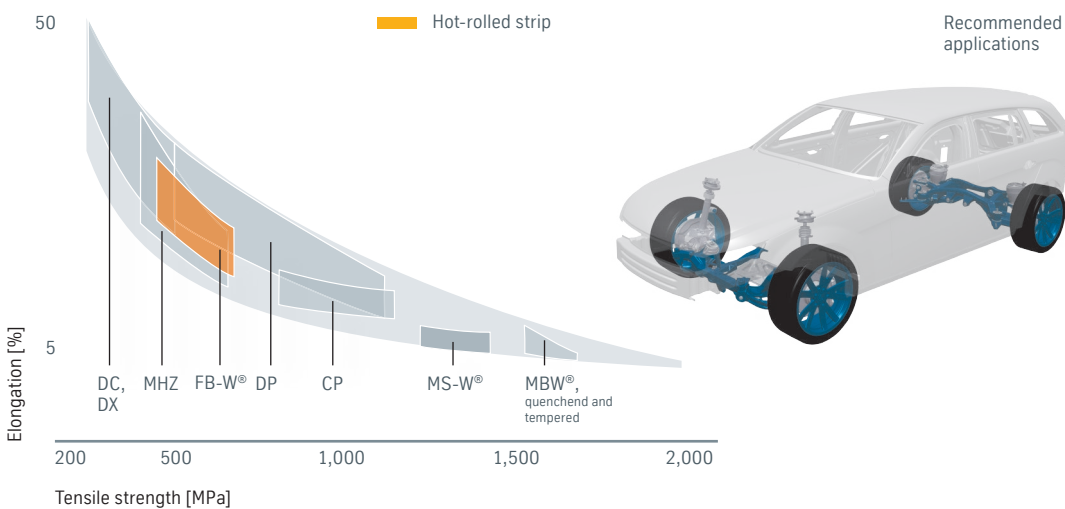




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## Overview of steel grades



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## Areas of application

Hot-rolled FB-W<sup>®</sup> ferritic-bainitic steels by thyssenkrupp are modern, multi-phase steels which exhibit minimum tensile strengths of 450 and 580 MPa in the thermomechanically rolled state. Their good dynamic behavior makes them ideal for vibration-exposed parts.

Ferritic-bainitic steels have a very fine microstructure, which combines high strength with good cold working and welding capabilities. They are particularly suitable for the production of cold-worked automotive components such as profiles, body reinforcements, wheels and chassis parts. Two steel grades are available.

## Steel grade designations and surface refinements

Steel grade	Respective grade DIN EN 10152, 10346, 10338	Respective grade VDA 239-100	Surface refinements					
			UC	EG	GI	GA	ZM	AS
● FB-W® 300Y450T	HDT450F	HR300Y450T-FB	●	●	●			
● FB-W® 460Y580T	HDT580F	HR440Y580T-FB	●	●	●			

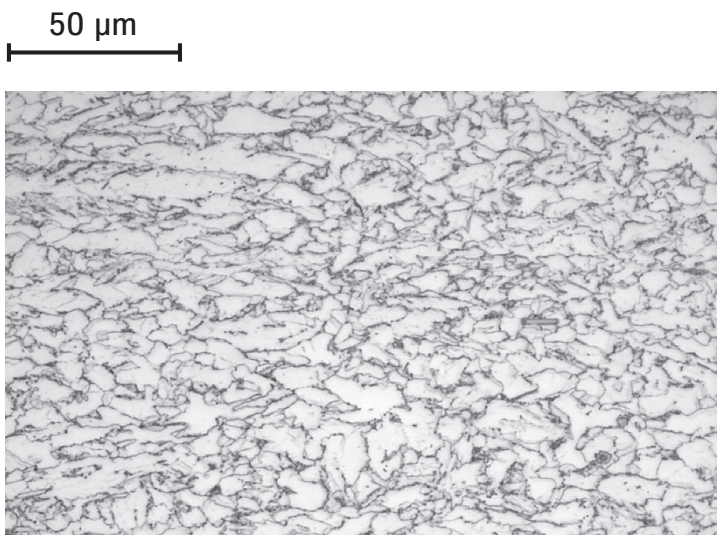
thyssenkrupp supplies the above steel grades as per the product information or on request in accordance with the listed standards.

- Hot-rolled strip
- Serial production for interior parts
- UC Uncoated
- EG Electrogalvanized zinc coating
- GI Hot-dip zinc coating
- GA Galvannealed
- ZM ZM Ecoprotect®
- AS Aluminum-silicon coating

## Material characteristics

Due to the selected chemical composition and the special rolling process, ferritic-bainitic phase steels have a very fine microstructure. The matching microstructure components of ferrite and bainite offer a particularly attractive combination of high strength plus good cold workability and weldability.

### Micrograph of FB-W®



Typical microstructure of ferritic-bainitic steel with nital.

## Technical features

### Chemical composition

Mass fractions in ladle analysis	C [%] max.	Si [%] max.	Mn [%] max.	P [%] max.	S [%] max.	Al [%] total	Ti + Nb [%] max.	Cr + Mo [%] max.	V [%] max.	B [%] max.
<b>Steel grade</b>										
● FB-W® 300Y450T	0.18	0.50	2.00	0.050	0.010	0.015–2.0	0.15	1.00	0.15	0.005
● FB-W® 460Y580T	0.18	0.50	2.00	0.050	0.010	0.015–2.0	0.15	1.00	0.15	0.010

Ferritic-bainitic steels by thyssenkrupp are fully killed fine grain steels with a minimum Al content of 0.015%. For additional formation of a finely granular structure and/or nitrogen fixation, Nb, Ti and B are used individually or added in combination as required.

### Mechanical properties

Test direction in rolling direction	Yield strength	Tensile strength	Elongation	
	$R_{p0.2}$ [MPa]	$R_m$ [MPa] min.	A [%] min.	$A_{80}$ [%] min.
<b>Steel grade</b>				
● FB-W® 300Y450T	300–420	450	27	24
● FB-W® 460Y580T	460–620	580	17	15

- Hot-rolled strip

$R_{p0.2}$  Proof strength at 0.2% plastic elongation

$R_m$  Tensile strength

A Percentage elongation after fracture using a proportional specimen with  $L_0 = 5.65 \sqrt{S_0}$  for sheet thicknesses  $\geq 3.0$  mm

$A_{80}$  Percentage elongation after fracture using a specimen with gauge length  $L_0 = 80$  mm for sheet thicknesses  $< 3.0$  mm

## 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/m <sup>2</sup> ]	Thickness [μm]	Mass [g/m <sup>2</sup> ]	Thickness [μm]	
<b>Electrogalvanized zinc coating</b>						
Designation						
ZE25/25	DIN EN	18	2.5	≥ 12	≥ 1.7	
EG18	VDA 239-100	–	–	18–38	2.5–5.4	
ZE50/50	DIN EN	36	5.0	≥ 29	≥ 4.1	
EG29	VDA 239-100	–	–	29–49	4.1–6.9	
ZE75/75	DIN EN	54	7.5	≥ 47	≥ 6.6	
EG53	VDA 239-100	–	–	53–73	7.5–10	
ZE100/100	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/m <sup>2</sup> ]		Coating on each side of single spot sample		Informative
		Triple spot sample	Single spot sample	Mass [g/m <sup>2</sup> ]	Thickness [μm]	Typical thickness [μm]
<b>Hot-dip zinc coating</b>						
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	–

## Surface finishes and surface qualities

	Finish type	Surface quality
<b>Products</b>		
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)

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

## Surface treatments

Type of surface treatment	UC	EG	GI	GA	ZM	AS
0 Oiled	●	●	●			

● Serial production	UC	Uncoated	GA	Galvannealed
	EG	Electrogalvanized zinc coating	ZM	ZM Ecoprotect®
	GI	Hot-dip zinc coating	AS	Aluminum-silicon coating

## Notes on applications and processing

### Forming

Despite their high strength, ferritic-bainitic phase steels typically support cold working well. Compared to hot-rolled dual-phase steels with a comparable tensile strength, ferritic-bainitic steels have a higher yield-to-tensile ratio, that is, the yield point is accordingly higher. In deep-drawing and stretch-forming operations, this leads to a slightly lower forming level than with corresponding dual-phase steels.

Due to their fine microstructure and the relatively low hardness differences within this structure, ferritic-bainitic steels exhibit very good hole expansion properties, which is particularly beneficial for through-hole extensions, as well as bending or folding operations.

### Processing instructions for joining

Ferritic-bainitic steels are suitable for welding both same-grade joints and other common steel grades. The precondition is welding parameters matched to the material.

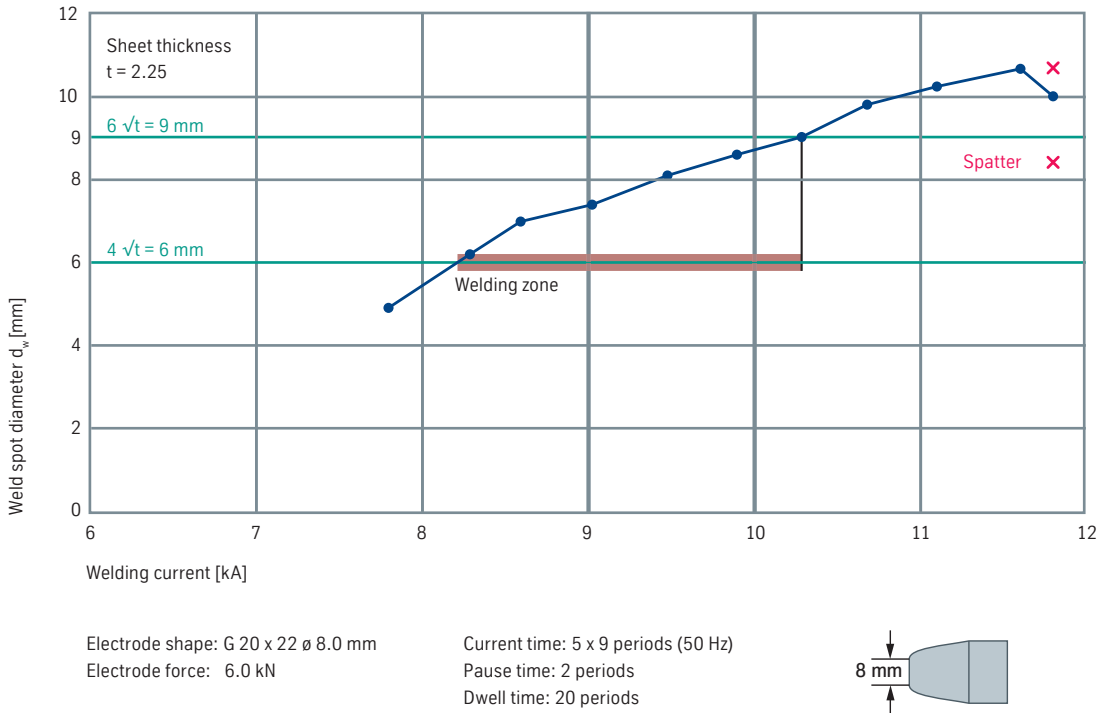
### Resistance spot welding

For spot welding ferritic-bainitic steels, the same equipment can basically be used as for welding unalloyed deep-drawing steels. However, the electrode forces should be increased slightly compared to these steel grades in order to achieve a large welding current setting range. Stable and rigid welding rods with large power reserves are therefore recommended for spot welding of ferritic-bainitic phase steels; this may also offer advantages in case of engineering fit issues.

Extending the current flow times; or for example the use of multi-pulse welding in line with SEP 1220-2, can also have a favorable effect on the width of the welding zone.

Compared to deep-drawing steels, ferritic-bainitic steels have a lower electrical conductivity; lower welding currents thus tend to be required for spot welding with electrodes with the same force. In resistance spot welding of galvanized sheets, the welding currents must be increased due to the higher conductivity of the coating compared with the base material (substrate).

Typical welding zone diagram for an FB-W® 460Y580T+GI ferritic-bainitic steel



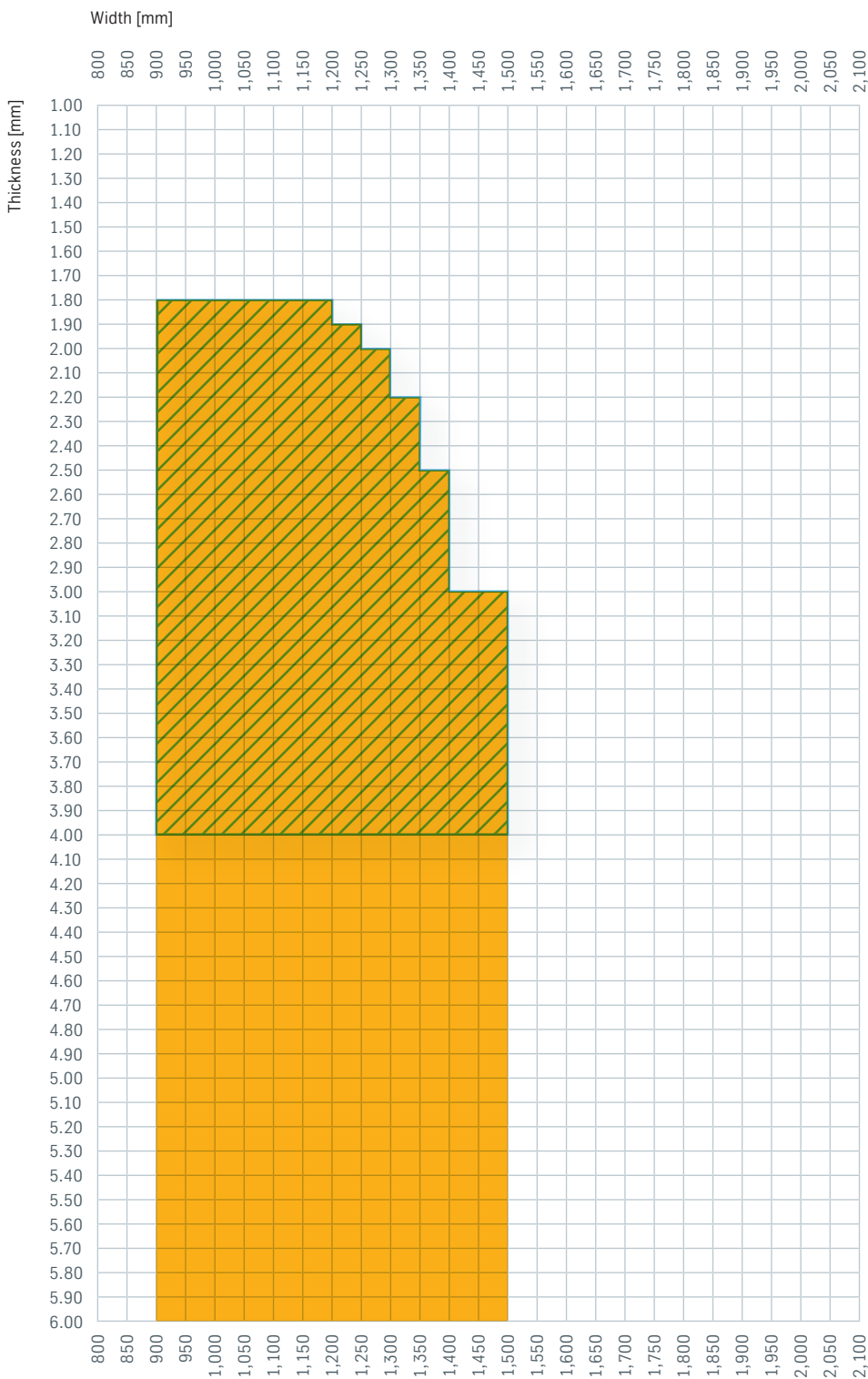
In addition to the sheet type, surface and thickness combination, other factors e.g., the type of electrode used, play an important role in determining optimum joining parameters. The relationships shown in the figure should therefore only be understood as examples.

### MIG arc brazing

Information sheet DVS 0938-2 "Arc brazing" describes brazing of steels up to a tensile strength of approximately 500 MPa. As the material described here is above this tensile strength, it is advisable to check the component-specific suitability for brazing.

## Available dimensions

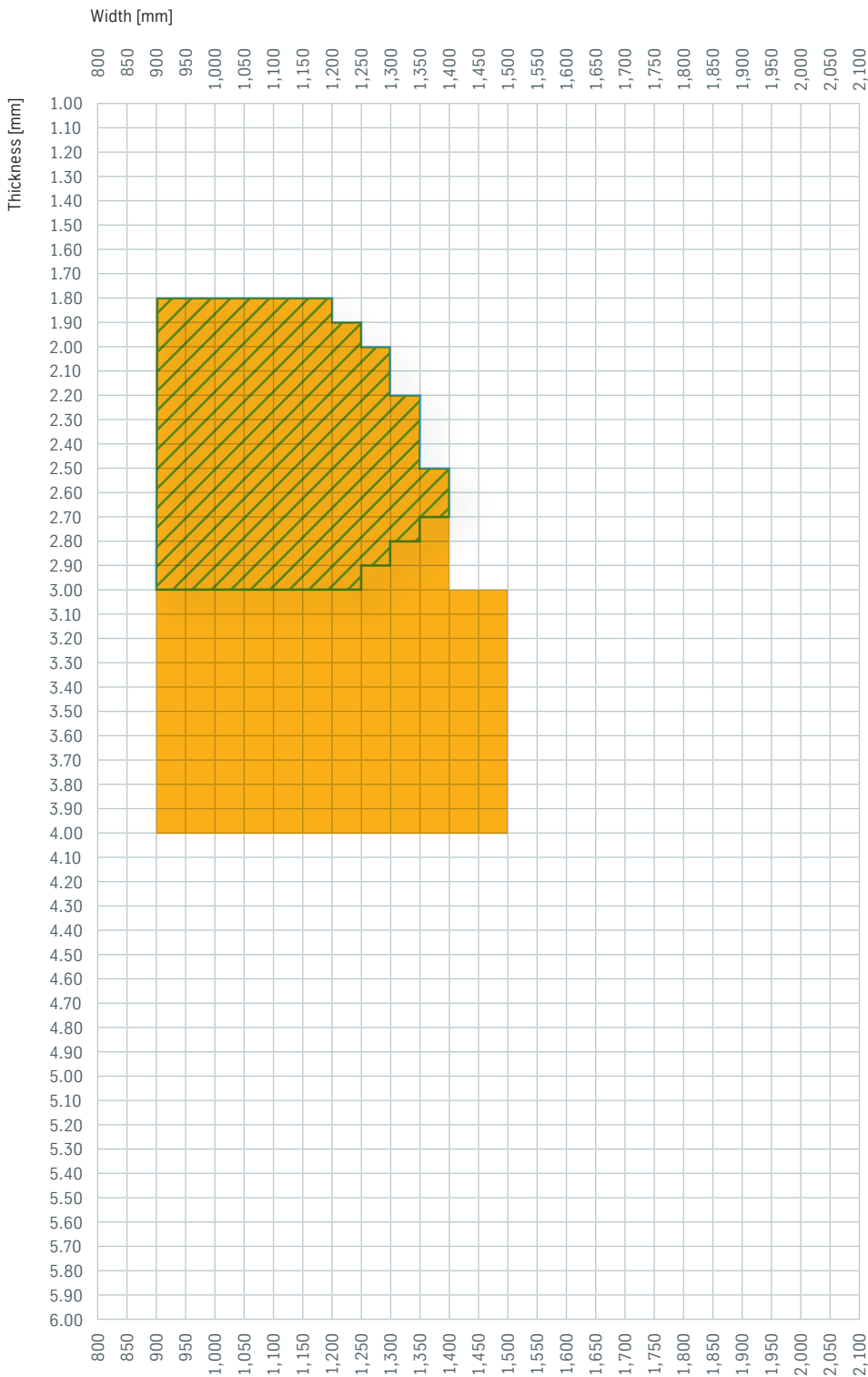
### FB-W® 300Y450T



- GI Hot-dip zinc coating
- GI trimmed
- Uncoated with mill edge

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

### FB-W® 460Y580T



- GI Hot-dip zinc coating
- GI trimmed
- Uncoated with mill edge

For interior parts  
 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.

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