

**STEEL**



**BN Trade**

PRODUCT CATALOGUE

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

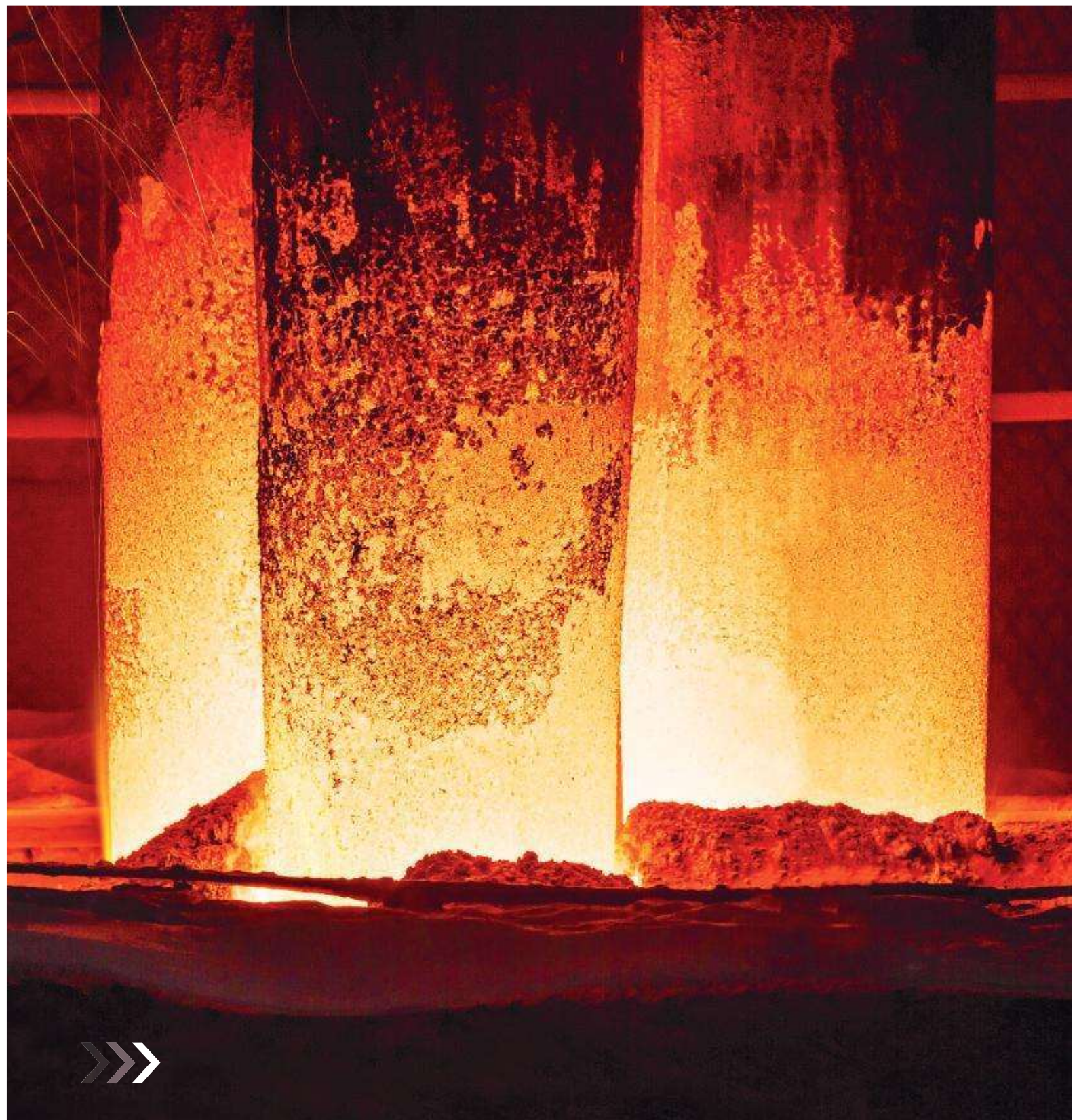
Abbreviations and Symbols Used for Chemical Elements	
Symbol	Element
C	Carbon
Mn	Manganese
P	Phosphorus
S	Sulphur
Si	Silicon
Al	Aluminum
Cu	Copper
N	Nitrogen
O	Oxygen
H	Hydrogen
Ca	Calcium
Ti	Titanium
V	Vanadium
Cr	Chromium
Ni	Nickel
Mo	Molybdenum
Nb	Niobium (Columbium)
B	Boron
Sn	Tin
Fe	Iron
Zn	Zinc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

- Please ask the relevant sales department for other dimensions not included in the catalogue.

- Please call the relevant 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 <sup>2</sup> )
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 ( $\pm 7\%$ )
- 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 natural 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/m<sup>2</sup>).
- 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/m<sup>2</sup>

Normal: 1.0-2.0g/m<sup>2</sup>

Abundant: 2.0-3.0 g/m<sup>2</sup>

- 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<sub>IW</sub>) 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					
	ASTM A 1018	SS Grade 50	151150					
		SS Grade 30	151830					
		SS Grade 33	151833					
SS Grade 36 Type 1		151836						
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  $\geq$  0,020) Cu % is max. 0.30.

## Mechanical Properties

Standard	Grade	MMK Grade No	ReL N/mm <sup>2</sup>		Rm N/mm <sup>2</sup>	Elongation				War- ranty period
			1.0mm $\leq$ t<2mm	2mm $\leq$ t<11mm		L0=80mm			L0=5,65 $\sqrt$ S0	
						1.0mm $\leq$ t<1.5mm	1.5mm $\leq$ t<2mm	2mm $\leq$ t<3mm	3mm $\leq$ 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  $\geq$  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.	max.	min.	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	---	---

- (a) Where an ellipsis (. . .) appears in the table, it means that there is no specified limit, but the analysis shall be reported.
- (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%.
- (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%.
- (d) Specify Type B to avoid carbon levels below 0.02%.
- (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.
- (f) When an aluminum deoxidized steel is required, it is permissible to order a minimum of 0.01% total aluminum
- (g) It is permissible to furnish as a vacuum degassed or chemically stabilized steel, or both, at producer's preference.
- (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
Standard	Grade		N/mm <sup>2</sup>	N/mm <sup>2</sup>	Thickness mm
		min	min	A <sub>50</sub> 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)

- (a) Tensile test and elongation values apply to "longitudinal" test pieces. They are determined according to ASTM A370 standard.
- (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  $\geq 0.020\%$ , the maximum limit of nitrogen does not apply.
2. For max. CEV value is increased by 0.02%, for Si %  $\leq 0.03$  and 0.01% for Si %  $\leq 0.25$ .
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/mm <sup>2</sup>		Rm N/mm <sup>2</sup>		Elongation					Impact(long) (c) 27.		
			$t \leq 16\text{mm}$	$16\text{mm} < t$	$t < 3\text{mm}$	$3\text{mm} \leq t$	L0=80mm				L0=5,65 $\sqrt{S0}$	3mm $\leq t$	Sic. °C	Joule (Min)
							$t \leq 1\text{mm}$	$1 < t \leq 1,5\text{mm}$	$1,5 < t \leq 2,0\text{mm}$	$2 < t \leq 2,5\text{mm}$	$2,5\text{mm} < t < 3\text{mm}$			
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	
Standard	Grade		N/mm <sup>2</sup>	N/mm <sup>2</sup>	Thickness mm	
			min	min	A <sub>50</sub> mm	A <sub>200</sub> 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

- Mechanical test is not carried out.
- 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	

- (a) If total Al % is at minimum 0.020 in the chemical composition of the steel, N top limit value is not applied.
- (b) The maximum CEV value increased is 0.02% for Si % ≤ 0.03, 0.01% for Si % ≤ 0.25.
- (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.
- (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.

<b>"Class 1" and "Class 3" suitability to galvanization classes are applied according to the table below:</b>			
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		Rm (1)		A (%) min						Impact (Lengthwise) (b,c)	
			N/mm <sup>2</sup>		N/mm <sup>2</sup>		Thickness mm							
Standard	Grade (4)		t = thickness mm		t = thickness mm		A80			L0=5,65 √S0			Sic °C	J (min)
			≤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		
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 angles 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.	max.	min.	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 N/mm <sup>2</sup>	Rm N/mm <sup>2</sup>	A (%) min				Folding (transverse 180 °C) (t= thickness)
					Thickness mm				
Standard	Grade		A50 mm		A200 mm				
		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.	max.	min.	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 N/mm <sup>2</sup>	Rm N/mm <sup>2</sup>	A (%) min		Impact (b) (lengthwise)		bending (b) (transverse 180 )
					Thickness mm		Temp. °C	J (min)	
Standard	Grade		min	min	A50 mm	A200 mm			
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  $6 \leq d \leq 20$  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.	max.	min.	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)  $V+Nb+Ti \leq 0.22\%$  and  $Mo+Cr \leq 0.30\%$

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	$\leq 0.030$	$\leq 0.090$	-
Class 2(a)	$\leq 0.35$		
Class 3	$0.14 \leq Si \leq 0.25$	-	$\leq 0.035$

- 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  $Si \leq 0.030\%$ , CEV is increased by 0.02%;
- For  $Si \leq 0.25\%$  CEV is increased by 0.01%.

**Mechanical Properties (a)**

	Grade	MMK Grade No	ReL N/mm <sup>2</sup>		Rm (a) N/mm <sup>2</sup>	Elongation L0=5,65 vS0		Impact ( longitudinal) (b)				Bending (transverse 180 °C) t= thickness
			t $\leq$ 16mm	16mm<t	t $\leq$ 20mm	L0=80mm		Temp. °C, Min (Joule)				
						t $\leq$ 16mm	16mm<t	+20 °C	0 °C	-20 °C	-50 °C	
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 negotiation.

### 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	
Standard	Grade		N/mm <sup>2</sup>	N/mm <sup>2</sup>	Thickness mm	
			min	min	A <sub>50</sub> mm	A <sub>200</sub> 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	Alttotal (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  $\leq 0,050\%$  Nb and/or  $\leq 0,03\%$  Ti. In such cases the content of these elements is to be reported in the inspection document
3. (c) If  $(Al / N) \% \geq 2.2$  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/mm <sup>2</sup>	N/mm <sup>2</sup>	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)  $Cr + Cu + Mo + Ni: \leq 0.70\%$ .
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		Rm (a)	A (%) min	Impact (b,c) (Transverse)J (min)			(a,b) R <sub>0,2</sub> Temp. =300°C	
Standard	Grade		N/mm <sup>2</sup> min		N/mm <sup>2</sup>	L0=5,65 √S0	Sic C			N/mm <sup>2</sup> min	
			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 <sub>(c)</sub> total	%Ti	%Cr	%Ni	%Mo	%Cu (e)	%N	%CEV (d)	
			max.	max.	max	max.	max.	max.	max.	max.	min.	max.	max.	max.	max.	max.	max.	t≤16mm
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/mm <sup>2</sup>		Rm (a) N/mm <sup>2</sup>	Elongation		Impact lengthwise (b)				Folding test (c,d) (Transverse 180 °C)
			t≤16mm	16mm<t	t≤20mm	L0=80mm L0=5,65 √S0		Sic. °C , Min (Joule)				t= thickness
						t≤20mm		+20 °C	0 °C	-20 °C	-50 °C	
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 separately 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
			N/mm <sup>2</sup>	N/mm <sup>2</sup>	A <sub>50</sub> mm	A <sub>50</sub> mm
Standard	Grade		min	min	Thickness mm	Thickness mm
					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)  $Nb + Ti + V \leq 0.22\%$
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°)
Standard	Grade		N/mm <sup>2</sup>	N/mm <sup>2</sup>	Thickness mm		Temp. °C	J (min)	
		min	min	A80 mm	L0=5,65 √S0				
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/mm<sup>2</sup> 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
Standard	Grade		N/mm <sup>2</sup>	N/mm <sup>2</sup>	Thickness mm
			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)

- (a) Tensile test values apply to "longitudinal" test pieces.
- (b)  $A_{50} (\%) = 1940 S_{0.2} / U_{0.9}$  ( $S_{0.2}$ : Cross-sectional area of the specimen, mm<sup>2</sup>; U: Specified minimum tensile strength, N/mm<sup>2</sup>).
- (c) Specified elongation value applies to thickness of  $\geq 4.57$  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

- (a)  $Cu \leq 0,50\%$ ,  $Ni \leq 0,50\%$ ,  $Cr \leq 0,50\%$ ,  $Mo \leq 0,15\%$
- (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..
- (c) Unless otherwise specified,  $Nb + V \leq 0.06$  % is applied
- (d)  $Nb + V + Ti \leq 0,15\%$
- (e) Unless otherwise specified, these values are valid.
- (f) Unless otherwise specified,  $(Nb + V + Ti) \leq 0.15$  % is applied
- (g) Unless otherwise specified, B is not added and  $B \leq 0,001\%$  is applied
- These grades are produced up to 12 mm thickness.

## Mechanical Properties

Standard Equivalent		MMK Grade No	Rt 0,5 N/mm <sup>2</sup> (a)	Rm (a)	A f (50mm or 2 inches)% (b)
Standard	Grade (c)		N/mm <sup>2</sup>	N/mm <sup>2</sup>	
			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  $\geq 12,7\text{mm}$ . For thinner thicknesses ( $<12,7\text{mm}$ );

$$A_{50} = A_f = C \frac{A_{xc}^{0,2}}{U^{0,9}}$$

Axc: cross-sectional area of specimen, mm<sup>2</sup>; U: minimum tensile strength, N/mm<sup>2</sup>

formulation is applied.

3. (c) There are some discrepancies (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  $\geq 0,020$ ) % Cu is max. 0.30.

### Mechanical Properties

Standard	Grade	MMK Grade No	ReL N/mm <sup>2</sup>		Rm N/mm <sup>2</sup>	Elongation				Guarantee
			1.0mm $\leq$ t<2mm	2mm $\leq$ t<11mm		L0=80mm			L0=5,65 $\sqrt{S0}$	
						1.0mm $\leq$ t<1.5mm	1.5mm $\leq$ t<2mm	2mm $\leq$ t<3mm	3mm $\leq$ 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.	%Mmax.	%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  $\leq 0.25\%$ , and 0.02 % for Si  $\leq 0.030\%$
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/mm <sup>2</sup>		N/mm <sup>2</sup>		Thickness mm							
Standard	Grade	MMK Grade No	t = thickness mm		t = thickness mm		A80			L0=5,65 √S0		3mm≤t	Sic °C	J (min)
			<=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			
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)
					Thickness mm				
Standard	Grade	MMK Grade no	N/mm <sup>2</sup>	N/mm <sup>2</sup>	A80 mm	L0=5,65 √S0	Sic C	J (min)	
			min	min	3<t	t≥3			
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/S275J0/S275J2C / EN 10025-4 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, EN 10025-4 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	EN 10025-4 S420N/S420 NL, S460 N/S460NL, EN 10025-4 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 1<sup>st</sup> and 2<sup>st</sup> 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 1<sup>st</sup> and 2<sup>nd</sup> 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/S275J0C/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 1<sup>st</sup> and 2<sup>st</sup> 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 1<sup>st</sup> and 2<sup>nd</sup> 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

Nominal thickness (t) mm	Table1: Thickness tolerances			Table 1:SPECIAL thickness tolerances		
	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/mm<sup>2</sup> (Re≤300 N/mm<sup>2</sup>):**

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/S275J0/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

Nominal thickness (t) mm	Table 2:Tolerances on thickness			Special tolerances on thickness		
	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  $300 < Re \leq 360$  N/mm<sup>2</sup>:**

EN 10025-2 S355JR/S355J0/S355J2/S355K2, EN 10025-2 S355JRC/S355J0C/S355J2C, EN 10025-4 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

Nominal thickness (t) mm	Table 3: Tolerances on thickness <sup>2</sup>			Special tolerances on thickness		
	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  $360 < Re \leq 420$  N/mm<sup>2</sup>**

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

Nominal thickness (t) mm	Table 4: Tolerances on thickness			Special thickness tolerances		
	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  $420 < Re \leq 900$  N/mm<sup>2</sup>:**

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,

Nominal thickness (t) mm	Table 5: Tolerances on thickness			Special thickness tolerances		
	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						
Nominal width (w) mm	Max. thickness change tolerance			Special tolerance		
	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

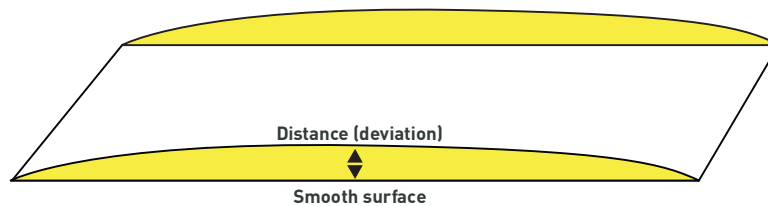
The length of the shorter one of both edges in the rolling direction is considered as the length of the sheet.

## FLATNESS TOLERANCE

Table 8: tolerances on flatness for steels with a specified minimum yield strength, Re ≤ 300 N/mm <sup>2</sup>			
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

Nominal thickness (t) mm	Nominal width (w) mm	300N/mm <sup>2</sup> <Re ≤ 360 N/mm <sup>2</sup>	360N/mm <sup>2</sup> <Re ≤ 420 N/mm <sup>2</sup>	420N/mm <sup>2</sup> <Re ≤ 900 N/mm <sup>2</sup>
t ≤ 20	w ≤ 1200	18 / 9*	23	It is subjected to agreement during order
	1200 < w ≤ 1500	23 / 12*	30	
	w > 1500	28 / 14*	38	
Note :	"Narrow flatness" between 360N/mm <sup>2</sup> <Re ≤ 420 N/mm <sup>2</sup> is not accepted			

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



### Flatness Measurement

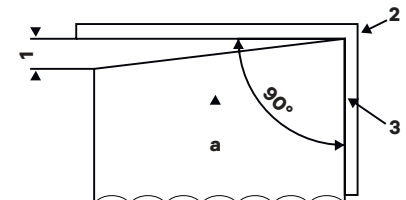
- The flatness tolerance is the maximum acceptable distance between the bottom surface of a metal sheet or plate, placed on a smooth surface, and the smooth surface.
- The flatness tolerance is guaranteed for cut to length from coil products. The flatness tolerance is not accepted for the orders produced 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 .

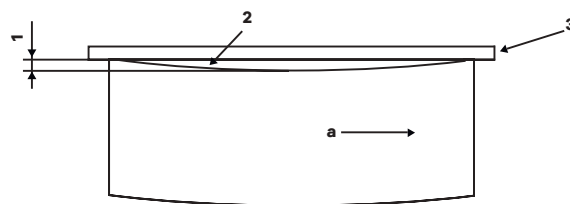
- 1: Corner perpendicularity (u)/ Out of squareness
- 2: Square
- 3: Side edge
- a: Rolling direction



### 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 exceeded 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 exceeded 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

Product type	Edge camber			
	Product dimensions		Tolerance (mm)	
	Width (mm)	Length (mm)	Mill edge	Trimmed edge
Plate/Sheet	w ≥ 600	l ≥ 5000	20	15
	w ≥ 600	l < 5000	l × 0,005	l × 0,005
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/mm <sup>2</sup>	300N/mm <sup>2</sup> <Re ≤ 360 N/mm <sup>2</sup>	360N/mm <sup>2</sup> <Re ≤ 420 N/mm <sup>2</sup>	420N/mm <sup>2</sup> <Re ≤ 900 N/mm <sup>2</sup>
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 (telescoping) shall not exceed the deviations given in the table.

TELESCOPY TOLERANCE			
Product	Width (mm)	With uncut edge	With 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



## **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 guaranteed 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 treatments 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 decrease 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/m<sup>2</sup>)

→ Light: 0,5-1,0 gr/m<sup>2</sup>

→ Normal: 1,0-1,5 gr/m<sup>2</sup>

→ Heavy: 1,5-2,0 gr/m<sup>2</sup>

\* For the oiling over 2g/m<sup>2</sup> 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/m<sup>2</sup> and minimum 70 g/m<sup>2</sup>. The orders greater than 400g/m<sup>2</sup> coating and the orders less than 70 g/m<sup>2</sup> coating are subjected to negotiation. For the orders with thickness less than 0.50 mm and coating greater than 180 g/m<sup>2</sup> 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	GHR Grade No					
Cold rolled/Hot rolled Galvanized low C steel, Suitable for cold forming	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	EN 10346 :2015	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
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	
Cold rolled/Hot rolled galvanized low C steels for cold forming		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	ASTM A 653	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	
Cold rolled/hot rolled Galvanized High strength, low alloyed steels for cold forming		SS 60/ 410	251410	261410			EN 10346 S420GD+Z	
		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/mm <sup>2</sup>	Group -2 <= 260 kg/mm <sup>2</sup>	Group -3 <= 300 kg/mm <sup>2</sup>	Group -4 <= 400 kg/mm <sup>2</sup>	Group -5 <= 550 kg/mm <sup>2</sup>
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/mm <sup>2</sup>	Group -2 <= 260 kg/mm <sup>2</sup>	Group -3 <= 300 kg/mm <sup>2</sup>	Group -4 <= 400 kg/mm <sup>2</sup>	Group -5 <= 550 kg/mm <sup>2</sup>	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/mm <sup>2</sup>	Group -2 <= 260 kg/mm <sup>2</sup>	Group -3 <= 300 kg/mm <sup>2</sup>	Group -4 <= 400 kg/mm <sup>2</sup>	Group -5 <= 550 kg/mm <sup>2</sup>
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	
							min.	max.
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/m <sup>2</sup> (both of surface)*	600 g/m <sup>2</sup> 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 coil is 508 or 610.

- Internal diameter of the coil tolerances may be +/- 20mm.
- \* For the coating less than 70g/m<sup>2</sup> and greater than 400g/m<sup>2</sup>, 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)	America	Japanese
			EN 10346:2015		
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)	America	Japanese
			EN 10346:2015		
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)		Rela) (Rp0.2/ReL)(N/mm <sup>2</sup> )	Rm(N/mm <sup>2</sup> )	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/mm<sup>2</sup>
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								
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/mm <sup>2</sup>	Rm N/mm <sup>2</sup>	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/mm<sup>2</sup>
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/mm <sup>2</sup>	Rm N/mm <sup>2</sup> (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.	Alttotal	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/mm <sup>2</sup> )	Rm	A80%(b,c)	r90 (c, d)	n90
				(N/mm <sup>2</sup> )	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 Ti can be added singly or in combination for increasing strength.

## Mechanical Properties

Grade	MMK Grade No	MMK Grade no	Re N/mm <sup>2</sup>	Rm N/mm <sup>2</sup> (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/m <sup>2</sup>				Surface quality
	Triple spot test		Single Spot Test		
	g/m <sup>2</sup>	µm	g/m <sup>2</sup>	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/m<sup>2</sup>, 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/ft <sup>2</sup>	mil
	oz/ft <sup>2</sup>	mil	oz/ft <sup>2</sup>	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/m <sup>2</sup>	μm	
	g/m <sup>2</sup>	μm	g/m <sup>2</sup>	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/ft <sup>2</sup> = 305 g/m <sup>2</sup> = 1.68 mils			
Coating weight		Coating thickness	
oz/ft <sup>2</sup>	[g/m <sup>2</sup> ]	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,  $Re < 260 \text{ N/mm}^2$

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  $260 \leq$  minimum Yield strength,  $Re < 360 \text{ N/mm}^2$  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  $360 \leq$  minimum Yield strength,  $Re < 420N/mm^2$**

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

\* 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  $\leq 80$  mm.
3. For Z450 and Z600 total coating weights, normal and special thickness tolerances are increased  $\pm 0.01$  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**

Width	Tolerances on width of sheet and wide strip of width $\geq 600$ mm			
	Width tolerances		Special tolerance (*), (**)	
	-	+	-	+
$600 \leq w \leq 1200$	0	5	0	2
$1200 < w \leq 1500$	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.

Nominal thickness (t) (mm)	The tolerances on width of slit wide strip of width $< 600$ mm							
	$w < 125$		$125 \leq w < 250$		$250 < w \leq 400$		$400 \leq w \leq 600$	
	-	+	-	+	-	+	-	+
$t < 0,6$	0	0,4	0	0,5	0	0,7	0	1
$0,6 \leq w < 1,0$	0	0,5	0	0,6	0	0,9	0	1,2
$1,0 \leq w < 2,0$	0	0,6	0	0,8	0	1,1	0	1,4
$2,0 \leq w \leq 3,0$	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  $R_{p0,2} < 260$  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  $260 \text{ MPa} \leq R_{p0,2} < 360$  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  $R_{p0,2} \geq 360$  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.

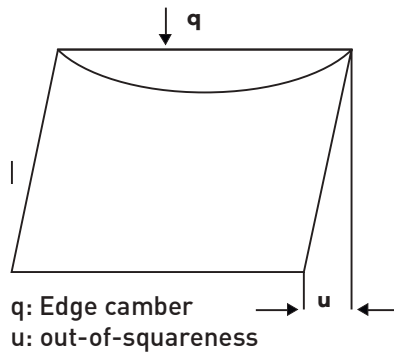
### EDGE CAMBER TOLERANCE

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



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/m<sup>2</sup>)

**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/m<sup>2</sup>, 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/m<sup>2</sup>)

**M:** Minimized spangle (flowerless)

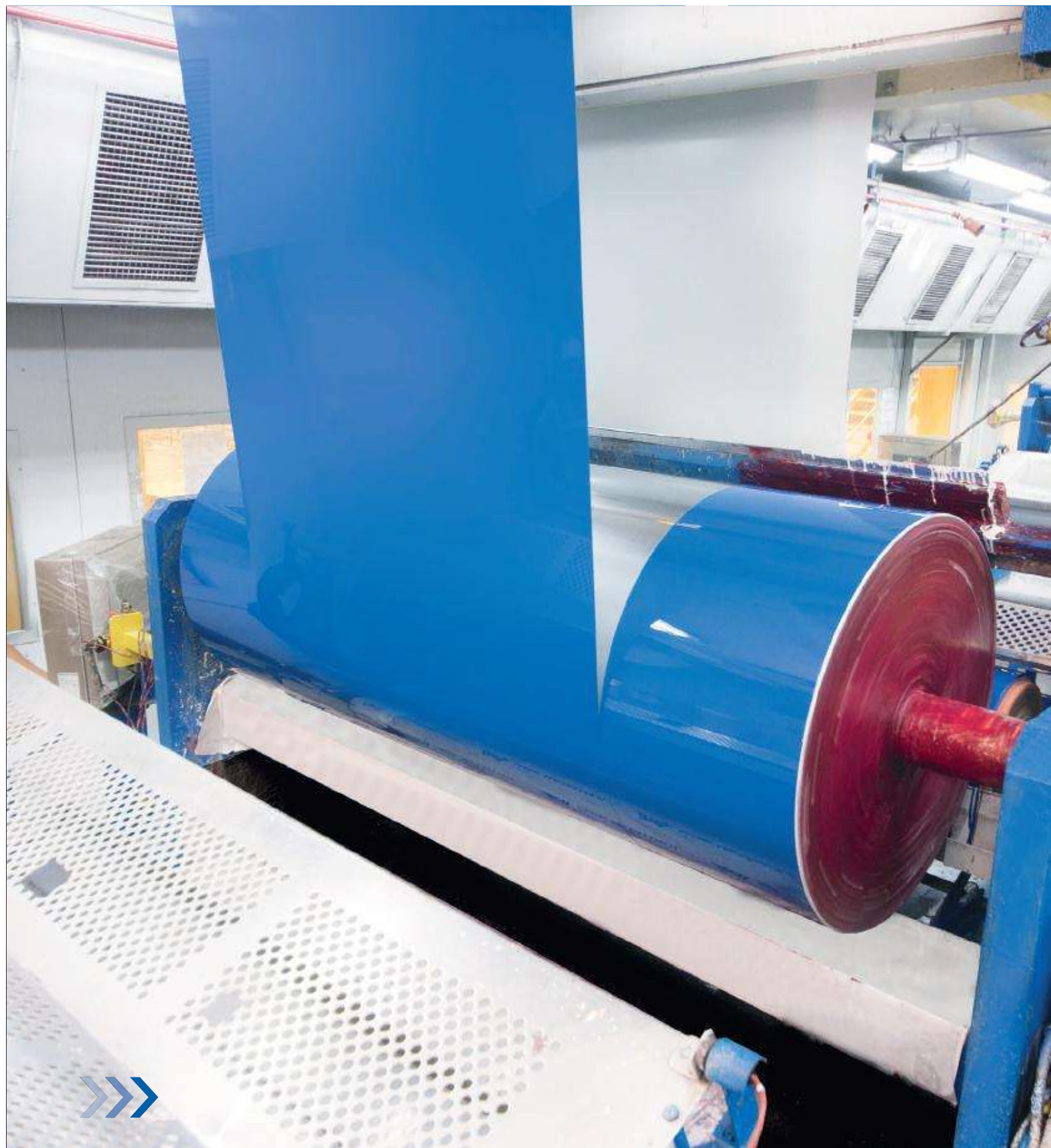
**A:** Surface

**O:** Oil

**C:** Chromate

Surface treatment oiled (O) and chromate (C), of A surface, with minimized spangle galvanized coating of 100g/m<sup>2</sup>, 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 diluents 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 polyamide-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
<b>C1 – Very low</b>	-	Buildings heated with clean atmosphere, e.g. offices, stores, schools, hotels.
<b>C2 – Low</b>	Atmospheres with low pollution level, (Mostly rural areas.)	Unheated buildings with condensation possibility, e.g. warehouse, storage, sport halls.
<b>C3 – Medium</b>	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.
<b>C4 – High</b>	Industrial areas. (Medium saltiness and shoreline.)	Chemical facilities, swimming pools, shore, ship and shipyard.
<b>C5 - I – Very high</b>	High moisture and aggressive atmosphere and industrial zones.	Buildings and zones with almost always condensation and high pollution.
<b>C5 - M Very high</b>	With High saltiness, shore and sea areas.	Buildings and zones with almost always condensation and high pollution.

#### UV resistance category depend on regions

<b>RUV2</b>	Regions located north of about latitude 45 °N, with an altitude not greater than 900 m.
<b>RUV3</b>	Regions located south of about latitude 45 °N and north of about latitude 37° N, with an altitude not greater than 900 m.
<b>RUV4</b>	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 (R <sub>Gb</sub> ),	≥%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	Surface	Chemical	Moisture	Corrosion	Color and Gloss
		Radius	Hardness	Aggressivity	Resistance	Resistance	Retentiont
<b>Polyester</b>	SP	3,5	4	3	3	4	3
<b>Wrinkle Polyester</b>	SP WR	4	4,5	3	3	4	3,5
<b>High Durable Polyester</b>	HD SP	4	4	3	3,5	4	4
<b>Poliamid - Modified Polyester</b>	PUR-SP	3,7	5	3	3,5	4	3
<b>Poliamid - Modified Polyurethan</b>	PUR-PA	4	5	3	3,5	4	3
<b>Polyvinylide ne Fluoride</b>	PVDF	4,5	3	5	5	4,5	5
<b>Polyvinyl Chloride Plastisol</b>	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  $Z \geq 200\text{g/m}^2$ , 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 as 5T.

\* Impact test is 5J only for galvanized coating mass is  $100\text{ g/m}^2 \leq Z < 200\text{g/m}^2$ .

\* For the coatings  $Z \geq 200\text{g/m}^2$ , impact resistance test is not guaranteed.

\* For the coatings  $Z \geq 200\text{g/m}^2$ , back coat cupping test is not guaranteed.

\* Metallic colors: RAL 9006 – RAL 9007

\* Luminous colors: 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	Total top coat thickness
Standard 20 ±2 µm; for Metallic, luminous and naced colors 18 ±2 µm	25 ±3µm; for Metallic, luminous and naced 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 naced 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 naced ≥ 50
MEK rub test for back coat	≥ 50
Adhesion test for top coat (After cupping)	≥ 6mm - 0
Adhesion test for top coat (After cupping)	≥ 4mm - 0
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 METALURJI PREPAINTED STRIP PRODUCTION TOLERANCE TABLE (EN 10169:2010)

	Wrinkle Polyester	PUR-PA and PUR	Plastisol
	Standard	Standard	
Topcoat thickness	20 ±2 µm;	20 ±2 µm; for metallic, luminous and naced 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 (for metallic luminous and naced ΔE ≤ 2)	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 naced ≥ 50		-
MEK rub test for back coat	≥ 50		≥ 50
Adhesion test for top coat (After cupping)	≥ 6mm - 0		≥ 6mm - 0
Adhesion test for top coat (After cupping)	≥ 4mm - 0		≥ 4mm - 0
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 on 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 deviation on 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)
<b>Thickness</b>	0,25*	1,2
<b>Width</b>	800	1500
<b>Internal diameter of the coil</b>	508	610
<b>External diameter of the coil</b>		1520
<b>Coil weight</b>	3 ton	11 ton
<b>Plate length</b>	500	6000
<b>Plate width</b>	370	1530
<b>Package weight of the plate</b>	.....	8 ton
<b>Slitted coil width</b>	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 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 valued depending on negotiation.

**PRODUCIBILITY LIMITS - EN 10143**

PRODUCIBILITY 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.

PRODUCIBILITY 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.

PRODUCIBILITY 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/m<sup>2</sup>)

**SP:** Polyester

**T:** Flexibility

**RC:** Corrosion resistance

**RUV:** Ultraviolet resistance

The material according to EN 10346 standard, Grade DX51, 100g/m<sup>2</sup> 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