# STEEL

BN Trade

PRODUCT CATALOGUE

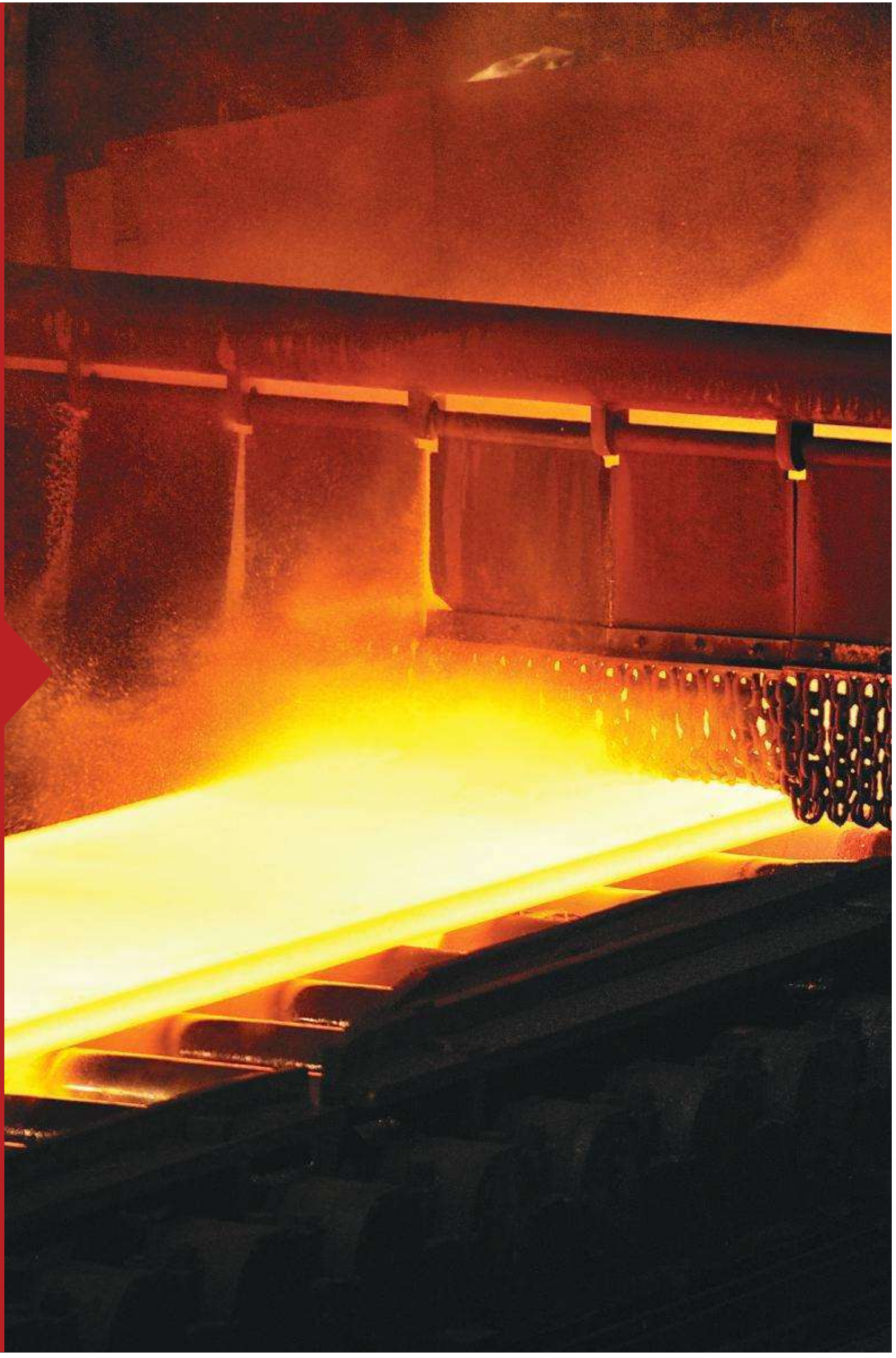
| International Standards | | |
|---|---|---|
| International Standards and Related Institutions | | Country |
| ABS | American Bureau of Shipping | U.S.A. |
| AFNOR | Association Française de Normalisation | FRANCE |
| AISI | American Iron and Steel Institute | U.S.A. |
| ANSI | American National Standards Institute | U.S.A. |
| API | American Petroleum Institute | U.S.A. |
| ASME | American Society of Mechanical Engineers | U.S.A. |
| ASMI | American Society for Materials International | U.S.A. |
| ASTM | American Society for Testing and Materials | U.S.A. |
| BS | British Standard | BRITAIN |
| BSI | British Standards Institution | BRITAIN |
| CSA | Canadian Standards Association | CANADA |
| DIN | Deutsches Institut für Normung | GERMANY |
| DNV | Det Norske Veritas | NORWAY |
| DS | Dansk Standard | DENMARK |
| ELOT | Hellenic Organization for Standardization | GREECE |
| EN | European Standard | EUROPE |
| EU | EURONORM | EUROPE |
| FSA | Finnish Standards Association | FINLAND |
| GOST | USSR State Standard | RUSSIA |
| IBN | Institut Belge de Normalisation | BELGIUM |
| ISO | International Organization for Standardization | INTERNATIONAL |
| JIS | Japanese Industrial Standard | JAPAN |
| JSA | Japanese Standards Association | JAPAN |
| LRS | Lloyd's Register of Shipping | BRITAIN |
| MIL | US Military Standards | U.S.A. |
| NF | Norme Française | FRANCE |
| NNI | Netherlands Normalisatie Instituut | NETHERLAND |
| NSF | Norges Standardiseringsforbund | NORWAY |
| ON | Austrian Standards Institute | AUSTRIA |
| RINA | Registro Italiano Navale | ITALY |
| SAE | Society of Automotive Engineers | U.S.A. |
| SNV | Swiss Association for Standardization | SWITZERLAND |
| TSE | Turkish Standards Institution | TURKEY |
| UNI | Ente Nazionale Italiano di Unifcazione | ITALY |

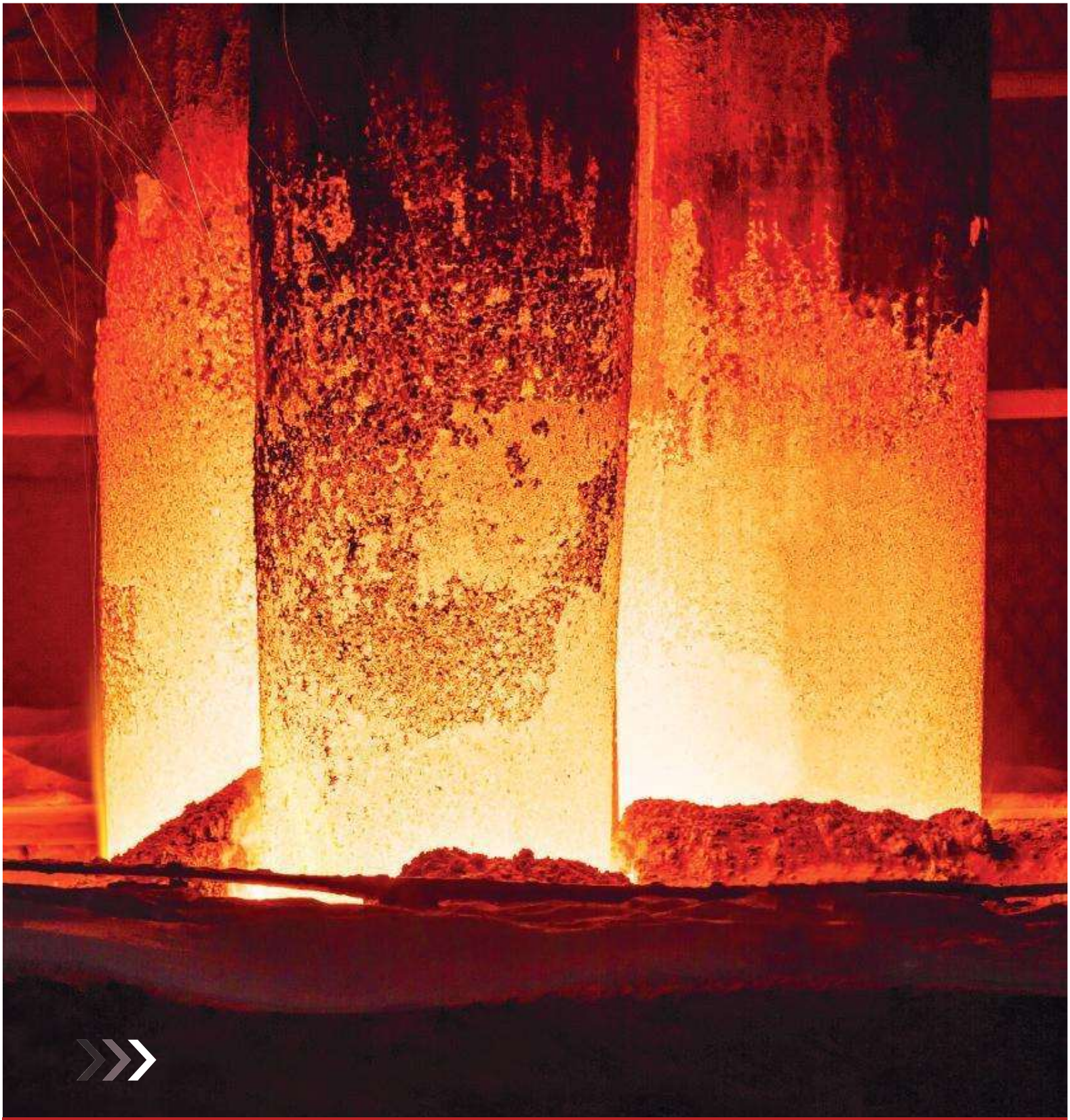
| Abbreviations and Symbols Used for Chemical Elements | |
|---|---|
| **Symbol** | **Element** |
| C | Carbon |
| Mn | Manganese |
| P | Phosphorus |
| S | Sulphur |
| Si | Silicon |
| Al | Aluminum |
| Cu | Copper |
| N | Nitrogen |
| O | Oxygen |
| H | Hydrogen |
| Ca | Calcium |
| Ti | Titanium |
| V | Vanadium |
| Cr | Chromium |
| Ni | Nickel |
| Mo | Molybdenum |
| Nb | Niobium (Columbium) |
| B | Boron |
| Sn | Tin |
| Fe | Iron |
| Zn | Zinc |
| Pb | Lead |
| As | Arsenic |
| W | Wolfram (Tungsten) |

• Please ask the relavant sales department for other dimensions not included in the catalogue.

• Please call the relavant sales department for more information on the steel grades and technical specifications of our products.

| Abbreviations and Symbols Used in the Physical Tests | |
|---|---|
| **Symbol** | **Meaning** |
| Re | Yield strength |
| Rm | Tensile strength |
| Rp0.2 | Proof strength at elevated temperature |
| BH2 | Increase in proof strength after heat treatment |
| A | Elongation (%) |
| A5 | Elongation (L0 =5.65x√S0) |
| A50 | Elongation (L0 =50 mm) |
| A80 | Elongation (L0 =80 mm) |
| A100 | Elongation (L0 =100 mm) |
| A200 | Elongation (L0 =200 mm) |
| S0 | Cross-sectional area of the specimen ($mm^2$) |
| L0 | Original gauge length of the specimen |
| d | Nominal thickness (mm) |
| t | Ton |
| r | Plastic stain ratio |
| n | Strain hardening exponent |
| Ra | Surface roughness (µm) |
| Impact | Impact test |
| KVc | Impact energy (J) |
| T | Test temperature (˚C) |
| Folding | Folding test |
| kmy | Folding mandrel radius |
| kmc | Folding mandrel diameter |
| Trans. | Transverse test rod |
| Long. | Longitudinal test rod |
| HRB | Hardness of Rockwell “B” |
| min. | Minimum |
| max. | Maximum |
| = | Equal to |
| < | Smaller than |
| ≤ | Smaller than or equal |
| > | Greater than |
| ≥ | Greater than or equal |





# HOT STRIP MILL AND PICKLING LINE PRODUCTS

HOT STRIP MILL
Two strand tin slab caster, Double track tunnel furnace rolling mill with 6 stands and double two down coiler

- Thickness range: 1 - 20 mm
- Width range: 800 - 1570 mm
- Max. tonnage: 30 ton
- Internal coil diameter: 762 mm (±%7)
- External coil diameter (max.): 2000 mm
- Hot rolled sheet plate thickness: Min. 1 mm, Max. 8 mm
- Hot rolled sheet plate width: Min. 800 mm, Max. 1570 mm
- Hot rolled sheet plate length: 8000 mm
- Hot rolled sheet plate package weight: Max. 10 tons
- Production capacity: 2,3 million t/year

PICKLING LINE:
- Thickness: Min. 0.8 mm - Max. 5.0 mm
- Width: Min. 800 mm - Max. 1600 mm
- Roll weight: Max. 35 Tons
- Internal coil diameter: 610 mm
- External coil diameter: Min. 900 mm - Max. 2200 mm
- Hot rolled sheet plate thickness: Min. 1mm, Max. 5mm
- Hot rolled sheet plate width: Min. 800 mm, Max. 1600 mm
- Hot rolled sheet plate length: 1000 mm - 8000 mm
- Hot rolled sheet plate package weight: Max. 10 tons
- Production capacity: 1,2 million t/year

MMK Metalurji has the first and only mini mill with a capacity of 2.300.000 tons/year, designed according to the "thin slab caster+hot rolling mill" technology which is popular recently in the world. This technology is called as "QSP (Quality Strip Plant)".

The liquid steel which is produced in the steel mill where production is done with scrap via electric arc furnace is processed in the ladle furnace and/or depending on the quality, additionally, in the vacuum degassing station. It is poured from the pot/ladle to tundish and it has controlled conditions from tundish to water cooled mold. The first slab is formed in the mould; by "soft reduction", slab is casted at the required dimensions and solidification is completed via spray cooling. The slabs are produced with a thickness of 50, 70-80 mm, width of 800-1570 mm and length of 14-43 m depending on the order which are transferred to the hot rolling mill unit on the continuous line. Hot rolled coil thickness range of 1.00-20.00 mm and width of 800-1570 mm can be produced via hot rolling. Pickling line: The scale layer formed on the surface of the coils at hot strip mill is cleaned by HCl in the continuous pickling line and edge trimming is done. The coils are made ready for cold rolling process and/or after lubricating with protective oil, for selling.

It is possible to produce the products with a thickness at the range of 0.80-5.00 mm and width of 800-1600 mm in the continuous pickling line with a capacity of 1.200.000 ton/year.

## HOT ROLLED AND ACIDIFIED PRODUCT NAME ABBREVIATIONS AND DESCRIPTIONS

| | |
|---|---|
| HR | : Hot Rolled Coil |
| HRC | : Hot Rolled Sheet Cut from Coil |
| PHRP | : Hot Rolled Pickled Coil |
| PHRCP | : Hot Rolled Pickled Sheet Cut from Coil |

## GENERAL INFORMATION ON HOT ROLLED and/or PICKLED-OILED PRODUCTS

### General Areas of Application

For meeting the requests of our customers who have activities in the industrial field and each of which has different expectations and needs, we serve a wide range of application of hot rolled steel products. The deep drawn steel grades indicate a perfect performance in the bending, cold shaping and forming applications, high strength low alloyed steel grades. They give perfect results in the applications which require high strength resistance and are presented for the usage of the automotive industry. Wheel rim and chassis steels are used for producing wheel rim and chassis parts which are the basic inputs of the automotive that require both high strength and superior formability.

Hot rolled pipe steel grades are used for producing pipes which have the high strength, perfect toughness and good weldability characteristics that are suitable for water/oil or naturel petroleum gas/ oil transportation in them. Boiler steel grades are used in the production of high pressure vessels and boilers, pipes subjected to steam,industrial thermal containers and heat exchangers due to their perfect formability and weldability characteristics. These characteristics of them are suitable to use under high temperature and pressure. Tube steels are used in the production of LPG cylinders which are formed with high temperature and pressure due to their high formability, perfect weldability and toughness characteristics. The ship building steels which give superior weldability, required high toughness and high strength characteristics, the general structural steel grades with which ductility and toughness optimization are enabled by guaranteeing mechanical properties can be welded via conventional methods. These conventional methods are mainly used in the production of construction machinery and caterpillars; in the general construction plates, they are used in the production of motorway and railway vehicles as well as in the production of storage tanks and containers.

**General Information on the Hot milled Flat Steel Products;**

• Hot rolled, pickled and/or oiled products are produced as coil and sheets via cutting the coil as to length.
• The products which are hot rolled, pickled and oiled are produced with or without edge trimming.
• Unless otherwise is stated, the width, thickness and length values are nominal.
• The hot products are produced within the range of 1.0-20.00 mm thickness interval and the internal diameter of the roll is 762 mm (+/- %7 mm).
• Pickled coils are produced within the range of 0.80-5.00 mm thickness interval and for mill edge, the internal diameter is 610 mm (+/- %7) whereas for trimmed edge, the internal diameter is 610 mm (+/- %3).
• The products as pickled, are lubricated against corrosion unless otherwise is stated (oiling: 0.5-3.0 g/m²). In case that it is requested that the oiling level is "Light oiled" or there is no oiling requested, MMK Metalurji shall not be responsible for the corrosion defects which may occur on the surface.

**Oil amounts;**
Light: 0.5-1.0 g/m²
Normal: 1.0-2.0g/m²
Abundant: 2.0-3.0 g/m²

• The warranty period for not having corrosion in the pickled and normal oiled products is 3 months after the date of notification.
• For the pickled and normal oiled products, MMK Metalurji shall not be responsible for the corrosion risk which may occur due to storage and transportation which is not done by MMK Metalurji.
• Hot rolled coils are produced suitable for hot dip galvanising in compliance with Class 1 and Class 3 in scope of EN 10025-2 2004 standard. When compatibility with galvanize coating is requested, it should be stated during the ordering stage.
• The surface defects are guaranteed according to DIN EN 10163-2 (Class B, Subclass 3) standard for the hot rolled products.
• Coil break defect is not under warranty excluding tempered products for the materials with a thickness of 6 mm or less.
• For determining weldability, it is required to assess C and CE values together which is interpreted/ calculated by using carbon equivalent (CE_IIW) formula.

**Accordingly:**

CE % ⩽ 0,30: Very good weldability characteristic; it can be welded without requirement of any processes.
0,30 < % CE < 0,55: It can be welded using a suitable welding material and suitable temperature.
CE % ⩾ 0,55: It can be welded via special welding practices.

**• The requests/requirements for products that will be suitable for galvanizing should be stated in the ordering stage.**

**NOTE: For the HR products, the size/dimensions tolerance is as l (m) = 90/t (nominal thickness, mm) which do not warrant that total length is max. 20 meters at the head and end of the coil.**

## PRODUCTION INFORMATION (HR – HRC)

Hot rolled coil - Hot rolled sheet cut from coil (20 mm)

| | Min.(mm) | Max.(mm) |
|---|---|---|
| Thickness | 1,0 | 20 |
| Width | 800 | 1570 |
| Internal Coil Diameter | 762 | ±%7 |
| External Coil Diameter | | 2000 |
| Roll Weight | | 30 tons |
| Hot Plate Thickness | 1,00 | 8,00 |
| Hot Plate Width | 800 | 1600 |
| Hot Plate length | 1000 | 8000 |
| Package Weight of Hot Plate | | 10 tons |

* Thickness of less than 1.5 mm is to be subjected to negotiation.

## PRODUCTION INFORMATION (PHR – PHRCP)

Hot rolled, pickled coil-sheet cut from coil

| | Min.(mm) | Max.(mm) |
|---|---|---|
| Thickness | 0.8 | 5 |
| Width | 800 | 1570 |
| Internal coil diameter | 762 | ±%7 |
| External coil diameter | 900 | 2000 |
| Roll weight | | 30 ton |
| Hot plate thickness | 1,00 | 8,00 |
| Hot plate width | 800 | 1600 |
| Hot plate length | 1000 | 8000 |
| Package weight of hot plate | | 10 tons |

* Thickness of less than 1.5 mm is to be subjected to negotiation.

## Steel Grades

| General Usage Area and Main Properties | Standard Equivalent | | MMK Grade No | Material No | Former STD | American | Japanese |
|---|---|---|---|---|---|---|---|
| | Standard Grade | Grade No | | | | | |
| Hot rolled and/or pickled low-carbon steel suitable for cold forming | EN 10111 : 2008 | DD11 | 100011 | 10.332 | DIN 1614-P2 StW22 | ASTM A1011 CSType B | JIS G3131 SPHC |
| | | DD12 | 100012 | 10.398 | DIN 1614-P2RRStW23 | ASTM A1011 DSType A | JIS G3131 SPHD |
| | | DD13 | 100013 | 10.335 | DIN 1614-P2RRStW24 | ASTM A1011 DSType B | JIS G3131 SPHD |
| | | DD14 | 100014 | 10389 | | | JIS G3131 SPHE |
| | DIN 1614-1 | St 22 | 101422 | 10320 | | | |
| | | St 23 | 101423 | 10359 | | | |
| | | St 24 | 101424 | 10327 | | | |
| | ASTM A 1011 | CS Type A | 151101 | | | | |
| | | CS Type B | 151102 | | | ASTM A1011 CS Type A | |
| Hot rolled and/or pickled, high-strength structural steels for manufacturing of any kind of machines and machine parts, general construction, road and railway vehicles | EN 10025 -2 : 2004 | S235JR | 101235 | 10.038 | DIN 17100 St37-2 | ASTM A1011 SS Gr33 | |
| | | S235J0 | 100235 | 10.114 | DIN 17100 St37-3 | ASTM A1011 SS Gr33 | |
| | | S235J2 | 102235 | 10.117 | DIN 17100 St37-3 | ASTM A1011 SS 36 Type 1 | |
| | | S275JR | 101275 | 10.044 | DIN 17100 St44-2 | ASTM A1011 SS Gr40 | |
| | | S275J0 | 100275 | 10.143 | DIN 17100 St44-3 | ASTM A1011 SS Gr40 | |
| | | S275J2 | 102275 | 10.145 | DIN 17100 St44-3 | ASTM A1011 SS Gr40 | |
| | | S355JR | 101355 | 10.045 | DIN 17100 St52-3 | ASTM A1011 SS Gr50 | |
| | | S355J0 | 100355 | 10.553 | | | |
| | | S355J2 | 102355 | 10.577 | DIN 17100 St52-3 | ASTM A1011 SS Gr50 | |
| | | S355K2 | 102356 | 10.596 | | | |
| | DIN 17100 | St37.2 | 101372 | 10.038 | EN 10025-2 S235JR | ASTM A1011 SS Gr33 | |
| | | St44.2 | 101442 | 10.044 | EN 10025-2 S275JR | ASTM A1011 SS Gr40 | |
| | | St 52.3 | 101523 | 10.045 | EN 10025-2 S355JR | ASTM A1011 SS Gr50 | |
| | ASTM A36 | A36 | 150036 | | | | JIS G 3101 SS 400 |
| | SAE 403 C | 1018 | 151018 | | | | |
| | | 1019 | 151019 | | | | |
| | | 1020 | 151020 | | | | |
| | | 1022 | 151022 | | | | |

## Steel Grades

| General Usage Area and Main Properties | Standard Equivalent | | MMK Grade No | Material No | Former STD | American | Japanese |
|---|---|---|---|---|---|---|---|
| | Standard Grade | Grade No | | | | | |
| Hot rolled and/or pickled structural steels suitable for folding | EN 10025-2 | S235JRC | 111235 | 10.122 | | ASTM A1011 SS Gr33 | |
| | | S235J0C | 110235 | 10.115 | | | |
| | | S235J2C | 112235 | 10.119 | DIN 17100 QSt37-3N | | |
| | | S275JRC | 111275 | 10.128 | DIN 17100 St44-2 | ASTM A1011 SS Gr40 | |
| | | S275J0C | 110275 | 10.140 | | | |
| | | S275J2C | 112275 | 10.142 | DIN 17100 QSt44-3N | | |
| | | S355JRC | 111355 | 10.551 | | | |
| | | S355J0C | 110355 | 10.554 | | | |
| | | S355J2C | 112355 | 10.579 | DIN 17100 QSt52-3N | | |
| | ASTM A 1011 | SS Grade 30 | 151130 | | | | |
| | | SS Grade 33 | 151133 | | | | |
| | | SS Grade 36 Type 1 | 151136 | | | | |
| | | SS Grade 36 Type 2 | 151137 | | | | |
| | | SS Grade 40 | 151140 | | | | |
| | | SS Grade 45 | 151145 | | | | |
| | | SS Grade 50 | 151150 | | | | |
| | | SS Grade 30 | 151830 | | | | |
| | ASTM A 1018 | SS Grade 33 | 151833 | | | | |
| | | SS Grade 36 Type 1 | 151836 | | | | |
| | | SS Grade 36 Type 2 | 151837 | | | | |
| | | SS Grade 40 | 151840 | | | | |
| Low and medium strength carbon steel | SAE 403 C | 1006 | 151006 | | | ASTM A1011 CS Type D | |
| | | 1008 | 151008 | | | ASTM A1011 CS Type A | |
| | | 1015 | 151015 | | | | |
| Steels suitable for pipe and profile production | ASTM A 53 | Grade A | 155301 | | | | |
| | | Grade A | 154301 | | | | |
| | | Grade B | 155302 | | | | |
| Hot rolled steels for pressure purposes (boilers, steam boiler plants, pressure vessels, etc.) at elevated temperatures | EN 10028 | P235 GH | 128235 | 10.345 | DIN 17155 H I 91 | | |
| | | P 265 GH | 128265 | 10.425 | DIN 17155 H II 91 | | |
| | | P 295 GH | 128295 | 10.481 | DIN 17155 17Mn4 91 | | |
| | | P 355 GH | 128355 | 10.473 | DIN 17155 19Mn6 | | |
| Hot Rolled Steels For Welded Gas Cylinders (LPG Tubes) and Hot Rolled Pickled coil | EN 10120 : 2008 | P 245 NB | 120245 | 10.111 | | | JIS G3116 SG255 |
| | | P 265 NB | 120265 | 10.423 | | | JIS G3116 SG295 |
| | | P 310 NB | 120310 | 10.437 | | | JIS G3116 SG325 |
| | | P 355 NB | 120355 | 10.557 | | | JIS G3116 SG365 |
| Hot rolled fine grain weldable structural steels | EN10025-3 | S275N | 103275 | 10.490 | | | |
| | | S275 NL | 103276 | 10.491 | | | |
| | | S355N | 103355 | 10.545 | DIN EN 10113-2 S355N | ASTM A1011 HSLAS Gr.50 Class 1 | |
| | | S355NL | 103356 | 10.546 | DIN EN 10113-2 S355NL | ASTM A1011 HSLAS Gr.50 Class 1 | |
| | | S420N | 103420 | 18.902 | DIN EN 10113-2 S420N | ASTM A1011 HSLAS Gr.60 Class 1 | |
| | | S420NL | 103421 | 18.912 | DIN EN 10113-2 S420NL | ASTM A1011 HSLAS Gr.60 Class 1 | |
| | | S460N | 103460 | 18.901 | DIN EN 10113-2 S460N | ASTM A1011 HSLAS Gr.65 Class 1 | |
| | | S460NL | 103461 | 18.903 | DIN EN 10113-2 S460NL | ASTM A1011 HSLAS Gr.65 Class 1 | |
| | ASTM A572 | S275M | 104275 | | | | |
| | | 42 Type 2 | 157242 | | | | |
| | | 50 Type 2 | 157550 | | | ASTM A709 Gr.345F Type 2 | |
| | | 55 Type 2 | 157255 | | | | |
| | | 60 Type 3 | 157260 | | | | |

## Steel Grades

| General usage area and main properties | | Standard equivalent | | MMK Grade No | Material No | Former STD | American | Japanese |
|---|---|---|---|---|---|---|---|---|
| | | Standard Grade | Grade No | | | | | |
| Thermomechanically hot rolled weldable fine grain high strength structural steels | | EN10025-4 | S275 M | 104275 | 18.818 | | | |
| | | | S275 ML | 104276 | 18.819 | | | |
| | | | S355M | 104355 | 18.823 | | | |
| | | | S355ML | 104356 | 18.834 | | | |
| | | | S420M | 104420 | 18.825 | | | |
| | | | S420 ML | 104421 | 18.836 | | | |
| | | | S460 M | 104460 | 18.827 | | | |
| | | | S460ML | 104461 | 18.838 | | | |
| High-strength low-alloy steels suitable for improved bending | | ASTM A 1011 | HSLAS Gr 45 Type 1 | 152145 | | | | |
| | | | HSLAS Gr 45 Type 2 | 152146 | | | | |
| | | | HSLAS Gr 50 Type 1 | 152150 | | | | |
| | | | HSLAS Gr 50 Type 2 | 152151 | | | | |
| | | | HSLAS Gr 55 Type 1 | 152155 | | | | |
| | | | HSLAS Gr 55 Type 2 | 152156 | | | | |
| | | | HSLAS Gr 60 Type 1 | 152160 | | | | |
| | | | HSLAS Gr 60 Type 2 | 152161 | | | | |
| Medium and high strength low alloyed steels suitable for cold forming for manufacture of chassis, cranes, trailers and railings in particular. | | EN 10149- 2 :2013 | S 315 MC | 149315 | 10.972 | | ASTM A1011 HSLAS Gr40 Type 2 | |
| | | | S 355MC | 149355 | 10.976 | | ASTM A1011 HSLAS Gr50 Type 2 | |
| | | | S 420MC | 149420 | 10.980 | | ASTM A1011 HSLAS Gr60 Type 2 | |
| | | | S 460MC | 149460 | 10.982 | | ASTM A1011 HSLAS Gr65 Type 2 | |
| | | | S 500MC | 149500 | 10.984 | | ASTM A1011 HSLAS Gr70 Type 2 | |
| | | | S 550MC | 149550 | 10.986 | | ASTM A1011 HSLAS-FGr80 | |
| | | | S 600MC | 149600 | 18.969 | | | |
| Hot rolled steels for manufacturing pipelines of crude oil and natural gas | | API 5L 45th Edition -2012 / EN ISO 3183:2012 | PSL1 L 210 A | 191210 | | | | |
| | | | PSL1 L 245 B | 191245 | | | | |
| | | | PSL1 L290/X42 | 191290 | | | | |
| | | | PSL1 L320/X46 | 191320 | | | | |
| | | | PSL1 L360/X52 | 191360 | | | | |
| | | | PSL1 L390/X56 | 191390 | | | | |
| | | | PSL1 L415/X60 | 191415 | | | | |
| | | | PSL1 L450/X65 | 191450 | | | | |
| | | | PSL1 L485 /X70 | 191485 | | | | |
| Rim steels | Low strength for wheel / rims | EN 10111 | DD11 | 139012 | 10.398 | DIN 1614-P2RRStW23 | ASTM A1011 DSType A | JIS G3131 SPHD |
| | Medium, low strength steels for wheel/rims | EN 10025 - 2 | S275JRC | 139235 | 10.122 | | ASTM A1011 SS Gr33 | |
| | | | S355JRC | 139275 | 10.128 | | ASTM A1011 SS Gr40 | |
| | High strength low alloy steels | EN 10149 -2 | S 355MC | 139355 | 10.976 | | ASTM A1011 HSLAS Gr50 Type 2 | |
| | | | S 420MC | 139420 | 10.980 | | ASTM A1011 HSLAS Gr60 Type 2 | |

## Hot Rolled Low-Carbon Steel Suitable For Cold Forming
## Standard: EN 10111 - 2008
## Chemical composition (%)

| Standard | Grade | MMK Grade No | %C | %Mn | %P | %S |
|---|---|---|---|---|---|---|
| | | | max. | max. | max. | max. |
| EN 10111 | DD11 | 100011 | 0,12 | 0,6 | 0,045 | 0,045 |
| EN 10111 | DD12 | 100012 | 0,1 | 0,45 | 0,035 | 0,035 |
| EN 10111 | DD13** | 100013 | 0,08 | 0,4 | 0,03 | 0,03 |
| EN 10111 | DD14** | 100014 | 0,08 | 0,35 | 0,025 | 0,025 |

* Si % amount is 0.03 for these grades and it is suitable for continuous hot dipped galvanized coating as Class 1.
** All grades are produced as "fully killed". (Al ≥ 0,020) Cu % is max. 0.30.

## Mechanical Properties

| Standard | Grade | MMK Grade No | ReL N/mm² | | Rm N/mm² | Elongation | | | | War-ranty period |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | L0=80mm | | | L0=5,65 √S0 | |
| | | | 1.0mm≤t<2mm | 2mm≤t<11mm | | 1.0mm≤t<1.5mm | 1.5mm≤t<2mm | 2mm≤t<3mm | 3mm≤t<11mm | |
| EN 10111 | DD11 | 100011 | 170 - 360 | 170 - 340 | 440 | 22 | 23 | 24 | 28 | |
| EN 10111 | DD12 | 100012 | 170 - 340 | 170 - 320 | 420 | 24 | 25 | 26 | 30 | 6 month |
| EN 10111 | DD13** | 100013 | 170 - 310 | 170 - 310 | 400 | 27 | 28 | 29 | 33 | 6 month |
| EN 10111 | DD14** | 100014 | 170 - 290 | 170 - 290 | 380 | 30 | 31 | 32 | 36 | 6 month |

**1.** Mechanical properties are valid for untempered, hot rolled and/or pickled oiled coils.
**2.** Unless otherwise agreed at the time of enquiry and order, nitrogen-fixing elements such as titanium and boron may be added at the discretion of the manufacturer
**3.** As long as the width of the product permits, the pieces for the tensile tests shall be taken transversely to the direction of rolling.
**4.** Rp0,2 shall be used instead of ReL if the product does not exhibit any yield phenomenon.
**5.** It is recommended that products in grade DD11 should be formed within 6 weeks from the time of their availability.
* Guarantee periods specified in the table begin on the date on which products are made available.
** DD13 and DD14 grades are to be subjected to negotiation during the order stage.

## Hot Rolled Low Carbon Steels Suitable For Cold Rolling
## Standard: DIN 1614-1
## Chemical Composition (a) (%)

| Standard | Grade | MMK Grade No | %C | %Si | %Mn | %P | %S | %Al | %N (b) |
|---|---|---|---|---|---|---|---|---|---|
| | | | max. | max. | max | max. | max. | min. | max. |
| DIN 1614-1 | St 22 (c,d) | 101422 | 0,08 | 0,03 | 0,4 | 0, 025 | 0, 025 | 0,02 | 0,007 (e) |
| DIN 1614-1 | St 23 (c,d) | 101423 | 0,06 | 0,03 | 0,35 | 0,02 | 0,02 | 0,02 | - |
| DIN 1614-1 | St 24 (c,d) | 101424 | 0,06 | 0,03 | 0,3 | 0,02 | 0,02 | 0,02 | - |

**1.** (a) Mechanical test is not carried out.
**2.** (b) If the content of metallic aluminium is ≥ 0.020 %, the maximum limit of nitrogen does not apply.
**3.** (c) Cr+Ni+Cu+Mo toplamı max. 0.21 dir.
**4.** (d) For "Fully Killed" grades, if Al(tot) value is lower than 0.020%, Al/N shall not be lower than 2/1.
**5.** (e) This is the aimed value.

## Low Strength Carbon Steels
## Standard: ASTM A 1011
## Chemical Composition (a) (%)

| Standard | Grade | MMK Grade No | %C | %Si | %Mn | %P | %S | %Nb | %V | %Al | %Ti (c) | %Cr (b) | %Ni | %Mo | %Cu (h) | %N | %B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | max. | max. | max | max. | max. | max. | max. | min. | max. | max. | max. | max. | max. | max. | max. |
| ASTM A 1011 | CS Grade A (d,e,f,g) | 151101 | 0,1 | - - - | 0,6 | 0,3 | 0,35 | 0,008 | 0,008 | - - - | 0,025 | 0,15 | 0,2 | 0,06 | 0,2 | - - - | - - - |
| ASTM A 1011 | CS Grade B | 151102 | 0,02-0,15 | - - - | 0,6 | 0,3 | 0,35 | 0,008 | 0,008 | - - - | 0,025 | 0,15 | 0,2 | 0,06 | 0,2 | - - - | - - - |

**1.** (a) Where an ellipsis (. . .) appears in the table, it means that there is no specified limit, but the analysis shall be reported.
**2.** (b) Chromium is permitted at the producer's preference up to 0.25% at maximum when the carbon content is less than or equal to 0.05%.
**3.** (c) For steels containing 0.02% carbon or more, titanium is permitted at the producer's preference to a range lesser of 3.4N + 1.5S or 0.025%.
**4.** (d) Specify Type B to avoid carbon levels below 0.02%.
**5.** (e) For carbon levels less than or equal to 0.02%, it is permissible to use vanadium, columbium, ortitanium, or combinations there of as stabilizing elements at the producer's.
**6.** (f) When an aluminum deoxidized steel is required, it is permissible to order a minimum of 0.01% total aluminum
**7.** (g) It is permissible to furnish as a vacuum degassed or chemically stabilized steel, or both, at producer's preference.
**8.** (h) When copper is specified, a minimum of 0.20% is required. When copper steel is not specified, the copper limit is a maximum requirement

## Mechanical Properties (a, b)

| Standard Equivalent | | MMK Grade No | Re | Rm | A (%) min |
|---|---|---|---|---|---|
| | | | N/mm² | N/mm² | Thickness mm |
| Standard | Grade | | min | min | $A_{50}$ mm |
| ASTM A 1011 | CS Grade A | 151101 | 205 - 340 | - | 25 |
| ASTM A 1011 | CS Grade B | 151102 | 205 - 340 | - | 25 |

## Mechanical properties (a, b)

**1.** (a) Tensile test and elongation values apply to "longitudinal" test pieces. They are determined according to ASTM A370 standard.
**2.** (b) Mechanical test is carried out only when specified at the time of enquiry and order.
* Mechanical test is not carried out.

## Hot Rolled Unalloyed Structural Steels
## Standard: EN 10025 - 2 : 2004
## Chemical Composition (%)

| Standard | Grade | MMK Grade No | %C (max.) | | %Mn | %P | %S | %Si (e) | %Cu | %N (a) | %CEV (c,d) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | t≤16 | 16<t | max. | max. | max. | max. | max. | max. | max. |
| EN 10025 -2 | S235JR | 101235 | 0,17 | 0,17 | 1,4 | 0,35 | 0,35 | - | 0,55 | 0,01 | 0,35 |
| | S235J0 | 100235 | 0,17 | 0,17 | 1,4 | 0,3 | 0,3 | - | 0,55 | 0,01 | 0,35 |
| | S235J2 | 102235 | 0,17 | 0,17 | 1,4 | 0,25 | 0,25 | - | 0,55 | - | 0,35 |
| | S275JR (b) | 101275 | 0,21 | 0,21 | 1,5 | 0,04 | 0,05 | - | 0,55 | 0,01 | - |
| | S275J0 (b) | 100275 | 0,18 | 0,18 | 1,5 | 0,03 | 0,03 | - | 0,55 | 0,01 | - |
| | S275J2 (b) | 102275 | 0,18 | 0,18 | 1,5 | 0,03 | 0,03 | - | 0,55 | - | - |
| | S355JR (b) | 101355 | 0,24 | 0,24 | 1,6 | 0,04 | 0,04 | 0,55 | 0,55 | - | - |
| | S355J0 (b) | 100355 | 0,2 | 0,2 | 1,6 | 0,03 | 0,03 | 0,55 | 0,55 | - | - |
| | S355J2 (b) | 102355 | 0,2 | 0,2 | 1,6 | 0,03 | 0,03 | 0,55 | 0,55 | - | - |
| | S355K2 (b) | 102356 | 0,2 | 0,2 | 1,6 | 0,03 | 0,03 | 0,55 | 0,55 | - | - |

1. If the content of metallic aluminium is ≥ 0.020 %, the maximum limit of nitrogen does not apply.
2. For max. CEV value is increased by 0.02%, for Si % ≤ 0.03 and 0.01% for Si % ≤ 0.25.
3. If Cu % is between 0.25 and 0.40 according to the order conditions, max. CEV amount is increased by 0.02%.
4. Carbon equivalent, CEV (IIW) % = C + Mn / 6 + (Cr + Mo + V) / 5 + (Ni + Cu) / 15
5. It is suitable for galvanization as "Class 1"/ Suitable for galvanizing as "Class 1".

## Mechanical Properties (a)

| Standard | Grade | MMK Grade No | ReL N/mm² | | Rm N/mm² | | Elongation | | | | | Impact(long) (c) 27. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | L0=80mm | | | | L0=5,65 √S0 | | | |
| | | | t≤16mm | 16mm<t | t<3mm | 3mm≤t | t≤1mm | 1<t≤1,5mm | 1,5<t≤2,0mm | 2<t≤2,5mm | 2,5mm<t<3mm | 3mm≤t | Sıc. °C | Joule (Min) |
| EN 10025-2 | S235JR | 101235 | 235 | 225 | 235 | 225 | 15 | 16 | 17 | 18 | 19 | 24 | 20 | 27 (b) |
| | S235J0 | 100235 | 235 | 225 | 235 | 225 | 15 | 16 | 17 | 18 | 19 | 24 | 0 | 27 |
| | S235J2 | 102235 | 235 | 225 | 235 | 225 | 15 | 16 | 17 | 18 | 19 | 24 | -20 | 27 |
| | S275JR | 101275 | 275 | 265 | 275 | 265 | 13 | 14 | 15 | 16 | 17 | 21 | 20 | 27 (b) |
| | S275J0 | 100275 | 275 | 265 | 275 | 265 | 13 | 14 | 15 | 16 | 17 | 21 | 0 | 27 |
| | S275J2 | 102275 | 275 | 265 | 275 | 265 | 13 | 14 | 15 | 16 | 17 | 21 | -20 | 27 |
| | S355JR | 101355 | 355 | 345 | 355 | 345 | 12 | 13 | 14 | 15 | 16 | 20 | 20 | 27 (b) |
| | S355J0 | 100355 | 355 | 345 | 355 | 345 | 12 | 13 | 14 | 15 | 16 | 20 | 0 | 27 |
| | S355J2 | 102355 | 355 | 345 | 355 | 345 | 12 | 13 | 14 | 15 | 16 | 20 | -20 | 27 |
| | S355K2 | 102356 | 355 | 345 | 355 | 345 | 12 | 13 | 14 | 15 | 16 | 20 | -20 | 40 |

1. (a) Tensile test values apply to "transverse" test pieces.
2. (b) Impact test is carried out only when specified at the time of enquiry and order.
3. (c) Impact test is not carried out for thickness thinner than 6 mm.
4. Steels with "JR" notation can be produced as "AR". The steels with "J0 and J2" notations can be produced to be normalized as "controlled rolling".

## Standard: ASTM A 36
## Chemical Composition (%)

| Standard | Grade | MMK Grade No | %C (a) | %Si | %P | %S |
|---|---|---|---|---|---|---|
| | | | max. | max. | max. | max. |
| ASTM A36 | A 36 | 150036 | 0,25 | 0,4 | 0,03 | 0,03 |

1. (a) For each reduction of 0.01 percentage less the specified carbon limit, an increase of 0.06 percentage point manganese above the specified maximum will be permitted up to the maximum of 1.35%.
2. Copper content shall be minimum 0,20% when Cu steel is specified.

## Mechanical Properties

| Standard Equivalent | | MMK Grade No | Re | Rm | A (%) min | |
|---|---|---|---|---|---|---|
| | | | N/mm² | N/mm² | Thickness mm | |
| Standard | Grade | | min | min | $A_{50}$ mm | $A_{200}$ mm |
| ASTM A 36 | A 36 | 150036 | 250 | 400-550 | 21 | 18 |

1. Tensile test values apply to "transverse" test pieces.

**Standard: SAE J403 C**
**Chemical Composition (%)**

**Hot Rolled Unalloyed Structural Steels**

| Standard | Grade | MMK Grade No | %C | %Si (a) | %Mn | %P | %S |
|---|---|---|---|---|---|---|---|
| | | | max. | max. | max | max. | max. |
| SAE J403 | 1018 | 151018 | 0,15 - 0,20 | - - - | 0,60 - 0,90 | 0,03 | 0,035 |
| SAE J403 | 1019 | 151019 | 0,15 - 0,20 | - - - | 0,70 - 1,00 | 0,03 | 0,035 |
| SAE J403 | 1020 | 151020 | 0,18 - 0,23 | - - - | 0,30 - 0,60 | 0,03 | 0,035 |
| SAE J403 | 1022 | 151022 | 0,18 - 0,23 | - - - | 0,70 - 1,00 | 0,03 | 0,035 |

**1.** Mechanical test is not carried out.
**2.** When Silicon ranges or limits are required, the following are commonly used: 0,10% max; 0,10 to 0,20%; 0,15 to 0,35%; 0,20 to 0,40%; or 0,30 to 0,60%.

**Hot Rolled Unalloyed Structural Steels with Improved Formability**
**Standard: EN 10025 - 2 : 2004 Chemical Composition (%)**

| Standard | Grade | MMK Grade No | %C (max.) | | %Mn | %P | %S | %Si (d) | %Cu | %N (a) | %CEV (b,c) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | t≤16 | 16<t≤20 | max. | max. | max. | max. | max. | max. | max. |
| EN 10025-2 | S235JRC | 111235 | 0,17 | 0,17 | 1,4 | 0,35 | 0,35 | - | 0,55 | 0,01 | 0,35 |
| | S235J0C | 100235 | 0,17 | 0,17 | 1,4 | 0,3 | 0,3 | - | 0,55 | 0,01 | 0,35 |
| | S235J2C | 112235 | 0,17 | 0,17 | 1,4 | 0,25 | 0,25 | - | 0,55 | 0,01 | 0,35 |
| | S275JRC | 111275 | 0,21 | 0,21 | 1,5 | 0,35 | 0,35 | - | 0,55 | 0,01 | 0,4 |
| | S275J0C | 110275 | 0,18 | 0,18 | 1,5 | 0,3 | 0,3 | - | 0,55 | 0,01 | 0,4 |
| | S275J2C | 112275 | 0,18 | 0,18 | 1,5 | 0,25 | 0,25 | - | 0,55 | 0,01 | 0,4 |
| | S355JRC | 111355 | 0,24 | 0,24 | 1,5 | 0,35 | 0,35 | 0,55 | 0,55 | 0,01 | 0,45 |
| | S355J0C | 110355 | 0,2 | 0,2 | 1,5 | 0,3 | 0,3 | 0,55 | 0,55 | 0,01 | 0,45 |
| | S355J2C | 112355 | 0,2 | 0,2 | 1,5 | 0,25 | 0,25 | 0,55 | 0,55 | 0,01 | 0,45 |

**1.** (a) If total Al % is at minimum 0.020 in the chemical composition of the steel, N top limit value is not applied.
**2.** (b) The maximum CEV value increased is 0.02% for Si % ⩽ 0.03, 0.01% for Si % ⩽ 0.25.
**3.** (c) If Cu % is between 0.25 and 0.40, at maximum CEV amount is increased by 0.02% according to the agreement with the user.
**4.** (d) For the steels suitable for galvanizing as "Class 1", Si % amount shall be at maximum 0.03%.

The steels will be produced for galvanizing as "Class 3"; it will be appropriate to take confirmation at the time of enquiry and order.
Classes suitable for galvanization are only valid for coil and sheet produced from coil.

| "Class 1" and "Class 3" suitability to galvanization classes are applied according to the table below: | | | |
|---|---|---|---|
| Classes | Elements | | |
| | Si | Si + 2.5P | P |
| Class 1 | ⩽ 0.030 | ⩽ 0.090 | - |
| Class 3 | 0.14 ⩽ Si ⩽ 0.25 | - | ⩽ 0.030 |

## Mechanical Properties (a)

| Standard Equivalent | | MMK Grade No | Re N/mm² t =thickness mm | | Rm (1) N/mm² t =thickness mm | | A (%) min Thickness mm A80 t≤1mm | 1<t≤1,5mm | 1,5<t≤2,0mm | 2<t≤2,5mm | L0=5,65 √S0 2,5mm<t<3mm | 3mm≤t | Impact (Lengthwise) (b,c) Sıc °C | J (min) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Standard | Grade (4) | | <=16 | 16<t<=40 | <3 | 3≤ t<=100 | | | | | | | | |
| EN 10025-2 | S235JRC | 111235 | 235 | 225 | 360-510 | 360-510 | 15 | 16 | 17 | 18 | 19 | 24 | 20 | 27 (b) |
| | S235J0C | 110235 | 235 | 225 | 360-510 | 360-510 | 15 | 16 | 17 | 18 | 19 | 24 | 0 | 27 |
| | S235J2C | 112235 | 235 | 225 | 360-510 | 360-510 | 15 | 16 | 17 | 18 | 19 | 24 | -20 | 27 |
| | S275JRC | 111275 | 275 | 265 | 430-580 | 410-560 | 13 | 14 | 15 | 16 | 17 | 21 | 20 | 27 (b) |
| | S275J0C | 110275 | 275 | 265 | 430-580 | 410-560 | 13 | 14 | 15 | 16 | 17 | 21 | 0 | 27 |
| | S275J2C | 112275 | 275 | 265 | 430-580 | 410-560 | 13 | 14 | 15 | 16 | 17 | 21 | -20 | 27 |
| | S355JRC | 111355 | 355 | 345 | 510-680 | 470-630 | 12 | 13 | 14 | 15 | 16 | 20 | 20 | 27 (b) |
| | S355J0C | 110355 | 355 | 345 | 510-680 | 470-630 | 12 | 13 | 14 | 15 | 16 | 20 | 0 | 27 |
| | S355J2C | 112355 | 355 | 345 | 510-680 | 470-630 | 12 | 13 | 14 | 15 | 16 | 20 | -20 | 27 |

1. (a) Tensile test values apply to "transverse" test pieces
2. (b) Impact test is carried out optionally only when specified at the time of enquiry and order.
3. (c) For the materials thinner than 6 mm, the "impact tests" are not performed.
4. Steels with "JR" notation can be produced as "AR". The steels with "J0 and J2" notations can be produced to be normalized as "controlled rolling".

## Bending Test

| Unalloyed Structural Steels, Hot Rolled, Suitable for Folding | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Standard Equivalent | | MMK Grade No | Bending Direction | BENDING TEST 90° t = thickness (mm) | | | | | | | | | | | | | |
| Standard | Grade (4) | | | t≤1,5 | 1,5<t≤2,5 | 2,5<t≤3 | 3<t≤4 | 4<t≤5 | 5<t≤6 | 6<t≤7 | 7<t≤8 | 8<t≤10 | 10<t≤12 | 12<t≤14 | 14<t≤16 | 16<t≤18 | 18<t≤20 |
| DIN EN 10025-2 | S235JRC | 111235 | E | 1,6 | 2,5 | 3 | 5 | 6 | 8 | 10 | 12 | 16 | 20 | 25 | 28 | 36 | 40 |
| | S235J0C | 100235 | | | | | | | | | | | | | | | |
| | S235J2C | 112236 | B | 1,6 | 2,5 | 3 | 6 | 8 | 10 | 12 | 16 | 20 | 25 | 28 | 32 | 40 | 45 |
| | S275JRC | 111275 | E | 2 | 3 | 4 | 5 | 6 | 10 | 12 | 16 | 20 | 25 | 28 | 32 | 40 | 45 |
| | S275J0C | 100275 | | | | | | | | | | | | | | | |
| | S275J2C | 112276 | B | 2 | 3 | 4 | 6 | 8 | 12 | 16 | 20 | 25 | 32 | 36 | 40 | 45 | 50 |
| | S355JRC | 111355 | E | 2,5 | 4 | 5 | 6 | 8 | 10 | 12 | 16 | 20 | 25 | 32 | 36 | 45 | 50 |
| | S355J0C | 100355 | | | | | | | | | | | | | | | |
| | S355J2C | 112356 | B | 2,5 | 4 | 5 | 8 | 10 | 12 | 16 | 20 | 25 | 32 | 36 | 40 | 50 | 63 |

1. Values are applicable at bending tests on angels of ≤90°.

## Standard ASTM A1011 : 2015
## Chemical Composition (%) (a)

| Standard | Grade | MMK Grade No | %C | %Si | %Mn (d) | %P | %S | %Nb | %V | %Al | %Ti (c) | %Cr | %Ni | %Mo | %Cu (b) | %N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | max. | max. | max | max. | max. | max. | max. | min. | max. | max. | max. | max. | max. | max. |
| ASTM A 1011 | SS30 | 151130 | 0,25 | --- | 0,9 | 0,035 | 0,04 | 0,008 | 0,008 | 0,02 | 0,025 | 0,15 | 0,2 | 0,06 | 0,2 | --- |
| ASTM A 1011 | SS33 | 151133 | 0,25 | --- | 0,9 | 0,035 | 0,04 | 0,008 | 0,008 | 0,02 | 0,025 | 0,15 | 0,2 | 0,06 | 0,2 | --- |
| ASTM A 1011 | SS36 Type 1 | 151136 | 0,25 | --- | 0,9 | 0,035 | 0,04 | 0,008 | 0,008 | 0,02 | 0,025 | 0,15 | 0,2 | 0,06 | 0,2 | --- |
| ASTM A 1011 | SS36 Type 2 (d) | 151137 | 0,25 | --- | 1,35 | 0,035 | 0,04 | 0,008 | 0,008 | 0,02 | 0,025 | 0,15 | 0,2 | 0,06 | 0,2 | --- |
| ASTM A 1011 | SS40 | 151140 | 0,25 | --- | 0,9 | 0,035 | 0,04 | 0,008 | 0,008 | 0,02 | 0,025 | 0,15 | 0,2 | 0,06 | 0,2 | --- |
| ASTM A 1011 | SS45 Type 1 (d) | 151145 | 0,25 | --- | 1,35 | 0,035 | 0,04 | 0,008 | 0,008 | 0,02 | 0,025 | 0,15 | 0,2 | 0,06 | 0,2 | --- |
| ASTM A 1011 | SS50 (d) | 151150 | 0,25 | --- | 1,35 | 0,035 | 0,04 | 0,008 | 0,008 | 0,02 | 0,025 | 0,15 | 0,2 | 0,06 | 0,2 | --- |
| ASTM A 1011 | SS55 (d) | 151155 | 0,25 | --- | 1,35 | 0,035 | 0,04 | 0,008 | 0,008 | 0,02 | 0,025 | 0,15 | 0,2 | 0,06 | 0,2 | --- |

**1.** (a) Where an ellipsis (. . .) appears in the table, there is no specified limit, but the analysis shall be reported.
**2.** (b) When copper is specified, a minimum of 0.20% is required. When copper steel is not specified, the copper limit is the maximum limit.
**3.** (c) Titanium is permitted at the producer's option, to the lesser of 3.4N + 1.5S or 0.025%.
**4.** (d) For each reduction of 0.01 percentage point below the specified carbon maximum, an increase of 0.06 percentage point manganese above the specified maximum will be permitted up to the maximum of 1.50%.

### Mechanical Properties

| Standard Equivalent | | MMK Grade No | Re | Rm | A (%) min | | | | Folding (transverse 180 °C) (t= thickness) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Thickness mm | | | | |
| | | | N/mm² | N/mm² | A50 mm | | | A200 mm | |
| Standard | Grade | | min | min | t<1,6 | 1,6≤t<2,5 | 2,5≤t<6,0 | t≤6,0 | |
| ASTM A 1011 | SS Grade 30 | 151130 | 205 | 340 | 21 | 24 | 25 | 19 | 1 t |
| ASTM A 1011 | SS Grade 33 | 151133 | 230 | 360 | 18 | 22 | 23 | 18 | 1 t |
| ASTM A 1011 | SS Grade 36 Type 1 | 151136 | 250 | 365 | 17 | 21 | 22 | 17 | 1,5 t |
| ASTM A 1011 | SS Grade 36 Type 2 | 151137 | 250 | 400-550 | 16 | 20 | 21 | 16 | 2 t |
| ASTM A 1011 | SS40 | 151140 | 275 | 380 | 15 | 20 | 21 | 16 | 2 t |
| ASTM A 1011 | SS45 Type 1 | 151145 | 310 | 410 | 13 | 18 | 19 | 14 | 2 t |
| ASTM A 1011 | SS Grade 50 | 151150 | 340 | 450 | 11 | 16 | 17 | 12 | 2,5 t |
| ASTM A 1011 | SS Grade 55 | 151155 | 380 | 480 | 9 | 14 | 15 | 10 | 3t |

**1.** Tensile test values apply to "longitudinal" test pieces.
**2.** Bending test is carried out optionally only when specified at the time of enquiry and order.

## STRUCTURAL STEELS
## Standard ASTM A1018: 2016
### Chemical Composition (%) (a)

| Standard | Grade | MMK Grade No | %C | %Si | %Mn | %P | %S | %Nb | %V | %Al | %Ti (c) | %Cr | %Ni | %Mo | %Cu (b) | %N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | max. | max. | max | max. | max. | max. | max. | min. | max. | max. | max. | max. | max. | max. |
| ASTM 1018 | SS30 | 151830 | 0,25 | --- | 1,5 | 0,035 | 0,04 | 0,008 | 0,008 | 0,02 | 0,025 | 0,15 | 0,2 | 0,06 | 0,2 | 0,014 |
| ASTM 1018 | SS33 | 151833 | 0,25 | --- | 1,5 | 0,035 | 0,04 | 0,008 | 0,008 | 0,02 | 0,025 | 0,15 | 0,2 | 0,06 | 0,2 | 0,014 |
| ASTM 1018 | SS36 Type 1 | 151836 | 0,25 | --- | 1,5 | 0,035 | 0,04 | 0,008 | 0,008 | 0,02 | 0,025 | 0,15 | 0,2 | 0,06 | 0,2 | 0,014 |
| ASTM 1018 | SS36 Type 2 | 151837 | 0,25 | --- | --- | 0,035 | 0,04 | 0,008 | 0,008 | 0,02 | 0,025 | 0,15 | 0,2 | 0,06 | 0,2 | 0,014 |
| ASTM 1018 | SS40 | 151840 | 0,25 | --- | 1,5 | 0,035 | 0,04 | 0,008 | 0,008 | 0,02 | 0,025 | 0,15 | 0,2 | 0,06 | 0,2 | 0,014 |

**1.** (a) Where an ellipsis (. . .) appears in the table, there is no specified limit, but the analysis shall be reported.
**2.** (b) When copper is specified, a minimum of 0.20% is required. When copper steel is not specified, the copper limit is the maximum requirement.
**3.** (c) Titanium is permitted at the producer's option, to the lesser of 3.4N + 1.5S or 0.025%.

### Mechanical Properties (a)

| Standard Equivalent | | MMK Grade No | Re | Rm | A (%) min | | Impact (b) (lengthwise) | | bending (b) (transverse 180 ) |
|---|---|---|---|---|---|---|---|---|---|
| | | | N/mm² | N/mm² | Thickness mm | | | | |
| Standard | Grade | | min | min | A50 mm | A200 mm | Temp. °C | J (min) | |
| ASTM A 1018 | SS30 | 151830 | 205 | 340 | 22 | 17 | 20 | 40 (2) | 1 t |
| ASTM A 1018 | SS33 | 151833 | 230 | 360 | 22 | 16 | 20 | 40 (2) | 1,5 t |
| ASTM A 1018 | SS36 Type 1 | 151836 | 250 | 365 | 21 | 15 | 20 | 40 (2) | 1,5 t |
| ASTM A 1018 | SS36 Type 2 | 151837 | 250 | 400-550 | 21 | 18 | 20 | 40 (2) | 2 t |
| ASTM A 1018 | SS40 | 151840 | 275 | 380 | 19 | 14 | 20 | 40 (2) | 2 t |

1. (a) Tensile test values apply to "transverse" test pieces.
2. (b) Impact and bending test are carried out optionally only when specified at the time of enquiry and order
3. Only available for thickness of 6 ⩽ d ⩽ 20 mm.

**Weldable Fine-Grained Structural Steels**
**Standard EN 10025 - 3: 2004**
**Chemical Composition (%)**

| Standard | Grade | MMK Grade No | %C | %Si | %Mn | | %P | %S | %Nb | %V | %Al (a) Total | %Ti | %Cr | %Ni | %Mo | %Cu (b) | %N | %CEV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | max. | max. | min. | max. | max. | max. | max. | max. | max. | min. | max. | max. | max. | max. | max. | max. |
| EN 10025-3 | S275N | 103275 | 0,18 | 0,40 | 0,50 | 1,50 | 0,030 | 0,025 | 0,05 | 0,05 | 0,02 | 0,05 | 0,30 | 0,30 | 0,10 | 0,55 | 0,015 | 0,40 |
| | S275NL | 103276 | 0,16 | | | | 0,025 | 0,020 | | | | | | | | | | |
| | S355N | 103355 | 0,20 | 0,50 | 0,90 | 1,65 | 0,030 | 0,025 | 0,05 | 0,12 | 0,02 | 0,05 | 0,30 | 0,30 | 0,10 | 0,55 | 0,015 | 0,43 |
| | S355NL | 103356 | 0,18 | | | | 0,025 | 0,020 | | | | | | | | | | |
| | S42N | 103420 | 0,20 | 0,50 | 1,00 | 1,70 | 0,030 | 0,025 | 0,05 | 0,20 | 0,02 | 0,05 | 0,30 | 0,30 | 0,10 | 0,55 | 0,015 | 0,48 |
| | S420NL | 103421 | 0,20 | | | | 0,025 | 0,020 | | | | | | | | | | |
| | S460N (c) | 103460 | 0,20 | 0,60 | 1,00 | 1,70 | 0,030 | 0,025 | 0,05 | 0,20 | 0,02 | 0,05 | 0,30 | 0,30 | 0,10 | 0,55 | 0,015 | 0,53 |
| | S460NL (c) | 103461 | 0,20 | | | | 0,025 | 0,020 | | | | | | | | | | |

1. a) If sufficient nitrogen-binding elements are present, the minimum total aluminium content does not apply.
2. (b) Cu content above 0.40% may cause hot shortness during hot forming.
3. (c) V+Nb+Ti ⩽0.22%and Mo+Cr ⩽ 0.30%

Compatibility for hot dip galvanizing
* Product type, composition of the zinc bath, the other hot dip galvanizing process parameters and the other factors should be taken into account during the order stage

| The "Class 1" and "Class 3" suitability to galvanized coating classes are applied according to the table below. | | | |
|---|---|---|---|
| Classes | Elements | | |
| | Si | Si + 2.5P | P |
| Class 1 | ⩽ 0.030 | ⩽ 0.090 | - |
| Class 2(a) | ⩽ 0.35 | | |
| Class3 | 0.14 ⩽ Si ⩽ 0.25 | - | ⩽ 0.035 |

1.(a) Class 2 applies only for special zinc alloys.

*During production, Si % is controlled according to Class 1 and Class 2. For example for the zinc coating with hot dip galvanizing, C and Mn elements may be added to increase the maximum CEV value as below.
- For Si ⩽ 0.030%, CEV is increased by 0.02%;
- For Si ⩽ 0.25% CEV is increased by 0.01%.

**Mechanical Properties (a)**

| | Grade | MMK Grade No | ReL N/mm² | | Rm (a) N/mm² | Elongation L0=5,65 √S0 | | Impact ( longitudinal) (b) | | | | Bending (transverse 180 °C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | L0=80mm | | Temp. °C, Min (Joule) | | | | |
| | | | t⩽16mm | 16mm<t | t⩽20mm | t⩽16mm | 16mm<t | +20 °C | 0 °C | -20 °C | -50 °C | t= thickness |
| EN 10025-3 | S275N | 103275 | 275 | 265 | 370-510 | 24 | 24 | 55 | 47 | 40 | - | 2t |
| | S275 NL | 103276 | | | | | | 63 | 55 | 47 | 27 | |
| | S355N | 103355 | 355 | 345 | 470-630 | 22 | 22 | 55 | 47 | 40 | - | 2t |
| | S355NL | 103356 | | | | | | 63 | 55 | 47 | 27 | |
| | S42N | 103420 | 420 | 400 | 520-680 | 19 | 19 | 55 | 47 | 40 | - | 4t |
| | S420NL | 103421 | | | | | | 63 | 55 | 47 | 27 | |
| | S460N | 103460 | 460 | 440 | 540-720 | 17 | 17 | 55 | 47 | 40 | - | 4t |
| | S460NL | 103461 | | | | | | 63 | 55 | 47 | 27 | |

**1.** (a) Tensile test values apply to "transverse" test pieces.
**2.** (b) The impact test isn't performed for the products with a thickness under 6 mm.
**3.** (c) The bending test isn't performed for the products with a thickness over 16 mm.
**4.** (d) Bending test is carried out optionally only when specified at the time of enquiry and order.
**5.** These grades are produced up to 12 mm thickness and are to be subjected to negotation.

**High Strength Low Alloyed (Nb, V) Structural Steels**
**Standard: ASTM A572: 2015**
**Chemical Composition (%)**

| Standard | Grade | MMK Grade No | %C (a,b) | %Si | %Mn (a,b) | %P | %S | %Nb | %V | %Cu |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | max. | max. | max | max. | max. | max. | max. | max. |
| ASTM A572 | 42 Type 2 | 157242 | 0,21 | 0,4 | 0,80-1,35 | 0,03 | 0,03 | - - - | 0,01-0,15 | 0,2 |
| ASTM A572 | 50 Type 2 | 157550 | 0,23 | 0,4 | 0,80-1,35 | 0,03 | 0,03 | - - - | 0,01-0,15 | 0,2 |
| ASTM A572 | 55 Type 2 | 157255 | 0,25 | 0,4 | 0,80-1,35 | 0,03 | 0,03 | - - - | 0,01-0,15 | 0,2 |
| ASTM A572 | 60 Type 3 | 157260 | 0,26 | 0,4 | 0,80-1,35 | 0,03 | 0,03 | 0,005-0,05 | 0,01-0,15 | 0,2 |

**1.** (a) For each reduction of 0.01 percentage point below the specified carbon maximum, an increase of 0.06 percentage point manganese above the specified maximum will be permitted up to the maximum of 1.60%.
**2.** (b) Minimum manganese content is 0.50% for thickness of ⩽ 10,00 mm. The manganese to carbon ratio shall not be less than 2 to 1.

**Mechanical Properties**

| Standard equivalent | | MMK Grade No | Re | Rm | A (%) min | |
|---|---|---|---|---|---|---|
| | | | N/mm² | N/mm² | Thickness mm | |
| Standard | Grade | | min | min | $A_{50}$ mm | $A_{200}$ mm |
| ASTM A572 | 42 Type 2 | 157242 | 290 | 415 | 22 | 18 |
| ASTM A572 | 50 Type 2 | 157550 | 345 | 450 | 19 | 16 |
| ASTM A572 | 55 Type 2 | 157255 | 380 | 485 | 18 | 15 |
| ASTM A572 | 60 Type 3 | 157260 | 415 | 520 | 16 | 13 |

**1.** Tensile test values apply to "transverse" test pieces.

**Low and Medium Strength Carbon steels**
**Standard SAE J403 C: 2014**
**Chemical Composition (%)**

| Standard | Grade | MMK Grade No | %C | %Si (a) | %Mn | %P | %S |
|---|---|---|---|---|---|---|---|
| | | | max. | max. | max | max. | max. |
| SAE J403 | 1006 | 151006 | 0,08 | - - - | 0,25 - 0,40 | 0,03 | 0,035 |
| SAE J403 | 1008 | 151008 | 0,1 | - - - | 0,30 - 0,50 | 0,03 | 0,035 |
| SAE J403 | 1015 | 151015 | 0,13 - 0,18 | - - - | 0,30 - 0,60 | 0,03 | 0,035 |
| SAE J403 | 1018 | 151018 | 0,15 - 0,20 | - - - | 0,60 - 0,90 | 0,03 | 0,035 |
| SAE J403 | 1019 | 151019 | 0,15 - 0,20 | - - - | 0,70 - 1,00 | 0,03 | 0,035 |
| SAE J403 | 1020 | 151020 | 0,18 - 0,23 | - - - | 0,30 - 0,60 | 0,03 | 0,035 |
| SAE J403 | 1022 | 151022 | 0,18 - 0,23 | - - - | 0,70 - 1,00 | 0,03 | 0,035 |

**1.** (a) Mechanical test is not carried out.
**2.** (b) When Silicon ranges or limits are required, the following ranges are commonly used: 0,10% at maximum; 0,10 to 0,20%; 0,15 to 0,35%; 0,20 to 0,40%; or 0,30 to 0,60%..

## LPG Cylinder Steels
## Standard EN 10120: 2008
## Chemical Composition (a) (%)

| Standard | Grade | MMK Grade No | %C | %Mn | %P | %S | %Si | Altotal (b) | %N (c) | %Ti |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | max. | max. | max. | max. | max. | min. | max. | max. |
| EN 10120 | P 245 NB | 120245 | 0,16 | 0,3 | 0,025 | 0,015 | 0,25 | 0,02 | 0,009 | 0,03 |
| | P 265 NB | 120265 | 0,19 | 0,4 | 0,025 | 0,015 | 0,25 | 0,02 | 0,009 | 0,03 |
| | P 310 NB | 120310 | 0,2 | 0,7 | 0,025 | 0,015 | 0,5 | 0,02 | 0,009 | 0,03 |
| | P 355 NB | 120355 | 0,2 | 0,7 | 0,025 | 0,015 | 0,5 | 0,02 | 0,009 | 0,03 |

**1.** (a) Elements not listed in this table may not be intentionally added to the steel without the approval of the purchaser except for finishing the cast. All appropriate measures shall be taken to prevent the addition from scrap or other materials used in steel making of these elements which may adversely affect the mechanical properties and usability.
**2.** (b) The aluminium content may partly be replaced by ⩽ 0,050% Nb and/or ⩽ 0,03% Ti. In such cases the content of these elements is to be reported in the inspection document
**3.** (c)If (Al / N) % ⩾ 2.2 or if Nb and/or Ti additions are applied, the nitrogen content may be 0.012% at maximum

### Mechanical Properties

| Standard equivalent | | | Re | Rm (1) | A (%) min | |
|---|---|---|---|---|---|---|
| | | | N/mm² | N/mm² | t<3,0 | 3⩽t⩽5mm |
| Standard | Grade (4) | MMK Grade No | min | min | A80 mm | L0=5,65 √S0 |
| EN 10120 | P 245 NB | 120245 | 245 | 360-450 | 26 | 34 |
| EN 10120 | P 265 NB | 120265 | 265 | 410-500 | 24 | 32 |
| EN 10120 | P 310 NB | 120310 | 310 | 460-550 | 21 | 28 |
| EN 10120 | P 355 NB | 120355 | 355 | 510-620 | 19 | 24 |

**1.** Tensile test values apply to "transverse" direction in terms of rolled condition.

## Hot Rolled Steels for Pressure Purposes (Boilers, Steam Boiler Plants, Pressure Vessels, etc.) at Elevated Temperatures
## Standard EN 10028 - 2: 2017
## Chemical Composition (%)

| Standard | Grade | MMK Grade No | %C | %Si | %Mn | %P | %S | %Al | %Cr (a) | %N (c) | %V | %Cu (a) | %Ti | %Nb | %Mo (a) | %Ni (a) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | max. | max. | max. | max. | max. | min. | max. | max. | max. | max. | max. | max. | max. | max. |
| EN 10028-2 | P235 GH | 128235 | 0,16 | 0,35 | 0,60-1,20 (b) | 0,025 | 0,01 | 0,02 | 0,3 | 0,012 | 0,02 | 0,3 | 0,03 | 0,02 | 0,08 | 0,3 |
| | P265 GH | 128265 | 0,2 | 0,4 | 0,80-1,40 (b) | 0,025 | 0,01 | 0,02 | 0,3 | 0,012 | 0,02 | 0,3 | 0,03 | 0,02 | 0,08 | 0,3 |
| | P295 GH | 128295 | 0,08-0,20 | 0,4 | 0,90-1,50 (b) | 0,025 | 0,01 | 0,02 | 0,3 | 0,012 | 0,02 | 0,3 | 0,03 | 0,02 | 0,08 | 0,3 |
| | P355 GH | 128355 | 0,10-0,22 | 0,6 | 1,10-1,70 | 0,025 | 0,01 | 0,02 | 0,3 | 0,012 | 0,02 | 0,3 | 0,03 | 0,02 | 0,08 | 0,3 |

**1.** (a) Cr + Cu + Mo + Ni: ⩽ 0.70%.
**2.** (b) For the thicknesses less than 6mm, minimum amounts may be decreased by 0.20%..
**3.** c) Deoxidation method of these products is "Fully-Killed". Minimum aluminium to nitrogen ratio is 2:1..

## Mechanical Properties

| Standard Equivalent | | MMK Grade | Re N/mm² min | | Rm (a) N/mm² | A (%) min L0=5,65 √S0 | Impact (b,c) (Transverse)J (min) Sıc C | | | (a,b) $R_{0,2}$ Temp. =300°C N/mm² min | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Standard | Grade | | t≤16 min. | 16<t | min | A5 | -20 | 0 | 20 | t≤16 min. | 16<t |
| EN 10028-2 | P235 GH | 128235 | 235 | 225 | 360-480 | 24 | 27 | 34 | 40 | 153 | 147 |
| EN 10028-2 | P 265 GH | 128265 | 265 | 255 | 410-530 | 22 | 27 | 34 | 40 | 173 | 166 |
| EN 10028-2 | P 295 GH | 128295 | 295 | 290 | 460-580 | 21 | 27 | 34 | 40 | 192 | 189 |
| EN 10028-2 | P 355 GH | 128355 | 355 | 345 | 510-650 | 20 | 27 | 34 | 40 | 232 | 225 |

**1.** (a) Tensile test values apply to "transverse" test pieces.
**2.** (b) For the materials thinner than 6 mm, the "impact tests" isn't performed.

## Thermomechanic Rolled High Yield Structural Steels
## Standard EN 10025-4: 2004
## Chemical Composition (a,b) (%)

| Standard | Grade | MMK Grade No | %C | %Si | %Mn | %P | %S | %N(b) | %V | %Al (c) total | %Ti | %Cr | %Ni | %Mo | %Cu (e) | %N | %CEV (d) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | max. | max. | max | max. | max. | max. | max. | min. | max. | max. | max. | max. | max. | max. | t≤16mm | 16mm<t |
| EN 10025-4 | S275M | 104275 | 0,13 | 0,5 | 1,5 | 0,03 | 0,025 | 0,05 | 0,08 | 0,02 | 0,05 | 0,3 | 0,3 | 0,1 | 0,55 | 0,015 | 0,34 | 0,34 |
| | S275 ML | 104276 | | | | 0,025 | 0,02 | | | | | | | | | | | |
| | S355M | 104355 | 0,14 | 0,5 | 1,6 | 0,03 | 0,025 | 0,05 | 0,1 | 0,02 | 0,05 | 0,3 | 0,5 | 0,1 | 0,55 | 0,015 | 0,39 | 0,39 |
| | S355ML | 104356 | | | | 0,025 | 0,02 | | | | | | | | | | | |
| | S42M | 104420 | 0,16 | 0,5 | 1,7 | 0,03 | 0,025 | 0,05 | 0,12 | 0,02 | 0,05 | 0,3 | 0,8 | 0,2 | 0,55 | 0,025 | 0,43 | 0,45 |
| | S420ML | 104421 | | | | 0,025 | 0,02 | | | | | | | | | | | |
| | S460M | 104460 | 0,16 | 0,5 | 1,7 | 0,03 | 0,025 | 0,05 | 0,12 | 0,02 | 0,05 | 0,3 | 0,8 | 0,2 | 0,55 | 0,025 | 0,45 | 0,46 |
| | S460ML | 104461 | | | | 0,025 | 0,02 | | | | | | | | | | | |

**2.** (b) It is produced up to 8 mm thickness. Thicker materials are to be subjected to negotiation.
**3.** (c) In case that adequate amount of elements binding N in the chemical composition of the steel, Al value can't be applied.
**4.** (d) Maximum C equivalent, %CEV may be increased by 0.02% for Si %≤0.03 and 0.01% for ≤0.25.
**5.** (d) Maximum C equivalent, %CEV may be increased by 0.02% for Si %.
**6.** C equivalent is calculated according to the formula :CEV (IIW) % = C+Mn/6v + (Cr+ Mo + V) / 5 + (Ni + Cu) / 15.

## Mechanical Properties

| Standard | Grade | MMK Grade No | ReL N/mm² | | Rm (a) N/mm² | Elongation L0=80mm L0=5,65 √S0 | Impact lengthwise (b) Sıc. °C , Min (Joule) | | | | Folding test (c,d) (Transverse 180 °C) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | t≤16mm | 16mm<t | t≤20mm | t≤20mm | +20 °C | 0 °C | -20 °C | -50 °C | t= thickness |
| EN 10025 - 4 | S275M | 104275 | 275 | 265 | 370-530 | 24 | 55 | 47 | 40 | - | 2t |
| | S275 ML | 104276 | | | | | 63 | 55 | 47 | 27 | |
| | S355M | 104355 | 355 | 345 | 470-630 | 22 | 55 | 47 | 40 | - | 2t |
| | S355ML | 104356 | | | | | 63 | 55 | 47 | 27 | |
| | S42M | 104420 | 420 | 400 | 520-680 | 19 | 55 | 47 | 40 | - | 4t |
| | S420ML | 104421 | | | | | 63 | 55 | 47 | 27 | |
| | S460M | 104460 | 460 | 440 | 540-720 | 17 | 55 | 47 | 40 | - | 4t |
| | S460ML | 104461 | | | | | 63 | 55 | 47 | 27 | |

1. (a) The tensile test values are applied to the "transverse" test samples.
2. (b) The impact test isn't performed for the products with a thickness under 6 mm.
3. (c) Bend test is not carried out for thickness greater than 12 mm.
4. (d) Bend test is carried out only when specified at the time of enquiry and order.

**Standard: ASTM A 1011: 2012**
**Chemical Composition (a) (%)**

| Standard | Grade | MMK Grade No | %C | %Si | %Mn | %P | %S | %Nb | %V | %Al | %Ti | %Cr | %Ni | %Mo | %Cu (b) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | max. | | max | max. | max. | min. | min. | | min. | max. | max. | max. | max. |
| ASTM A 1011 | HSLAS Gr 45 Type 1 (c) | 152145 | 0,22 | - - - | 1,35 | 0,04 | 0,04 | 0,005 | 0,005 | - - - | 0,005 | 0,15 | 0,2 | 0,06 | 0,2 |
| ASTM A 1011 | HSLAS Gr 45 Type 2 | 152146 | 0,15 | - - - | 1,35 | 0,04 | 0,04 | 0,005 | 0,005 | - - - | 0,005 | 0,15 | 0,2 | 0,06 | 0,2 |
| ASTM A 1011 | HSLAS Gr 50 Type 1 (c) | 152150 | 0,23 | - - - | 1,35 | 0,04 | 0,04 | 0,005 | 0,005 | - - - | 0,005 | 0,15 | 0,2 | 0,06 | 0,2 |
| ASTM A 1011 | HSLAS Gr 50 Type 2 | 152151 | 0,15 | - - - | 1,35 | 0,04 | 0,04 | 0,005 | 0,005 | - - - | 0,005 | 0,15 | 0,2 | 0,06 | 0,2 |
| ASTM A 1011 | HSLAS Gr 55 Type 1 (c) | 152155 | 0,15 | - - - | 1,35 | 0,04 | 0,04 | 0,005 | 0,005 | - - - | 0,005 | 0,15 | 0,2 | 0,06 | 0,2 |
| ASTM A 1011 | HSLAS Gr 55 Type 2 | 152156 | 0,15 | - - - | 1,35 | 0,04 | 0,04 | 0,005 | 0,005 | - - - | 0,005 | 0,15 | 0,2 | 0,06 | 0,2 |
| ASTM A 1011 | HSLAS Gr 60 Type 1 | 152160 | 0,26 | - - - | 1,5 | 0,04 | 0,04 | 0,005 | 0,005 | - - - | 0,005 | 0,15 | 0,2 | 0,06 | 0,2 |
| ASTM A 1011 | HSLAS Gr 60 Type 2 | 152161 | 0,15 | - - - | 1,5 | 0,04 | 0,04 | 0,005 | 0,005 | - - - | 0,005 | 0,15 | 0,2 | 0,06 | 0,2 |

1. (a) Where an ellipsis (. . .) appears in the table, there is no specified limit, but the analysis shall be reported.
2. (b) When copper steel is specified, the copper limit is a minimum requirement. When copper steel is not specified, the copper limit is a maximum requirement.
3. (c) For each reduction of 0.01% below the specified carbon maximum, an increase of 0.06% manganese above the specified maximum will be permitted up to a maximum of 1.50%
4. (d) Steels contain the strengthening elements of niobium, vanadium, titanium, and molybdenum added seperately or jointly. The minimum requirements only apply to the micro alloy elements selected for strengthening of the steel.

**Mechanical Properties**

| Standard Equivalent | | MMK Grade No | Re | Rm | A (%) min | A (%) min |
|---|---|---|---|---|---|---|
| | | | | | $A_{50}$ mm | $A_{50}$ mm |
| | | | N/mm² | N/mm² | Thickness mm | Thickness mm |
| Standard | Grade | | min | min | t ≤ 2,5 | 2,5 < t |
| ASTM A 1011 | HSLAS Gr 45 Type 1 | 152145 | 310 | 410 | 23 | 25 |
| ASTM A 1011 | HSLAS Gr 45 Type 2 | 152146 | 310 | 380 | 23 | 25 |
| ASTM A 1011 | HSLAS Gr 50 Type 1 | 152150 | 340 | 450 | 20 | 22 |
| ASTM A 1011 | HSLAS Gr 50 Type 2 | 152151 | 340 | 410 | 20 | 22 |
| ASTM A 1011 | HSLAS Gr 55 Type 1 | 152155 | 380 | 480 | 18 | 20 |
| ASTM A 1011 | HSLAS Gr 55 Type 2 | 152156 | 380 | 450 | 18 | 20 |
| ASTM A 1011 | HSLAS Gr 60 Type 1 | 152160 | 410 | 520 | 16 | 18 |
| ASTM A 1011 | HSLAS Gr 60 Type 2 | 152161 | 410 | 480 | 16 | 18 |

1. Tensile test values apply to "longitudinal" test pieces.

## Hot Rolled High Yield Strength Steels for Cold Forming
## Standard: EN 10149-2: 2013
## Chemical Composition (a) (%)

| Standard | Grade | MMK Grade No | %C | %Mn | %P | %S | %Si | %Al | %Nb (b) | %Ti (b) | %V (b) | %Mo | %B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | max. | max. | max. | max. | max. | min. | max. | max. | max. | max. | max. |
| EN 10149-2 | S 315 MC | 149315 | 0,12 | 1,2 | 0,03 | 0,2 | 0,5 | 0,02 | 0,09 | 0,15 | 0,2 | - | - |
| | S 355MC | 149355 | 0,12 | 1,4 | 0,03 | 0,2 | 0,5 | 0,02 | 0,09 | 0,15 | 0,2 | - | - |
| | S 420MC | 149420 | 0,12 | 1,6 | 0,03 | 0,02 | 0,5 | 0,02 | 0,09 | 0,15 | 0,2 | - | - |
| | S 460MC | 149460 | 0,12 | 1,6 | 0,03 | 0,02 | 0,5 | 0,02 | 0,09 | 0,15 | 0,2 | - | - |
| | S 500MC | 149500 | 0,12 | 1,7 | 0,03 | 0,02 | 0,5 | 0,02 | 0,09 | 0,15 | 0,2 | - | - |

**1.** (a) It is produced through thermomechanical rolling method.
**2.** (b) Nb + Ti + V ⩽ 0.22%
**3.** It is produced up to 12 mm thickness. Thicker materials are to be subjected to negotiation.

## Mechanical Properties

| Standard Equivalent | | MMK Grade No | Re (c) | Rm (a) | A (%) min | | Impact (b) (Longitudinal) | | Bending (transverse 180 ) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Thickness mm | | | | |
| | | | N/mm² | N/mm² | A80 mm | L0=5,65 √S0 | | | |
| Standard | Grade | | min | min | 3<t | t>=3 | Temp. °C | J (min) | |
| EN 10149- 2 | S315MC | 149315 | 315 | 390-510 | 20 | 24 | -20 | 40 | 0 t |
| | S355MC | 149355 | 355 | 430-550 | 19 | 23 | -20 | 40 | 0,5 t |
| | S420MC | 149420 | 420 | 480-620 | 16 | 19 | -20 | 40 | 0,5 t |
| | S460MC | 149460 | 460 | 520-670 | 14 | 17 | -20 | 40 | 1 t |
| | S500MC | 149500 | 500 | 550-700 | 12 | 14 | -20 | 40 | 1 t |

**1.** (a) Tensile test values apply to "longitudinal" test pieces.
**2.** (b) Impact test only made for material thicknesses of 6mm at minimum, upon request.
**3.** (c) For thicknesses over 8 mm, yield strength is decreased by 20N/mm² from the values stated in the table

## Steels for Profile and Pipe Production
## ASTM A53: 2012
## Chemical Composition (%)

| Standard | Grade | MMK Grade No | %C | %Si | %Mn | %P | %S | %V (a) | %Cr | %Ni (a) | %Mo (a) | %Cu (a) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | max. | max. | max | max. | max. | max. | max. | max. | max. | max. |
| ASTM A 53 | Grade A (c) | 155301 | 0,25 | 0.15-0.30 | 0,95 | 0,05 | 0,045 | 0,08 | 0,4 | 0,4 | 0,15 | 0,4 |
| ASTM A 53 | Grade A (c,e) | 154301 | 0,25 | 0,03 | 0,95 | 0,05 | 0,045 | 0,08 | 0,4 | 0,4 | 0,15 | 0,4 |
| ASTM A 53 | Grade B (b,d) | 155302 | 0,26 | --- | 1,35 | 0,035 | 0,035 | - | - | - | - | - |

**1.** (a) For ASTM A53 Grade A, the total of Cu+Ni+Cr+Mo+V elements should be 1.00% at maximum.
**2.** (b) For each reduction of 0.01 percentage point below the specified maximum C, an increase of 0.06 percentage point above the specified maximum for Mn is permitted for ASTM A53 Grade B up to a maximum of 1.50% by heat analysis.
**3.** For each reduction of 0.01 percentage point below the specified maximum C, an increase of 0.06 percentage point above the specified maximum for Mn is permitted, for ASTM A53 Grade A up to a maximum of 1.35% by heat analysis.
**4.** (d) If copper-containing steel is specified in the purchase order, copper content shall be at the minimum of 0.20%.
**5.** (e) It is low Si % and suitable for Class 1 galvanized coating.

## Mechanical Properties

| Standard Equivalent | | MMK Grade No | Re | Rm (a) | A (%) min |
|---|---|---|---|---|---|
| | | | N/mm² | N/mm² | Thickness mm |
| Standard | Grade | | min | min | A50 mm |
| ASTM A 53 | Grade A | 155301 | 205 | 330 | (b) |
| ASTM A 53 | Grade A | 154301 | 205 | 330 | (b) |
| ASTM A 53 | Grade B | 155302 | 290 | 400 | 23 (c) |

**1.** (a) Tensile test values apply to "longitudinal" test pieces.
**2.** (b) A50 (% ) = 1940 S00.2 / U0.9 (S0: Cross-sectional area of the specimen, mm²; U: Specified minimum tensile strength, N/mm²).
**3.** (c) Specified elongation value applies to thickness of ⩾ 4.57 mm. For thickness of < 4.57 mm, the minimum elongation value is calculated by the formula of: Elongation% = 2.40 d+12".

## Petroleum and Natural Gas Industries - Steel Pipe For Pipeline Transportation Systems
## Standard: API 5L 45th Edition-2012 / EN ISO 3183:2012
## Chemical Composition (a,g) (%)

| Standard | Grade | MMK Grade No | %C (b) | %Mn (b) | %P | %S | %V | Other |
|---|---|---|---|---|---|---|---|---|
| | | | max. | max. | max. | max. | max. | |
| API 5 L /EN ISO 3183 | PSL1 L 210 A | 191210 | 0,22 | 0,9 | 0,03 | 0,03 | - | - |
| API 5 L /EN ISO 3183 | PSL1 L 245 B | 191245 | 0,26 | 1,2 | 0,03 | 0,03 | c,d | - |
| API 5 L /EN ISO 3183 | PSL1 L290/X42 | 191290 | 0,26 | 1,3 | 0,03 | 0,03 | d | - |
| API 5 L /EN ISO 3183 | PSL1 L320/X46 | 191320 | 0,26 | 1,4 | 0,03 | 0,03 | d | - |
| API 5 L /EN ISO 3183 | PSL1 L360/X52 | 191360 | 0,26 | 1,4 | 0,03 | 0,03 | d | - |
| API 5 L /EN ISO 3183 | PSL1 L390/X56 | 191390 | 0,26 | 1,4 | 0,03 | 0,03 | d | - |
| API 5 L /EN ISO 3183 | PSL1 L415/X60 | 191415 | 0,26 (e) | 1,4 (e) | 0,03 | 0,03 | f | - |
| API 5 L /EN ISO 3183 | PSL1 L450/X65* | 191450 | 0,26 (e) | 1,45 (e) | 0,03 | 0,03 | f | - |
| API 5 L /EN ISO 3183 | PSL1 L485 /X70* | 191485 | 0,26 (e) | 1,65 (e) | 0,03 | 0,03 | f | - |

*It is to be subjected to negotiation during the order stage

**1.** (a) Cu⩽0,50%, Ni ⩽ 0,50%, Cr ⩽ 0,50%, Mo ⩽ 0,15%
**2.** (b) For each reduction of 0,01 % below the specified maximum concentration for carbon, an increase of 0,05 % above the specified Maximum concentration for manganese is permissible, up to a maximum of 1,65% for grades W L245 or B, but u L360 or X52; upto a maximum of 1,75 % for grades W L360 or X52, but W L485 or X70; and up to a maximum of 2,00 % for grade L485 or X70..
**3.** (c) Unless otherwise specified, Nb + V ⩽ 0.06 % is applied
**4.** (d) Nb + V + Ti ⩽ 0,15%
**5.** (e) Unless otherwise specified, these values are valid.
**6.** (f) Unless otherwise specified, (Nb + V + Ti) ⩽ 0.15 % is applied
**7.** (g) Unless otherwise specified, B is not added and B ⩽ 0,001% is applied
**8.** These grades are produced up to 12 mm thickness.

## Mechanical Properties

| Standard Equivalent | | MMK Grade No | Rt 0,5 N/mm² (a) | Rm (a) | A f (50mm or 2 inches)% (b) |
|---|---|---|---|---|---|
| | | | N/mm² | N/mm² | |
| Standard | Grade (c) | | min. | min. | min. |
| API 5 L /EN ISO 3183 | PSL1 L 210 A | 191210 | 210 | 335 | 36 |
| API 5 L /EN ISO 3183 | PSL1 L 245 B | 191245 | 245 | 415 | 30 |
| API 5 L /EN ISO 3183 | PSL1 L290/X42 | 191290 | 290 | 415 | 30 |
| API 5 L /EN ISO 3183 | PSL1 L320/X46 | 191320 | 320 | 435 | 28 |
| API 5 L /EN ISO 3183 | PSL1 L360/X52 | 191360 | 360 | 460 | 27 |
| API 5 L /EN ISO 3183 | PSL1 L390/X56 | 191390 | 390 | 490 | 25 |
| API 5 L /EN ISO 3183 | PSL1 L415/X60 | 191415 | 415 | 520 | 24 |
| API 5 L /EN ISO 3183 | PSL1 L450/X65 | 191450 | 450 | 535 | 24 |
| API 5 L /EN ISO 3183 | PSL1 L485/X70 | 191485 | 485 | 570 | 22 |

**1.** (a) Test values apply to transverse specimens taken from the coil, although these test values apply to transverse specimens taken from the pipe body.
**2.** (b) Elongation percentage values given on the table are valid for thickness ≥ 12,7mm. For thinner thicknesses (<12,7mm);

A50 = $A_f = C \frac{A_{xc}^{0,2}}{U^{0,9}}$ Axc: cross-sectional area of specimen, mm²; U: minimum tensile strength, N/mm²)

formulation is applied.
**3.** (c) There are some discrepansies (increase or decrease) between the test results, according to taken specimens from coil or pipe depending on diameter, type and direction of test taken from pipe. Therefore we advise our customers to consider this issue and determine the most suitable grade for their intended production accordingly. Mechanical properties which are specified in the above table for hot rolled bands are only guaranteed on the sample taken perpendicular to the rolling direction. (PSL1)(PSL2)

## Wheel / Rim Steels

### Low strength rim steels
### Standard: EN 10111: 2008
### Chemical Composition: (%)

| Standard | Grade | MMK Grade No | %C | %Mn | %P | %S |
|---|---|---|---|---|---|---|
| | | | max. | max. | max. | max. |
| EN 10111 | DD11 | 139012 | 0,12 | 0,6 | 0,045 | 0,045 |

** All grades are produced as "fully killed". (Al ≥ 0,020) % Cu is max. 0.30.

### Mechanical Properties

| Standard | Grade | MMK Grade No | ReL N/mm² | | Rm N/mm² | Elongation | | | | Guarantee |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1.0mm≤t<2mm | 2mm≤t<11mm | | L0=80mm | | | L0=5,65 √S0 | |
| | | | | | | 1.0mm≤t<1.5mm | 1.5mm≤t<2mm | 2mm≤t<3mm | 3mm≤t<11mm | |
| EN 10111 | DD11 | 139012 | 170 - 360 | 170 - 340 | 440 | 22 | 23 | 24 | 28 | |

**1.** Mechanical properties are valid for untempered hot rolled and/or pickled oiled coils.
**2.** Tensile test values apply to "transverse" test pieces.
**3.** Rp0,2 shall be used instead of ReL if the product does not exhibit any yield phenomenon.
**4.** Mechanical properties specified on the table are guaranteed for 6 months beginning from the date which products are made available

### Medium, low strength steels for for wheel rims
### Standard: EN 10025 - 2: 2004
### Chemical Composition: (%)

| Standard | Grade | MMK Grade No | %C max. | %Mn max. | %P max. | %S max. | %Si max. | %Al min. | %Nb max. | %Ti max. | %V max. | %Momax. | %B ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN 10025-2 | S235JRC | 139235 | 0.05-0.09 | 0.35-0.55 | 0.020 | 0.008 | 0.030 | 0.025-0.060 | 0.005 | 0.010 | 0.005 | 0.010 | 10 |
| | S275JRC | 139275 | 0.14-0.17 | 0.85-1.05 | 0.020 | 0.010 | 0.100 | 0.025-0.060 | 0.008 | 0.010 | 0.008 | 0.015 | 10 |

**1.** The maximum value for nitrogen does not apply if the chemical composition shows a minimum total aluminium content of 0.020%. Minimum aluminium to nitrogen ratio is 2:1.
**2.** Max carbon equivalent (CE) is increased by 0.01 % for Si ≤ 0.25%, and 0.02 % for Si ≤ 0.030%
**3.** (c ) According to order conditions % Cu: 0,25 - 0,40 max. The amount of CEV is increased by 0.02%.
**4.** Carbon equivalent, CEV (IIW) % = C + Mn / 6 + (Cr + Mo + V) / 5 + (Ni + Cu) / 15.

## Mechanical Properties

| Standard Equivalent | | MMK Grade No | Re | | Rm (a) | | A (%) min | | | | | Impact, (longitudinal) (b,c) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | N/mm² | | N/mm² | | Thickness mm | | | | | | | |
| | | | t = thickness mm | | t = thickness mm | | A80 | | | | L0=5,65 √S0 | | | |
| Standard | Grade | | <=16 | 16<t<=40 | <3 | 3≤ t<=100 | t≤1mm | 1<t≤1,5mm | 1,5<t≤2,0mm | 2<t≤2,5mm | 2,5mm<t<3mm | 3mm≤t | Sıc °C | J (min) |
| EN 10025-2 | S235JRC | 139235 | 235 | 225 | 360-510 | 360-510 | 15 | 16 | 17 | 18 | 19 | 24 | 20 | 27 (2) |
| | S275JRC | 139275 | 275 | 265 | 430-580 | 410-560 | 13 | 14 | 15 | 16 | 17 | 21 | 20 | 27 (2) |

1.(a) Tensile test values apply to "transverse" test pieces.
2.(b) Impact test is carried out only when specified at the time of enquiry and order.
3.(c) Impact test is not required for thickness thinner than 6 mm.

### Wheel Rim Steels with High Strength
### Standard: EN 10149 -2: 2013
### Chemical Composition: (a) (%)

| Standard | Grade | MMK Grade No | %C (max.) | %Mn | %P | %S | %Si | %Al | %Nb (b) | %Ti (b) | %V (b) | %Mo | %B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | max. | max. | max. | max. | max. | min. | max. | max. | max. | max. | max. |
| EN 10149 -2 | S 355MC | 139355 | 0,12 | 1,4 | 0,03 | 0,2 | 0,5 | 0,02 | 0,09 | 0,15 | 0,2 | - | - |
| | S 420MC | 139420 | 0,12 | 1,6 | 0,03 | 0,02 | 0,5 | 0,02 | 0,09 | 0,15 | 0,2 | - | - |

1. (a) The products are supplied in "thermomechanically" rolled condition.
2. (b) Nb + Ti + V ⩽ %0,22

## Mechanical Properties

| Standard Equivalent | | MMK Grade no | Re | Rm (a) | A (%) min | | Impact (b) (longitudinal) | | Bending (transverse 180) |
|---|---|---|---|---|---|---|---|---|---|
| | | | N/mm² | N/mm² | Thickness mm | | | | |
| | | | | | A80 mm | L0=5,65 √S0 | | | |
| Standard | Grade | | min | min | 3<t | t≥3 | Sıc C | J (min) | |
| EN 10149 -2 | S355MC | 139355 | 355 | 430-550 | 19 | 23 | -20 | 40 | 0,5 t |
| | S420MC | 139420 | 420 | 480-620 | 16 | 19 | -20 | 40 | 0,5 t |

1. (a) Tensile test values apply to "longitudinal" test pieces.
2. (b) Impact test is not required for thickness thinner than 6 mm.
3. For thicknesses 8 mm the minimum yield strength can be 20 N/mm' lower.
4. These grades are produced up to 12 mm thickness and subjected to negotiation for thickness>12 mm.

### INFORMATION ON PRODUCTION (HR – HRC)
### Hot rolled coil - Hot rolled sheet cut from coil (20 mm)

| | Min.(mm) | Max.(mm) |
|---|---|---|
| Thickness | 1 | 20 |
| Width | 800 | 1570 |
| Internal Coil Diameter | 762 | ±%7 |
| External Coil Diameter | 900 | 2000 |
| Roll Weight | | 30 ton |
| Hot Rolled Sheet Plate Thickness | 1 | 20 |
| Hot Rolled Sheet Plate Width | 800 | 1600 |
| Hot Rolled Sheet Plate Length | 1000 | 8000* |
| Package Weight of Hot Rolled Sheet Plate | | 10 ton |

* Thickness of less than 1.5 mm is subjected to negotiation.

## MANUFACTURABILITY LIMITS

| MMK MANUFACTURABILITY LIMITS FOR HOT MILLED ROLL, WITH MILL EDGES (HR) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Thickness (mm) | Width min (mm) | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 |
| 1,00-1,19 | 800 | 1200 | 1200 | (*) | | | |
| 1,20-1,34 | 800 | 1250 | 1250 | (*) | (*) | | |
| 1,35-1,49 | 800 | 1285 | 1285 | 1100 | 1100 | | |
| 1,50-1,79 | 800 | 1375 | 1375 | 1200 | 1200 | (*) | |
| 1,80-2,49 | 800 | 1570 | 1570 | 1400 | 1300 | (*) | (*) |
| 2,50-9,99 | 800 | 1570 | 1570 | 1570 | 1570 | (*) | (*) |
| 10,0-11,99 | 800 | 1570 | 1570 | 1570 | 1570 | (*) | (*) |
| 12,0-15,99 | 800 | 1570 | 1570 | 1570 | (*) | | |
| 16,0-20 | 800 | 1570 | 1570 | (*) | (*) | | |

*Plates are longer than 8 m are subjected to negotiation.
**Thickness of less than 1.5 mm is subjected to negotiation

| Thickness (mm) | Width min (mm) | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Length mm Min | Max |
|---|---|---|---|---|---|---|---|---|---|
| 1,00-1,19 | 800 | 1200 | 1200 | (*) | | | | 1000 - | 8000 |
| 1,20-1,34 | 800 | 1250 | 1250 | (*) | (*) | | | 1000 - | 8000 |
| 1,35-1,49 | 800 | 1285 | 1285 | 1100 | 1100 | | | 1000 - | 8000 |
| 1,50-1,79 | 800 | 1375 | 1375 | 1200 | 1200 | (*) | | 1000 - | 8000 |
| 1,80-2,49 | 800 | 1570 | 1570 | 1400 | 1300 | (*) | (*) | 1000 - | 8000 |
| 2,50-8,00 | 800 | 1570 | 1570 | 1570 | 1570 | (*) | (*) | 1000 - | 8000 |

(*) It is subjected to negotiation during the order stage.
(*) Thickness of less than 1.5 mm is subjected to negotiation.
(**) t > 8mm and l > 8000mm are subjected to negotiation during the order stage.

| Group No | INTERNATIONAL STANDARD STEEL GRADES |
|---|---|
| 1 | EN 10111 DD14, |
| 2 | DIN 1614-1 St 22 St 23,St 24 / EN 10111 DD11, DD12, DD13 / EN 10025-2 S235JR, S235J0. S235J2, EN 10025-2 S235JRC, S235J0C, S235J2C / ASTM A 1011, CS Grade A CS Grade B /SAE 403 C 1006/ 1008 , API 5 L PSL 1 L 210 A/ PSL 2 L 245 B ,ASTM A 53 Grade A / Grade B, EN 10028 P235 GH , EN 10120 P 245 NB , ASTM A 36 , ASTM A 1011 SS Grade 30, SS Grade 33, SS Grade 36 Type 1, ASTM A 1018 SS Grade 30, SS Grade 33, SS Grade 36 Type 1 |
| 3 | EN 10025-2 S275JR/S275J0/S275J2,EN 10025-2 S275JRC/S275JRC/S755J0/S275J2C / EN10025-4 S275N/S275 NL, S275M/S275 ML,ASTM A 1011 SS Grade 36 Type 2, SS Grade 40 ASTM A 1018 SS Grade 36 Type 2, SS Grade 40 /SS Grade 40, ASTM A 572 42 Type 2 / SAE J 403 C 1015, API 5L A PSL2 L 290 N X42 , EN 10028 P 265 GH /P 295 GH, EN 10120 P 265 NB, / DIN 17100 St44.2 |
| 4 | EN 10025-2 S355JR/S355J0/S355J2/S355K2,EN 10025-2 S355JRC/S355J0C/S355J2C,EN10025-4 S355N/S355NL, S355M/S355ML,ASTM A 1011 SS Grade 45/ 50/ 55, SAE J 403 C 1018/ 1019/1020 , API 5L A PSL1 L320N X46 / A PSL1 L360N X52 , ASTM A 572 Grade 50 Type 2/Grade 55 Type 2 , ASTM 1011 HSLAS Gr 45 Type 1/ HSLAS Gr 45 Type 2 ,HSLAS Gr 50 Type 1/ HSLAS Gr 50 Type 2/ HSLAS Gr 55 Type 1/ HSLAS Gr 55 Type 2, EN 10149-2 S 315 MC/ S 355MC , EN 10028 P 355 GH ,EN 10120 P 310 NB / P 355 NB / DIN 17100 St 52.3 |
| 5 | EN10025-4 S420N/S420 NL, S460 N/S460NL, EN10025-4 S420M/S420 ML/S460 M/S460ML, SAE J 403 C 1022, API 5L A PSL1 L390N X56 M / A PSL1 L415 X60 M/ A PSL1 L450N X65 M /A PSL1 L485N X70 M, EN 10149-2 S 420MC/ S 460MC/ S 500MC/ ASTM A 1011 HSLAS Gr 60 Type 1/ A 1011 HSLAS Gr 60 Type 2, ASTM A 572 60 Type 3 |
| 6 | EN 10149-2 S 600MC |

**1)** Production limits may change depending on rolling conditions. The customer representative should be contacted before accepting the order.
**2)** The orders for group 5 and 6 grades are accepted provided that "it is subjected to negotiation".
**3)** The order is accepted for the group 1st and 2st grades provided that "there shall be no complaint for coil break". In case that coil break is not desired, the order is accepted for hot tempered products for thicknesses of 6.50 mm and thinner.
**4)** Coil break complaints are not accepted for 1st and 2nd grade coil orders in case of customer applications such as cut to length,slitting,pickled oiled and pipe manufacturing e.t.c. over 6.50 mm thickness. It shall be convenient for the customers considering such defect as undesirable with respect to usage area to order as cut to length or a grade they select from the group 3.

**5)** EN 10028 P235 GH/P265 GH/P 295 GH/P 355 GH grades are produced equivalent to normalizing rolling (untreated).
**6)** For the grades which are suitable for wheel manufacturing, there may be casting or rolling process based imperfections such as thin scratches or shell on the coil surfaces in the region of 10 mm away from both sides. To avoid the problems which may these type of imperfections cause, orders should be given as trimmed edge product. In the situation of mill edge order, the claims about these type of imperfections which can be fixed by grinding the surface, are not accepted.
**7)** Claims related with wave defect will not be accepted if the cutting into length will be applied to the ordered coils by themselves without using adequate flattening units and practice. To avoid this problem, orders should be given as cut to length products.
**8)** For the surface imperfections, EN 10163-2 (Class B, Subclass 3) standard is guaranteed.
**9)** Edge trimming is subjected to negotiation in the order stage.
**10)** The order thickness conditions for the grades stated are shown in the table below;

| Grade | Order Thickness |
|---|---|
| EN 10120 P 245 NB/265/310/355 | Max. 5,00 mm |
| ASTM A 1011 SS Grade 30/33/36 Type 1/36 Type 2/40/45/50/55 | Max. 6,00 mm |
| ASTM A 1018 SS Grade 30/33/36 Type 1/36 Type 2/40 | Min. 6,01 mm |

## INFORMATION ON PRODUCTION (PHR – PHRCP)
### Hot Rolled Pickled-Oiled coil - sheet cut from coil

| | Min.(mm) | Max.(mm) |
|---|---|---|
| **Thickness** | 0,8 | 5 |
| **Width** | 800 | 1600 |
| **Internal Coil Diameter** | 610 | |
| **External Coil Diameter** | 900 | 2200 |
| **Roll Weight** | | 35 ton |
| **Hot Rolled Sheet Plate Thickness** | 1,00 | 5,00 |
| **Hot Rolled Sheet Plate Width** | 800 | 1600 |
| **Hot Rolled Sheet Plate Length** | 1000 | 8000* |
| **Package Weight of Hot Rolled Sheet Plate** | | 10 ton |

*Plates are longer than 8 m are subjected to negotiation.

### PRODUCIBILITY LIMITS

| MMK HOT ROLLED, PICKLED OILED COIL WITH EDGE TRIMMED(PHR) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Thickness (mm)** | **Width min (mm)** | **Group 1** | **Group 2** | **Group 3** | **Group 4** | **Group 5** | **Group 1** |
| 1,00-1,09 | 800 | 1285 | 1285 | (*) | (*) | (*) | (*) |
| 1,10-1,99 | 800 | 1285 | 1285 | (*) | (*) | (*) | (*) |
| 2,00-3,99 | 800 | 1525 | 1525 | (*) | (*) | (*) | (*) |
| 4,00-5,00 | 800 | 1525 | 1525 | 1500 | 1500 | (*) | (*) |

(*) It is subjected to negotiation in the order stage.
(**)Thickness of less than 1.5 mm is subjected to negotiation.

| MMK HOT ROLLED, PICKLED OILED CUT TO LENGTH FROM COIL WITH MILL EDGE (PHRCP) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Thickness (mm)** | **Width min (mm)** | **Group 1** | **Group 2** | **Group 3** | **Group 4** | **Group 5** | **Group 6** | **Lenght mm Min** | **Max** |
| 1,00-1,09 | 800 | 1285 | 1285 | (*) | (*) | (*) | (*) | 1000 - | 8000 |
| 1,10-1,99 | 800 | 1285 | 1285 | (*) | (*) | (*) | (*) | 1000 - | 8000 |
| 2,00-3,99 | 800 | 1525 | 1525 | (*) | (*) | (*) | (*) | 1000 - | 8000 |
| 4,00-5,00 | 800 | 1525 | 1525 | 1500 | 1500 | (*) | (*) | 1000 - | 8000 |

(*) It is subjected to negotiation during the order stage.
(**) Thickness of less than 1.5 mm is subjected to negotiation.
It is subjected to negotiation during order stage for l>8000 mm

| Group No | INTERNATIONAL STANDARD STEEL GRADES |
|---|---|
| 1 | EN 10111 DD14, |
| 2 | DIN 1614-1 St 22 St 23,St 24 / EN 10111 DD11, DD12, DD13 / EN 10025-2 S235JR, S235J0. S235J2, EN 10025-2 S235JRC, S235J0C, S235J2C / ASTM A 1011, CS Grade A CS Grade B /SAE 403 C 1006/ 1008, API 5 L PSL 1 L 210 A/ PSL 2 L 245 B ,ASTM A 53 Grade A / Grade B, EN 10028 P235 GH , EN 10120 P 245 NB , ASTM A 36 , ASTM A 1011 SS Grade 30, SS Grade 33, SS Grade 36 Type 1, ASTM A 1018 SS Grade 30, SS Grade 33, SS Grade 36 Type 1 |
| 3 | EN 10025-2 S275JR/S275J0/S275J2,EN 10025-2 S275JRC/S275JRC/S755J0/S275J2C / EN10025-4 S275N/S275 NL, S275M/S275 ML,ASTM A 1011 SS Grade 36 Type 2, SS Grade 40 ASTM A 1018 SS Grade 36 Type 2, SS Grade 40 /SS Grade 40, ASTM A 572 42 Type 2 / SAE J 403 C 1015, API 5L A PSL2 L 290 N X42 , EN 10028 P 265 GH /P 295 GH, EN 10120 P 265 NB, DIN 17100 St44.2 |
| 4 | EN 10025-2 S355JR/S355J0/S355J2/S355K2,EN 10025-2 S355JRC/S355J0C/S355J2C,EN10025-4 S355N/S355NL, S355M/S355ML,ASTM A 1011 SS Grade 45/ 50/ 55, SAE J 403 C 1018/ 1019/1020 , API 5L A PSL1 L320N X46 / A PSL1 L360N X52 , ASTM A 572 Grade 50 Type 2/Grade 55 Type 2 , ASTM 1011 HSLAS Gr 45 Type 1/ HSLAS Gr 45 Type 2 ,HSLAS Gr 50 Type 1/ HSLAS Gr 50 Type 2/ HSLAS Gr 55 Type 1/ HSLAS Gr 55 Type 2 , EN 10149-2 S 315 MC/ S 355MC , EN 10028 P 355 GH ,EN 10120 P 310 NB / P 355 NB, DIN 17100 St 52.3 |
| 5 | EN10025-4 S420N/S420 NL, S460 N/S460NL, EN10025-4 S420M/S420 ML/S460 M/S460ML, SAE J 403 C 1022, API 5L A PSL1 L390N X56 M / A PSL1 L415 X60 M/ A PSL1 L450N X65 M /A PSL1 L485N X70 M, EN 10149-2 S 420MC/ S 460MC/ S 500MC/ ASTM A 1011 HSLAS Gr 60 Type 1/ A 1011 HSLAS Gr 60 Type 2, ASTM A 572 60 Type 3 |

**1)** Production limits may change depending on rolling conditions. The customer representative should be contacted before accepting the order.
**2)** The orders for group 5 and 6 grades are accepted provided that "it is subjected to negotiation".
**3)** The order is accepted for the group 1st and 2st grades provided that "there shall be no complaint for coil break". In case that coil break is not accepted/desired, the order is accepted for hot tempered products for thicknesses of 5.00 mm and thinner.
**4)** Coil break claim are not accepted for 1st and 2nd group grade coil orders in case of customer applications such as slitting, cut to length, pickling and pipe manufacturing e.t.c. over 6.50 mm thickness. For mentioned application if coil break is not tolerable, customer must order as cut to length product or one of a 3rd. group grade.
**5)** EN 10028 P235 GH/P265 GH/P 295 GH/P 355 GH grades are produced equivalent to normalizing rolling (untreated).
**6)** For the grades which are suitable for wheel manufacturing, there may be casting or rolling process based imperfections such as thin scratches or shell on the coil surfaces in the region of 10 mm away from both sides. To avoid the problems which may these type of imperfections cause, orders should be given as trimmed edge product. In the situation of mill edge order, the claims about these type of imperfections which can be fixed by grinding the surface, are not accepted.
**7)** Claims related with wave defect will not be accepted if the cutting into length will be applied to the ordered coils by themselves without using adequate flattening units and practice. To avoid this problem, orders should be given as cut to length products.
**8)** It can be produced as edge trimming and/or oiled.
**9)** Special coil weight orders are subject to negotiation.
**10)** For the surface defects EN 10163-2 (Class B, Subclass 3) standard is guaranteed.
**11)** The order thickness conditions for the grades stated are shown in the table below;

| Grade | Order thickness |
|---|---|
| EN 10120 P 245 NB/265/310/355 | Max. 5,00 mm |
| ASTM A 1011 SS Grade 30/33/36 Type 1/36 Type 2/40/45/50/55 | Max. 5,00 mm |

## Tolerances for hot rolled, sheet and plate cut from coil, mill edge and trimmed edge
## Tolerance standard: EN 10051:2011-02
## General;

This tolerance standard is applied to continuously hot-rolled strip and plate / sheet cut from wide strip of non-alloy and alloy steel and also suitable for cold rolled.
The specified values for tolerances within this Standard shall not apply to the uncropped ends of the coil for a total length which is calculated using the formula :
"length (meters)= 90 /(t) nominal thickness (mm)" provided that the result does not exceed 20 meters.

### Table 1: Tolerances on thickness for hot rolled low carbon steel sheet/plate and strip for cold forming

### Tolerances on thickness are given in Table 1 for grades

DIN 1614-1 St 22 St 23,St 24 / EN 10111 DD11, DD12, DD13,DD14,ASTM A 1011, CS Grade A CS Grade B,SAE 403 C 1006

| Table1: Thickness tolerances | | | | Table 1:SPECIAL thickness tolerances | | |
|---|---|---|---|---|---|---|
| Nominal thickness (t) mm | Nominal Width interval (w) mm | | | Nominal Width interval (w) mm | | |
| | W ≤ 1200 | 1200<w ≤ 1500 | 1500<w ≤ 1800 | W ≤ 1200 | 1200<w ≤ 1500 | 1500<w ≤ 1800 |
| T ≤ 2,00 | +/-0,13 | +/-0,14 | +/-0,16 | +/-0,10 | +/-0,11 | +/-0,13 |
| 2,00<t ≤ 2,50 | +/-0,14 | +/-0,16 | +/-0,17 | +/-0,11 | +/-0,13 | +/-0,14 |
| 2,50<t ≤ 3,00 | +/-0,15 | +/-0,17 | +/-0,18 | +/-0,12 | +/-0,14 | +/-0,15 |
| 3,00<t ≤ 4,00 | +/-0,17 | +/-0,18 | +/-0,20 | +/-0,13 | +/-0,15 | +/-0,17 |
| 4,00<t ≤ 5,00 | +/-0,18 | +/-0,20 | +/-0,21 | +/-0,14 | +/-0,17 | +/-0,18 |
| 5,00<t ≤ 6,00 | +/-0,20 | +/-0,21 | +/-0,22 | +/-0,17 | +/-0,18 | +/-0,19 |
| 6,00<t ≤ 8,00 | +/-0,22 | +/-0,23 | +/-0,23 | +/-0,19 | +/-0,20 | +/-0,20 |
| 8,00<t ≤ 11,00 | +/-0,24 | +/-0,25 | +/-0,25 | +/-0,21 | +/-0,22 | +/-0,22 |

### Tolerances on thickness for grades with a specified minimum yield strength less than or equal to 300 N/mm2 (Re≤300 N/mm2):
### Tolerances on thickness are given in Table 2 for grades

EN 10025-2 S235JR, S235J0. S235J2, EN 10025-2 S235JRC, S235J0C, S235J2C /SAE 403 C 1008, API 5 L PSL 1 L 210 A/ PSL 2 L 245 B ,ASTM A 53 Grade A / Grade B, EN 10028 P235 GH , EN 10120 P 245 NB , ASTM A 36 , ASTM A 1011 SS Grade 30, SS Grade 33, SS Grade 36 Type 1, ASTM A 1018 SS Grade 30, SS Grade 33, SS Grade 36 Type 1 EN 10025-2 S275JR/S275J0/S275J2,EN 10025-2 S275JRC/S275JRC/S755J0/S275J2C / EN10025-4 S275N/S275 NL, S275M/S275 ML,ASTM A 1011 SS Grade 36 Type 2, SS Grade 40 ASTM A 1018 SS Grade 36 Type 2, SS Grade 40 /SS Grade 40, ASTM A 572 42 Type 2 / SAE J 403 C 1015, API 5L A PSL2 L 290 N X42 , EN 10028 P 265 GH /P 295 GH, EN 10120 P 265 NB, DIN 17100 St44.2

| Table 2:Tolerances on thickness | | | | Special tolerances on thickness | | |
|---|---|---|---|---|---|---|
| Nominal thickness (t) mm | Nominal Width interval (w) mm | | | Nominal Width interval (w) mm | | |
| | W ≤ 1200 | 1200<w ≤ 1500 | 1500<w | W ≤ 1200 | 1200<w ≤ 1500 | 1500<w |
| T ≤ 2,00 | +/-0,17 | +/-0,19 | +/-0,21 | +/-0,14 | +/-0,16 | +/-0,18 |
| 2,00<t ≤ 2,50 | +/-0,18 | +/-0,21 | +/-0,23 | +/-0,15 | +/-0,18 | +/-0,20 |
| 2,50<t ≤ 3,00 | +/-0,20 | +/-0,22 | +/-0,24 | +/-0,17 | +/-0,19 | +/-0,21 |
| 3,00<t ≤ 4,00 | +/-0,22 | +/-0,24 | +/-0,26 | +/-0,19 | +/-0,21 | +/-0,23 |
| 4,00<t ≤ 5,00 | +/-0,24 | +/-0,26 | +/-0,28 | +/-0,21 | +/-0,23 | +/-0,25 |
| 5,00<t ≤ 6,00 | +/-0,26 | +/-0,28 | +/-0,29 | +/-0,23 | +/-0,25 | +/-0,26 |
| 6,00<t ≤ 8,00 | +/-0,29 | +/-0,30 | +/-0,31 | +/-0,26 | +/-0,27 | +/-0,28 |
| 8,00<t ≤ 10,00 | +/-0,32 | +/-0,33 | +/-0,34 | +/-0,29 | +/-0,30 | +/-0,31 |
| 10,00<t ≤ 12,50 | +/-0,35 | +/-0,36 | +/-0,37 | +/-0,32 | +/-0,33 | +/-0,34 |
| 12,50<t ≤ 15,00 | +/-0,37 | +/-0,38 | +/-0,40 | +/-0,34 | +/-0,35 | +/-0,37 |
| 15,00<t ≤ 20,00 | +/-0,40 | +/-0,42 | +/-0,45 | +/-0,37 | +/-0,39 | +/-0,42 |

## Tolerances on thickness for grades with a specified yield strength 300<Re≤360 N/mm2:

EN 10025-2 S355JR/S355J0/S355J2/S355K2,EN 10025-2 S355JRC/S355J0C/S355J2C,EN10025-4 S355N/S355NL, S355M/S355ML,ASTM A 1011 SS Grade 45/ 50/ 55, SAE J 403 C 1018/ 1019/1020 , API 5L A PSL1 L320N X46 / A PSL1 L360N X52 , ASTM A 572 Grade 50 Type 2, ASTM 1011 HSLAS Gr 45 Type 1/ HSLAS Gr 45 Type 2 ,HSLAS Gr 50 Type 1/ HSLAS Gr 50 Type 2/, ABS Part 2 Gr AH 32 / Gr DH 32 /Gr EH 32 /Gr FH 32 ,ABS Part 2 Gr AH 36 / Gr DH 36 /Gr EH 36 /Gr FH 36 , EN 10149-2 S 315 MC/ S 355MC , EN 10028 P 355 GH ,EN 10120 P 310 NB / P 355 NB, DIN 17100 St 52.3

| Table 3:Tolerances on thickness [2] | | | | Special tolerances on thickness | | |
|---|---|---|---|---|---|---|
| Nominal thickness (t) mm | Nominal Width interval (w) mm | | | Nominal Width interval (w) mm | | |
| | w ≤1200 | 1200<w≤ 1500 | 1500<w | w<=1200 | 1200<w≤ 1500 | 1500<w |
| t ≤2,00 | +/-0,20 | +/-0,22 | +/-0,24 | +/-0,17 | +/-0,19 | +/-0,21 |
| 2,00<t≤ 2,50 | +/-0,21 | +/-0,24 | +/-0,26 | +/-0,18 | +/-0,21 | +/-0,23 |
| 2,50<t≤ 3,00 | +/-0,23 | +/-0,25 | +/-0,28 | +/-0,20 | +/-0,22 | +/-0,25 |
| 3,00<t≤ 4,00 | +/-0,25 | +/-0,28 | +/-0,30 | +/-0,22 | +/-0,25 | +/-0,27 |
| 4,00<t≤ 5,00 | +/-0,28 | +/-0,30 | +/-0,32 | +/-0,25 | +/-0,27 | +/-0,29 |
| 5,00<t≤ 6,00 | +/-0,30 | +/-0,32 | +/-0,33 | +/-0,27 | +/-0,29 | +/-0,30 |
| 6,00<t≤ 8,00 | +/-0,33 | +/-0,35 | +/-0,36 | +/-0,30 | +/-0,32 | +/-0,33 |
| 8,00<t≤ 10,00 | +/-0,37 | +/-0,38 | +/-0,39 | +/-0,34 | +/-0,35 | +/-0,36 |
| 10,00<t≤ 12,50 | +/-0,40 | +/-0,41 | +/-0,43 | +/-0,37 | +/-0,38 | +/-0,40 |
| 12,50<t≤ 15,00 | +/-0,43 | +/-0,44 | +/-0,46 | +/-0,40 | +/-0,41 | +/-0,43 |
| 15,00<t≤ 20,00 | +/-0,46 | +/-0,48 | +/-0,52 | +/-0,43 | +/-0,45 | +/-0,49 |

## Tolerances on thickness for grades with a specified minimum yield strength 360<Re≤420 N/mm2

EN10025-4 S420N/S420 NL, EN10025-4 S420M/S420 ML, SAE J 403 C 1022, API 5L A PSL1 L390N X56 M / A PSL1 L415 X60 M/ A PSL1 , EN 10149-2 S 420MC, ASTM A 1011 HSLAS Gr 55 Type 1/ HSLAS Gr 55 Type 2 HSLAS Gr 60 Type 1/ A 1011 HSLAS Gr 60 Type 2, ASTM A 572 Grade 55 Type 2, ASTM A 572 60 Type 3

| Table 4:Tolerances on thickness | | | | Special thickness tolerances | | |
|---|---|---|---|---|---|---|
| Nominal thickness (t) mm | Nominal Width interval (w) mm | | | Nominal Width interval (w) mm | | |
| | w<=1200 | 1200<w≤ 1500 | 1500<w | w<=1200 | 1200<w≤ 1500 | 1500<w |
| t<= 2,00 | +/-0,22 | +/-0,25 | +/-0,27 | +/-0,19 | +/-0,22 | +/-0,24 |
| 2,00<t≤ 2,50 | +/-0,23 | +/-0,27 | +/-0,30 | +/-0,20 | +/-0,24 | +/-0,27 |
| 2,50<t≤ 3,00 | +/-0,26 | +/-0,29 | +/-0,31 | +/-0,23 | +/-0,26 | +/-0,28 |
| 3,00<t≤ 4,00 | +/-0,29 | +/-0,31 | +/-0,34 | +/-0,26 | +/-0,28 | +/-0,31 |
| 4,00<t≤ 5,00 | +/-0,31 | +/-0,34 | +/-0,36 | +/-0,28 | +/-0,31 | +/-0,33 |
| 5,00<t≤ 6,00 | +/-0,34 | +/-0,36 | +/-0,38 | +/-0,31 | +/-0,33 | +/-0,35 |
| 6,00<t≤ 8,00 | +/-0,38 | +/-0,39 | +/-0,40 | +/-0,35 | +/-0,36 | +/-0,37 |
| 8,00<t≤ 10,00 | +/-0,42 | +/-0,43 | +/-0,44 | +/-0,39 | +/-0,40 | +/-0,41 |
| 10,00<t≤ 12,50 | +/-0,46 | +/-0,47 | +/-0,48 | +/-0,43 | +/-0,44 | +/-0,45 |

## Tolerances on thickness for grades with a specified minimum yield strength 420<Re≤900 N/mm2:

EN10025-4 S460 N/S460NL, EN10025-4 S460 M/S460ML, API 5L PSL1 L450N X65 M / PSL1 L485N X70 M, EN 10149-2 S 460MC/ S 500MC,

| Table 5:Tolerances on thickness | | | | Special thickness tolerances | | |
|---|---|---|---|---|---|---|
| Nominal thickness (t) mm | Nominal Width interval (w) mm | | | Nominal Width interval (w) mm | | |
| | w<=1200 | 1200<w≤ 1500 | 1500<w | w<=1200 | 1200<w≤ 1500 | 1500<w |
| t<= 2,00 | +/-0,24 | +/-0,27 | +/-0,29 | +/-0,21 | +/-0,24 | +/-0,26 |
| 2,00<t≤ 2,50 | +/-0,25 | +/-0,29 | +/-0,32 | +/-0,22 | +/-0,26 | +/-0,29 |
| 2,50<t≤ 3,00 | +/-0,28 | +/-0,31 | +/-0,34 | +/-0,25 | +/-0,28 | +/-0,31 |
| 3,00<t≤ 4,00 | +/-0,31 | +/-0,34 | +/-0,36 | +/-0,28 | +/-0,31 | +/-0,33 |
| 4,00<t≤ 5,00 | +/-0,34 | +/-0,36 | +/-0,39 | +/-0,31 | +/-0,33 | +/-0,36 |
| 5,00<t≤ 6,00 | +/-0,36 | +/-0,39 | +/-0,41 | +/-0,33 | +/-0,36 | +/-0,38 |
| 6,00<t≤ 8,00 | +/-0,41 | +/-0,42 | +/-0,43 | +/-0,38 | +/-0,39 | +/-0,40 |
| 8,00<t≤ 10,00 | +/-0,45 | +/-0,46 | +/-0,48 | +/-0,42 | +/-0,43 | +/-0,45 |
| 10,00<t≤ 12,50 | +/-0,49 | +/-0,50 | +/-0,52 | +/-0,46 | +/-0,47 | +/-0,49 |

• For products with trimmed edge, the thickness shall be measured minimum 25 mm inside of coil and at any point from the edges. For products with mill edge, the thickness shall be measured minimum 40 mm inside of coil and at any point from the edge.
• Orders for special thickness are subjected to negotiation.
• For the hot rolled steel grades to suitable for cold rolling, the maximum and special thickness change values, along the coil, are shown in the table below.

| THICKNESS CHANGE TOLERANCE IN HOT ROLLED COIL, WILL BE COLD ROLLED | | | | | | |
|---|---|---|---|---|---|---|
| | Max. thickness change tolerance | | | Special tolerance | | |
| Nominal width (w) mm | w ≤1200 | 1200<w ≤ 1500 | 1500<w | w ≤1200 | 1200<w ≤ 1500 | 1500<w |
| t≤ 2,00 | 0,2 | 0,24 | 0,28 | 0,1 | 0,12 | 0,13 |
| 2,00<t ≤3,00 | 0,22 | 0,27 | 0,33 | 0,13 | 0,15 | 0,17 |
| 3,0<t ≤4,00 | 0,28 | 0,32 | 0,4 | 0,16 | 0,18 | 0,21 |
| 4,00<t ≤8,00 | 0,28 | 0,32 | 0,4 | 0,2 | 0,23 | 0,26 |

• There shall not be a sudden change in the thickness along the coil. It may change gradually provided that it is in the tolerance.
• The thickness change along the roll is confirmed by making thickness measurement at a point with a certain distance from the edge (minimum 40 mm for products with mill edge and minimum 25 mm for the products with trimmed edge) along the length of the roll.

## WIDTH TOLERANCE

| Tolerances on width for flat plate/metal sheet products | | | | | | |
|---|---|---|---|---|---|---|
| Nominal width (w) mm | With mill edge | | With mill edge (special) | | With edge trimmed (1) | |
| | Min | Max | Min | Max | Min | Max |
| w≤1200 | 0 | 20 | 0 | 18 | 0 | 3 |
| 1200<w≤1570 | 0 | 20 | 0 | 18 | 0 | 5 |

1. The width measurement is done perpendicular to the long edge.

## LENGTH TOLERANCE

| Table 6: length tolerance | | |
|---|---|---|
| Nominal length (l) mm | Tolerance | |
| | min | Max |
| t< 2000 | 0 | 10 |
| 2000≤l<8000 | 0 | +0,005xl |
| 8000 ≤ l | 0 | 40 |

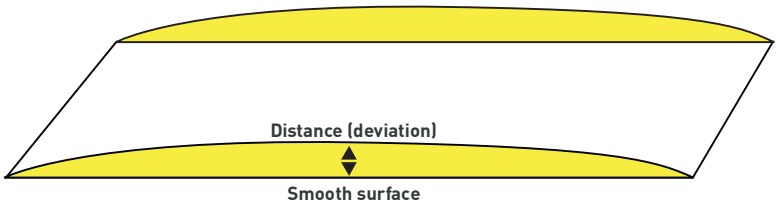
The length of the shorter one of both edges in the rolling direction is considered as the length of the sheet.

## FLATNESS TOLERANCE

| Table 8:tolerances on flatness for steels with a specified minimum yield strength, Re ≤ 300 N/mm² | | | |
|---|---|---|---|
| Nominal thickness (t) mm | Nominal width (w) mm | Surface smoothness tolerance mm | Special tolerance mm |
| t ≤ 2,00 | w ≤1200 | 18 | 9 |
| | 1200<w ≤1500 | 20 | 10 |
| | w>1500 | 25 | 13 |
| 2,0< t ≤ 20 | w ≤1200 | 15 | 8 |
| | 1200<w ≤1500 | 18 | 9 |
| | w>1500 | 23 | 12 |

| Table 9: Tolerances on flatness for steels with a specified minimum yield strength | | | | |
|---|---|---|---|---|
| **Nominal thickness (t) mm** | **Nominal width (w) mm** | **300N/mm²<Re ≤ 360 N/mm²** | **360N/mm²<Re ≤ 420 N/mm²** | **420N/mm²<Re ≤ 900 N/mm²** |
| t ≤20 | w ≤1200 | 18 / 9* | 23 | It is subjected to agree mentdurin gorder |
| | 1200<w ≤ 1500 | 23 / 12* | 30 | |
| | w>1500 | 28 / 14* | 38 | |
| Note : | "Narrow flatness" between 360N/mm²<Re ≤ 420 N/mm² is not accepted | | | |

* Special flatness values are subjected to negotiation in the order stage.



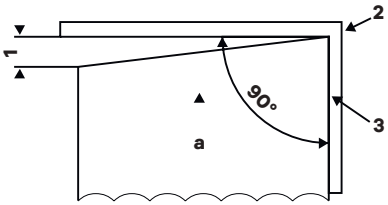

## Flatness Measurement

• The flatness tolerance is the maximum acceptable distance between the bottom surface of a metal sheet or plate, placed on a smooth surface, and the smooth surface.
• The flatness tolerance is guaranteed for cut to lengt from coil products.The flatness tolerance is not accepted for the orders produced as coil.
• For the products cut to the length at steel center service rather than MMK Metalurji, Flatness tolerances are not guaranteed.
*The flatness tolerance is not guaranteed for coil orders; it is subjected to negotiation.

## OUT OF SQUARENESS FOR SHEET/PLATE

**1)** The out of squareness (U) is orthogonal projection of a transverse edge over a longitudinal.
**2)** Corner perpendicularity tolerance is maximum 1% of the width of the product./The out of squareness (u) measured shall not exceed 1% of the actual width of the sheet/plate .

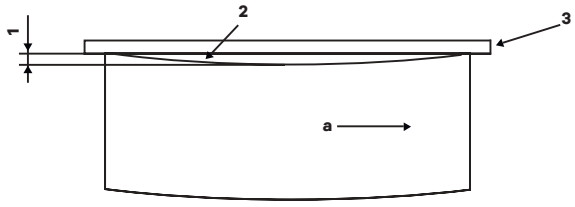
**1: Corner perpendicularity (u)/ Out of squareness**
**2: Square**
**3: Side edge**
**a: Rolling direction**




## EDGE CAMBER

• The edge camber is the amount of maximum distance between a straight line combining both edges of the long edge and this long edge.
• Edge camber measurement is done in the concave edge of the product.
• The edge camber shall not be exceed 0,5% of the actual length of the sheet/plate for a nominal length l<5000 mm.
• For strip w≥600 mm, the edge camber shall not be exceed 20 mm for any length of 5000 mm in the case of strip with mill edges and 15 mm in the case of strip with trimmed edge

| Edge camber | | | | |
|---|---|---|---|---|
| **Product type** | **Product dimensions** | | **Tolerance (mm)** | |
| | **Width (mm)** | **Length (mm)** | **Mill edge** | **Trimmed edge** |
| Plate/Sheet | w ≥ 600 | l ≥ 5000 | 20 | 15 |
| | w ≥ 600 | l<5000 | lx0,005 | lx0,005 |
| Coil | w ≥600 | - | 20 | 15 |
| Slitted Coil | w ≥600 | - | Stated when ordering. | |




**1: Corner perpendicularity (u)/Out of squareness** **3: Side edge**
**2: Square** **a: Rolling direction**

## CROWN TOLERANCE (CAMBER)

| CROWN TOLERANCE | | | | |
|---|---|---|---|---|
| Max. Crown tolerance for hot rolled coil, will be cold rolled | | | | |
| **Nominal width (w) mm** | **Re ≤ 300N/mm²** | **300N/mm²<Re ≤ 360 N/mm²** | **360N/mm²<Re ≤ 420 N/mm²** | **420N/mm²<Re ≤ 900 N/mm²** |
| W ≤ 1200 | 0,1 | 0,12 | 0,13 | 0,14 |
| 1200<w ≤ 1500 | 0,13 | 0,15 | 0,17 | 0,18 |
| 1500<w | 0,16 | 0,18 | 0,21 | 0,22 |

The crown shall be measured as the thickness difference between center line of the product and a measuring point at 40 mm from any edge of the product in case of mill edges and at 25 mm in case of trimmed/slit edges.

## TELESCOPY TOLERANCE

• The standard of "DIN 1016 – 1987" is based on for telescopy tolerance.
• Gradually stepped displacement of the edges of the coil stone side (telescopy) shall not exceed the deviations given in thetable.

| TELESCOPY TOLERANCE | | | |
|---|---|---|---|
| **Product** | **Width (mm)** | **With uncut edge** | **Wit cut edge** |
| Coil | ≥ 600 | 60 | 40 |
| Slitted Coil | <600 | 35 | 25 |

## INTERNAL COIL DIAMETER TOLERANCE

• The standard of "DIN 1016 – 1987" is based on for internal coil diameter tolerances.
• If the internal coil diameter tolerance value is not stated in the order stage, the internal coil diameter tolerance percentages, given in the table below, are applied.

| ROLL INTERNAL DIAMETER TOLERANCE | | | |
|---|---|---|---|
| **PRODUCT** | **Width** | **Mill edge** | **Edge Trimming** |
| Coil | ≥ 600 | +/- % 7 | +/- % 3 |
| Slitting coil | <600 | +/- % 7 | +/- % 3 |

## NORM READING

**20 Plate EN 10051 - 2,0x1200GK x 2500**

**GK:** Trimmed edge

With the EN 10051 standard tolerances; plate material with trimmed edge

**5t Bobbin EN 10051 - 4,5 x 1500 steel EN 10025 -2 S235JR**

With the EN 10051 standard tolerances; material of S235JR grade according to EN 10025-2 standard


DANIELI

## GALVANIZED COATED PRODUCTS

Galvanized coated flat steels are produced as GHR after hot rolling, cleaning the surface with pickling process and GCR is produced as hot rolled pickled coil after cold rolling process. Galvanized coating process is applied to both surfaces.

Zinc prevents against corrosion depend on the environmental conditions by coating the surface of the metal sheet. The usage time period of the zinc coated metal sheet depends on the thickness of the coating and atmospheric conditions of the environment.

With the galvanized flat steel;

- Product is ready for painting with correct pretreatment process.
- It is suitable for welding processes.
- It is suitable for producing parts obtained via processes such as bending, drawing, deep drawing etc.
- It has a wide usage area such as white goods, air conditioning systems, silos, roofs, doors, rolling shutters and carrier profiles and pipes as it is used in the construction sector including panel, trapeze, gutter construction.

Especially in recent years, the use of galvanized products in the automotive industry is growing because of the requirements for improved corrosion resistance.

## GALVANIZED PRODUCT NAME ABBREVIATIONS AND DESCRIPTIONS

**GCRP:** Galvanized cold rolled coil
**GCRSP:** Galvanized cold rolled slitted coil
**GCRCP:** Galvanized cold rolled cut to length from coil
**GHRP:** Galvanized hot rolled coil
**GHRCP:** Galvanized hot rolled slitted coil
**GHRSP:** Galvanized hot rolled cut to length from coil

## GENERAL INFORMATION

**1.** Our zinc (Z) coated products are produced according to DIN EN 10346 standard and for the dimension tolerances, DIN EN 10143 standard is applied.
**2.** Surface grades A and B are produced according to EN 10346 standard. Unless otherwise is specified, production is carried out according to 'A' surface quality.

**Surface A: As Coated surface**
Imperfections such as pimples, marks, scratches, pits, variations in surface appearance, dark spots, stripe marks and light passivation stains are permissible. Stretch levelling breaks, run-off marks and stretcher strains may appear.

**Surface B: Improved surface**
Surface quality B is obtained by skin passing. With this surface quality, small imperfections such as stretch levelling breaks, skin pass marks, slight scratches, surface structure, run-off marks and light passivation stains are permissible.It is guarantee that does not appear stretcher strain marks (Lüder bands) during production.The surface suitable for painting process is surface quality B which is applied to skin-pass.

**3.** Unless otherwise is specified, skin pass is applied for Surface quality A.As coated surface (A) may be delivered with or without skin passing at the discretion of the MMK Metalurji during the order acceptance. Surface quality A, which is applied to skin-pass, usually seems brighter than surface quality B.
**4.** According to the customer's order, marking process (logo application) is applied to on single surface and single edge in surface quality A&B.
**5.** Coating appearance: It has been produced with minimized spangle (M).
**6.** The surface of the material is protected by surface treatment to prevent corrosion on the galvanized flat steel surface.It is applied to chemical passivation(C), oiling(O), chemical passivation and oiling(CO) surface treatmens for against corrosion.

• If product is requested without surface protection, MMK Metalurji shall not be responsible against corrosion which may occur on the surface.
• Unless otherwise specified, MMK Metalurji is used chemical passivation (C) as surface protection process.
• Even though chemical passivation brings resistance against corrosion, it may not be adequate depending on the environment conditions. In this case, MMK Metalurji recommends that orders are given as chemical passivation and oiling (CO).
• To decrase the risk of corrosion, oiling is applied both surfaces totally in the following proportions.Unless otherwise is specified, it is produced as light oil (0,50-1,0 gr/m²)

→ Light: 0,5-1,0 gr/m²
→ Normal: 1,0-1,5 gr/m²
→ Heavy: 1,5-2,0 gr/m²
* For the oiling over 2g/m² it is subjected to negotiation during the order stage.
* Electrostatic oiling is made.

**7.** MMK Metallurji production is carried out in accordance with Reach and Rohs obligations.
**8.** Mechanical properties are valid for the warranty periods, given below, beginning from the date when the customer is notified that the material is ready for shipment. It is guaranteed for:
- For steel grades DX51, DX52 and DX53D, 1 month,
- For steel grades S220GD, S250GD, S320GD, S350GD, S420GD, 1 month,
- For steel grades DX54D, 6 months,
- For steel grades HX 260LAD, HX 300LAD, HX 340LAD, HX380LAD and HX420LAD, 6 months.
*Surface quality B, not having Lüder lines (flow trace) guarantee is for 6 months for Grade DX54D. It is guarantee that does not appear stretcher strain marks (Lüder bands) for surface quality B,
- For steel grade DX54D, 6 month.
- For other grades stretcher strain marks formation period are not guaranteed
**9.** Depending on ageing, all galvanized coated products formability feature decreases.Coil break may occur during the next process. For the materials with thicker than, t>0.9 mm,coil break and Stretcher Strains Marks risk increases as the storage time increases. Therefore, the materials should be used as soon as possible after the delivery.
**10.** It has been produced according to ASTM and DIN EN norms in MMK Metalurji.
**11.** For GCR and GHR products, the total coating weight is maximum 600 g/m² and minimum 70 g/m². The orders greater than 400g/m² coating and the orders less than 70 g/m² coating are subjected to negotiation. For the orders with thickness less than 0.50 mm and coating greater than 180 g/m² are produced with the conditions stated below by staggered winding. (max. 5 mm) (zigzag).
**a)** For order widths greater than 1300 mm, the edge wave complaints related with heavy coating are not accepted.
**b)** If staggered winding is not requested (normal winding is requested) this case should be specified with special remark code and for any order width the edge wave complaints cause by heavy coating are not accepted.
**12.** The requests made for roll weight out of acceptance limits are subjected to negotiation.
**13.** The orders where surface roughness (Ra) is maximum 0.40 µm (bright) are subjected to negotiation.
**14.** In case that the coils are cut to length without using straightening equipment and practice with the customers' own facilities, the complaint related with flatness, wave, coil break etc. defects are not accepted.
**15.** As MMK Metalurji, the mechanical tests are not guaranteed for the first 5 m at the beginning and end of the bobbin/coil.
**16.** Black points may be formed on the surfaces of the hot dipped coated materials due to friction. These usually spoil only the surface appearance. They can be decreased by oiling.

**NOTE:** Because there is the term "the zinc coated materials may not be used for acidic foods and alcoholic beverages" in the scope of the subparagraph (b) of the article 15 of the regulation on the materials and substances contacting with food of Turkish Food Codex, dated: 03.08.2012 and no: 28373, galvanized products may not be used for acidic foods and alcoholic beverages

## Application areas and standard equivalents of the galvanized products

| General usage area and main properties | Standard equivalent | | | | Material No | Revised STD | Europe | American | Japanese |
|---|---|---|---|---|---|---|---|---|---|
| | | Standard/Grade | MMK Kalite No GCR Grade No | MMK Kalite No GHR Grade No | | | | | |
| Cold rolled/Hot rolled Galvanized low C steel, Suitable for cold forming | EN 10346 :2015 | DX 51D+Z | 200051 | 210051 | 1,092 | DIN EN 10142 Fe P02 G Z | ASTM A653 CS Type | | JIS 3302 SGCC |
| | | DX 52D+Z | 200052 | 210052 | 1,092 | DIN EN 10142 Fe P03 G Z | ASTM A653 CS Type | | JIS 3302 SGCD1 |
| | | DX 53D+Z | 200053 | 210053 | 1,095 | DIN EN 10142 Fe P05 G Z | ASTM A653 FS Type | | JIS 3302 SGCD2 |
| | | DX 54D+Z | 200054 | 210054 | 1,095 | DIN EN 10142 Fe P06 G Z | ASTM A653 DDS Type | | JIS 3302 SGDD3 |
| Cold rolled/hot rolled galvanized structural steels | | S220GD+Z | 201220 | 211220 | 1,024 | DIN EN 10147 Fe E 220 G Z | ASTM A653 SS Gr 230 | | |
| | | S250GD+Z | 201250 | 211250 | 1,024 | DIN EN 10147 Fe E 250 G Z | ASTM A653 SS Gr 25 | | JIS 3302 SGC 340 |
| | | S280GD+Z | 201280 | 211280 | 1,024 | DIN EN 10147 Fe E 280 G Z | ASTM A653 SS Gr 27 | | JIS 3302 SGC 400 |
| | | S320GD+Z | 201320 | 211320 | 1,025 | DIN EN 10147 Fe E 320 G Z | ASTM A653 SS Gr 34 | | JIS 3302 SGC 440 |
| | | S350GD+Z | 201350 | 211350 | 1,053 | DIN EN 10147 Fe E 350 G Z | ASTM A653 SS Gr 34 | | JIS 3302 SGC 490 |
| | | S390GD+Z | 201390 | 211390 | 1,024 | DIN EN 10147 Fe E 390 G Z | ASTM A653 SS Gr 390 | | |
| | | S420GD+Z | 201420 | 211420 | 1,024 | DIN EN 10147 Fe E 420 G Z | ASTM A653 SS Gr 410 | | |
| Cold rolled/Hot rolled High strength, low alloyed, Galvanized steels for cold forming | | HX260LAD+Z | 213260 | 223260 | 1,093 | DIN EN 10292 HX260LAD+Z | ASTM A653 HSLAS Gr 275 | | |
| | | HX300LAD+Z | 213300 | 223300 | 1,093 | DIN EN 10292 HX300LAD+Z | | | |
| | | HX340LAD+Z | 213340 | 223340 | 1,093 | DIN EN 10292 HX340LAD+Z | ASTM A653 HSLAS Gr 340 | | |
| | | HX380LAD+Z | 213380 | 223380 | 1,093 | DIN EN 10292 HX380LAD+Z | ASTM A653 HSLAS Gr 380 | | |
| | | HX420LAD+Z | 213420 | 223420 | 1,094 | DIN EN 10292 HX420LAD+Z | ASTM A653 HSLAS Gr 410 | | |
| Cold rolled/Hot rolled galvanized low C steels for cold forming | ASTM A 653 | CS Type A | 250380 | 260380 | | | EN 10346 DX52D+Z | | |
| | | CS Type B | 250381 | 260381 | | | EN 10346 DX52D+Z | | |
| | | CS Type C | 250410 | 260410 | | | EN 10346 DX51D+Z | | |
| | | FS Type A | 250310 | - | | | EN 10346 DX53D+Z | | |
| | | FS Type B | 250311 | - | | | EN 10346 DX53D+Z | | |
| Cold rolled/hot rolled galvanized structural steels | | SS 33/230 | 251230 | 261230 | | EN 10346 S220GD+Z | | | |
| | | SS 37/255 | 251255 | 261255 | | EN 10346 S250GD+Z | | | |
| | | SS 40/275 | 251275 | 261275 | | EN 10346 S280GD+Z | | | |
| | | SS50Cl 1/340 Cl 1 | 251341 | 261341 | | EN 10346 S350GD+Z | | | |
| | | SS50Cl 2/340 Cl 2 | 251342 | 261342 | | EN 10346 S350GD+Z | | | |
| | | SS50Cl 3/340 Cl 3 | 251343 | 261343 | | EN 10346 S350GD+Z | | | |
| | | SS50Cl 4/340 Cl 4 | 251344 | 261344 | | EN 10346 S350GD+Z | | | |
| | | SS 55/ 390 | 251390 | 261390 | | EN 10346 S380GD+Z | | | |
| | | SS 60/ 410 | 251410 | 261410 | | EN 10346 S420GD+Z | | | |
| Cold rolled/hot rolled Galvanized High strength, low alloyed steels for cold forming | | HSLAS 40/275 | 253275 | 263275 | | EN 10346 HX260LAD+Z | | | |
| | | HSLAS 50/340 | 253340 | 263340 | | EN 10346 HX340LAD+Z | | | |
| | | HSLAS 55Cl 1/380Cl 1 | 253380 | 263380 | | EN 10346 HX380LAD+Z | | | |
| | | HSLAS 55Cl 2/380Cl 2 | 253381 | 263381 | | EN 10346 HX380LAD+Z | | | |
| | | HSLAS 60/410 | 253410 | 263410 | | EN 10346 HX420LAD+Z | | | |

## PRODUCIBILITY LIMITS

| COLD ROLLED, GALVANIZED COIL (GCRP) | | | | | | |
|---|---|---|---|---|---|---|
| Thickness (mm) | Width min (mm) | Group -1 <=190 kg/mm² | Group -2 <= 260 kg/mm² | Group -3 <= 300 kg/mm² | Group -4 <= 400 kg/mm² | Group -5 <= 550 kg/mm² |
| 0,25-0,30* | 800 | 1250 | 1070 | - | - | - |
| 0,31-0,34 | 800 | 1250 | 1250 | 1070 | 1070 | - |
| 0,35-0,40 | 800 | 1530 | 1300 | 1250 | 1070 | 1070 |
| 0,41-0,45 | 800 | 1530 | 1300 | 1250 | 1070 | 1070 |
| 0,46-0,49 | 800 | 1530 | 1530 | 1250 | 1070 | 1070 |
| 0,50-0,69 | 800 | 1530 | 1530 | 1530 | 1250 | 1150 |
| 0,70-3,00 | 800 | 1530 | 1530 | 1530 | 1530 | 1250 |

(*) Orders for thickness less than and equal 0,27 mm, special thickness tolerance is not accepted.
(**) Thickness of greater than 2.5 mm is subjected to negotiation.

| COLD ROLLED, GALVANIZED CUT TO LENGTH SHEET FROM COIL (GCRCP) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Thickness (mm) | Width min (mm) | Group -1 <=190 kg/mm² | Group -2 <= 260 kg/mm² | Group -3 <= 300 kg/mm² | Group -4 <= 400 kg/mm² | Group -5 <= 550 kg/mm² | Length mm min. | max. |
| 0,25-0,30* | 800 | 1250 | 1070 | - | - | - | 500 | 6000 |
| 0,31-0,34 | 800 | 1250 | 1250 | 1070 | 1070 | - | 500 | 6000 |
| 0,35-0,40 | 800 | 1530 | 1300 | 1250 | 1070 | 1070 | 500 | 6000 |
| 0,41-0,45 | 800 | 1530 | 1300 | 1250 | 1070 | 1070 | 500 | 6000 |
| 0,46-0,49 | 800 | 1530 | 1530 | 1250 | 1070 | 1070 | 500 | 6000 |
| 0,50-0,69 | 800 | 1530 | 1530 | 1530 | 1250 | 1150 | 500 | 6000 |
| 0,70-3,00 | 800 | 1530 | 1530 | 1530 | 1530 | 1250 | 500 | 6000 |

(*) Orders for thickness less than and equal 0,27 mm, special thickness tolerance is not accepted.
(**) Thickness of greater than 2.5 mm is subjected to negotiation.

| COLD ROLLED, GALVANIZED SLITTED COIL (GCRSP) | | | | | | |
|---|---|---|---|---|---|---|
| Thickness (mm) | Width min (mm) | Group -1 <=190 kg/mm² | Group -2 <= 260 kg/mm² | Group -3 <= 300 kg/mm² | Group -4 <= 400 kg/mm² | Group -5 <= 550 kg/mm² |
| 0,25-0,30* | 60 | 1250 | 1070 | - | - | - |
| 0,31-0,34 | 60 | 1250 | 1250 | 1070 | 1070 | - |
| 0,35-0,40 | 60 | 1530 | 1300 | 1250 | 1070 | 1070 |
| 0,41-0,45 | 60 | 1530 | 1300 | 1250 | 1070 | 1070 |
| 0,46-0,49 | 60 | 1530 | 1530 | 1250 | 1070 | 1070 |
| 0,50-0,69 | 60 | 1530 | 1530 | 1530 | 1250 | 1150 |
| 0,70-3,00 | 60 | 1530 | 1530 | 1530 | 1530 | 1250 |

(*) Orders for thickness less than and equal 0,27 mm, special thickness tolerance is not accepted.
(**) Thickness of greater than 2.5 mm is subjected to negotiation.

| HOT ROLLED, GALVANIZED COIL (GHRP) | | | | | | |
|---|---|---|---|---|---|---|
| Thickness (mm) | Width min (mm) | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 |
| 1,10-1,19 | 800 | 1200 | 1200 | * | - | - |
| 1,20-1,34 | 800 | 1250 | 1250 | * | * | - |
| 1,35-1,49 | 800 | 1285 | 1285 | 1100 | 1100 | - |
| 1,50-1,79 | 800 | 1375 | 1375 | 1200 | 1200 | * |
| 1,80-2,49 | 800 | 1530 | 1530 | 1400 | 1300 | * |
| 2,50-3,00 | 800 | 1530 | 1530 | 1530 | 1530 | * |

(*) It is subjected to negotiation during the order stage.
(**) Thickness of less than 1.5 mm is subjected to negotiation.

| HOT ROLLED GALVANIZED CUT TO LENGTH SHEET FROM COIL (GHRCP) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Thickness (mm) | Width min (mm) | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Length mm | |
| 1,10-1,19 | 800 | 1200 | 1200 | * | | | 500 | 6000 |
| 1,20-1,34 | 800 | 1250 | 1250 | * | * | | 500 | 6000 |
| 1,35-1,49 | 800 | 1285 | 1285 | 1100 | 1100 | | 500 | 6000 |
| 1,50-1,79 | 800 | 1375 | 1375 | 1200 | 1200 | * | 500 | 6000 |
| 1,80-2,49 | 800 | 1530 | 1530 | 1400 | 1300 | * | 500 | 6000 |
| 2,50-3,00 | 800 | 1530 | 1530 | 1530 | 1530 | * | 500 | 6000 |

(*) It is subjected to negotiation during the order stage.
(**) Thickness of less than 1.5 mm is subjected to negotiation.

| HOT ROLLED GALVANIZED SLITTED COIL (GHRSP) | | | | | | |
|---|---|---|---|---|---|---|
| **Thickness (mm)** | **Width min (mm)** | **Group 1** | **Group 2** | **Group 3** | **Group 4** | **Group 5** |
| 1,10-1,19 | 800 | 1200 | 1200 | * | | |
| 1,20-1,34 | 800 | 1250 | 1250 | * | * | |
| 1,35-1,49 | 800 | 1285 | 1285 | 1100 | 1100 | |
| 1,50-1,79 | 800 | 1375 | 1375 | 1200 | 1200 | * |
| 1,80-2,49 | 800 | 1530 | 1530 | 1400 | 1300 | * |
| 2,50-3,00 | 800 | 1530 | 1530 | 1530 | 1530 | * |

(*) It is subjected to negotiation during the order stage.
(**) Thickness of less than 1.5 mm is subjected to negotiation

| GROUP | INTERNATIONAL STANDARD STEEL GRADES |
|---|---|
| **1** | EN 10346 DX54D, |
| **2** | EN 10346 DX51D,DX52,DX53,S220GD,S250GD, HX260LAD, ASTM A 653 CS Type A CS Type B, CS Type C, FS Type A, FS Type B,SS 33/230, SS 37/255, |
| **3** | EN 10346 S280GD, S320GD,HX300LAD, ASTM A 653 SS 40 / 275 ,HSLAS 40 / 275 |
| **4** | EN 10346 S350GD,S390GD, HX340LAD, HX380LAD, ASTM A 653 SS 50 Cl 1/340 Cl 1,SS 50 Cl 2/340 Cl 2, SS 50 Cl 3/340 Cl 3, SS 50 Cl 4/340 Cl 4, SS 55/ 390, HSLAS 50 / 340, HSLAS 55 Cl1 /380Cl 1,HSLAS 55 Cl2 /380Cl 2 |
| **5** | EN 10346 S420GD,S450GD, HX420LAD, ASTM A 653 SS 60 / 410, HSLAS 60 / 410 |

## GENERAL INFORMATION ON THE GALVANIZED PRODUCTS THAT CAN BE PRODUCED

| | Min. (mm) | Max. (mm) |
|---|---|---|
| **Thickness (GCR)** | 0,25 | 3 |
| **Thickness (GHR)** | 1,5 | 3 |
| **Width** | 800 | 1530 |
| **Internal diameter of coil** | 508 | 610 |
| **External diameter of coil** | | 2200 |
| **Coilweight** | 5 ton | 35 ton |
| **Coating weight** | 70 g/m² (both of surface)* | 600 g/m² both of surface * |
| **Plate length** | 500 | 6000 |
| **Plate width** | 370 | 1530 |
| **Plate package weight** | ..... | 8 ton |
| **Slit width** | 50 | |

NOTE: The dimensions out of the dimensions specified in the table for the limits that can be produced are subjected to negotiation. The production is possible as the internal diameter of the coilis 508 or 610.

• Internal diameter of the coil tolerances may be +/- 20mm.
* For the coating less than 70g/m² and greater than 400g/m²,it is subjected to negotiation during the order stage.
• Between thickness of 1.10 – 1.15 mm range is subjected to negotiation for GHR productions.
• For GCR production, thickness of greater than 2.5 mm is subjected to negotiation.
• Coil break guarantee is valid for the metal sheets, produced from the tempered hot rolled coils for GHR orders.
• Since GHR is produced by coating pickled hot rolled coils, the surface quality is different from metal sheets, cold rolled, galvanized coil (GCR). For the products which high surface quality is expected in the visible surfaces, opening order for GCR and Surface B is convenient.
• Mandrel fracture, occurring in the metal sheets, thickness equal and greater than 1.5 mm, is not in the scope of complaint and for Surface B orders are subjected to negotiation.

## Standard equivalents of galvanized products

| GALVANIZED STRUCTURAL STEELS | | | | | |
|---|---|---|---|---|---|
| Class | Thickness, mm (GCR) | Thickness, mm (GHR) | Standard (Europe) EN 10346:2015 | America | Japanese |
| Galvanized Structural Steels | 0,25 <t ≤ 3,0 | 1,5<t≤ 3,0 | S220GD | ASTM A653 SS Gr 230 | |
| Galvanized Structural Steels | 0,25 <t ≤ 3,0 | 1,5<t≤ 3,0 | S250GD | ASTM A653 SS Gr 255 | JIS 3302 SGC 340 |
| Galvanized Structural Steels | 0,25 <t ≤ 3,0 | 1,5<t≤ 3,0 | S280GD | ASTM A653 SS Gr 275 | JIS 3302 SGC 400 |
| Galvanized Structural Steels | 0,25 <t ≤ 3,0 | 1,5<t≤ 3,0 | S320GD | ASTM A653 SS Gr 340 | JIS 3302 SGC 440 |
| Galvanized Structural Steels | 0,25 <t ≤ 2,0 | 1,5<t≤ 3,0 | S350GD | ASTM A653 SS Gr 340 | JIS 3302 SGC 490 |
| Galvanized Structural Steels | 0,25 <t ≤ 2,0 | 1,5<t≤ 3,0 | S390GD | ASTM A653 SS Gr 390 | |
| Galvanized Structural Steels | 0,25 <t ≤ 2,0 | 1,5<t≤ 3,0 | S420GD | ASTM A653 SS Gr 410 | |

| GALVANIZED, DRAWING AND DEEP DRAWING GRADES | | | | | |
|---|---|---|---|---|---|
| Class | Thickness, mm (GCR) | Thickness, mm (GHR) | Standard (Europe) EN 10346:2015 | America | Japanese |
| Commercial Grade | 0,25 <t≤ 3,0 | 1,5<t≤ 3,0 | DX51 D | ASTM A653 CS Type B | JIS 3302 SGCC |
| Drawing Grade | 0,25 <t ≤2,5 | 1,5<t≤ 3,0 | DX52 D | ASTM A653 CS Type A | JIS 3302 SGCD1 |
| Deep Drawing Grade | 0,25 <t ≤ 2,0 | 1,5<t≤ 3,0 | DX53 D | ASTM A653 FS Type B | JIS 3302 SGCD2 |
| Extra Deep Drawing Grade | 0,25 <t ≤ 2,0 | 1,5<t≤ 3,0 | DX54 D | ASTM A653 DDS Type A | JIS 3302 SGDD3 |

*For GCR, thickness of greater than 2.5 mm is subjected to negotiation

## Galvanized Low carbon steels suitable for cold forming
## Standard: EN 10346: 2015
## Chemical Composition (%)

| Standard | Grade | MMK Grade No | %C | %Si | %Mn | %P | %S | %Ti |
|---|---|---|---|---|---|---|---|---|
| | | | max. | max. | max. | max. | max. | max. |
| EN 10346 | DX51D+Z | 200051 | 0,18 | 0,5 | 1,2 | 0,12 | 0,05 | 0,3 |
| EN 10346 | DX52D+Z | 200052 | 0,12 | 0,5 | 0,6 | 0,1 | 0,05 | 0,3 |
| EN 10346 | DX53D+Z | 200053 | 0,12 | 0,5 | 0,6 | 0,1 | 0,05 | 0,3 |
| EN 10346 | DX54D+Z | 200054 | 0,12 | 0,5 | 0,6 | 0,1 | 0,05 | 0,3 |

## Mechanical Properties

| Standard | Grade | MMK Grade No | Guarantee periods (f) | | Re(a) (Rp0.2/ ReL)(N/mm²) | Rm(N/mm²) | A80(b) % min. | r90 | n90 |
|---|---|---|---|---|---|---|---|---|---|
| | | | Mechanic values | Not having flow trace (d) | | | | | |
| EN 10346 | DX51D+Z | 200051 | 1 month | - | - | 270-500 | 22 | - | - |
| EN 10346 | DX52D+Z | 200052 | 1 month | - | 140-300(c) | 270-420 | 26 | - | - |
| EN 10346 | DX53D+Z | 200053 | 1 month | - | 140-260 | 270-380 | 30 | - | - |
| EN 10346 | DX54D+Z | 200054 | 6 month | 6 month | 120-220 | 260-350 | 36 | 1,6 | 0,18 |

**1.** Tensile test values apply to "transverse" test pieces.
**2.** (a) If the yield point is not pronounced, the values apply to the 0,2% - proof strength Rp0,2; if the yield strength is pronounced, the values apply to the lower yield point ReL.
**3.** (b) Decreased minimum elongation values apply for product thickness.
0,50 mm < t< 0,70 mm (minus 2 units),
0,35 mm < t< 0,50 mm (minus 4 units) and
t<0,35 mm (minus 7 units)
**4.** (c) For surface quality A, the upper value for yield strength Re is 360 MPa.
**5.** (d) Decreased minimum r90-values apply for product thickness
1,5 mm <t< 2 mm (minus 0,2)
t≥2 mm (minus 0,4)
**6.** 1MPa=1 N/mm²
**7.** (e) Guaranteed periods are applied for the orders for surface B.
**8.** (f) Guarantee periods is started in the date when it is notified that the material is ready for shipment.

## ASTM A653M - 17
## Chemical Composition (%)

| Standard | Grade | MMK Grade No | %C | %Mn | %Si | %P | %S | %Al | Cu | %Ni | %Cr | %Mo | %V | %Nb | %Ti (a) | %N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | max. | max. | max. | max. | max. | min | max. | max. | max. | max. | max. | max. | max. | max |
| ASTM A653 | CS Type A (b,c,d) | 250380 | 0,10 | 0,60 | 0,03 | 0,030 | 0,035 | - - - | 0,25 | 0,20 | 0,15 | 0,06 | 0,008 | 0,008 | 0,025 | - - - |
| ASTM A653 | CS Type B (b,e) | 250381 | 0,02-0,15 | 0,60 | 0,03 | 0,030 | 0,035 | - - - | 0,25 | 0,20 | 0,15 | 0,06 | 0,008 | 0,008 | 0,025 | - - - |
| ASTM A653 | CS Type C (b,c,d) | 250410 | 0,080 | 0,60 | 0,03 | 0,10 | 0,035 | - - - | 0,25 | 0,20 | 0,15 | 0,06 | 0,008 | 0,008 | 0,025 | - - - |
| ASTM A654 | FS Type A (b,f) | 250310 | 0,10 | 0,50 | 0,03 | 0,02 | 0,035 | - - - | 0,25 | 0,20 | 0,15 | 0,06 | 0,008 | 0,008 | 0,025 | - - - |
| ASTM A655 | FS Type B (b,e) | 250311 | 0,02-0,10 | 0,50 | 0,03 | 0,02 | 0,035 | - - - | 0,25 | 0,20 | 0,15 | 0,06 | 0,008 | 0,008 | 0,025 | - - - |

**1.** Where an ellipsis (. . .) appears in this table, there is no requirement, but the analysis shall be reported.
**2.** (a) For the steels which contains 0.02% C and/or more, Ti % amount is the option of the producer..
**3.** (b) When a deoxidized steel is required for the application, the purchaser has the option to order CS and FS to a minimum of 0.01% total aluminum.
**4.** (c) Steel is permitted to be produced as a vacuum degassed or chemically stabilized steel, or both, at the producer's option.
**5.** (d) Provided that these steels are the option of the producer, if C % is 0.02 or less, V, Nb or Ti and/or their combination may be used as stabilizing element. In this case, V and Nb shall be max. 0.10 and Ti max. 0.15
**6.** (e) For CS and FS, specify Type B to avoid carbon levels below 0.02%.
**7.** (f) Shall not be produced as a stabilized steel.

## Mechanical Properties (a,b),Nonmandatory

| Grade | MMK Grade No | MMK Grade No | Guarantee periods | Re N/mm² | Rm N/mm² | Elongation 2 inches (50mm) % min. | rm (c) | n (d) |
|---|---|---|---|---|---|---|---|---|
| ASTM A653 | CS Type A | 250380 | | 170-380 | | ≥20 | - | - |
| ASTM A653 | CS Type B | 250381 | | 205-380 | | ≥20 | - | - |
| ASTM A653 | CS Type C | 250410 | | 170-410 | | ≥15 | - | - |
| ASTM A654 | FS Type A | 250310 | | 170-310 | | ≥26 | 1.0/1.4 | 0.17/0.21 |
| ASTM A655 | FS Type B | 250311 | | 170-310 | | ≥26 | 1.0/1.4 | 0.17/0.21 |

**1.** (a) Mechanical properties are not mandatory. They are intended solely to provide the purchaser with as much information as possible to make an informed decision on the steel to be specified. Values outside of these ranges are to be expected. The purchaser may negotiate with the supplier if a specific range or a more restrictive range is required for the application.
**2.** (b) These typical mechanical properties apply to the full range of steel sheet thicknesses. The yield strength tends to increase and some of the formability values tend to decrease as the sheet thickness decreases.
**3.** (c) rm value, average plastic strain ratio, is determined according to the test method, E517.
**4.** (d) n value, strain-hardening exponent is determined according to the test method, E646.

## Galvanized Structural Steels
## Standard: EN 10346: 2015
## Chemical Composition (%)

| Standard | Grade | MMK Grade no | %C max. | %Si max. | %Mn max. | %P max. | %S max. |
|---|---|---|---|---|---|---|---|
| EN 10346 | S220GD+Z | 201220 | 0,2 | 0,6 | 1,7 | 0,1 | 0,045 |
| EN 10346 | S250GD+Z | 201250 | 0,2 | 0,6 | 1,7 | 0,1 | 0,045 |
| EN 10346 | S280GD+Z | 201280 | 0,2 | 0,6 | 1,7 | 0,1 | 0,045 |
| EN 10346 | S320GD+Z | 201320 | 0,2 | 0,6 | 1,7 | 0,1 | 0,045 |
| EN 10346 | S350GD+Z | 201350 | 0,2 | 0,6 | 1,7 | 0,1 | 0,045 |
| EN 10346 | S390GD+Z | 201390 | 0,2 | 0,6 | 1,7 | 0,1 | 0,045 |
| EN 10346 | S420GD+Z | 201420 | 0,2 | 0,6 | 1,7 | 0,1 | 0,045 |

## Mechanical Properties

| Standard | Grade | MMK Grade No | RP0,2 (a) Mpa | Rm (b) Mpa | A80 (c) % min. |
|---|---|---|---|---|---|
| EN 10346 | S220GD+Z | 201220 | 220 | 300 | 20 |
| EN 10346 | S250GD+Z | 201250 | 250 | 330 | 19 |
| EN 10346 | S280GD+Z | 201280 | 280 | 360 | 18 |
| EN 10346 | S320GD+Z | 201320 | 320 | 390 | 17 |
| EN 10346 | S350GD+Z | 201350 | 350 | 420 | 16 |
| EN 10346 | S390GD+Z | 201390 | 390 | 460 | 16 |
| EN 10346 | S420GD+Z | 201420 | 420 | 480 | 15 |

**1.** Tensile test values apply to the "longitudinal" test samples.
**2.** (a) If the yield point is pronounced, the values apply to the upper yield point ReH.
**3.** (b) For all grades,a range of 140 MPa can be expected for tensile strength.
**4.** (c) Decreased minimum elongation values apply for product thickness.
0,50 mm < t < 0,70 mm (minus 2 units),
0,35 mm < t < 0,50 mm (minus 4 units);
and t < 0,35 mm (minus 7 units).
**5.** 1MPa=1 N/mm²
**6.** The mechanical properties specified in the table are guaranteed for 1 months starting from the date when it is notified that the material is ready for shipment.

## ASTM A653M: 17
## Chemical Composition (%)

| Standard | Grade (a,b) | MMK Grade No | %C | %Mn | %Si | %P | %S | %Al | Cu | %Ni | %Cr | %Mo | %V | %Nb | %Ti (a) | %N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | max. | max. | max. | max. | max. | min | max. | max. | max. | max. | max. | max. | max. | max |
| ASTM A653 | SS 33/230 | 251230 | 0,20 | 1,35 | | 0,10 | 0,04 | - - - | 0,25 | 0,2 | 0,15 | 0,06 | 0,008 | 0,008 | 0,025 | - - - |
| ASTM A653 | SS 37/255 | 251255 | 0,20 | 1,35 | | 0,10 | 0,04 | - - - | 0,25 | 0,2 | 0,15 | 0,06 | 0,008 | 0,008 | 0,025 | - - - |
| ASTM A653 | SS 40/275 | 251275 | 0,25 | 1,35 | | 0,10 | 0,04 | - - - | 0,25 | 0,2 | 0,15 | 0,06 | 0,008 | 0,008 | 0,025 | - - - |
| ASTM A653 | SS50Cl 1/340 Cl 1 | 251341 | 0,25 | 1,35 | | 0,20 | 0,04 | - - - | 0,25 | 0,2 | 0,15 | 0,06 | 0,008 | 0,008 | 0,025 | - - - |
| ASTM A653 | SS50Cl 2/340 Cl 2 | 251342 | 0,25 | 1,35 | | 0,20 | 0,04 | - - - | 0,25 | 0,2 | 0,15 | 0,06 | 0,008 | 0,008 | 0,025 | - - - |
| ASTM A653 | SS50Cl 3/340 Cl 3 | 251343 | 0,25 | 1,35 | | 0,04 | 0,04 | - - - | 0,25 | 0,2 | 0,15 | 0,06 | 0,008 | 0,008 | 0,025 | - - - |
| ASTM A653 | SS50Cl 4/340 Cl 4 | 251344 | 0,25 | 1,35 | | 0,20 | 0,04 | - - - | 0,25 | 0,2 | 0,15 | 0,06 | 0,008 | 0,008 | 0,025 | - - - |
| ASTM A653 | SS 55/ 380 | 251380 | 0,25 | 1,35 | | 0,04 | 0,04 | - - - | 0,25 | 0,2 | 0,15 | 0,06 | 0,008 | 0,008 | 0,025 | - - - |
| ASTM A653 | SS 60/ 410 | 251410 | 0,25 | 1,35 | | 0,04 | 0,04 | - - - | 0,25 | 0,2 | 0,15 | 0,06 | 0,008 | 0,008 | 0,025 | - - - |

**1.** Where an ellipsis (. . .) appears in this table there is no requirement, but the analysis shall be reported
**2.** (a) Provided that these steels are the option of the producer, if C % ⩽ 0.02, V, Nb or Ti and/or their combination may be used as stabilizing element. In this case, V and Nb shall be max. 0.10 and Ti max. 0.15.
**3.** For steels containing more than 0.02% carbon, titanium is permitted to the lesser of 3.4N + 1.5S or 0.025%.

## Mechanical Properties

| Grade | MMK Grade no | MMK Grade no | Re N/mm² | Rm N/mm² (a) | elongation 2 inc (50mm) % min. (a) |
|---|---|---|---|---|---|
| ASTM A653 | SS 33/230 | 251230 | 230 | 310 | 20 |
| ASTM A653 | SS 37/255 | 251255 | 255 | 360 | 18 |
| ASTM A653 | SS 40/275 | 251275 | 275 | 380 | 16 |
| ASTM A653 | SS50Cl 1/340 Cl 1 | 251341 | 340 | 450 | 12 |
| ASTM A653 | SS50Cl 2/340 Cl 2 | 251342 | 340 | - - - | 12 |
| ASTM A653 | SS50Cl 3/340 Cl 3 | 251343 | 340 | 480 | 12 |
| ASTM A653 | SS50Cl 4/340 Cl 4 | 251344 | 340 | 410 | 12 |
| ASTM A653 | SS 55/ 380 | 251380 | 380 | 480 | 11 |
| ASTM A653 | SS 60/ 410 | 251410 | 410 | 480 | 10 (b) |

**1.** Tensile test values apply to the "longitudinal" test samples .
**2.** (a) Where an ellipsis (. . .) appears in this table there is no requirement.
**3.** (b) For t ⩽ 0,71mm the elongation requirement is reduced two percentage points (2%) for SS Grades 60 [410].
**4.** As there is no discontinuous yield curve, the yield strength should be taken as the stress at 0.5% elongation under load or 0.2% offset

## High Strength Low Alloy Steels Suitable for Cold Forming
## Standard: EN 10346: 2015
## Chemical Composition (%)

| Standard | Grade | MMK Grade No | %C max. | %Si max. | %Mn max. | %P max. | %S max. | Altotal | Nb max. | Ti max. |
|---|---|---|---|---|---|---|---|---|---|---|
| EN 10346 | HX260LAD+Z | 213260 | 0,11 | 0,5 | 0,6 | 0,03 | 0,025 | ≥0,015 | 0,09 | 0,12 |
| EN 10346 | HX300LAD+Z | 213300 | 0,11 | 0,5 | 1 | 0,03 | 0,025 | ≤0,1 | 0,09 | 0,15 |
| EN 10346 | HX340LAD+Z | 213340 | 0,11 | 0,5 | 1 | 0,03 | 0,025 | ≥0,015 | 0,09 | 0,15 |
| EN 10346 | HX380LAD+Z | 213380 | 0,11 | 0,5 | 1,4 | 0,03 | 0,025 | ≥0,015 | 0,09 | 0,15 |
| EN 10346 | HX420LAD+Z | 213420 | 0,11 | 0,5 | 1,4 | 0,03 | 0,025 | ≥0,015 | 0,09 | 0,15 |

## Mechanical Properties

| Standard | Grade | MMK Grade no | Re (a) (Rp0.2/ ReL) (N/mm²) | Rm | A80(%)(b,c) | r90 (c, d) | n90 |
|---|---|---|---|---|---|---|---|
| | | | | (N/mm²) | min. | min. | min. |
| EN 10346 | HX260LAD+Z | 213260 | 260-330 | 350-430 | 26 | - | - |
| EN 10346 | HX300LAD+Z | 213300 | 300-380 | 380-480 | 23 | - | - |
| EN 10346 | HX340LAD+Z | 213340 | 340-420 | 410-510 | 21 | - | - |
| EN 10346 | HX380LAD+Z | 213380 | 380-480 | 440-560 | 19 | - | - |
| EN 10346 | HX420LAD+Z | 213420 | 420-520 | 470-590 | 17 | - | - |

**1.** Tensile test values apply to "transverse" test pieces.
**2.** (a) If the yield strength is pronounced, the values apply to the lower yield point ReL.
**3.** (b,c) Decreased minimum elongation values apply for product thickness
0,50 mm < t < 0,70 mm (minus 2 units),
0,35 mm < t < 0,50 mm (minus 4 units) and
t < 0,35 mm (minus 7 units).
**4.** Yielding value is applied to the products to which is tempered.
**5.** (d) Decreased minimum r90-values apply for product thickness.
1,5 < t < 2 mm (minus 0,2),
t ⩾ 2 mm (minus 0,4).
**6.**The mechanical values specified in the table are guaranteed for 6 months starting in the date when it is notified that the material is ready for shipment.

## ASTM A653M - 17
## Chemical Composition (%)

| Standard | Grade (a) | MMK Grade No | %C | %Mn | %Si | %P | %S | %Al | Cu | %Ni | %Cr | %Mo | %V | %Nb | %Ti | %N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | max. | max. | max. | max. | max. | min | max. | max. | max. | max. | min. | min | min | max |
| ASTM A653 | HSLAS 40/275 | 253275 | 0,15 | 1,20 | | - - - | 0,35 | | - - - | 0,20 | 0,15 | 0,16 | 0,01 | 0,005 | 0,01 | - - - |
| ASTM A653 | HSLAS 50/340 | 253340 | 0,15 | 1,20 | | - - - | 0,35 | | 0,20 | 0,20 | 0,15 | 0,16 | 0,01 | 0,005 | 0,01 | - - - |
| ASTM A653 | HSLAS 55Cl 1/380Cl 1 | 253381 | 0,20 | 1,35 | | - - - | 0,35 | | 0,20 | 0,20 | 0,15 | 0,16 | 0,01 | 0,005 | 0,01 | - - - |
| ASTM A653 | HSLAS 55Cl 2/380Cl 2 | 253382 | 0,15 | 1,20 | | - - - | 0,35 | | 0,20 | 0,20 | 0,15 | 0,16 | 0,01 | 0,005 | 0,01 | - - - |
| ASTM A653 | HSLAS 60/410 | 253410 | 0,15 | 1,20 | | - - - | 0,35 | | 0,20 | 0,20 | 0,15 | 0,16 | 0,01 | 0,005 | 0,01 | - - - |

1. Where an ellipsis (. . .) appears in this table there is no requirement.
2. (a) For HSLAS steels, Nb, V and T can be added singly or in combination for increasing strength.

## Mechanical Properties

| Grade | MMK Grade No | MMK Grade no | Re N/mm² | Rm N/mm² (a) | Elongation 2 inches (50mm) % min. |
|---|---|---|---|---|---|
| ASTM A653 | HSLAS 40/275 | 253275 | 275 | 340 | 22 |
| ASTM A653 | HSLAS 50/340 | 253340 | 340 | 410 | 20 |
| ASTM A653 | HSLAS 55Cl 1/380Cl 1 | 253381 | 380 | 480 | 16 |
| ASTM A653 | HSLAS 55Cl 2/380Cl 2 | 253382 | 380 | 450 | 18 |
| ASTM A653 | HSLAS 60/410 | 253410 | 410 | 480 | 16 |

1. (a) If a higher tensile strength is required, the user should consult the producer.

## DIN EN 10346 : 2015
## PROPERTIES OF GALVANIZED COATING

| Total coating mass (both surfaces) | Minimum total coating mass, both surfaces g/m2 | | | | Surface quality |
|---|---|---|---|---|---|
| | Triple spot test | | Single Spot Test | | |
| | g/m² | µm | g/m² | µm | |
| Z100 | 100 | 14 | 85 | 12 | A,B |
| Z140 | 140 | 20 | 120 | 17 | A,B |
| Z200 | 200 | 28 | 170 | 24 | A,B |
| Z225 | 225 | 32 | 195 | 27 | A,B |
| Z275 | 275 | 39 | 235 | 33 | A,B |
| Z350* | 350 | 49 | 300 | 42 | A,B |
| Z450* | 450 | 63 | 385 | 54 | A,B |
| Z600* | 600 | 84 | 510 | 71 | A,B |

(*) Orders for any further coating weights, beyond those of the table above, it is subjected to negotiation. The coating type is minimized spangle (M).
(*) The order is accepted such that the surface qualities are subjected to negotiation.
(**) For the thicknesses of greater than 1.5 mm and coating mass greater than 140g/m², MMK Metalurji recommends surface B for appearance of the surface coating ripple.
(*) Surface quality B is recommended for GHR products depending on the coating mass. Contact with your sales representative for coating amount.

NOTE: Measurement of the intermediary coatings, not included in the standard, is done according to the triple spot test in the DIN EN 10346: 2015 standard.

## ASTM A653M - 17
## PROPERTIES OF GALVANIZED COATING (a, b, c)

| Coating mass | ASTM A653M Min. Coating mass (Triple spot test) | | | | Total test value for single spot, double surface | |
|---|---|---|---|---|---|---|
| | Total test value of two surfaces | | Single surface test value | | | |
| | oz/ft2 | mil | oz/ft2 | mil | oz/ft2 | mil |
| G01 | - | - | - | - | - | - |
| G30 | 0,3 | 0,504 | 0,1 | 0,168 | 0,25 | 0,42 |
| G40 | 0,4 | 0,672 | 0,12 | 0,202 | 0,3 | 0,504 |
| G60 | 0,6 | 1,008 | 0,2 | 0,336 | 0,5 | 0,84 |
| G90 | 0,9 | 1,512 | 0,32 | 0,538 | 0,8 | 1,344 |
| G100 | 1 | 1,68 | 0,36 | 0,605 | 0,9 | 1,512 |
| G115 | 1,15 | 1,932 | 0,4 | 0,672 | 1 | 1,68 |
| G140* | 1,4 | 2,352 | 0,48 | 0,806 | 1,2 | 2,016 |
| G165* | 1,65 | 2,772 | 0,56 | 0,941 | 1,4 | 2,352 |
| G185* | 1,85 | 3,108 | 0,64 | 1,075 | 1,6 | 2,688 |
| G210* | 2,1 | 3,528 | 0,72 | 1,21 | 1,8 | 3,024 |

| Coating mass | ASTM A653M Min. Coating mass (Triple spot test) | | | | Total test value for single spot, double surface | | Surface quality |
|---|---|---|---|---|---|---|---|
| | Total test value of two surfaces | | Single surface test value | | | | |
| | g/m² | µm | g/m² | µm | g/m² | µm | |
| Z001 | - | - | - | - | - | - | A,B |
| Z90 | 90 | 13 | 30 | 4 | 75 | 11 | A,B |
| Z120 | 120 | 17 | 36 | 5 | 90 | 13 | A,B |
| Z180 | 180 | 25 | 60 | 8 | 150 | 21 | A,B |
| Z275 | 275 | 39 | 94 | 13 | 235 | 33 | A,B |
| Z305 | 305 | 43 | 110 | 15 | 275 | 39 | A,B |
| Z350 | 350 | 49 | 120 | 17 | 300 | 42 | A,B |
| Z450* | 450 | 63 | 154 | 22 | 385 | 54 | A,B |
| Z500* | 500 | 70 | 170 | 24 | 425 | 60 | A,B |
| Z550* | 550 | 77 | 190 | 27 | 475 | 67 | A,B |
| Z600* | 600 | 84 | 204 | 29 | 510 | 71 | A,B |

**1.** The coating designation is the term by which the minimum triple spot, total both sides coating mass is specified. Because of the many variables and changing conditions that are characteristic of continuous hot-dip coating lines, the zinc or zinc-iron alloy coating is not always evenly divided between the two surfaces of a coated sheet; nor is it always evenly distributed from edge to edge. However, the minimum triple-spot average coating mass on any one side shall not be less than 40% of the single-spot requirement..
**2.** (b) As it is an established fact that the atmospheric corrosion resistance of zinc or zinc-iron alloy-coated sheet products is a direct function of coating thickness (mass), the selection of thinner (lighter) coating designations will result in almost linearly reduced corrosion performance of the coating. For example, heavier galvanized coatings perform adequately in bold atmospheric exposure whereas the lighter coatings are often further coated with paint or a similar barrier coating for increased corrosion resistance. Because of this relationship, products carrying the statement "meets ASTM A653/A653M requirements" should also specify the particular coating designation.
**3.** (c) International Standard, ISO 3575, continuous hot-dip zinc-coated carbon steel sheet contains Z100 and Z200 designations and does not specify a ZF75 coating.
**4.** (-) There is no value for triple - and single-spot tests.
**5.** (*) It is subjected to negotiation during the order stage.

| Coating – Thickness conversation table | | | |
|---|---|---|---|
| Kabul 1.00 oz/ft2 =305 g/m² = 1.68 mils | | | |
| Coating weight | | Coating thickness | |
| oz/ft2 | [g/m²] | mil | µm |
| 1 | 305 | 1,68 | 42,7 |
| 0 | 1 | 0,01 | 0,14 |
| 0,6 | 181 | 1 | 25,4 |
| 0,02 | 7,14 | 0,04 | 1 |

## BENDING TEST

| Coating weight (a) | ASTM A653M - 13 Coating bending test | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Steel grades (CS,FS) | | | Steel grades (SS) (b) | | | Steel grades (HSLAS) (b) | | |
| | t≤1,0mm | 1mm<t≤2mm | 2mm<t | SS230 | SS255 | SS275 | HSLAS275 | HSLAS340 | HSLAS410 |
| Z001 | 0 | 0 | 0 | 1,5 | 2 | 2,5 | 1,5 | 1,5 | 3 |
| Z90 | 0 | 0 | 0 | 1,5 | 2 | 2,5 | 1,5 | 1,5 | 3 |
| Z120 | 0 | 0 | 0 | 1,5 | 2 | 2,5 | 1,5 | 1,5 | 3 |
| Z180 | 0 | 0 | 0 | 1,5 | 2 | 2,5 | 1,5 | 1,5 | 3 |
| Z275 | 0 | 0 | 0 | 1,5 | 2 | 2,5 | 1,5 | 1,5 | 3 |
| Z305 | 0 | 0 | 1 | 1,5 | 2 | 2,5 | 1,5 | 1,5 | 3 |
| Z350 | 0 | 0 | 1 | 1,5 | 2 | 2,5 | 1,5 | 1,5 | 3 |
| Z450* | 1 | 1 | 2 | 2 | 2 | 2,5 | | | |
| Z500* | 2 | 2 | 2 | 2 | 2 | 2,5 | | | |
| Z550* | 2 | 2 | 2 | 2 | 2 | 2,5 | | | |
| Z600* | 2 | 2 | 2 | 2 | 2 | 2,5 | | | |

1. (a) The test values are subjected to negotiation for the other coating ranges.
2. (b) For SS340,SS380 and SS410 and HSLAS steel grades are not applied to coating bending test.
3. (*) It is subjected to negotiation during the order stage.

## TOLERANCES (Tolerance standard: DIN EN 10143-2006)
## GALVANIZED COATED COIL THICKNESS TOLERANCE
### Thickness tolerance for the grades with Minimum Yield strength, Re<260N/mm²

| Nominal thickness | Nominal tolerances | | | Special tolerances (*) | | |
|---|---|---|---|---|---|---|
| | Width (mm) | | | Width (mm) | | |
| | ≤1200 | 1200<w≤1500 | >1500 | ≤1200 | 1200<w≤1500 | >1500 |
| 0,25<t≤0,40 | ±0,04 | ±0,05 | ±0,06 | ±0,030 | ±0,035 | ±0,040 |
| 0,40<t≤0,60 | ±0,04 | ±0,05 | ±0,06 | ±0,035 | ±0,040 | ±0,045 |
| 0,60<t≤0,80 | ±0,05 | ±0,06 | ±0,07 | ±0,040 | ±0,045 | ±0,050 |
| 0,80<t≤1,00 | ±0,06 | ±0,07 | ±0,08 | ±0,045 | ±0,050 | ±0,060 |
| 1,00<t≤1,20 | ±0,07 | ±0,08 | ±0,09 | ±0,050 | ±0,060 | ±0,070 |
| 1,20<t≤1,60 | ±0,10 | ±0,11 | ±0,12 | ±0,060 | ±0,070 | ±0,080 |
| 1,60<t≤2,00 | ±0,12 | ±0,13 | ±0,14 | ±0,070 | ±0,080 | ±0,090 |
| 2,00<t≤2,50 | ±0,14 | ±0,15 | ±0,16 | ±0,090 | ±0,100 | ±0,110 |
| 2,50<t≤3,00 | ±0,17 | ±0,17 | ±0,18 | ±0,110 | ±0,120 | ±0,130 |

* Thickness tolerances not included in the table are subjected to negotiation.

### Thickness tolerance for the grades with 260 ≤ minimum Yield strength, Re <360N/mm² DX51D

| Nominal thickness | Nominal tolerances | | | Special tolerances | | |
|---|---|---|---|---|---|---|
| | Width (mm) | | | Width (mm) | | |
| | ≤1200 | 1200<w≤1500 | 1500< | ≤1200 | 1200<w≤1500 | 1500< |
| 0,25<t≤0,40 | ±0,05 | ±0,06 | ±0,07 | ±0,035 | ±0,040 | ±0,045 |
| 0,40<t≤0,60 | ±0,05 | ±0,06 | ±0,07 | ±0,040 | ±0,045 | ±0,050 |
| 0,60<t≤0,80 | ±0,06 | ±0,07 | ±0,08 | ±0,045 | ±0,050 | ±0,060 |
| 0,80<t≤1,00 | ±0,07 | ±0,08 | ±0,09 | ±0,050 | ±0,060 | ±0,070 |
| 1,00<t≤1,20 | ±0,08 | ±0,09 | ±0,11 | ±0,060 | ±0,070 | ±0,080 |
| 1,20<t≤1,60 | ±0,11 | ±0,13 | ±0,14 | ±0,070 | ±0,080 | ±0,090 |
| 1,60<t≤2,00 | ±0,14 | ±0,15 | ±0,16 | ±0,080 | ±0,090 | ±0,110 |
| 2,00<t≤2,50 | ±0,16 | ±0,17 | ±0,18 | ±0,110 | ±0,120 | ±0,130 |
| 2,50<t≤3,00 | ±0,19 | ±0,20 | ±0,20 | ±0,130 | ±0,140 | ±0,150 |

* Thickness tolerances not included in the table are subjected to negotiation.

### Thickness tolerance for the grades with 360 ⩽ minimum Yield strength, Re <420N/mm²

| Nominal thickness | Nominal tolerances | | | Special tolerances | | |
|---|---|---|---|---|---|---|
| | Width (mm) | | | Width (mm) | | |
| | ⩽1200 | 1200<w⩽1500 | >1500 | ⩽1200 | 1200<w⩽1500 | >1500 |
| 0,25<t⩽0,40* | ±0,05 | ±0,06 | ±0,07 | ±0,040 | ±0,045 | ±0,050 |
| 0,40<t⩽0,60* | ±0,06 | ±0,07 | ±0,08 | ±0,045 | ±0,050 | ±0,060 |
| 0,60<t⩽0,80* | ±0,07 | ±0,08 | ±0,09 | ±0,050 | ±0,060 | ±0,070 |
| 0,80<t⩽1,00 | ±0,08 | ±0,09 | ±0,11 | ±0,060 | ±0,070 | ±0,080 |
| 1,00<t⩽1,20 | ±0,10 | ±0,11 | ±0,12 | ±0,070 | ±0,080 | ±0,090 |
| 1,20<t⩽1,60 | ±0,13 | ±0,14 | ±0,16 | ±0,080 | ±0,090 | ±0,110 |
| 1,60<t⩽2,00 | ±0,16 | ±0,17 | ±0,19 | ±0,090 | ±0,110 | ±0,120 |
| 2,00<t⩽2,50 | ±0,18 | ±0,20 | ±0,21 | ±0,120 | ±0,130 | ±0,140 |
| 2,50<t⩽3,00 | ±0,22 | ±0,22 | ±0,23 | ±0,140 | ±0,150 | ±0,160 |

* Thickness tolerances not included in the table are subjected to negotiation.
* The thicknesses of less than 0.80 are subjected to negotiation during the order stage.

**1.** The thickness shall be measured at any point situated at least 40 mm from the edges.
**2.** The thickness shall be measured at the center of the slit for the slitted coils or cut to length from coil, with a width of ⩽ 80 mm.
**3.** For Z450 and Z600 total coating weights, normal and special thickness tolerances are increased ± 0.01 mm.
**4.** The thickness tolerances in the region of coil welds may be increased by a maximum of 50% over a length of 10 m.
**5.** The thickness tolerance of 25% is not applied for nominal order thicknesses of equal and less than 0.45 mm.
**6.** Production is subjected to negotiation with the thickness tolerance of 25%.

### WIDTH TOLERANCE

| Tolerances on width of sheet and wide strip of width⩾600 mm | | | | |
|---|---|---|---|---|
| Width | Width tolerances | | Special tolerance (*),(**) | |
| | - | + | - | + |
| 600⩽w⩽1200 | 0 | 5 | 0 | 2 |
| 1200<w⩽1500 | 0 | 6 | 0 | 2 |
| 1500<w | 0 | 7 | 0 | 3 |

* Width is measured perpendicularly to the longitudinal axis of the product.
* Special width tolerance is subjected to negotiation during the order stage.

| The tolerances on width of slit wide strip of width < 600 mm | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Nominal thickness (t) (mm) | w<125 | | 125⩽w<250 | | 250<w⩽400 | | 400⩽w⩽600 | |
| | - | + | - | + | - | + | - | + |
| t<0,6 | 0 | 0,4 | 0 | 0,5 | 0 | 0,7 | 0 | 1 |
| 0,6⩽w<1,0 | 0 | 0,5 | 0 | 0,6 | 0 | 0,9 | 0 | 1,2 |
| 1,0⩽w<2,0 | 0 | 0,6 | 0 | 0,8 | 0 | 1,1 | 0 | 1,4 |
| 2,0⩽w⩽3,0 | 0 | 0,7 | 0 | 1 | 0 | 1,3 | 0 | 1,6 |

* For the special tolerances, order should be taken as edge trimmed.
NOTE: For width tolerance less than 0.4 mm shall be agreed at the time of enquiry and order..

## LENGTH TOLERANCE (*)

| Nominal length (L)(mm) | Nominal tolerances | | Special tolerances (**) | |
|---|---|---|---|---|
| | - | + | - | + |
| <2000 | 0 | 6 | 0 | 3 |
| ≥2000 | 0 | 0,3xL | 0 | 0,15xL |

* Length is measured along one of the long sides of the metal sheet.
** Special length tolerances are subjected to negotiation during the order stage.

NOTE: For special projects, it may produce with a length special tolerance up to +1.

## FLATNESS TOLERANCES

### Flatness tolerances for steel grades with specified minimum yield strength Re or specified minimum proof strength Rp0,2 < 260 MPa

| Tolerance class | Nominal width | Max. wave height (mm) for nominal thickness (t) | | | |
|---|---|---|---|---|---|
| | | t<0,7 | 0,7<t<1,6 | 1,6<t<3,0 | 3,0≤t |
| Normal | w<1200 | 10 | 8 | | 15 |
| | 1200≤w<1500 | 12 | 10 | | 18 |
| | 1500≤w | 17 | 15 | | 23 |
| Special (FS) | w<1200 | 5 | 4 | 3 | 8 |
| | 1200≤w<1500 | 6 | 5 | 4 | 9 |
| | 1500≤w | 8 | 7 | 6 | 12 |

### Flatness tolerances for steel grades with specified minimum proof strength 260 MPa ≤Rp0,2 < 360 MPa and for grades DX51D and S550GD

| Tolerance class | Nominal width | Max. wave height (mm) for nominal thickness (t) | | | |
|---|---|---|---|---|---|
| | | t<0,7 | 0,7<t<1,6 | 1,6<t<3,0 | 3,0≤t |
| Normal | w<1200 | 13 | 10 | | 18 |
| | 1200≤w<1500 | 15 | 13 | | 25 |
| | 1500≤w | 20 | 19 | | 28 |
| Special (FS) | w<1200 | 8 | 6 | 5 | 9 |
| | 1200≤w<1500 | 9 | 8 | 6 | 12 |
| | 1500≤w | 12 | 10 | 9 | 14 |

### Flatness tolerances for Steel grades with specified minimum Rp0,2 ≥360 MPa

* For these steel grades, the values for flatness tolerances shall be specified at the time of enquiry and order.
** Flatness tolerance is not guaranteed for coil orders; it is subjected to negotiation
*** The requests under the special flatness tolerances are subjected to negotiation.

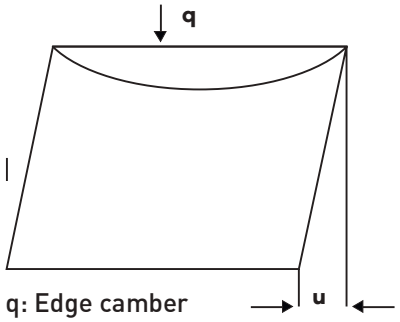
## EDGE CAMBER TOLERANCE

1. The edge camber is the amount of maximum distance between a straight line combining both edges of the long edge and this long edge.
2. Edge camber shall be measured on the concave edge.

| Product type | Product dimensions | | Measurement length (mm) | Tolerance (mm) |
|---|---|---|---|---|
| | Width | Length | | |
| Metal sheet | ≥600 | ≥2000 | 2000 | 5 |
| | | <2000 | | +0,0025L |
| Coil | ≥600 | - | 2000 | 5 |
| Slitted Coil | <600 | - | 2000 | 5 |

3. The basis of measurement shall be a distance of 2 m taken at any point on the edge. In the case of sheets and cut lengths with a length less than 2 m, the basis measurement shall be equal to their length.
4. The edge camber shall not exceed 5 mm over a length of 2 m.
*The requests for special edge camber tolerances are subjected to negotiation.

### Tolerances on out-of-squareness




**q: Edge camber**
**u: out-of-squareness**

1. The out-of-squareness u is the orthogonal projection of transverse edge over a longitudinal edge.
2. The out-of-squareness shall not exceed 1% of the actual width of the sheet.

* For special projects, the out-of-squareness can be applied less than half of the standard. The requests are subjected to negotiation.

## NORM READING

**EN 10143 - 0,80Sx1200Sx2500FS - steel EN 10346 - DX51D+Z 100 - M - B - O - C**

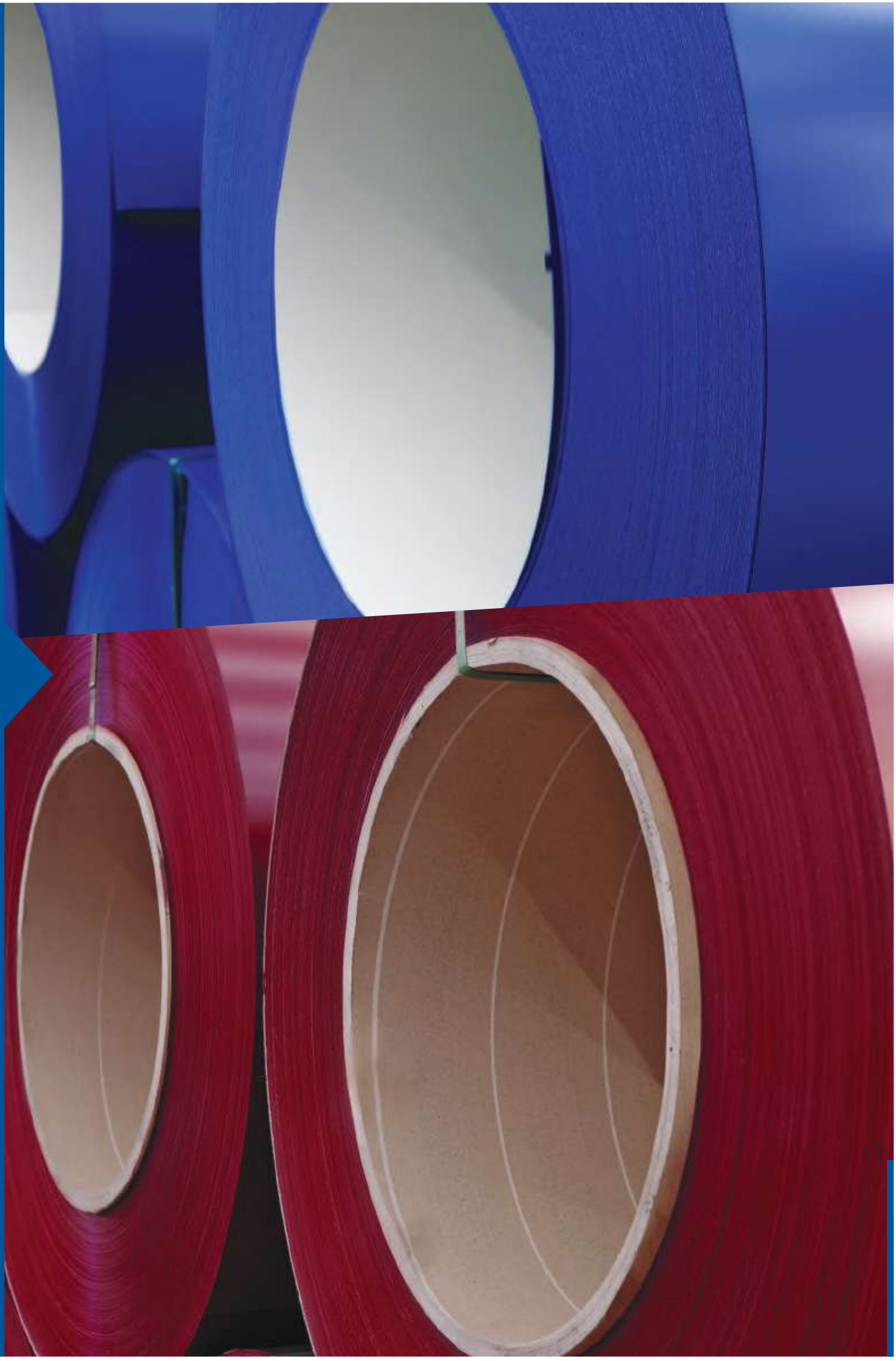
**S:** Special thickness, width, length
**FS:** Special flatness tolerance
**Z:** Zinc (gr/m²)
**M:** Minimize spangle
**B:** Surface
**O:** Oil
**C:** Chromate

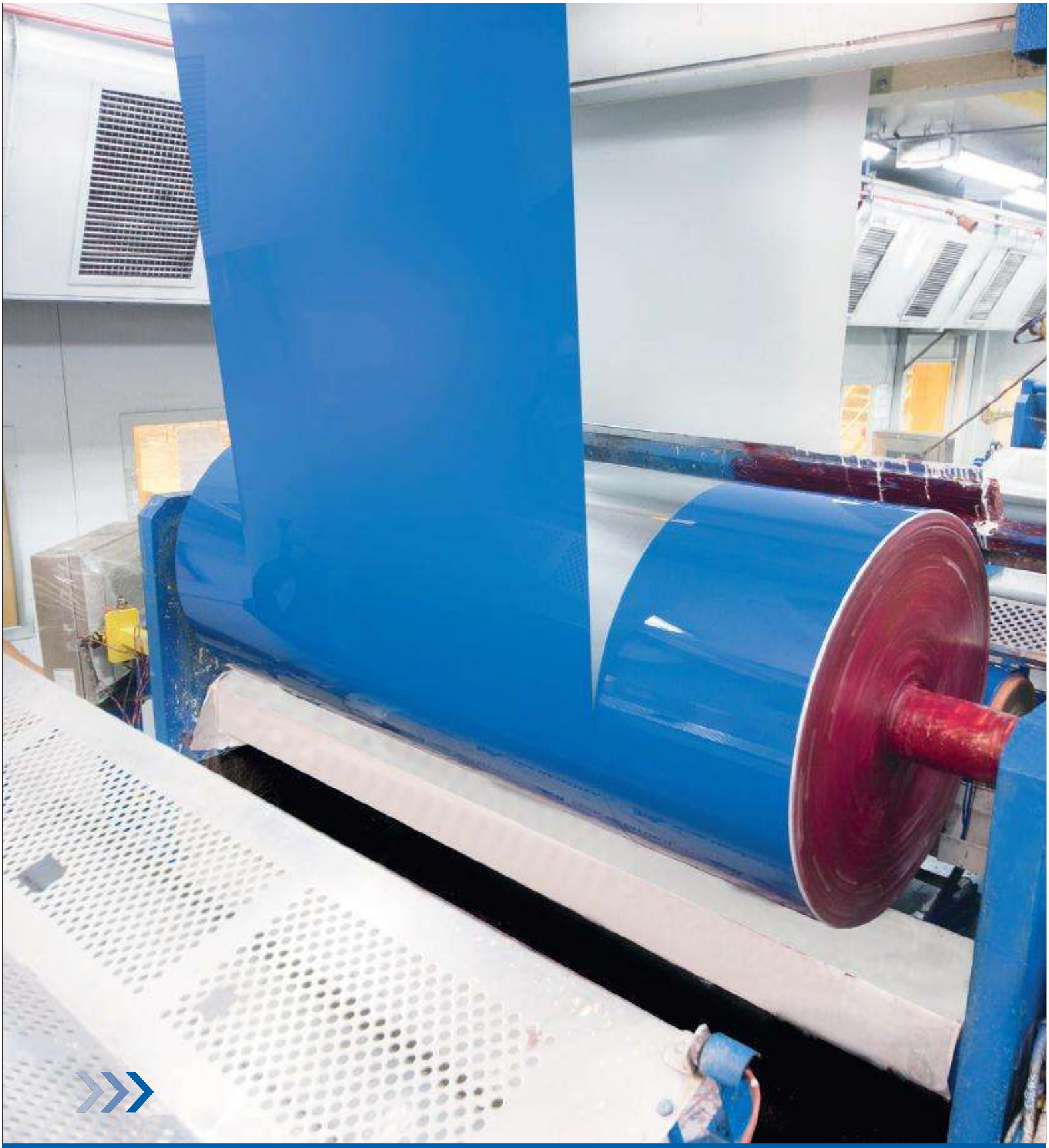
Surface treatment oiled (O) and chromate (C),surface quality B, minimized spangle galvanized coating of 100g/m², having the special width and flatness tolerances, of Grade DX51 within EN 10143 standard tolerance, according to EN 10346.

**EN 10143 - 0,80x1200R - steel EN 10346 - DX51D+Z 100 - M - A - O - C**

**Z:** Zinc (gr/m²)
**M:** Minimized spangle (flowerless)
**A:** Surface
**O:** Oil
**C:** Chromate

Surface treatment oiled (O) and chromate (C), of A surface, with minimized spangle galvanized coating of 100g/m², of Grade DX51 within EN 10143 standard tolerance, according to EN 10346.





# PREPAINTED PRODUCTS

**DIMENSIONS:**

- Thickness: Min. 0,25 mm - Max. 1,20 mm
- Width: Min. 800 mm - Max. 1530 mm
- Coil weight: Min. 3 Ton - Max. 12 Ton
- Internal diameter of coil: 508 mm, 610 mm
- External diameter of coil: Max. 1350 mm
- Plate length: Min. 500 - Max. 6000 mm
- Plate width: Min. 370 mm - Max. 1530 mm
- Package weight: Max. 8 Ton
- Slit width: Min. 50 mm
- Production capacity: 400,000 t/year

## WHAT IS PAINT?

Painting is called the coating applied for giving color to any object or for protection. They are the chemical components, protecting against physical and chemical affects by forming a film layer on the surface to which it is applied and at the same time giving a decorative appearance.

Paints are mainly composed of four components: binder, thinner, pigments and other additives. Using binder is mandatory because they are the binding substance, which enables that the dried paint film is formed by binding the hardfill substances inside it and agglutinant them to the surface. The type and amount of the binder determines the properties of the paint such as flexibility, hardness, adhesion, color retention. The diluenting agent is used for setting the viscosity of the paint. It is volatile and does not contribute to the formation of film layer. Pigments give color and coverage feature to the paint. All other additive materials, along with the above mentioned ones, ensure some physical or chemical characteristics for the paint by merging into the coating film.

## WHAT IS PAINTED METAL STRIP?

Colour coating of coils means continuous applying of paint to flat steel strip (rolled in a coil shape) with polyurethane rolls using high-tech automation.
Pre-painted metal sheets/strips have been painted continuously consisting of the following steps
* Coil is opened, top and bottom surfaces are cleaned with special chemical agents and rinsed .
* Passivation (chromating) is applied to the top and bottom surfaces in order to increase the corrosion resistance and to achieve the better adhesion of the paint, after than cured in furnace.
* Top surface is primed only for top surface painting, backcoat is applied on bottom surface which high polyurethane adhesive and cured in furnaces. If colour coating is requested over the primer on both sides, the paint is applied as the last layer and the strip is cured in the furnace.
* Depending on the customer's order, protective film is applied.Pre-painted metal strip is winded as coil and packaged.

All colour coated flat products galvanized metal strip (GA), Aluzinc, (AZ) produced at MMK Metalurji site are produced in compliance with EN 10169 standard.

## WHY YOU SHOULD BUY PAINTED STRIP FROM MMK METALURJI

Decreased the number of process during production and low production cost: thanks to the fact that colour coating is made by MMK Metalurji, our customers will avoid additional investment cost for painting and relevant facilities and the burden of costs such as labour costs, utilities costs and other expenses.

**Standardization:** By the the production of prepainted sheet/strip in continuous lines, paint of different type and color may be applied to both surfaces of the strip; paint is spread evenly to the surface; drop, burr and different paint thicknesses on the surface do not occur. A standard color is provided. A higher efficiency is obtained in corrosion resistance and surface adhesion of the paint according to alternative paint systems.

**Creativity and consultancy:** Consulting services are provided for our products with regard to different application areas. Besides, patterns which can not be produced with any colour coating procedure or materials, whose use is impossible due to related high costs, may be imitated by applying PVC lamination on standard strips. For example: Giving wood, marble, granite, etc. appearance to the metal for decorative purposes. Especially by wrinkle paint type application, a decorative product is provided for roof production. By our embosser application, pattern is given to the painted products.

**Safety and environment:** By using paints and solvents which are not flammable and combustible materials,the accident risk is eliminated for our customers. Besides, absence of hazardous waste issues ensures ecologically safe production process for our customers.

*For the outdoor spaces, are subjected to atmosphere corrosion, it is not suitable to use painted metal strip without zinc coating.

## PREPAINTED PRODUCT NAME ABBREVIATIONS and DESCRIPTIONS

**PPGP:** Prepainted galvanized coil
**PPGSP:** Prepainted galvanized slitted coil
**PPGCP:** Prepainted galvanized sheet,cut to length from coil

| Group No | INTERNATIONAL STANDARD STEEL GRADES |
|---|---|
| 1 | EN 10346 DX54 |
| 2 | EN 10346 DX51D,DX52D,DX53 / S220GD,S250GD |
| 3 | EN 10346 S280GD, S320GD |
| 4 | EN 10346 S350GD |

## APPLICATION AREAS OF PRE-PAINTED PRODUCTS:

**A- Construction sector**
- To produce polyurethane sandwich panel and composite panel,
- To produce exterior facade cladding, roof cladding and metal shingle,
- To produce in the agricultural and military building (hangar) construction products,
- To produce rain gutter,
- To produce building entrance, garage doors and shades,
- To produce suspended ceiling panels and accessories,
- To produce modular interior structural materials

**B- Consumer durable goods**
- To produce white goods
- To produce DVD and receiver

**C- Heating systems**
- To produce air conditioner and ventilator

**D- Lighting fixtures and electric panel production**
**E- Billboards and industrial design applications**
**F- In the agriculture – husbandry sector**
- To produce silos, animal housings.

## PREPAINTED METAL SHEETS / STRIPS PRODUCED DEPENDING ON TYPE OF PAINT

The painted metal sheets may be classified considering the types of polymers, assuming binder role, inside the contents of the paint used. / Based on the types of polymers which perform the role of binding agents in the composition of the paints to be used, prepainted flat products may be classified as given below;

**Polyester Based Prepainted Flat Products:** A wide range of colours, gloss selection and low consumption rate and being economical are the strongest points of polyester paints. Because of this, they have a very wide usage area. / For this reason they are very commonly used.

Besides, its flexibility, corrosion resistance, wear resistance, moisture resistance, and impact resistance are good. Having low external resistance, chalking resistance and gloss retention may be listed as their weak points. Polyester paint thicknesses are applied between 20-25 µm depending on the application area and performance expected from prepainted flat products. Although it is possible to apply paint film of greater thickness, but it is not really preferable because some weakness is revealed with regard to flexibility and surface appearance quality. The popular application areas of polyester painted metal sheets/strips are roof facade cladding, sandwich panels, garage doors, suspended ceiling, clutch production, white appliance goods, and rain water draining systems. Their UV resistance is assessed in the Class RUV 2.

By using chrome-free passivation and chrome-free prime coating ''Food Safety Certificate'' may be taken. Neutral salt spray test: 500 hours (EN 13523-8) is guaranteed.

**High Durable Polyester Based Prepainted flat products:** A type of paint with higher colour retention and flexibility properties (compared to regular polyester paints), whose usage increased in recent years, which is preferable for facade cladding, especially with composite panels

While polyester paints are evaluated as grade RUV2 with regard to UV resistance, high durable polyester paints, similar to PVDF paints, are evaluated as grade RUV4. Applied paint film thickness ranges between 20-25 µm, similar to thickness values for polyester paints.

By using chrome-free passivation and chrome-free prime coating ''Food Safety Certificate'' may be taken.

**PVDF-based painted flat products:** The strongest points of PVDF paints are very good colour and gloss retention, chalking resistance and resistance to quite a large number of chemical substances. Their flexibility, impact and wear resistance are also good. The following weak points may be specified: low resistance to scratching, smaller variety of colors and gloss compared to regular polyester paints, and, again compared to regular polyester paints, less application areas. Generally, thickness values for PVDF paint film range between 20 -25 µm..

**Common usage areas for PVDF prepainted flat products:** Having the best color and gloss retention properties among the paint types, these paints are preferable for regions where sun exposure is very strong to produce roof and facade cladding, sandwich panels and, in addition, composite products and advertising boards. PVDF paints are evaluated as grade RUV4

By using chrome-free passivation and chrome-free prime coating ''Food Safety Certificate'' may be taken.

**Neutral Salt Spray test: 750 hours (EN 13523-8) is guaranteed.**

**Polyurethane based prepainted flat products:** This type of paint reinforced with polyamide has very high scratching and friction resistance. Polyurethane-based paints may be applied smoothly or texture pattern (PUR- PA Texture). Their corrosion resistance, color, gloss retention and formability are also good. The usual application thickness of polyurethane paints is 20 micron.

**Popular application areas for polyurethane-based painted flat products:** Due to high scratching resistance, these paints are preferable for production of goods for which resistance to scratching is important, such as garage gates and roller shutters. Other application areas are roof and facade cladding. Polyurethane paints are evaluated as grade RUV3

**Neutral Salt spray test: 500 hours (EN 13523-8) is guaranteed.**

**Wrinkle polyester-based painted flat products:** Flexibility is as high as that of polyamidee-based paints. Due to the fact that the grain structure and texture are different from those of other paints, these are colour-coated flat products which create visual difference. These products are used especially for production of roofing tiles. Paint film thickness depends on the requested type of texture (pattern) and colour. Wrinkle polyester paints are evaluated as grade RUV3.

**Plastisol-based (PVC) painted flat products:** They have higher application thickness compared with the other paint types. Generally used thickness of dry paint film ranges between 100-200 µm. The strongest point of this paint is its very good resistance to corrosion and moisture. This paint type is suitable for bending and forming. One of the important properties is that they are suitable for embosser application.The color and gloss retention may be specified as their weakest aspects. For this reason, these paints are commonly used in regions where sun exposure is not very strong (e.g. Northern Europe).

**Neutral salt spray test: for finishing paint coat thickness: 150 – 200 micron, acc. to EN 13523-8 1000 hours is guaranteed**

## SPECIAL APPLICATIONS

**Antimicrobial products:** By using chrome-free passivation and chrome-free prime coating,the food safety tests of the polyester, high durable polyester, polyurethane and PVDF paints had been performed and certified. It prevents the formation of microorganism, such as bacteria, fungi and mold on the painted surfaces.

The application areas of antimicrobial paints: They are beneficial and preferred because they prevent microbial formations in interior facade cladding in hospitals, furniture and equipment, such as closet and drawer for hospital, in areas such as hospital elevators and restaurants, in the heating-cooling and ventilation systems, in the cold storage, kitchen applications and in the companies having production activity in the packaging sector.

**Antibacterial products:** These products prevent bacteria formation on the paint, not containing ftalat free

**Cool Roof products:** They are energy saving systems, decrease "heat island effect" which has a important effect on global warming.

**Finishing topcoat with orange effect (Orange Peel):** The products which have homogeneous orange peel appearance on the surface, which indicate very high flexibility and optimum hardness. Their area of application is white/home appliance goods.

**Chalkboard:** The surface has easily cleaning feature. FEVE varnish may be applied on the polyester topcoat or, if specified, special painting can be trialed.

## APPLICATION AREAS OF PREPAINTED STRIP/SHEET BASED ON PAINT TYPE

| Polyester, high durable polyester, polyurethane, PVDF, wrinkle polyester | Pur-Pa, Polyurethane, Polyester, High durable Polyester | Polyester, Gloss Polyester, Polyurethane, Pur-Pa |
|---|---|---|
| Roof and side facade cladding | Garage and entrance doors | Heaters, ventilators and air conditioners |
| Sandwich panels | shutter | Radiators |
| White/Home appliance panels | Rain gutters | Office furniture |
| Electronic device boxes | Internal panels | Window shades |
| Small home appliances | Truck and trailer side covers | Elevators |
| | Caravan side cladding | Waymark |
| | Trains | Profiles used in the roof manufacturing |
| | School buses | |

A warm climate, typical environment examples

| | Outdoor | Indoor |
|---|---|---|
| **C1 – Very low** | - | Buildings heated with clean atmosphere, e.g. offices, stores, schools, hotels. |
| **C2 – Low** | Atmospheres with low pollution level, (Mostly rural areas.) | Unheated buildings with condensation possibility, e.g. warehouse,storage, sport halls. |
| **C3 – Medium** | Urban and industrial atmospheres, medium sulfur dioxide pollution. (Low saltiness and shoreline ) | High moisture and air pollution, e.g. dining rooms, production-processing facilities, laundry rooms, breweries, dairy farms. |
| **C4 – High** | Industrial areas. (Medium saltiness and shoreline.) | Chemical facilities, swimming pools, shore, ship and shipyard. |
| **C5 - I – Very high** | High moisture and aggressive atmosphere and industrial zones. | Buildings and zones with almost always condensation and high pollution. |
| **C5 - M Very high** | With High saltiness,shore and sea areas. | Buildings and zones with almost always condensation and high pollution. |

## UV resistance category depend on regions

| | |
|---|---|
| **RUV2** | **Regions located north of about latitude 45 °N, with an altitude not greater than 900 m.** |
| **RUV3** | Regions located south of about latitude 45 °N and north of about latitude 37° N, with an altitude not greater than 900 m. |
| **RUV4** | Regions located south of about latitude 37 °N.Every region with an altitude greater than 900 m |

## Requirements for the UV resistance for natural and artificial testing conditions

| | RUV2 | | RUV3 | | RUV4 | |
|---|---|---|---|---|---|---|
| | Natural | QUV-A | Natural | QUV-A | Natural | QUV-A |
| **Minimum retained gloss after the test (RGb),** | ≥%30 | ≥%30 | ≥%50 | ≥%60 | ≥%80 | ≥%80 |
| **ΔE** | ≤5 | ≤5 | ≤3 | ≤3 | ≤3 | ≤2 |

Natural radiation = 2 year natural UV QUV-A= 2000 hours of UV

Table I below given the comparison of top coat paint properties.

| Paint Type | Code | Bedding Radius | Surface Hardness | Chemical Aggresitivity | Moisture Resistance | Corrosion Resistance | Color and Gloss Retentiont |
|---|---|---|---|---|---|---|---|
| **Polyester** | SP | 3,5 | 4 | 3 | 3 | 4 | 3 |
| **Wrinkle Polyester** | SP WR | 4 | 4,5 | 3 | 3 | 4 | 3,5 |
| **High Durable Polyester** | HD SP | 4 | 4 | 3 | 3,5 | 4 | 4 |
| | | | | | | | |
| **Poliamid -** | PUR-SP | 3,7 | 5 | 3 | 3,5 | 4 | 3 |
| **Modified Polyester** | | | | | | | |
| | | | | | | | |
| **Poliamid -** | PUR-PA | 4 | 5 | 3 | 3,5 | 4 | 3 |
| **Modified Polyurethan** | | | | | | | |
| **Polyvinylide ne Fluoride** | PVDF | 4,5 | 3 | 5 | 5 | 4,5 | 5 |
| **Polyvinyl Chloride Plastisol** | PVC (P) | 5 | 2 | 4 | 4 | 5 | 2 |

For the classification given above, and to ensure the application of painting and achievement of mechanical properties, primer is applied under the top coat painting; as for the back surface of the strip, to ensure corrosion resistance, visual quality and polyurethane adhesion, back coat paint is applied.

The types of the primer and back coat used are given in the Table II and Table III.

| PRIMER TYPE | PRIMER TYPE TR |
|---|---|
| SP (CF) | POLYESTER PRIMER CHROME FREE |
| SP (FLCR) | (*) POLYESTER FLEX PRIMER WITH CHROMATE |
| SP (FLCF) | POLYESTER FLEX PRIMER CHROME FREE |
| PVC (P)-PR | PLASTISOL PRIMER |
| SP (CF)-(T) | (*) TEXTURE PRIMER |
| SPWG (FLCF) | POLY.WHITE GOOD FLEX CF PRIMER-FA32B2234 |
| SPHC (FLCF) | POLY. HIGH COVERAGE FLEX CF PRIMER |

Table II

(*) For white appliance goods production, texture primer is used as primer coat when painted strip is used instead of powder paint.
(*) Polyester flex primer is used when shaping in Pur-Pa production.

| BACK COAT | BACK COAT TR |
|---|---|
| EP | EPOXY BACK COAT |
| EP-SP | EPOXY MODF. POLYESTER BACK |
| EP-SP-WR | EPOXY MOD POLY WRINKLE BACKCOAT |

Table III

*Production of color back coat is subjected to negotiation.

## MMK METALURJİ
## PREPAINTED STRIP PRODUCTION TOLERANCE TABLE (EN 10169:2010)

* For coatings of Z ≥ 200g/m², top coat finish paint T-bent test is applied as 2.5T; For epoxy polyester, back coat T-bent Testis applied as 4.5T. Epoxy back coat T-bent test is applied as5T.
* Impact test is 5J only for galvanized coating mass is 100 g/m² ≤Z<200g/m².
* For the coatings Z ≥ 200g/m², impact resistance test is not guaranteed.
* For the coatings Z ≥ 200g/m², back coat cupping test is not guaranteed.
* Metallic colors: RAL 9006 – RAL 9007
* Luminouscolors: RAL 1026 - RAL 2005 - RAL 2007 - RAL 3024 - RAL 3026

| | Polyester (Antibacterial, Antimicrobial, Gloss Polyester Finishing, Super Polyester ( High Durable)) based top coats and PVDF paints | |
|---|---|---|
| Topcoat thickness | Standard | Total top coat thickness |
| | 20 ±2 µm; for Metallic, luminous and nacred colors 18 ±2 µm | 25 ±3µm; for Metallic, luminous and nacred colors, total top coat 23 ± 3 µm |
| Primer thickness | 4 - 6 µm ( 5 ± 1 µm ) | |
| Back coat thickness | 7 ± 1 µm | |
| Color deviation for top coat | ΔE ⩽ 1 | |
| | (for metallic luminous and nacred ΔE ⩽ 2) | |
| 60° top coat gloss | 1⩽ Matt <13 | |
| | 13 ⩽ Low Gloss <23 | |
| | 23 ⩽ Semi Gloss < 45 | |
| | 45 ⩽ Gloss < 76 | |
| | 76 ⩽ High Gloss <110 | |
| MEK rub test for top coat | ⩾ 100 | |
| | for metallic, luminous and nacred ⩾ 50 | |
| MEK rub test for back coat | ⩾ 50 | ⩾ 50 |
| Adhesion test for top coat | ⩾ 6mm - 0 | ⩾ 6mm - 0 |
| (After cupping) | | |
| Adhesion test for top coat | ⩾ 4mm - 0 | ⩾ 4mm - 0 |
| (After cupping) | | |
| Pencil hardness for top coat | Min. F | |
| T-bend test for Top coat | Max. 2T | |
| T-bend test for Back coat | Max. 3T | |
| Reverse impact test | ⩾ 10 J | |

## MMK METALURJİ
## PREPAINTED STRIP PRODUCTION TOLERANCE TABLE (EN 10169:2010)

| | **Wrinkle Polyester** | **PUR-PA and PUR** | **Plastisol** |
|---|---|---|---|
| Topcoat thickness | **Standard** | **Standard** | |
| | 20 ±2 µm; | 20 ±2 µm; for metallic, luminous and nacred colors 18 ±2 µm | Ordered paint thickness ± %10 |
| Primer thickness | 4 - 6 µm ( 5 ± 1 µm ) | | |
| Back coat thickness | 7 ± 1 µm | | |
| Color deviation for top coat | ΔE ⩽ 1 | ΔE ⩽ 1 | ΔE ⩽ 2 |
| | | (for metallic luminous and nacred ΔE ⩽ 2) | |
| 60° top coat gloss | Matt ⩽ 12 | 1⩽ Matt <13 | |
| | | 13 ⩽ Low Gloss <23 | |
| | | 23 ⩽ Semi Gloss < 45 | |
| | | 45 ⩽ Gloss < 76 | |
| | | 76 ⩽ High Gloss <110 | |
| MEK rub test for top coat | ⩾ 100 | | - |
| | for metallic, luminous and nacred ⩾ 50 | | |
| MEK rub test for back coat | ⩾ 50 | | ⩾ 50 |
| Adhesion test for top coat | ⩾ 6mm - 0 | | ⩾ 6mm - 0 |
| (After cupping) | | | |
| Adhesion test for top coat | ⩾ 4mm - 0 | | ⩾ 4mm - 0 |
| (After cupping) | | | |
| Pencil hardness for top coat | Min. F | | - |
| T-bend test for Top coat | Max. 2T | | Max. 0,5 T |
| T-bend test for Back coat | Max. 3T | | |
| Reverse impact test | ⩾ 10 J | | - |

The customer specs rather than above given table and limits are subjected to negotiation.

* For polyamide containing paints , PVC and wrinkle paints pencil hardness is not considered.
* Pencil hardness and MEK test are not performed for plastisol paints.
* The reverse impact test is 4J for polyamide (PUR-PA and PUR) containing paints.
* The gloss value of the wrinkle paints should be matt.
* Plastisol High Gloss paints are subjected to negotiation during the order stage.

## IMPORTANT NOTES:

• Tolerance tables for white appliance production are prepared based one valuation of customers' technical specifications.
• If requested, food-safe certificates can be given. It should be specified during the order stage.
• Our products have Reach and RoSH certificates.
• The paints, in the special products group are subjected to negotiation.
• For preventing the color deviationon the metallic painted sheet/strips productions, the orders are required to be given at least the project amount.

## GENERAL INFORMATION ABOUT PREPAINTED PRODUCTS

| | Min. (mm) | Max. (mm) |
|---|---|---|
| **Thickness** | 0,25* | 1,2 |
| **Width** | 800 | 1500 |
| **Internal diameter of the coil** | 508 | 610 |
| **External diameter of the coil** | | 1520 |
| **Coil weight** | 3 ton | 11 ton |
| **Plate length** | 500 | 6000 |
| **Plate width** | 370 | 1530 |
| **Package weight of the plate** | ..... | 8 ton |
| **Slitted coil width** | 50 | |

* For the orders thickness of less than 0.27 mm, special thickness tolerance is not accepted.

* 0.25 mm painted production is subjected to negotiation.

NOTE 1: For cold lamination (film coating) requested strips, cartoon or steel sleeve is used.
NOTE 2: For the top coat paint types are SP-WR (Polyester Wrinkle) and PUR-PA, cartoon sleeve must be used.

## Application areas of the prepainted products and standard equivalents

| General application area and main properties | Standard equivalent | | | Material no | Former STD | AMERICAN | JAPANESE |
|---|---|---|---|---|---|---|---|
| | | Standard grade | MMK Grade no | | | | |
| **Low carbon, galvanized coated, prepainted steels, suitable for cold forming** | EN 10169 | EN 10346 -DX51D+Z | 300051 | 10.917 | DIN EN 10142 Fe P02 G Z | ASTM A653 CS Type C | JIS 3302 SGCC |
| | | EN 10346 -DX52D+Z | 300052 | 10.918 | DIN EN 10142 Fe P03 G Z | ASTM A653 CS Type B | JIS 3302 SGCD1 |
| | | EN 10346 -DX53D+Z | 300053 | 10.951 | DIN EN 10142 Fe P05 G Z | ASTM A653 FS Type B | JIS 3302 SGCD2 |
| | | EN 10346 -DX54D+Z | 300054 | 10.952 | DIN EN 10142 Fe P05 G Z | ASTM A653 FS Type B | JIS 3302 SGCD2 |
| **Galvanized coated, prepainted structural steels** | | EN 10346 - S220GD+Z | 311220 | 10.241 | DIN EN 10147 Fe E 220 G Z | ASTM A653 SS Gr 230 | |
| | | EN 10346 - S250GD+Z | 311250 | 10.242 | DIN EN 10147 Fe E 250 G Z | ASTM A653 SS Gr 255 | JIS 3302 SGC 340 |
| | | EN 10346 - S280GD+Z | 311280 | 10.244 | DIN EN 10147 Fe E 280 G Z | ASTM A653 SS Gr 275 | JIS 3302 SGC 400 |
| | | EN 10346 - S320GD+Z | 311320 | 10.250 | DIN EN 10147 Fe E 320 G Z | ASTM A653 SS Gr 340 | JIS 3302 SGC 440 |
| | | EN 10346 - S350GD+Z | 311350 | 10.529 | DIN EN 10147 Fe E 350 G Z | ASTM A653 SS Gr 340 | JIS 3302 SGC 490 |

* The mechanical properties of the steel products used in painting may change because of the painting process. Steel exposed to aging, may occur increasing in the tensile and yield strength, decreasing in percentage elongation, Lüders band appearance and fluting effect. For this reason, it is recommended to order for the upper grade for deep drawing grades.

* The mechanical test guarantee of the painted products is given according to DIN EN 10346 for the products which are galvanized coated before painting. After painting, the results of the mechanical test are valuated depending on negotiation.

## PRODUCIBILTY LIMITS - EN 10143

| PRODUCIBILTY LIMITS of COLD ROLLED, GALVANIZED COATED,PREPAINTED COIL (PPG) | | | | | |
|---|---|---|---|---|---|
| Thickness (mm) | Width min (mm) | Group 1 | Group 2 | Group 3 | Group 4 |
| 0,25-0,30 | 800 | - | 1070 | - | - |
| 0,31-0,34 | 800 | - | 1250 | 1070 | 1070 |
| 0,35-0,40 | 800 | - | 1300 | 1250 | 1070 |
| 0,41-0,45 | 800 | - | 1300 | 1250 | 1070 |
| 0,46-0,49 | 800 | - | 1500 | 1250 | 1070 |
| 0,50-0,69 | 800 | - | 1500 | 1250 | 1250 |
| 0,70-1,20 | 800 | 1500 | 1500 | 1500 | 1500 |

The dimensions out of the dimensions specified in the table for the limits that can be produced are subjected to negotiation.

| PRODUCIBILTY LIMITS of COLD ROLLED, GALVANIZED COATED, PREPAINTED CUT TO LENGTH FROM COIL(PPGCP) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Thickness (mm) | Width min (mm) | Group 1 | Group 2 | Group 3 | Group 4 | Length | |
| | | | | | | Min | Max |
| 0,25-0,30 | 800 | - | 1070 | - | | 500 | 6000 |
| 0,31-0,34 | 800 | - | 1250 | 1070 | 1070 | 500 | 6000 |
| 0,35-0,40 | 800 | - | 1300 | 1250 | 1070 | 500 | 6000 |
| 0,41-0,45 | 800 | - | 1300 | 1250 | 1070 | 500 | 6000 |
| 0,46-0,49 | 800 | - | 1500 | 1250 | 1070 | 500 | 6000 |
| 0,50-0,69 | 800 | - | 1500 | 1250 | 1250 | 500 | 6000 |
| 0,70-1,20 | 800 | 1500 | 1500 | 1500 | 1500 | 500 | 6000 |

The dimensions out of the dimensions specified in the table for the limits that can be produced are subjected to negotiation.

| PRODUCIBILTY LIMITS of COLD ROLLED, GALVANIZED COATED, PREPAINTED SLITTED COIL(PPGSP) | | | | | |
|---|---|---|---|---|---|
| Thickness (mm) | Width min (mm) | Group 1 | Group 2 | Group 3 | Group 4 |
| 0,25-0,30 | 800 | - | 1070 | - | |
| 0,31-0,34 | 800 | - | 1250 | 1070 | 1070 |
| 0,35-0,40 | 800 | - | 1300 | 1250 | 1070 |
| 0,41-0,45 | 800 | - | 1300 | 1250 | 1070 |
| 0,46-0,49 | 800 | - | 1500 | 1250 | 1070 |
| 0,50-0,69 | 800 | - | 1500 | 1250 | 1250 |
| 0,70-1,20 | 800 | 1500 | 1500 | 1500 | 1500 |

The dimensions out of the dimensions specified in the table for the limits that can be produced are subjected to negotiation.

## IMPORTANT NOTES 2:

• For the mechanical properties of the prepainted sheet/strip, the bottom sheet is taken as the basis. The bottom sheet/strip is the galvanized sheet produced according to EN 10346 standard.
• For the dimension and shape tolerances of the prepainted sheet/strip, the bottom sheet is taken as the basis. The bottom sheet/strip is the galvanized sheet produced according to EN 10143 standard.

## NORM READING

**EN 10169 – DX51D+Z 100 – EN 10346 – SP 25 – 2T – RC2 – RUV2**

**Z:** Zinc (gr/m²)
**SP:** Polyester
**T:** Flexibility
**RC:** Corrosion resistance
**RUV:** Ultraviolet resistance

The material according to EN 10346 standard, Grade DX51, 100g/m² galvanized coated; EN 10169 standard 25 micron total paint (5 micron primer / 20 micron top coat), top coat is polyester paint type, flexibility resistance 2T, corrosion resistance category 2, ultraviolet resistance category 2