C20 - Solfer®: decarburised cold rolled steel range for white and coloured enamelling processes

The use of Solfer® decarburised cold rolled steel grades for white and coloured enamelling processes produces an excellent surface finish after enamel firing.

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Properties

Solfer® grades are obtained by decarburisation. Two decarburisation processes are used:

- Decarburisation during open-coil annealing process – Solfer® and Solfer®+ grades: these grades are particularly suitable for the direct-on white or coloured enamelling process after degreasing, pickling and deposition of a nickel layer. However, they can also be used for two-coat / one-fire or for ground enamelling processes using ground-coat enamel specially designed for the low intrinsic reactivity of these grades (e.g. enamelling of self-cleaning pyrolytic oven cavities).
- Surface decarburisation during continuous annealing process – Solfer® CA grade: this patented steel grade has been developed for the two-coat / one-fire enamelling process. Nevertheless, it can also be used for ground or conventional enamelling processes.

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Advantages

Solfer® and Solfer®+ grades are suitable for the manufacture of complex parts (medium to deep drawing) and are compatible with all existing enamelling processes (direct-on white or coloured enamelling after degreasing, pickling and coating with nickel, two-coat / one-fire or ground enamelling after degreasing), with enamel layers being applied as either a liquid or a powder. These grades offer excellent resistance to "fish scale" defects. A minimum TH of 100 is guaranteed, in accordance with EN 10209:2013.

Solfer® CA grade is suitable for light to medium drawing and is compatible, after degreasing, with the two-coat / one-fire enamelling process using the wet/dry or dry/dry method. This grade can also be used for the ground enamelling process. It offers excellent resistance to "fish scale" defects. A minimum TH of 100 is guaranteed, in accordance with EN 10209:2013.

For the whole Solfer® range, surface appearance after enamelling is excellent: no pinholes or black spots. This is linked to the ultra-low carbon content of these grades (throughout for Solfer® and Solfer®+ grades and on the surface for Solfer® CA grade). Moreover, for Solfer® and Solfer®+ grades, deformation at high temperature (e.g. sagging, during pyrolytic cycles) is limited.

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Applications

Solfer® grades are particularly suitable for the manufacture of casing panels for domestic appliances (hobs, covers, control panels, side panels etc) and for kitchen utensils (pots and pans). They can also be used for architectural applications, thanks to their excellent resistance to deformation during enamel firing.

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Recommendations for use

Forming

Solfer® grades can be formed by bending, profiling or deep drawing.

Joining

Solfer® grades can easily be welded, whatever the welding process may be. Other joining processes (clinching, crimping) may also be used.

Direct-on enamelling process: Solfer® and Solfer®+ grades

Surface preparation:

Surface preparation before enamelling must be performed with the greatest care (degreasing, pickling and coating with nickel). This is essential to achieve a good surface appearance of the part after enamelling and good adhesion of the enamel. The level of iron loss after pickling and the quantity of nickel deposited must therefore be monitored very precisely.

Application of the enamel and firing:

The thickness of the enamel layer deposited is generally about 130 microns. Moreover, Solfer® and Solfer®+ grades are compatible with all the common enamelling processes: wet spraying, electrostatic liquid or powder deposition. Taking into account its limited Al content, the Solfer® grade is particularly suitable for the ETE application process.

Where wet application is used, it is imperative to dry the enamel layer before firing.

Finally, firing is performed at a temperature of about 830 °C.

Two-coat / one-fire enamelling process: Solfer® CA, Solfer® and Solfer®+ grades

Surface preparation:

- Very meticulous degreasing before enamel application is essential

Enamel application and firing:

- Solfer® grades are compatible with all the common enamelling processes: wet spraying, electrostatic liquid or powder deposition.
- It is essential that the following requirements are met:
  - Use of ground-coat enamel containing a high level of metallic adhesion oxides
  - The thickness of the ground-coat enamel should not be less than 35 microns or more than 45 microns
  - The thickness of the cover-coat enamel should be about 100 microns
  - Where wet application is used, it is imperative to dry the enamel layer before firing
- Finally, firing is performed at a temperature of about 830°C

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Brand correspondence

	EN 10209:2013	DIN 1623/3	ASTM A424	JIS 3141 + 3133
Solfer®	DC03ED	ED3	Type 1 CS	SPP
Solfer®+	DC04ED	ED4	Type 1 DS	SPP
Solfer® CA				

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Dimensions

Thickness (mm)	Min width	Solfer®, Solfer®+	Solfer® CA
		Max width	Max width
0.40 ≤ th < 0.50	650	-	1460
0.50 ≤ th < 0.70		1640	
0.70 ≤ th < 0.80		1800	
0.80 ≤ th < 1.60			1680
1.60 ≤ th < 2.00			1365

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Mechanical properties

	Direction	Thickness (mm)	R_e (MPa)	R_m (MPa)	A_{80} (%)
Solfer®	T	0.5 - 0.7	140 - 260	270 - 370	≥ 32
		0.7 - 2	140 - 240		≥ 34
Solfer®+	T	0.5 - 0.7	140 - 230	270 - 350	≥ 36
		0.7 - 2	140 - 210		≥ 38
Solfer® CA	T	0.4 - 0.5	140 - 260	270 - 390	≥ 32
		0.5 - 0.7	140 - 240		≥ 34
		0.7 - 2	140 - 220		≥ 36

Mechanical properties as delivered

Solfer® CA: mechanical properties as well as fish scale resistance comply with EN 10209:2013.

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Chemical composition

	Notes	C (%)	Mn (%)	P (%)	S (%)	Si (%)	Al (%)
Solfer®		≤ 0.004	≤ 0.40	-	-	≤ 0.030	≤ 0.020
Solfer®+		≤ 0.004	≤ 0.40	-	-	≤ 0.030	≤ 0.060
Solfer® CA	1	0.025 - 0.045	0.16 - 0.24	≤ 0.018	≤ 0.018	≤ 0.030	-

1. C (%): heat analysis

The manufacturing conditions guarantee very good resistance to "fish scale" defects (TH > 100 in accordance with EN 10209:2013).

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