRJ0/J2/N$ available for thicknesses ≤ 10mm.
3) $S355JRJ0/J2/N$ available for thicknesses ≤ 10mm.

#### Dimensional capability for steel produced in the UK – non-pickled

*Dimensions in mm.*

<table>
<thead>
<tr>
<th>Thickness</th>
<th>Max. width</th>
</tr>
</thead>
<tbody>
<tr>
<td>From - up to $S185$</td>
<td>$S235JR$</td>
</tr>
<tr>
<td>1.50 - 1.599</td>
<td>1250</td>
</tr>
<tr>
<td>1.60 - 1.699</td>
<td>1275</td>
</tr>
<tr>
<td>1.70 - 1.799</td>
<td>1315</td>
</tr>
<tr>
<td>1.80 - 1.899</td>
<td>1511</td>
</tr>
<tr>
<td>1.90 - 1.999</td>
<td>1511</td>
</tr>
<tr>
<td>2.00 - 2.099</td>
<td>1600</td>
</tr>
<tr>
<td>2.10 - 2.199</td>
<td>1600</td>
</tr>
<tr>
<td>2.20 - 2.499</td>
<td>1600</td>
</tr>
<tr>
<td>2.50 - 2.899</td>
<td>1749</td>
</tr>
<tr>
<td>2.90 - 2.999</td>
<td>1830</td>
</tr>
<tr>
<td>3.00 - 5.000</td>
<td>1830</td>
</tr>
<tr>
<td>5.01 - 15.999</td>
<td>1830</td>
</tr>
<tr>
<td>16.00 - 16.50</td>
<td>1830</td>
</tr>
</tbody>
</table>

All grades are available in the as-rolled (+AR) and suitable for cold rolling (C) conditions. The minimum width is 700mm. The maximum thickness for these grades in cold-forming quality is 12.5mm.
Trouble-free processing

- S355J2+N class 1 galvanisable from Tata Steel **meets or exceeds** all requirements of EN10025:2

- This product is suitable for class 1 galvanising; the uniform surface and low Si level of the steel <0.03% contribute to a more consistent and smoother coating finish.

- Suitability for **efficient laser cutting** is ensured by low Si level and uniform surface.

- Homogeneity of strength and other mechanical properties throughout the length of the coil, and from sheet to sheet ensures **trouble-free processing** during bending and other fabrication activities.
Tata Steel: S355 J2+N (HR up to 25 mm)

Value proposition

For the Lifting and Excavating market, the hot-rolled S355J2+N (up to 25mm)

Offers a Hot Rolled steel with high yield strength, outstanding formability and consistent quality, good welding properties and excellent flatness surface appearance. That reduces shot blast needs and has the ability to reach high laser cut speeds vs. RMP products.

Application areas

The main applications of S355J2+N heavy gauges are structural components, typically requiring welding, bending and painting.

Available dimensions

<table>
<thead>
<tr>
<th>Thickness (mm)</th>
<th>Width (mm)</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>1000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Available as hot-rolled non-pickled coils

CURRENT PROPOSAL

Chemical properties

<table>
<thead>
<tr>
<th>Element</th>
<th>Min</th>
<th>Max</th>
<th>C</th>
<th>0.23</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEV</td>
<td>0.45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Si</td>
<td>0.55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mn</td>
<td>1.60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>0.025</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>0.025</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Al</td>
<td>0.015</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cu</td>
<td>0.55</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| ReH (MPa) | 355 |
| Rm (MPa)  | 510 680 |

Elongation (%) 14

Charpy properties J2 or K2
Decoiled AR400/450 material

- Application areas
  - The main applications of AR400/450 wear resistant strip heavy gauges are components that are used in heavy wear and tear application such as road building, mining, and dredging.

Key requirements:
1. Abrasive resistance properties
2. Good shape (flatness)
3. Excellent surface appearance
Coretinium® Composite Honeycomb Panel

**Outstanding durability, rigidity / weight ratio**

- Inline production & lamination of OCS – skinned polypropylene honeycomb sandwich panels
- Outstanding combination of durability, rigidity / weight ratio, degradation resistance and fire safety compared to alternatives such as plywood, GRP composite, aluminium composite
- Leverages the functionality and aesthetics of TSE’s differentiated Colorcoat Prisma® OCS
- Initial 10mm gauge offering for buses (firewalls & floors), trailers and manufactured goods applications
Services customised for your specific needs

- One step further
  - Adaptable to ensure the level of partnership you need
  - Ability to meet your quality accreditation requirements
  - Access to a world-leading R&D facility and certified steel industry experts
  - Objective assessment of your design solution
  - Optimisation of steel products
  - Dedicated on-site inventory where required
  - Customer Engineering

![Diagram showing variations of number of bars across the OHG which results in significantly different vertical displacements: 9 bars, 7 bars, 6 bars](image-url)
Product case studies
Key drivers and design trends for Trailers

- **Efficiency / Performance** e.g. extra load volume or fuel saving
- **Light-weighting** e.g. increased payload and meeting axle-load regulations
- **Environmental** e.g. Lead free anti corrosion coatings
- **“High yield strength fine grain steel to give optimum deadweight to payload ratio”** – Goldhofer
- **Flexibility of designs** e.g. modular systems
- **“High strength steel in the chassis, which helps minimise kerb weight without compromising the structural integrity of the truck frame”** – MAN
- **Safety** e.g. stability
- **Services / support** e.g. Full service contracts, telematics, spare parts
- **Reliability**
- **Environment** e.g. Lead free anti corrosion coatings
- **Flexibility of designs** e.g. modular systems
- **Safety** e.g. stability
- **Services / support** e.g. Full service contracts, telematics, spare parts
- **Reliability**
Optimal use of Ympress S700MC: BERGERecotrail®

Specific steel info

- Using Ympress S700MC the steel usage is 1.6t, a difference of 0.9t with a reference 2.5t EU trailer using S355MC.
- Less steel cost: when weight reduction is more than the steel price increase.
- The two slim 13.3m longitudinal beams are made of Ympress 100 XF with a 4mm web and 6 and 8mm flanges.
- Cut-outs in form of Reuleaux triangles for weight saving retaining high degree of stiffness.
- Cross-member Z profiles using Ympress 100XF in 2 and 3mm.
- Avoiding water inclusion adding to optimal corrosion protection.
- Cost-efficient roll-forming production possible.
Case Study: BERGERecotrail®

European lightweighting benchmark

- Tata Steel delivers all sheet material including S700MC and manages supply chain

- Use of Ympress S700MC allows for
  - extremely low unladen weight of less than 4.7 tonnes whilst retaining stiffness and fatigue strength.
  - design containing only hollow, U and Z profiles. This avoids water inclusion.

- The increased payload to 28t delivers cost benefits and protects the environment. Berger claims 7% fewer journeys or additional freight. Combined with lower fuel consumption due to low unladen weight results in overall 6% cost savings

- Thanks to its high strength and outstanding formability, Ympress® S700MC makes it possible to manufacture steel semi-trailers that are both high-quality and lightweight.
JCB FASTRAC: Evolution of the tractor

### Traditional Tractor (1980s)
- Designed for the field
- Tight turning circle, fat tyres, 2-wheel drive
- On-road – low speed.
- Limited driver safety
- Poor driver comfort – no suspension

### Original Fastrac 2000
- Designed for field and road
- Four wheel drive, limited turning circle
- On-road – improvement in speed and towing capacity
- Improved driver comfort – suspension and cab
- Improved driver safety

### Fastrac 4000
- Designed as a utility vehicle – field, road, farmyard, airport, etc
- Four wheel drive, four wheel steer, tight turning circle
- Class leading road speed and towing capacity
- Class leading driver comfort / safety – independent air suspension
Synergies achieved through co-operation

**Fastrac 2000**

**Fastrac 4000**

**Synergies**

1. Efficient material use  
   No increase in cost / weight of main structure
2. Reduced design time  
   Use of virtual prototyping reduced design time, reduced development costs, reduced prototype tests
3. Improved performance  
   40% increase in towing / load capacity  
   20% reduction in turning circle, wider tyres
4. Improved driver comfort  
   Independent suspension, improved cab
5. Collaborative design team  
   Key skills from key suppliers. JCB focused on market requirements

**FASTRAC 4000:** Improved productivity, flexibility, safety and comfort  
Targeting new segments in the agricultural market