Steel

ZM Ecoprotect®

Product information on zinc-magnesium-coated sheet for the automotive industry

thyssenkrupp

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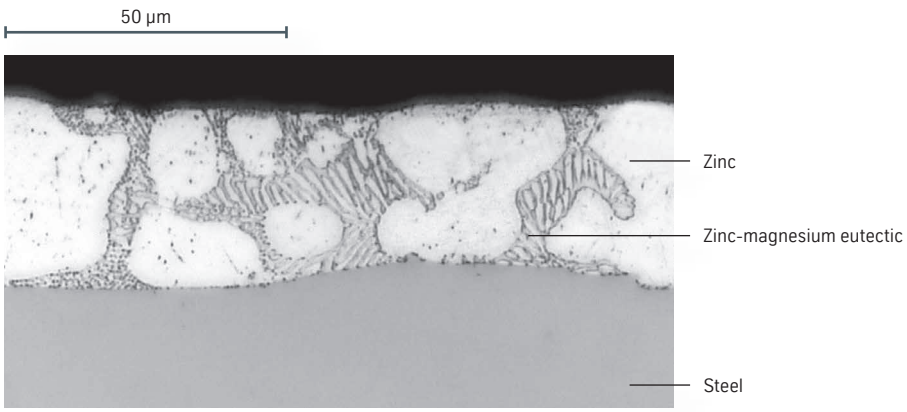
Areas of application

ZM Ecoprotect® from thyssenkrupp is the new generation of zinc-magnesium-based coatings for interior and exterior parts in the automotive industry.

ZM Ecoprotect® delivers improved formability, reduces adhesive wear in the die and ultimately reduces downtime for die cleaning. ZM Ecoprotect® also offers improved corrosion behavior: at comparable coating thicknesses, corrosion protection is significantly better, while a 30% reduction in coating weight still offers equivalent performance – with greater cut edge protection. It constitutes an ecological alternative to conventional zinc coatings because it requires less zinc.

ZM Ecoprotect® in primetex® quality additionally offers a premium paint appearance and allows fillerless painting.

Sample microstructure of ZM Ecoprotect® in vertical section



Content

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Available steel grades

As with hot-dip coated sheet, ZM Ecoprotect®-coated sheet is produced in a continuous process (continuous annealing furnace, metal bath). The coating is made from a zinc alloy containing 1–2% aluminum and 1–2% magnesium.

ZM Ecoprotect®-coated sheet is available in a maximum width of 1,650 mm, depending on grade and thickness.

Deep-drawing steel

DIN EN 10346	VDA 239-100	ZM Coating
DX51D	–	◉
DX52D	CR1	◉
DX53D	CR2	◉
DX54D	CR3	▣
DX56D	CR4	▣
DX57D	CR5	▣

Structural steel

DIN EN 10346	ZM Coating
S220GD	●
S250GD	●
S280GD	●
S320GD	●
S350GD	●
S390GD	●

Microalloyed steel

Steel grade	Reference grade DIN EN 10268, 10346	Reference grade VDA 239-100	ZM Coating
MHZ® 220	–	CR210LA	●
MHZ® 260	HC260LA/HX260LAD	CR240LA	●
MHZ® 300	HC300LA/HX300LAD	CR270LA	●
MHZ® 340	HC340LA/HX340LAD	CR300LA	●
MHZ® 380	HC380LA/HX380LAD	CR340LA	●
MHZ® 420	HC420LA/HX420LAD	CR380LA	●
MHZ® 460	HC460LA/HX460LAD	CR420LA	●
MHZ® 500	HC500LA/HX500LAD	CR460LA	●

High-strength IF steel

Steel grade	Reference grade DIN EN 10268, 10346	Reference grade VDA 239-100	ZM Coating
HX 160	HX160YD	CR160IF	◉
HX 180	HX180YD	CR180IF	▣
HX 220	HX220YD	CR210IF	▣
HX 260	HX260YD	CR240IF	◉

Dual-phase steel

Steel grade	Reference grade DIN EN 10268, 10346	Reference grade VDA 239-100	ZM Coating
DP-K® 290Y490T	HCT490X	CR290Y490T-DP	▣
DP-K® 330Y590T	HCT590X	CR330Y590T-DP	●

Bake-hardening steel

Steel grade	Reference grade DIN EN 10268, 10346	Reference grade VDA 239-100	ZM Coating
BHZ 180	HX180BD	CR180BH	▣
BHZ 220	HX220BD	CR210BH	▣
BHZ 260	HX260BD	CR240BH	◉

● Serial production of interior parts
◉ Serial production of interior and exterior parts
▣ Serial production of exterior parts in primetex® quality

ZM ZM Ecoprotect®

Detailed information on properties, processing and sizes is provided in our product information at www.thyssenkrupp-steel.com.

Surfaces

Available hot-dip coatings [1)]

	Specification	Minimum coating – two-sided sample [g/m²]		Coating on each side of single spot sample		Informative details
		Triple spot sample	Single spot sample	Mass [g/m²]	Thickness [µm]	Typical thickness [µm]
ZM Ecoprotect®						
Designation						
ZM070	DIN EN	70	60	–	–	5.5
ZM30	VDA 239-100	–	–	30 – 55	4.5 – 7.7	–
ZM090	DIN EN	90	75	–	–	7
ZM100	DIN EN	100	85	–	–	8
ZM40	VDA 239-100	–	–	40 – 65	6.2 – 9.2	–
ZM120	DIN EN	120	100	–	–	9
ZM50	VDA 239-100	–	–	50 – 80	7.7 – 12	–
ZM130	DIN EN	120	100	–	–	9
ZM140	DIN EN	140	120	–	–	11
ZM200	DIN EN	200	170	–	–	15
ZM275	DIN EN	275	235	–	–	20
ZM300	DIN EN	300	255	–	–	23

[1)] Available ZM Ecoprotect® coatings depending on grade, strip cross-section and surface finish. Other coatings and different coatings per side on request.

Surface condition and finishes

	Condition	Finish	
Product			
Hot-dip coated flat products	ZM Ecoprotect®	A	Normal surface
		B	Improved surface
		U	Unexposed (interior parts)
		C	Best surface
		E	Exposed (exterior parts)
		primetex®	

A / B / C as per DIN EN
U / E as per VDA 239-100

Surface treatments

		ZM
Type of surface treatment		
O	Oiled	●
C	Chemically passivated	●
CO	Chemically passivated and oiled	●
S	Sealed	●

● Available for interior and exterior parts
ZM ZM Ecoprotect®

Surface finishes

ZM Ecoprotect® is available in the following surface finishes: normal surface (A), improved surface (B) or unexposed (U), as well as best surface (C) or exposed (E) surface. Thanks to reduced long waviness ZM Ecoprotect® in primetex finish meets the most stringent demands on paint appearance and allows fillerless painting.

Roughness

ZM Ecoprotect®-coated sheet is supplied with a mean roughness value of R_a, ranging from 1.1 to 1.6 µm, in surface finishes B and U. A reduced range of roughness can be agreed when ordering.

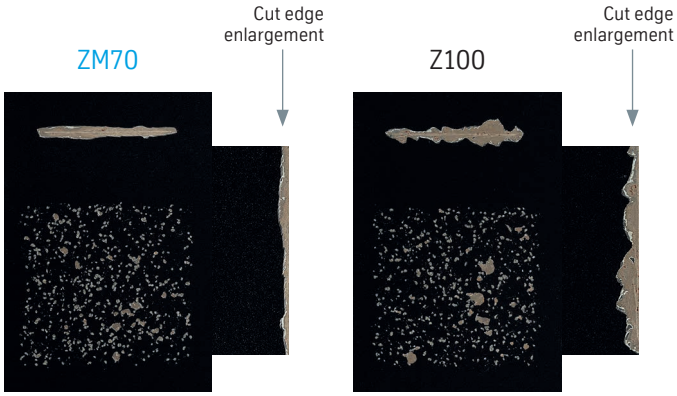
Notes on applications and processing

Corrosion protection

With comparable coating thicknesses, ZM Ecoprotect® offers significantly higher corrosion protection than conventional zinc coatings. The magnesium ions in the zinc-magnesium coating create a more stable coating on the iron substrate. The protective coating slows the corrosion of the base material, i.e. less zinc-magnesium has to dissolve to maintain cathodic protection than with conventional zinc coatings.

The improved corrosion properties are particularly evident in the case of cut edges and scratches. Delamination is much lower with ZM Ecoprotect® than with conventional zinc coatings. Investigations confirm improved stone chip protection through a significant reduction in creep corrosion.

Creep corrosion on areas of stone chip damage and scratches



ZM Ecoprotect® offers improved corrosion protection compared to conventional zinc coating: cut edges & scratches showing reduced coating thickness. Corrosion creep areas of stone chip damage according to DIN EN ISO 11997-1B (10 cycles).

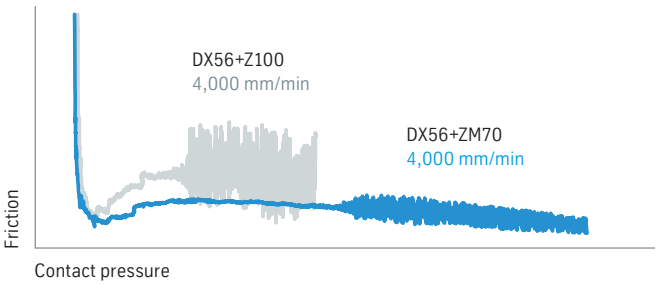
Forming

All common forming processes used for cold-rolled sheet can be used for ZM Ecoprotect®-coated flat products if die geometry and surfaces are adapted to these materials. The type of coating in conjunction with the surface topography has a decisive influence on the tribology of the forming process.

ZM Ecoprotect®-coated sheet displays significantly improved friction and abrasion properties versus conventional zinc coatings and thus provides for improved formability and reduced adhesive wear of press tooling – a significant economic advantage when it comes to volume production.

The characteristic parameter for tribological behavior is the coefficient of friction μ. To determine the behavior of the material in the blank holder area relevant to the forming process, thyssenkrupp determines the coefficient of friction in strip drawing tests comparing plano-levelling tools.

Strip drawing test



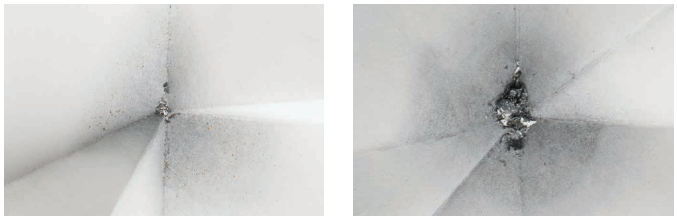
ZM Ecoprotect® coatings have a lower coefficient of friction with delayed stick-slip effect compared with all-zinc coatings.

Compared with hot-dip galvanized sheet with a coating weight of 100 g/m² and a coefficient of friction of μ = 0.09, ZM Ecoprotect®-coated sheet achieves a significantly lower coefficient of friction of μ = 0.07 and improved stick-slip behavior under the same processing parameters (a contact pressure of 20 MPa).

Requirements for die surfaces are comparable with those for hot-dip galvanized sheet; the drawing bead geometries may need to be adjusted due to the coefficient of friction. To avoid coating abrasion, the die surface – as in the case of conventional hot-dip galvanized coatings – should be free of surface defects such as machining marks and welding pores.

Zinc abrasion in strip drawing test

ZM70 Z100



Zinc abrasion after 2,000 strokes in the strip drawing test – ZM70 displays fewer and significantly smaller abrasion particles than Z100.

Joining

All thermal and mechanical joining techniques can be used, as can adhesive bonding and sealing. However, the particular properties of a metallic coating require the processing parameters for some joining processes to be adapted compared with uncoated sheet.

Adhesive bonding

ZM Ecoprotect® coatings deliver good bonding results with the majority of the adhesives used in the automotive industry. Key to the quality of the adhesive bond is the adhesive used, the adhesion of the adhesive to the coating, the adhesion of the coating to the steel substrate, and the processing conditions. Concrete combinations of ZM Ecoprotect®-coated sheet and adhesive should be validated in component tests before use.

Resistance spot welding

Resistance, inert gas and laser beam welding are the most frequently used joining processes. The former, in the form of spot and projection welding, is first choice in many areas of the automotive industry. Resistance welding offers the advantages of ready automation, low surface impairment and low part distortion as well as dispensing with the need for filler metals.

Compared with uncoated sheet, resistance spot welding of zinc-coated sheet requires higher currents and electrode force as the coating has a lower contact resistance. The higher thermal and mechanical loads and the tendency towards electrode pick-up when processing zinc-coated sheet reduce the electrode lifetime – though it is still high. This can be offset by the use of a suitable electrode material, e.g. CuCrZr, an adapted electrode geometry, good electrode cooling and optimized process management.

In industrial production, electrode wear is frequently offset by using the proven electrode tip milling method at set intervals. Optionally this can be supported by increasing the welding current stepwise within such milling intervals (current stepping).

When using resistance spot welding with ZM Ecoprotect®-coated sheet – and taking this information into account – welding ranges are usually comparable with those applicable to conventional hot-dip galvanized sheet, and electrode life-times are exactly the same. To keep impairment of the corrosion protection to a minimum, a fusion welding process should be selected with low heat input to the weld area.

Laser beam welding has proved ideal. Compared with uncoated sheet, a slower welding speed permits better degassing of the fused material, the amount of which is largely determined by the coating thickness and the welding method. Further information is available in the German Welding Society's bulletin DVS Merkblatt 2910.

Arc welding

When using the metal active gas (MAG), tungsten inert gas (TIG) and plasma arc welding processes, there is no significant difference between ZM Ecoprotect®-coated and conventionally hot-dip galvanized sheet.

In MAG welding, the provision of degassing gaps and the use of modern short-arc techniques improves process stability and significantly reduces pore formation in the welds. The choice of filler metal should be based on the strength of the base material. Standard solid wires such as G42 3 M G3Si1 can be used. Standard shield gas mixtures of 10% to 18% CO_2 in argon have proven successful; in certain applications the use of pure CO_2 may be advantageous in reducing weld pores.

With TIG and plasma welding the ZM Ecoprotect® coating, as with conventional zinc coatings, causes contamination of the tungsten electrode, which reduces the electrode lifetime. In such cases it may be beneficial to remove the coating in the weld zone. Due to the high temperatures associated with arc welding processes, the ZM Ecoprotect® coating burns away in the welding zone, resulting in reduced corrosion resistance.

Arc brazing

Arc brazing processes (MIG, TIG and plasma) are well-suited to the brazing of ZM Ecoprotect® coatings. The filler metal should be selected in accordance with the strength of the base material. The standard metals CuSi3Mn1 and CuAl7 have proven successful. Argon 4.6 or mixtures with low O_2/CO_2 content are used as shield gases to increase arc stability. It is generally recommended to keep energy input to a minimum in order to avoid liquid metal penetration. General information on arc brazing is provided in the German Weld-ing Society's bulletin DVS Merkblatt 0938-2.

As when welding and brazing conventional zinc-coated materials, welding and brazing fumes are unavoidable when processing ZM Ecoprotect®-coated sheet. The amount of fumes depends on the thickness of the coating, the welding or brazing process selected and the type of joint. In general, good workplace ventilation is recommended, in certain cases direct extraction of the welding fumes is advised.

Laser brazing

ZM Ecoprotect®-coated sheet can be joined reliably by laser brazing. With adjusted parameters, joints can be produced with improved visual properties in terms of ripples and edge waviness versus conventional hot-dip galvanized sheet. Compared with electrogalvanized sheet, the difference in absorption at the same feed rate calls for higher laser power.

Painting and phosphating

ZM Ecoprotect®-coated sheet, which is ideal for interior and exterior parts, can be painted using the processes and paints commonly used in the automotive industry. As with conventional zinc coatings, ZM Ecoprotect® can be readily pre-treated by phosphating it. The ZM coating offers good paint adhesion in both the dry and the wet condition.

For exposed exterior parts, ZM Ecoprotect® in primetex® quality allows fillerless painting.

Sample applications

ZM Ecoprotect®-coated sheet displays excellent deep-drawing behavior.

ZM Ecoprotect® is ideal for use in exposed body parts.

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