

## Coating & surface

### Coating

The zinc coating (Z) is produced in a continuously operating line, where the zinc crystallizes into a smooth layer with minimised spangle. The grain size may vary according to the coating conditions.

The zinc coating is lead-free and has a zinc content of a minimum of 99%.

The corrosion resistance offered by the coating is in direct proportion to its thickness, i.e. a thick coating will provide better protection for the underlying steel than a thin coating. However, thin coatings are recommended for applications with high formability requirements because a thick coating may make forming more difficult.

The coating finish designation for the minimised spangle coating is M.

### Coating mass

Coating designation	Minimum weight g/m <sup>2</sup> 1)		Coating thickness, µm 2)
	Mean from triple spot test	Single spot test	
Z100	100	85	7
Z140	140	120	10
Z200	200	170	14
Z275	275	235	20
Z350	350	300	25
Z450	450	385	32

1) The g/m<sup>2</sup> value refers to the combined mass of the coating on both surfaces of a one square-metre sheet.

2) The coating thickness (µm) is a calculated value from the mean value from triple spot test (g/m<sup>2</sup>) referring to the coating thickness of a single surface.

### Surface quality

#### As-coated surface (A)

Imperfections such as pimples, marks, scratches, pits, variations in surface appearance, dark spots, stripe marks and light passivation stains are permissible. Stretch levelling breaks or run-off marks may appear. Coil breaks and stretcher strains may appear as well.

#### Improved surface (B)

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.

#### Best quality surface (C)

Surface quality C is obtained by skin passing. The controlled surface makes it possible to apply a uniform high-class paint finish. The other surface must at least have the characteristics of surface quality B.

### Surface protection

Metal-coated steel sheets receive one of the following surface treatments at the producer's plant. The surface protection serves as temporary corrosion protection during transport and storage. The period of protection afforded is limited and depends on the atmospheric and environmental conditions.

#### Chemical passivation (C)

Unless otherwise agreed, a hot-dip zinc-coated sheet undergoes passivation treatment on the production line, whereby a thin passivation layer remains on the strip surface. Chemical passivation without Cr<sup>6+</sup> is also available.

#### Oiling (O)

If required, oiling may be used instead of chemical passivation.

#### Chemical passivation and oiling (CO)

If required, a combination of both chemical passivation and oiling may be applied. Chemical passivation without Cr<sup>6+</sup> is also available. The delivery is agreed on at the time of enquiry and order.

### Organic passivation (S)

The surface may also be protected by organic passivation AFP (Anti Finger Print), whereby the sheet is coated with a polymer film containing a corrosion-inhibiting substance that is free of Cr<sup>6+</sup>.

### Untreated (U)

At the purchasers own risk, the product can also be supplied untreated.

White rust tends to form easily on the surface of bright zinc-coated coils or in the space between tightly packed sheets if condensed water or rainwater collects on the surface. To avoid white rust, care must be taken to keep the coils and sheets dry during transportation and storage.

Condensation may occur between sheets due to, for example, daily temperature and humidity changes or when bringing cold products into warm buildings. If sheets become wet and white rust starts to form, the sheets should immediately be placed so that their surfaces dry quickly. This will prevent any further formation of white rust.

## Properties

### Material description

These steels are manufactured using the BOF process and are aluminium killed. The best formability properties are based on vacuum treatment, which will provide very low carbon and nitrogen contents. Furthermore, the remaining carbon and nitrogen are compounded by micro alloying with titanium and/or niobium.

### Mechanical properties

Steel grade	Yield strength R <sub>e</sub> <sup>1)</sup> MPa	Tensile strength R <sub>m</sub> MPa	Elongation A <sub>80</sub> %			Plastic strain ratio r <sub>90</sub> Minimum	Strain hardening exponent n <sub>90</sub> Minimum
			Minimum	Thickness mm			
			≤ 0.50	0.50-0.70	> 0.70		
DX51D	–	270 – 500	18	20	22	–	–
DX52D	140 – 300	270 – 420	22	24	26	–	–
DX53D	140 – 260	270 – 380	26	28	30	–	–
DX54D	120 – 220	260 – 350	32	34	36	1.6	0.18
DX56D	120 – 180	260 – 350	35	37	39	1.9 <sup>2)</sup>	0.21
DX57D <sup>3)</sup>	120 – 170	260 – 350	37	39	41	2.1 <sup>2)</sup>	0.22

<sup>1)</sup> If the yield point is not pronounced, the values apply to the 0.2% proof strength (R<sub>p0.2</sub>). If the yield point is pronounced, the values apply to the lower yield point (R<sub>eL</sub>).

<sup>2)</sup> For sheet thicknesses higher than 1.50 mm the r<sub>90</sub> value shall be reduced by 0.2 units.

<sup>3)</sup> Orders for this steel grade must be agreed on separately.

Testing is carried out transverse to the rolling direction.

**Typical values of mechanical properties**

Steel grade	Yield strength R <sub>e</sub> <sup>1)</sup> MPa	Tensile strength R <sub>m</sub> MPa	Elongation A <sub>80</sub> % Minimum Thickness mm	Plastic strain ratio r <sub>90</sub> Minimum	Strain hardening exponent n <sub>90</sub> Minimum
Tin Smith Pro	180	330	39	-	-

Testing is carried out transverse to the rolling direction.

**Chemical composition**

Steel grade	Content %, maximum					
	C	Si	Mn	P	S	Ti
DX52D-DX57D	0.12	0.50	0.60	0.10	0.045	0.30

**Processing instructions**

**Forming**

The bending and profiling DX51D quality is intended for tasks such as manufacturing enclosed structures and lock-forming. The deep drawing DX53D quality is suitable for regular deep drawing and stretch forming. The special deep drawing DX54D quality, extra deep drawing DX56D quality and super deep drawing DX57D quality are intended for the most demanding forming applications.

The DX53D, DX54D, DX56D and DX57D grades are non-aging steels, i.e. their properties will remain unaltered for no less than six months.

**Welding**

The best results in welding of zinc-coated sheets are obtained using resistance welding methods. If welding recommendations or welding method test results are observed, the mechanical properties of welded joints are comparable to those in non-coated sheets. The coating mass has an influence on the welding results. Thin coatings are recommended for applications to be welded, provided that the corrosion resistance remains sufficient.

Content of the manual:

- Background and advice in choosing welding parameters
- Recommended welding parameters for both cold-rolled un-coated sheets and metal coated sheets

**Painting**

Hot-dip zinc-coated sheets provide a good substrate for painting when appropriate paints are used. To ensure good adhesion, the chemical passivation layer, protective oil and any impurities should be removed from the surface to be painted. The organic passivation layer need not be removed. If a high quality is required for the painted surface, it is best to use surface quality class C.

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