Steel

MHZ®

Product information for micro-alloyed steels

thyssenkrupp

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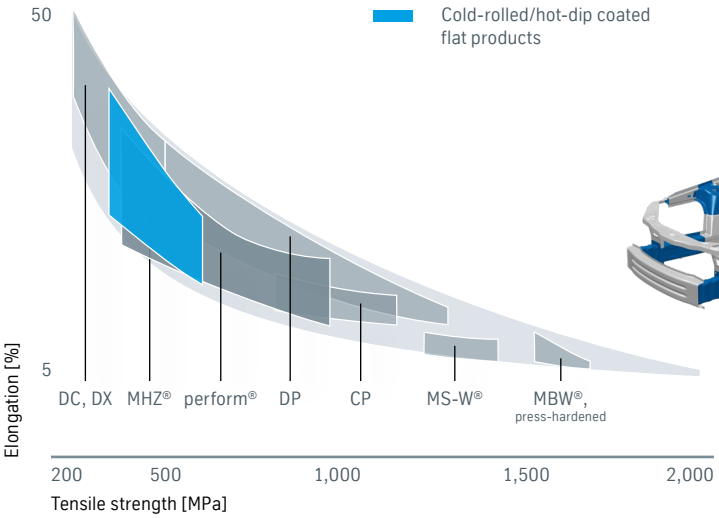
Overview of steel grades



Recommended applications in vehicles

Content

Areas of application

Owing to their good processing performance, MHZ® micro-alloyed cold-forming steels by thyssenkrupp have proven their value among other things in the automotive industry in body-in-white components, particularly for crash-relevant structural parts such as members and pillars, as well as in industrial applications such as furniture hardware and window fittings. The high strength properties result from precipitation hardening thanks to finely-dispersed carbonitrides and a fine-grained microstructure. Even very small amounts of the elements titanium and/or niobium in the region of 0.01% result in a significant increase in the yield point and tensile strength.

thyssenkrupp offers a wide range of cold-rolled and hot-dip coated MHZ® micro-alloyed steel grades with minimum yield points between 210 and 500 MPa and minimum tensile strengths between 310 and 540 MPa. A variety of surface finishes is available for lasting corrosion protection.

Available steel grades

thyssenkrupp supplies the following steel grades as per the product information or the reference steel grades in accordance with the respective standards.

Steel grade designations and surface refinements

			Surface refinements						
			UC	EG	GI	GA	ZM	AS	ZA
Micro-alloyed steel									
Steel grade	Reference grade DIN EN 10268, 10346	Reference grade VDA 239-100							
● 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			●		●		

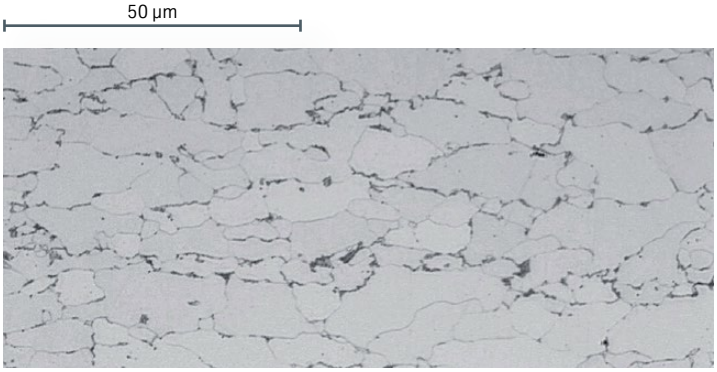
● Cold-rolled/hot-dip coated flat products
● Serial production for interior parts

UC	Uncoated	ZM	ZM Ecoprotect®
EG	Electrogalvanized zinc coating	AS	Aluminum-silicon coating
GI	Hot-dip zinc coating	ZA	galfan®
GA	Galvannealed		

Material characteristics

A finely globular microstructure with Ti and/or Nb carbonitride precipitations allows a high level of strength in the component. The solid solution hardening which is additionally required is achieved with the alloying elements Mn, Si and P.

Micrograph of MHZ®



Typical microstructure of cold-rolled micro-alloyed steels: microstructural contrasting through nital etching.

Technical features

Chemical composition

Mass fractions in ladle analysis	C [%] max.	Si [%] max.	Mn [%] max.	P [%] max.	S [%] max.	Al [%] total	Ti [%] max.	Nb [%] max.
Steel grade								
● MHZ® 220	0.10	0.50	1.0	0.030	0.025	≥ 0.015	0.15	0.09
● MHZ® 260	0.11	0.50	1.0	0.030	0.025	≥ 0.015	0.15	0.09
● MHZ® 300	0.12	0.50	1.4	0.030	0.025	≥ 0.015	0.15	0.09
● MHZ® 340	0.12	0.50	1.4	0.030	0.025	≥ 0.015	0.15	0.10
● MHZ® 380	0.12	0.50	1.5	0.030	0.025	≥ 0.015	0.15	0.10
● MHZ® 420	0.12	0.50	1.6	0.030	0.025	≥ 0.015	0.15	0.10
● MHZ® 460	0.15	0.50	1.7	0.030	0.025	≥ 0.015	0.15	0.10
● MHZ® 500	0.15	0.60	1.8	0.030	0.025	≥ 0.015	0.15	0.10

Mechanical properties

Test direction transverse to rolling direction	Yield strength $R_{p0.2}$ [1] [MPa]	Tensile strength R_m [MPa]	Elongation A_{80} min. [%]
Steel grade			
● MHZ® 220	210–300	310–410	28
● MHZ® 260	260–330	350–430	26
● MHZ® 300	300–380	380–480	23
● MHZ® 340	340–420	410–510	21
● MHZ® 380	380–480	440–580	19
● MHZ® 420	420–520	470–600	17
● MHZ® 460	460–580	500–660	15
● MHZ® 500	500–620	540–700	13

● Cold-rolled/hot-dip coated flat products

$R_{p0.2}$ Proof strength at 0.2% plastic elongation
R_m Tensile strength
A_{80} Percentage elongation after fracture using a specimen with gauge length L_0 = 80 mm for sheet thicknesses < 3.0 mm

[1] If the yield strength is pronounced, the values for the lower yield strength R_{eL} apply.

Surfaces

Surface refinements, electrogalvanized zinc coating

	Specification	Nominal coating on each side of single spot sample		Coating on each side of single spot sample	
		Mass [g/m²]	Thickness [µm]	Mass [g/m²]	Thickness [µm]
Electrogalvanized zinc coating					
Designation					
ZE 25/25	DIN EN	18	2.5	≥ 12	≥ 1.7
EG18	VDA 239-100	–	–	18 – 38	2.5 – 5.4
ZE 50/50	DIN EN	36	5.0	≥ 29	≥ 4.1
EG29	VDA 239-100	–	–	29 – 49	4.1 – 6.9
ZE 75/75	DIN EN	54	7.5	≥ 47	≥ 6.6
EG53	VDA 239-100	–	–	53 – 73	7.5 – 10
ZE 100/100	DIN EN	72	10	≥ 65	≥ 9.1
EG70	VDA 239-100	–	–	70 – 90	9.9 – 13

Surface refinements, hot-dip galvanized

	Specification	Minimum coating mass on both sides [g/m²]		Coating on each side of single spot sample		Informative
		Triple spot sample	Single spot sample	Mass [g/m²]	Thickness [µm]	Typical thickness [µm]
Hot-dip zinc coating						
Designation						
Z100	DIN EN	100	85	–	5 – 12	7
GI40	VDA 239-100	–	–	40 – 60	5.6 – 8.5	–
Z140	DIN EN	140	120	–	7 – 15	10
GI60	VDA 239-100	–	–	60 – 90	8.5 – 13	–
Z200	DIN EN	200	170	–	10 – 20	14
GI85	VDA 239-100	–	–	85 – 115	12 – 16	–
Z225	DIN EN	225	195	–	10 – 20	16
Z275	DIN EN	275	235	–	10 – 20	20
Z350	DIN EN	350	300	–	10 – 20	25
Galvannealed						
Designation						
ZF100	DIN EN	100	85	–	5 – 12	7
GA40	VDA 239-100	–	–	40 – 60	5.6 – 8.5	–
ZF120	DIN EN	120	100	–	6 – 13	8
GA50	VDA 239-100	–	–	50 – 80	7 – 10	–

Other coatings on request.

Surface refinements, hot-dip galvanized

	Specification	Minimum coating mass on both sides [g/m²]		Coating on each side of single spot sample		Informative
		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	–
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	130	110	–	–	10
ZM140	DIN EN	140	120	–	–	11
ZM150	DIN EN	150	130	–	–	11.5
galfan®						
Designation						
ZA95	DIN EN	95	80	–	5–12	7
ZA130	DIN EN	130	110	–	7–15	10
ZA185	DIN EN	185	155	–	10–20	14
ZA200	DIN EN	200	170	–	11–21	17
ZA255	DIN EN	255	215	–	15–27	20
ZA300	DIN EN	300	255	–	17–31	25
Aluminum-silicon coating						
Designation						
AS080	DIN EN	80	60	–	10–20	14
AS30	VDA 239-100	–	–	30–65	10–20	–
AS100	DIN EN	100	75	–	12–23	17
AS120	DIN EN	120	90	–	15–27	20
AS45	VDA 239-100	–	–	45–85	15–28	–
AS150	DIN EN	150	115	–	19–33	25

Other coatings on request.

Surface finishes and surface qualities

Designation	Finish type	Surface quality	
Cold-rolled flat products	Uncoated	A	Normal surface
		U	Unexposed (interior parts)
Electrolytically zinc coated flat products	Electrogalvanized zinc coating	A	Normal surface
		U	Unexposed (interior parts)
Hot-dip coated flat products	Hot-dip zinc coating	B	Improved surface
		U	Unexposed (interior parts)
	Galvannealed	B	Improved surface
		U	Unexposed (interior parts)
	ZM Ecoprotect®	B	Improved surface
		U	Unexposed (interior parts)
	Aluminum-silicon coating	B	Improved surface
	galfan®	B	Improved surface

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

Surface treatments

Type of surface treatment		UC	EG	GI	GA	ZM	AS	ZA
O	Oiled	●	●	●	●	●	●	●
C	Chemically passivated			●		●	●	●
P	Phosphated		●					
µPhos	Micro-phosphated		●		●			
µPhosO	Micro-phosphated and oiled		●		●			
JAZ®	JFE Advanced Zinc				●			
S	Sealed			●		●	●	●

● Serial production

UC Uncoated
EG Electrogalvanized zinc coating
GI Hot-dip zinc coating
GA Galvannealed
ZM ZM Ecoprotect®
AS Aluminum-silicon coating
ZA galfan®

Notes on applications and processing

Forming

MHZ® micro-alloyed steels are particularly suitable for structurally and crash-relevant parts such as members. The component geometry and forming process planning should be tailored to the strength. This allows optimum leveraging of specific benefits so that the steels can also be used for difficult drawn parts. This family of steels is ideally suited to multi-stage forming processes.

Processing instructions for joining

Micro-alloyed steels have a high suitability for joining and are suitable for welding in both same-grade and hybrid joints with other steel grades. The precondition is welding parameters matched to the material.

Resistance spot welding

The focus is traditionally on resistance spot welding, especially in car body manufacture. In particular, thin sheets with a thickness of less than 3 mm can be joined more economically and more reliably using this mass production process. However, doing so typically involves modifying the three welding parameters: welding current, welding time and electrode force. The influence of the electrode force and welding time on the welding zone is of central interest here.

Higher electrode forces and longer current flow times are normally required as the sheet thickness and strength increase, to ensure a sufficiently large welding zone. Alternatively, the use of multi-pulse welding as per SEP 1220-2 can have a positive effect on the width of the welding zone.

For zinc and zinc alloy coatings, the electrode forces, welding currents and welding times need to be increased compared to the non-alloyed base material, to compensate for contraction of the welding zone due to the coating. The width of the welding zone does not only depend on the combination of sheet grade, surface and thickness; process parameters such as the current type (AC 50 Hz/DC 1,000 Hz) and electrode geometry also play a significant role.

As the example in the figure on the next page shows, the welding zones of conventional higher and high-strength steels largely overlap. In addition to good welding suitability of the individual steel grades, welding suitability is also assured for combinations of the various materials offered by the steel industry today for similar welding parameter settings.

Arc brazing

Arc brazing processes (MIG, TIG and plasma) are well suited for brazing MHZ® steels. The filler metal (e.g. CuSi3Mn1 or CuAl7) should be selected in accordance with the strength of the base material. Argon 4.6 or argon mixtures with a low O_2/CO_2 content are used as shielding gases to increase arc stability. With MHZ® steels, energy input has to be controlled to prevent liquid metal penetrations. The typical applications include thin galvanized steel sheets in automotive body construction. General information is provided in the German Welding Society's information sheet DVS0938-2 "Lichtbogenlöten" ("Arc brazing").

Arc welding

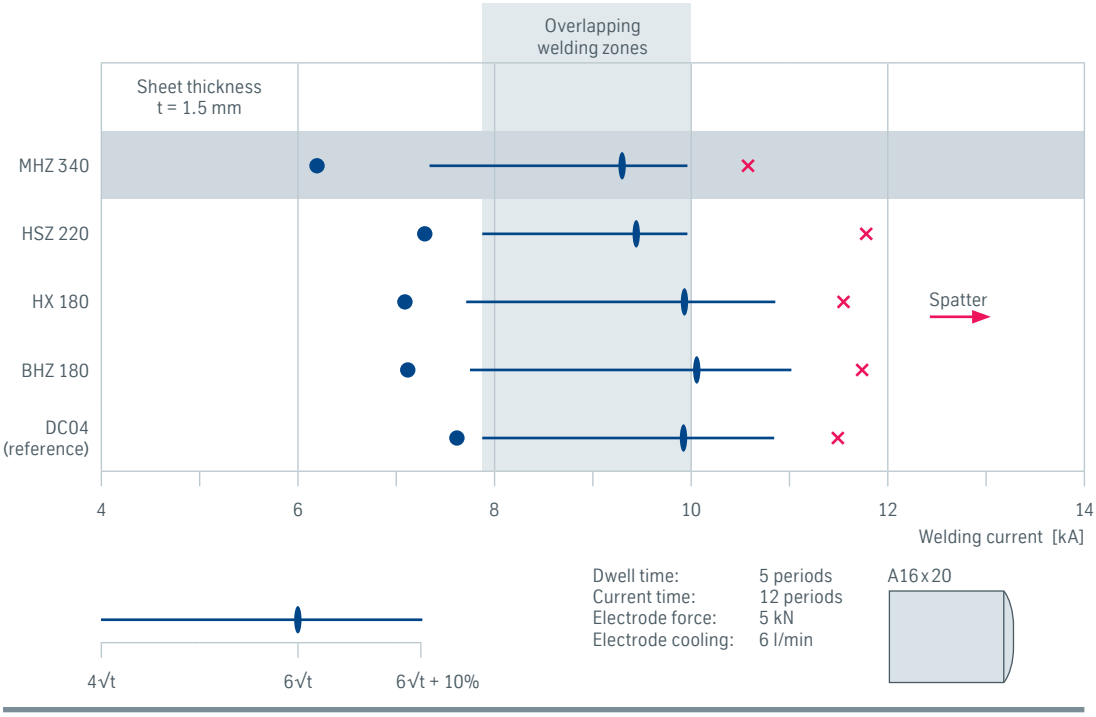
Arc welding processes (MAG, TIG and plasma) are well suited to welding MHZ® steels. The filler metal (e.g. G42 3 M G3Si1) should be selected in accordance with the strength of the base material. Shielding gas mixtures of argon and 8% to 18% CO_2 are used as shielding gases for MAG welding, and argon 4.6 for plasma/TIG welding.

For MHZ® steels with metallic coatings (e.g. zinc) it can be advantageous to provide a degassing gap or use modern MAG short circuit processes to reduce pore formation. Plasma/TIG welding is not recommended for galvanized MHZ® steels due to contamination of the tungsten electrode (short life). Cold cracking is not a risk with MHZ® steels under normal conditions.

Laser welding

There is no restriction on the type of laser used (gas or solid state). Both butt and overlap welds are possible. For overlap welds, depending on the coating, a gap must be provided between the sheets to allow degassing. Suitable parameters must be calculated for the laser according to the wall thickness, type of weld, finish and materials being joined. The heat-affected zone displays moderate hardening which is generally noncritical.

Welding zones of higher-strength and conventional steels compared



● First reproducible weld spot diameter
× Spatter limit

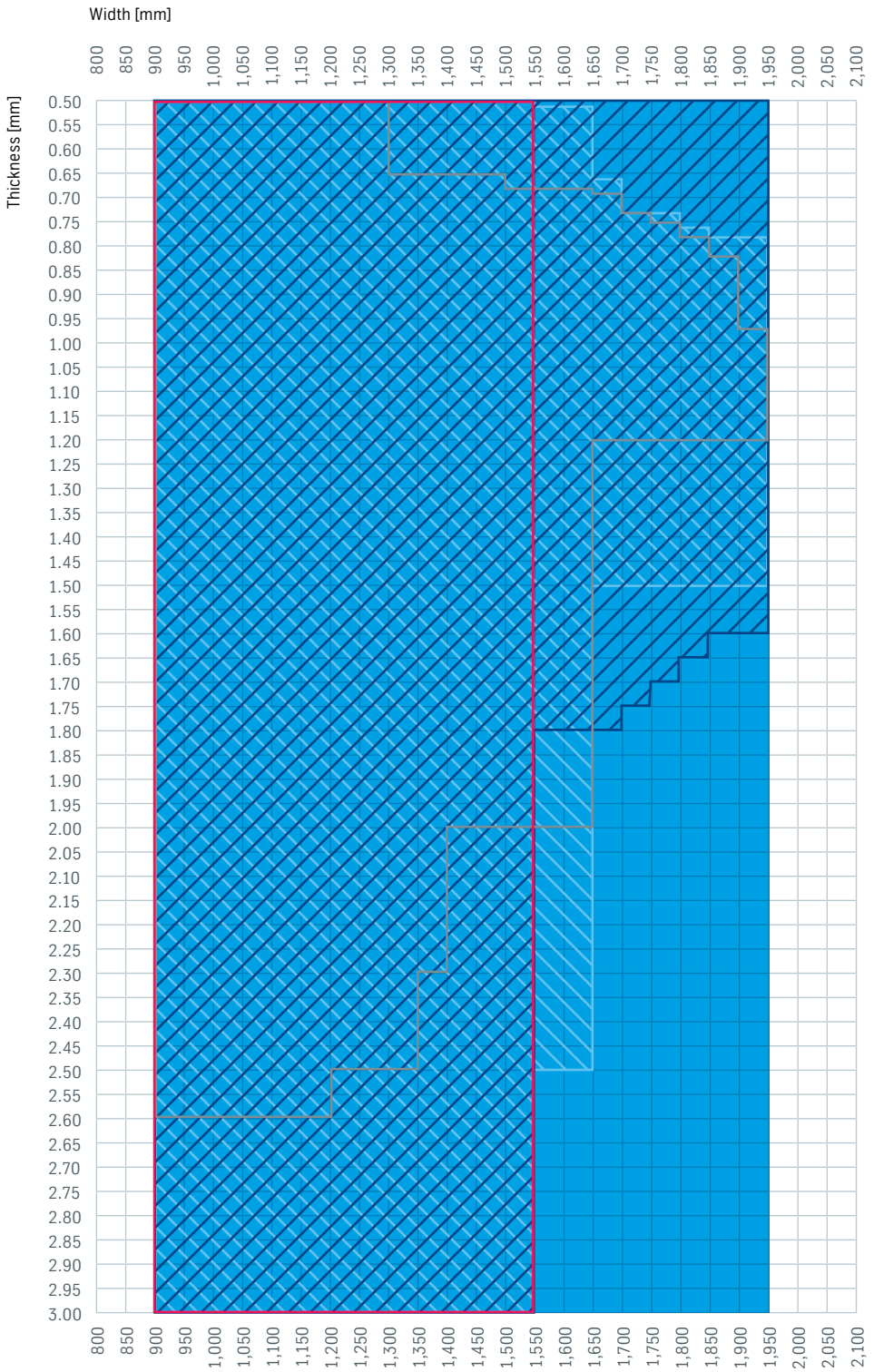
Fatigue strength and crash performance

Compared to deep-drawing steels higher minimum values for the yield point and tensile strength are assured for micro-alloyed steels. These key features enable a safe and practical structural durability assessment. MHZ® micro-alloyed steels are available in different strengths. As the yield point and tensile strength increase, so does the fatigue limit. Parallel to the increase in strength, formability tends to decrease; at this point the design engineer and the production planner need to agree on a meaningful optimum.

MHZ® micro-alloyed steels are the materials conventionally used for shell and structural components. Due to their high residual elongation capacity, they exhibit very robust crash behavior in the event of a crash. However, compared to dual-phase steel grades and retained-austenite steels, they exhibit a lower strain-hardening capacity, possibly accompanied by a lower yield limit, and thus a lower energy absorption capacity. This is the classic grade for structural components, but it is gradually being superseded by advanced multiphase steels due to lightweight design considerations in the field of crash-relevant structural components.

Available dimensions

MHZ® 220

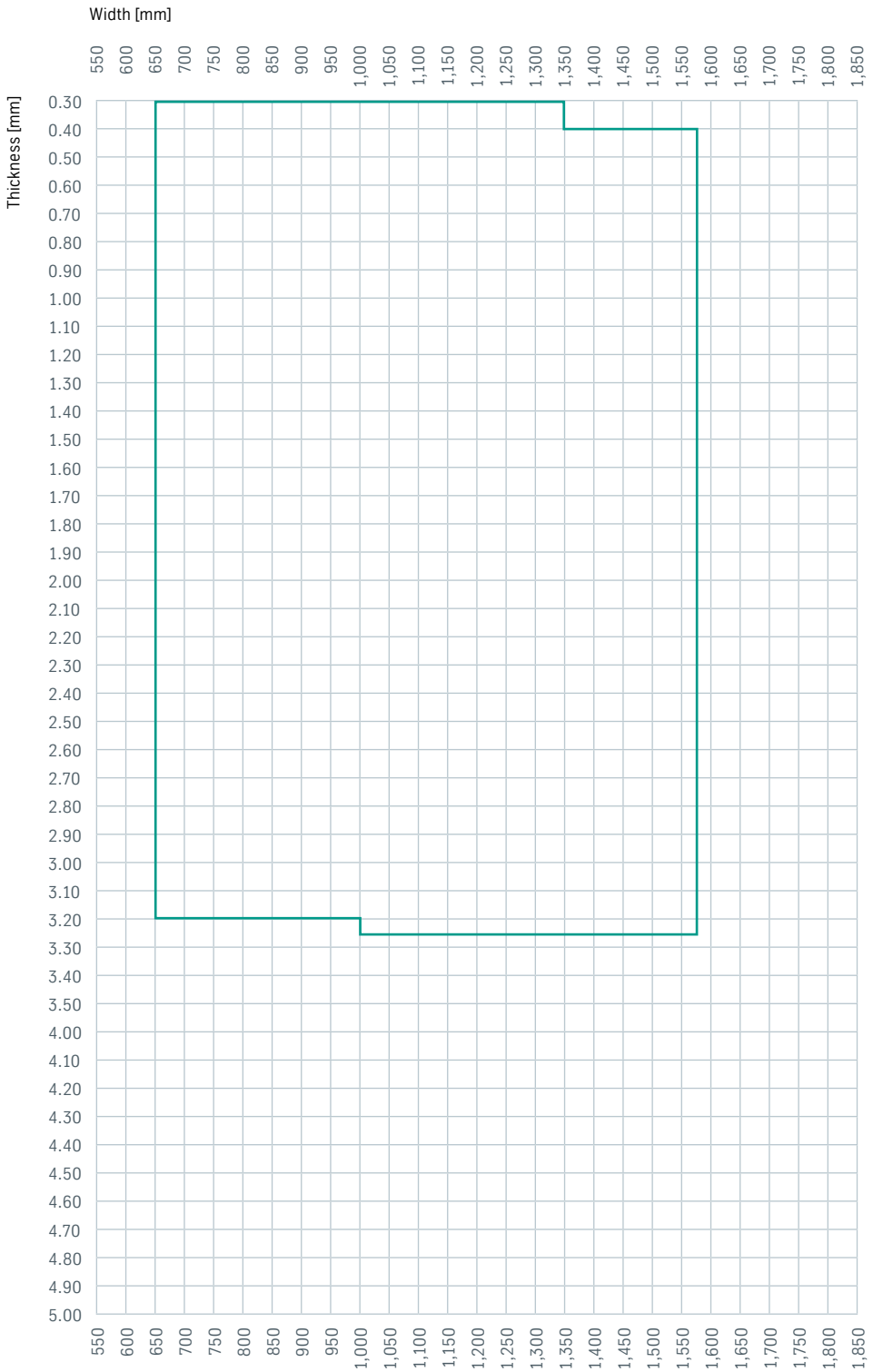


EG Electrogalvanized zinc coating
GI Hot-dip zinc coating
GA Galvannealed
ZM ZM Ecoprotect®

Uncoated with mill edge
EG trimmed
GI trimmed
GA trimmed
ZM trimmed

Typical dimensions for automotive customers. Restrictions may apply to steel grades as per VDA 239-100. Further dimensions on request.

MHZ® 220

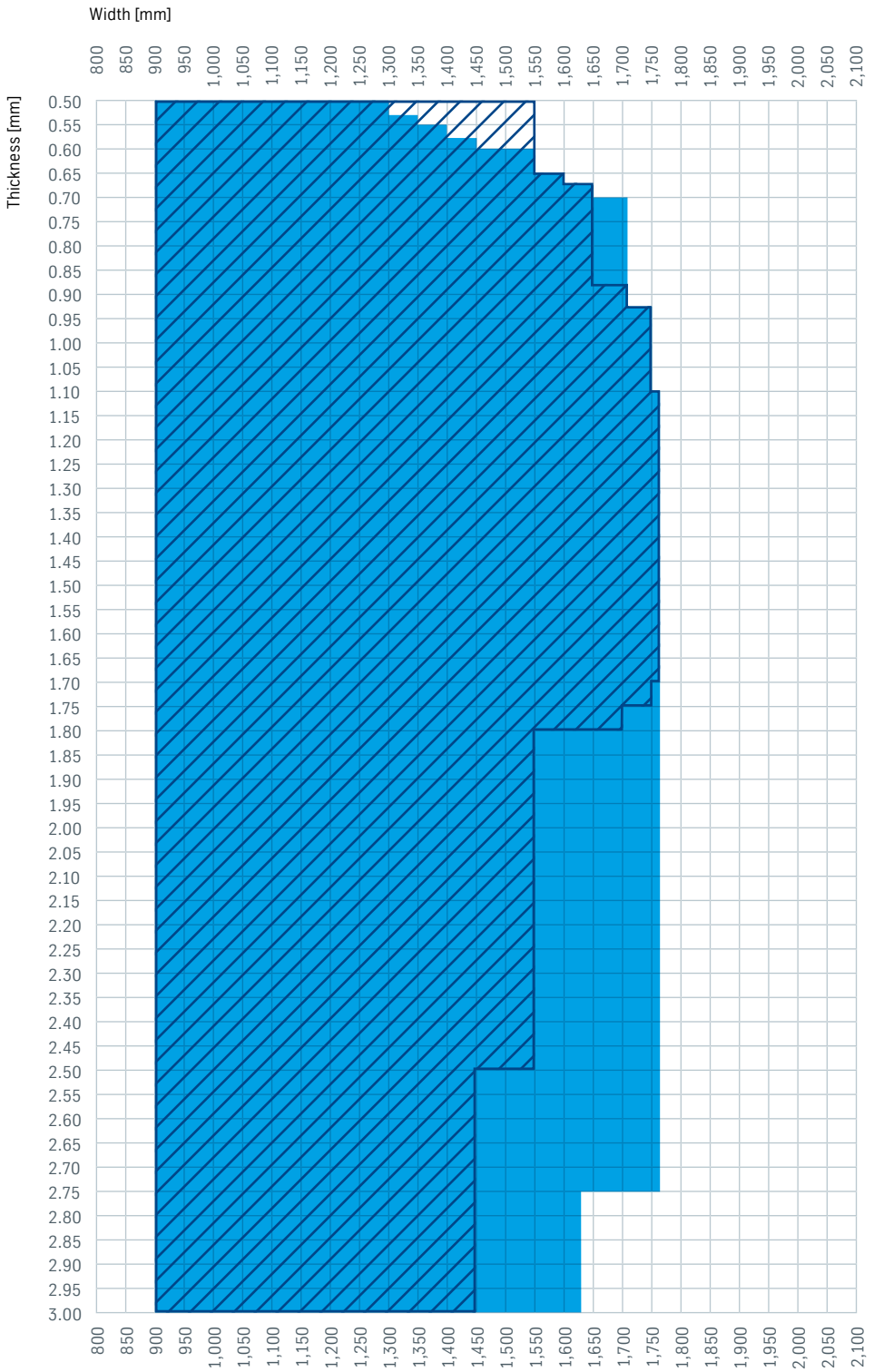


AS Aluminum-silicon coating

AS trimmed

Typical dimensions for automotive customers. Restrictions may apply to steel grades as per VDA 239-100. Further dimensions on request.

MHZ® 260

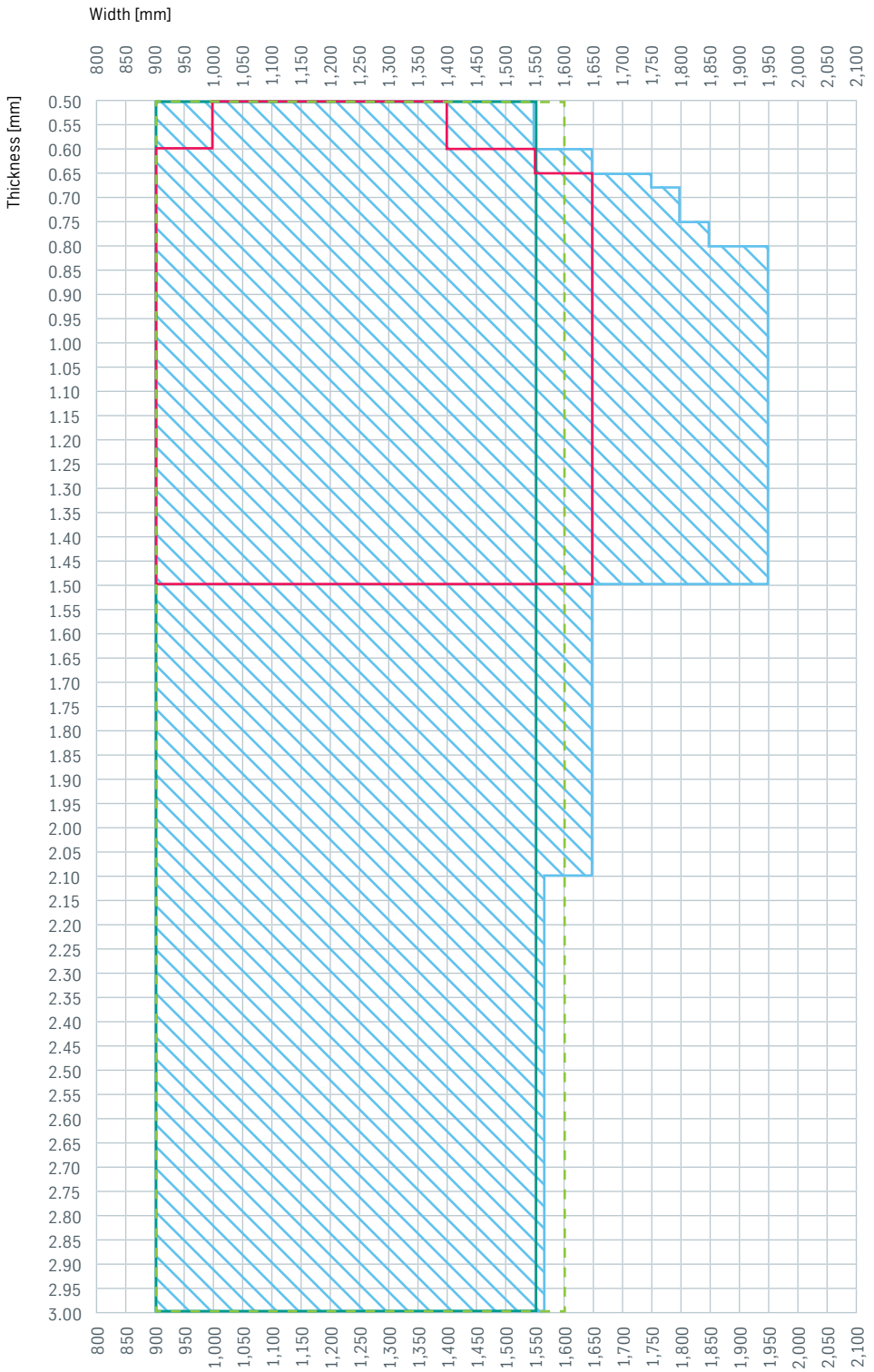


EG Electrogalvanized zinc coating

Uncoated with mill edge
EG trimmed

Typical dimensions for automotive customers. Restrictions may apply to steel grades as per VDA 239-100. Further dimensions on request.

MHZ® 260

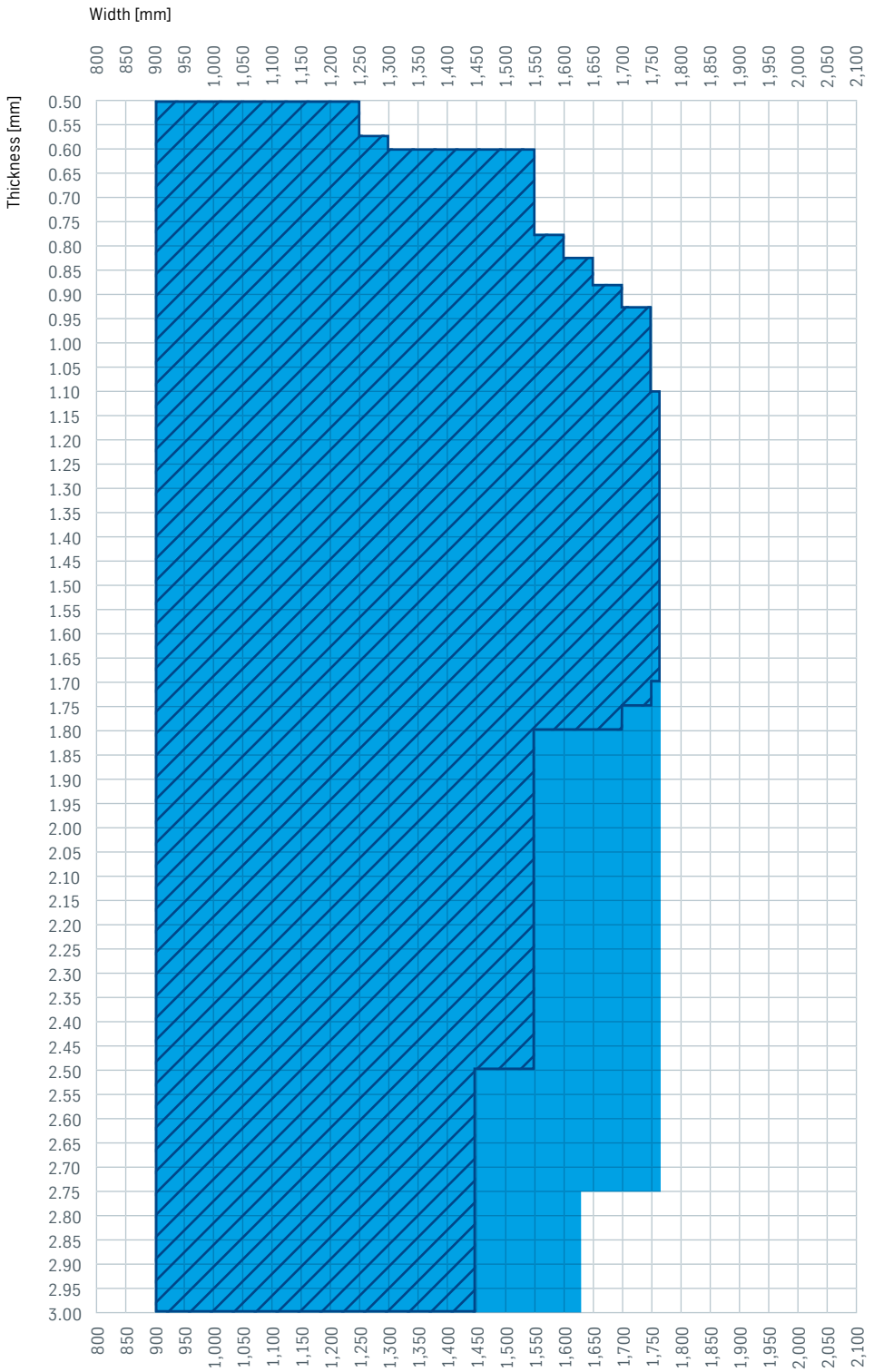


GI	Hot-dip zinc coating
GA	Galvannealed
ZM	ZM Ecoprotect®
AS	Aluminum-silicon coating
ZA	galfan®

GI trimmed
GA trimmed
ZM trimmed
AS trimmed
ZA trimmed

Typical dimensions for automotive customers. Restrictions may apply to steel grades as per VDA 239-100. Further dimensions on request.

MHZ® 300, MHZ® 340

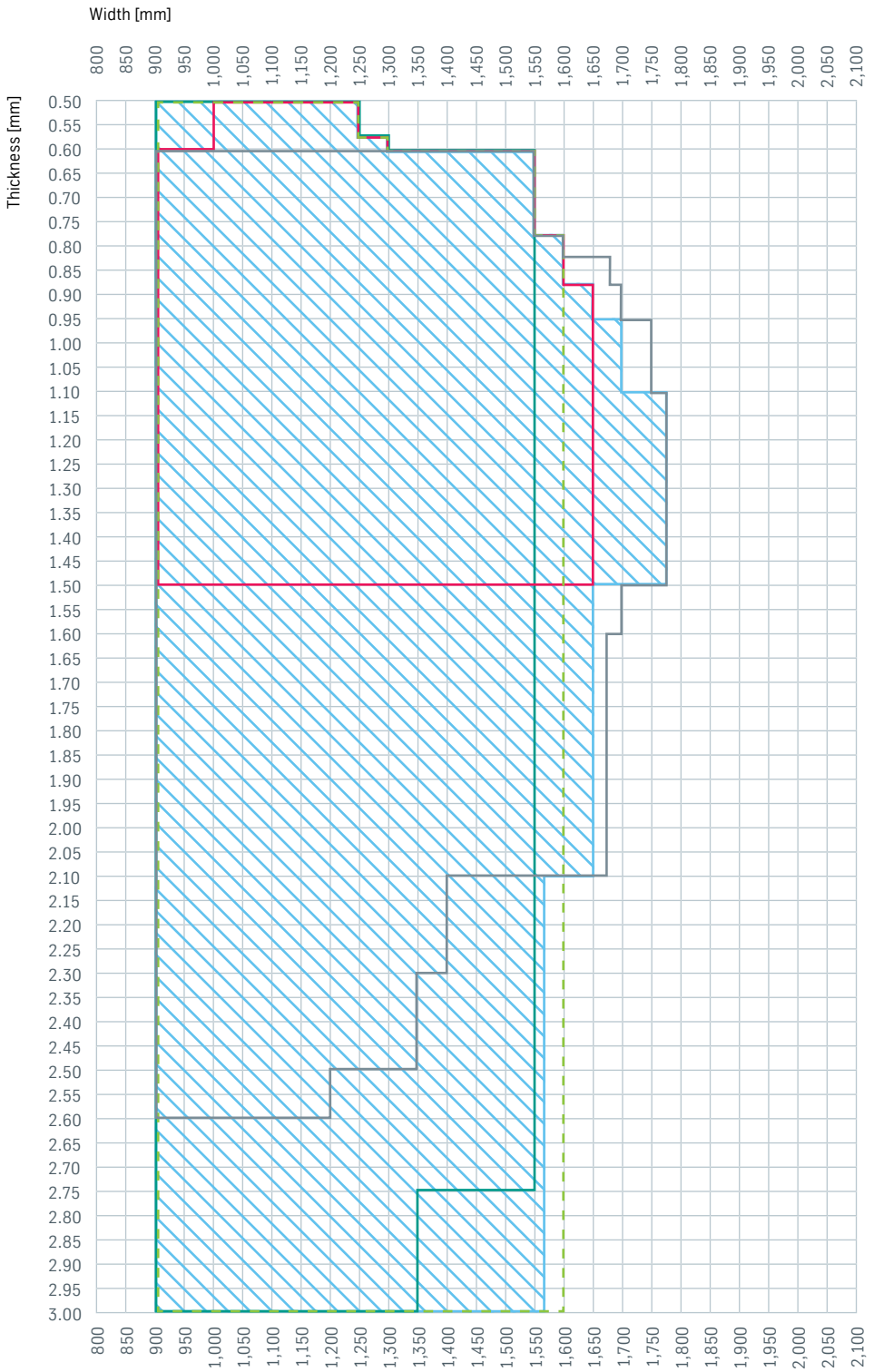


EG Electrogalvanized zinc coating

Uncoated with mill edge
EG trimmed

Typical dimensions for automotive customers. Restrictions may apply to steel grades as per VDA 239-100. Further dimensions on request.

MHZ® 300, MHZ® 340

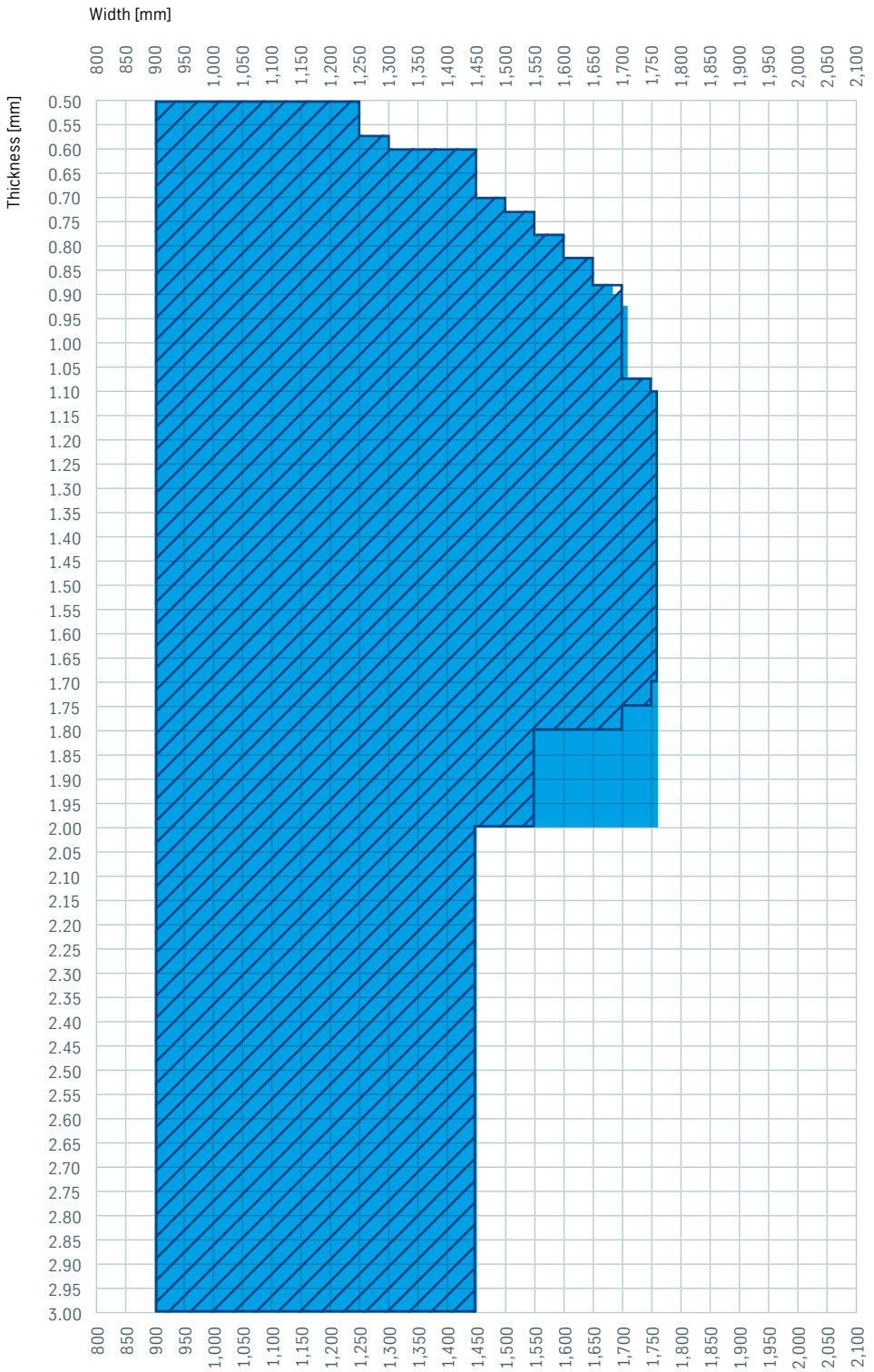


GI	Hot-dip zinc coating
GA	Galvannealed
ZM	ZM Ecoprotect®
AS	Aluminum-silicon coating
ZA	galfan®

GI trimmed
GA trimmed
ZM trimmed
AS trimmed
ZA trimmed

Typical dimensions for automotive customers. Restrictions may apply to steel grades as per VDA 239-100. Further dimensions on request.

MHZ® 380

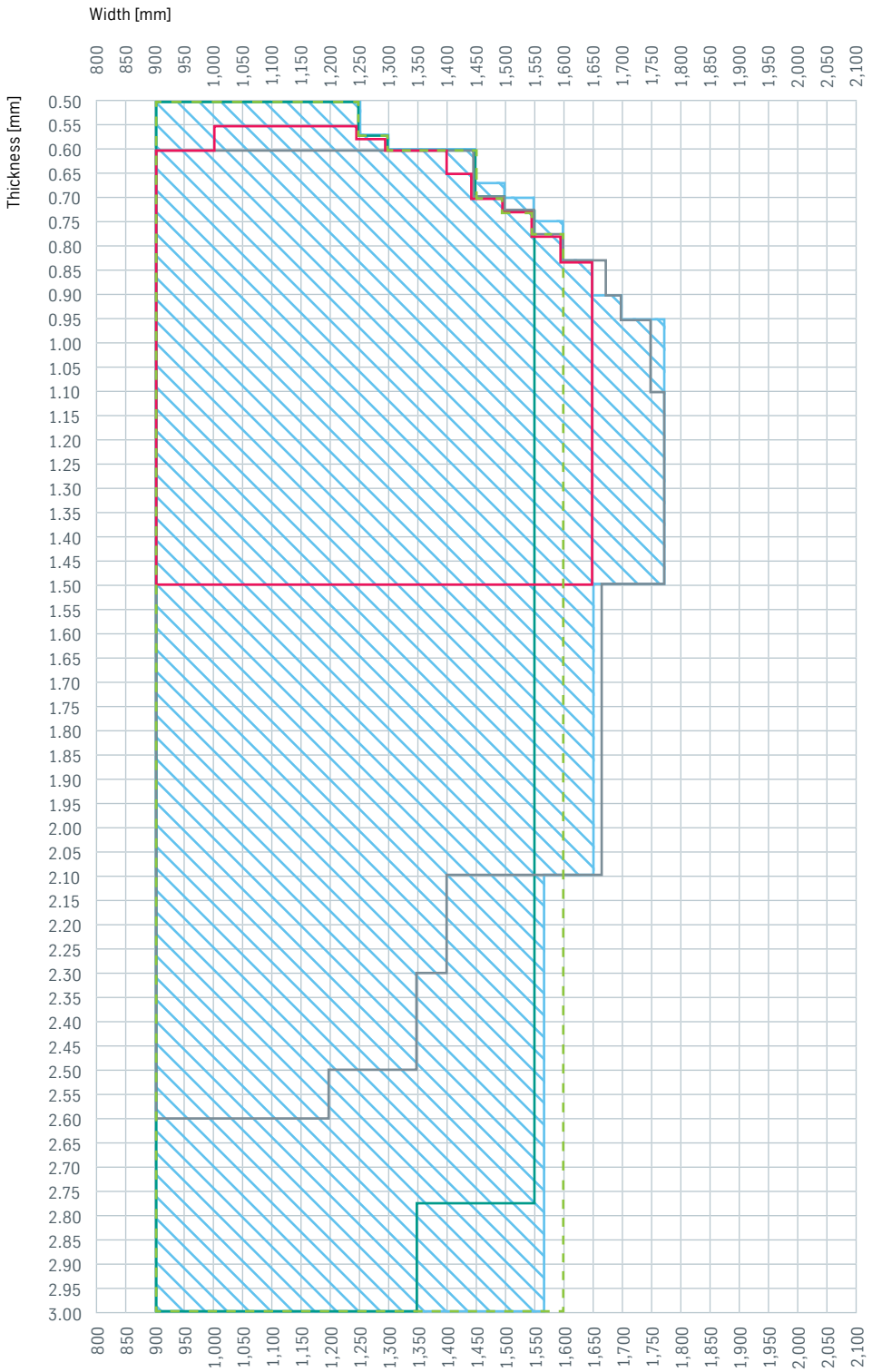


EG Electrogalvanized zinc coating

Uncoated with mill edge
EG trimmed

Typical dimensions for automotive customers. Restrictions may apply to steel grades as per VDA 239-100. Further dimensions on request.

MHZ® 380

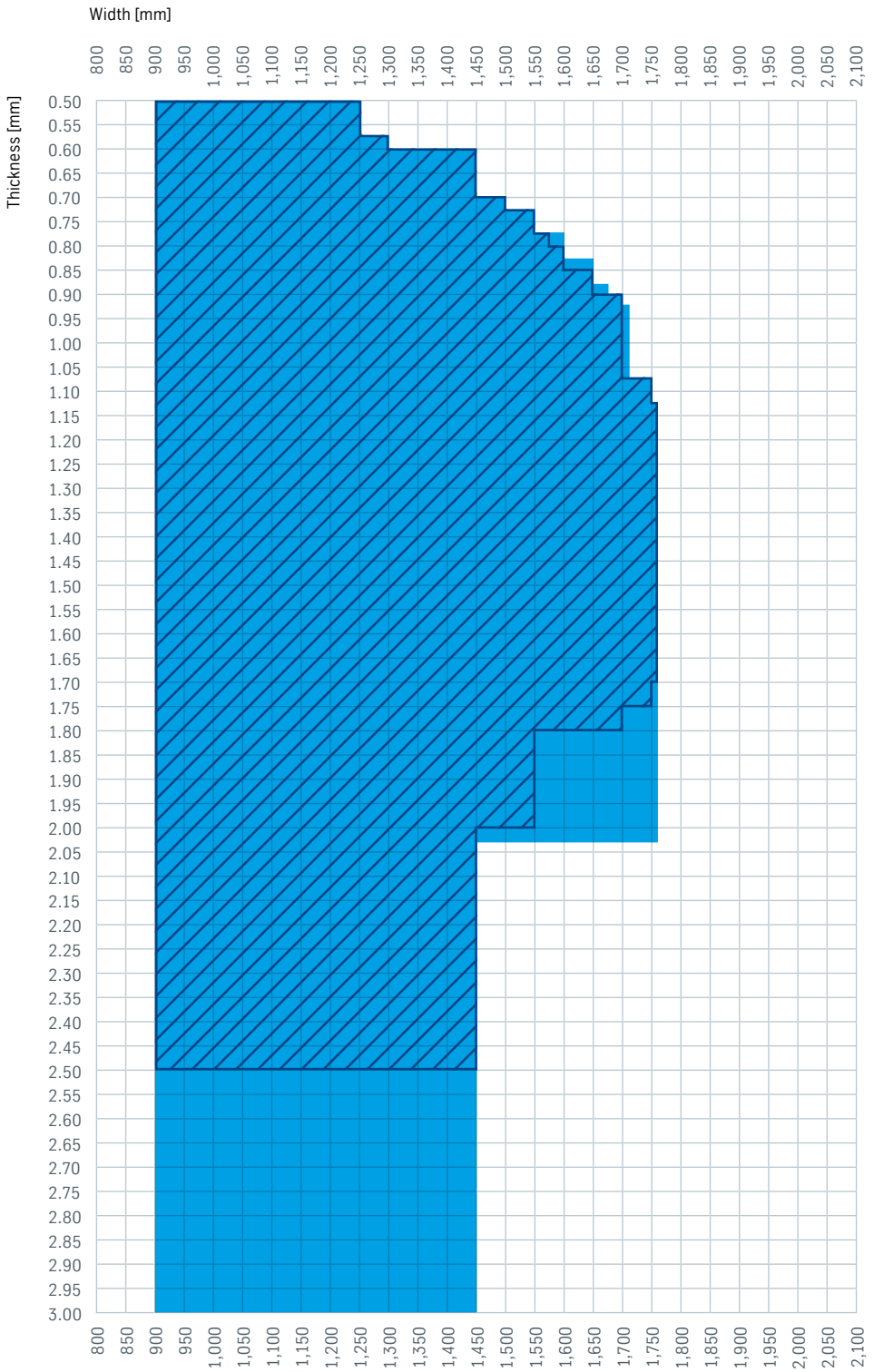


GI	Hot-dip zinc coating
GA	Galvannealed
ZM	ZM Ecoprotect®
AS	Aluminum-silicon coating
ZA	galfan®

GI trimmed
GA trimmed
ZM trimmed
AS trimmed
ZA trimmed

Typical dimensions for automotive customers. Restrictions may apply to steel grades as per VDA 239-100. Further dimensions on request.

MHZ® 420

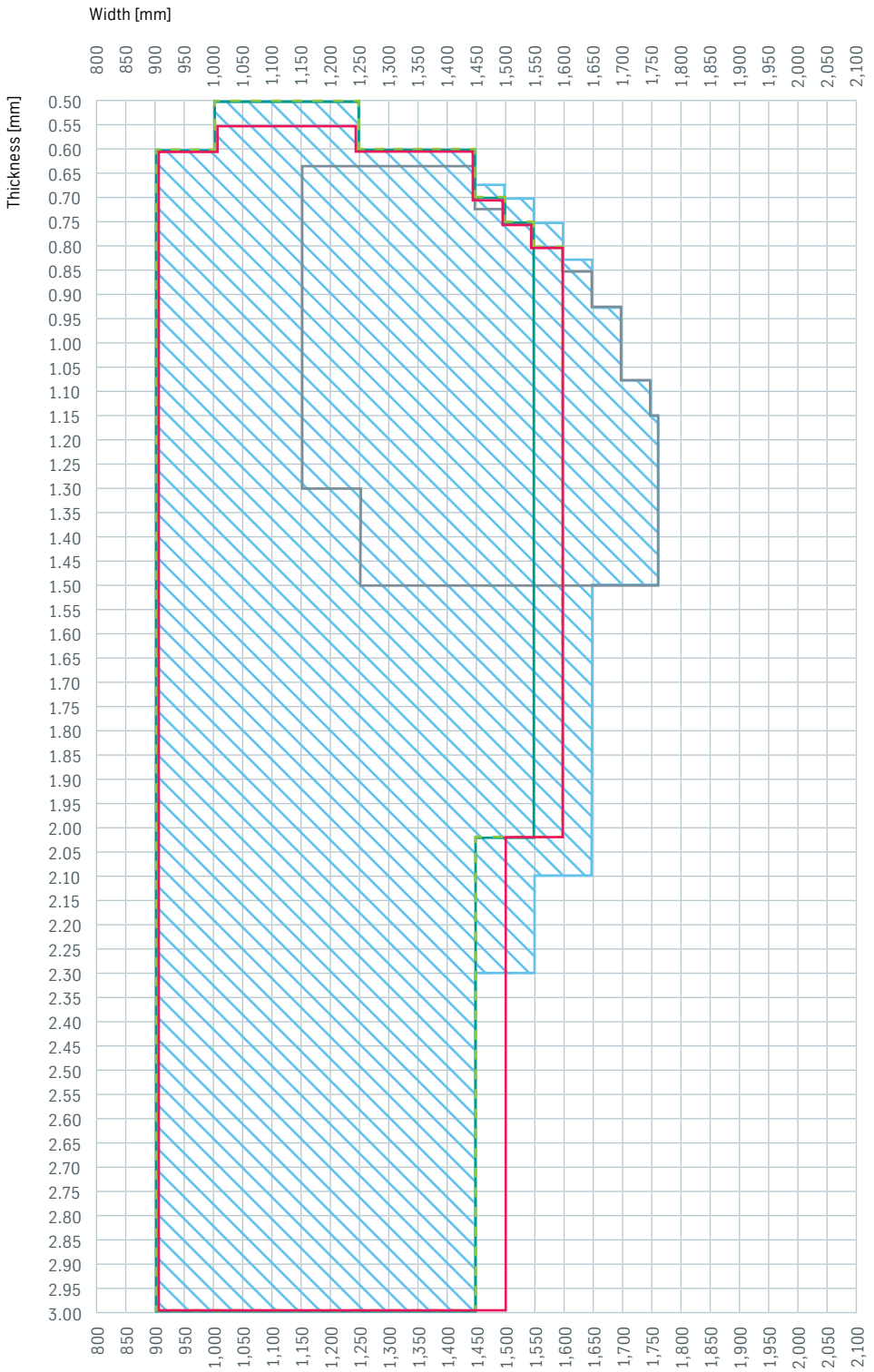


EG Electrogalvanized zinc coating

Uncoated with mill edge
EG trimmed

Typical dimensions for automotive customers. Restrictions may apply to steel grades as per VDA 239-100. Further dimensions on request.

MHZ® 420

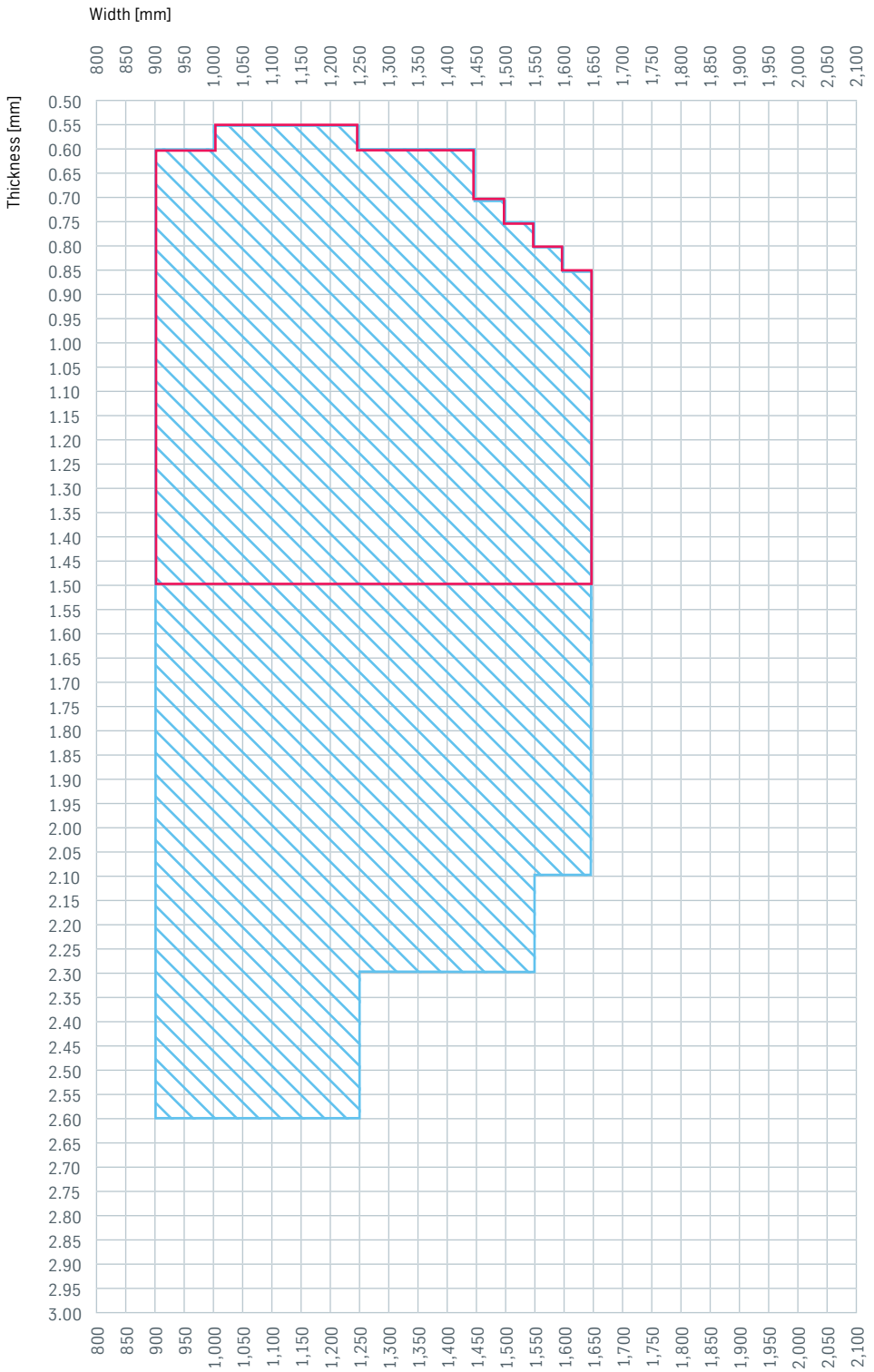


GI	Hot-dip zinc coating
GA	Galvannealed
ZM	ZM Ecoprotect®
AS	Aluminum-silicon coating
ZA	galfan®

GI trimmed
GA trimmed
ZM trimmed
AS trimmed
ZA trimmed

Typical dimensions for automotive customers. Restrictions may apply to steel grades as per VDA 239-100. Further dimensions on request.

MHZ® 460

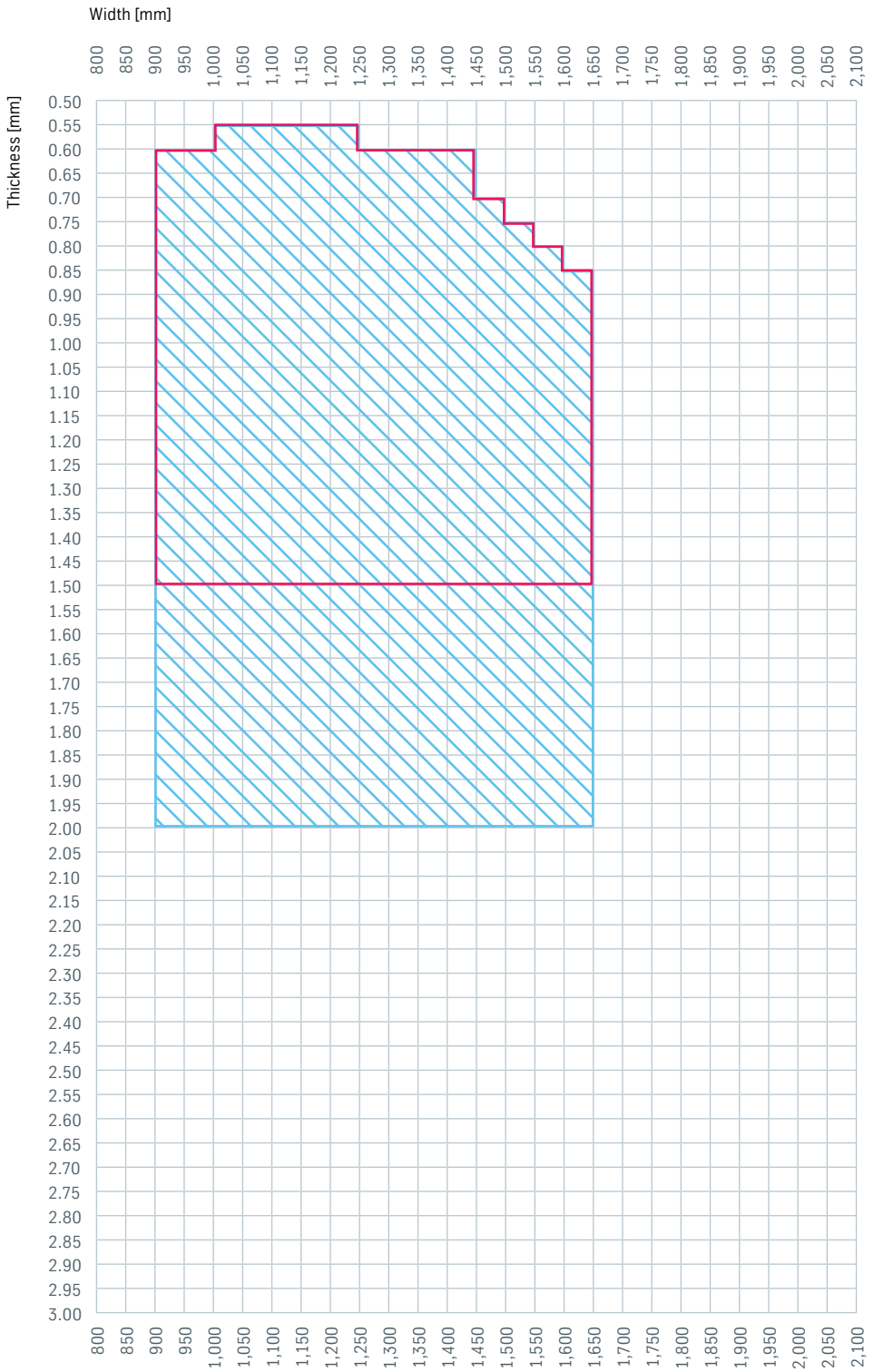


GI Hot-dip zinc coating
ZM ZM Ecoprotect®

GI trimmed
ZM trimmed

Typical dimensions for automotive customers. Restrictions may apply to steel grades as per VDA 239-100. Further dimensions on request.

MHZ® 500



GI Hot-dip zinc coating
ZM ZM Ecoprotect®

GI trimmed
ZM trimmed

Typical dimensions for automotive customers. Restrictions may apply to steel grades as per VDA 239-100. Further dimensions on request.

Special mill grades are supplied subject to the special conditions of thyssenkrupp. Other delivery conditions not specified here will be based on the applicable specifications. The specifications used will be those valid on the date of issue of this product information brochure.

General information

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