LightProtect® fal

Hot dip aluminized sheet for corrosion- and heat-resistant components in sheet thicknesses of less than 0.40 mm

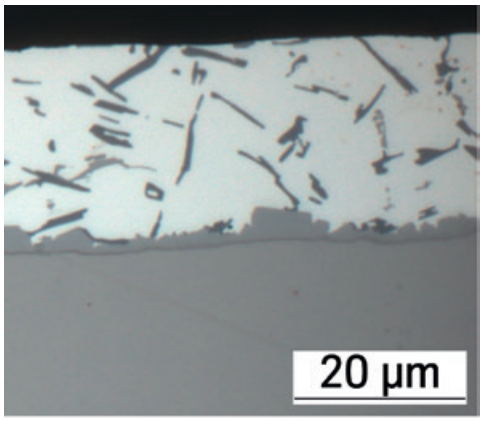
Applications

LightProtect® fal is ideal for very thin components that have to display corrosion resistance at elevated temperatures. LightProtect® fal is therefore the perfect material e.g. for the production of heat shields for vehicle exhaust systems.

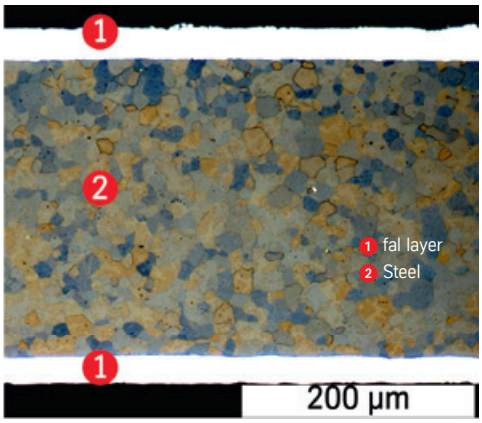
Technical features

Coating process

Like hot-dip galvanized sheet, LightProtect® fal is produced in a continuous process (furnace, metal bath). The coating typically consists of approx. 10% silicon, 3% iron and 87% aluminum.



Example of the microscopic structure of LightProtect® fal in a vertical section



Cross-section showing the top and bottom of LightProtect® fal

Steel grades

LightProtect® fal is available in various deep drawing grades:

- DX52D+AS
- DX53D+AS
- DX54D+AS
- DX56D+AS

LightProtect® fal coating weights

LightProtect® fal is available with a coating weight of 120 g/m² as standard. Coating weights of 100 g/m² or 80 g/m² by arrangement only.

Coating thicknesses

Available LightProtect® fal coating thicknesses (other coating thickness groups by arrangement)			
AS layer g/m²	Arithmetic coating thickness µm/side[1)]	AZ layer g/m², both sides	
		Triple-spot test[2)]	Single-spot test[2)]
80	14	75	65
100	17	100	85
120	20	150	130

[1)] A LightProtect® fal layer of 120 g/m² (both sides) corresponds to a thickness of approx. 20 µm/side
[2)] The test is carried out using the gravimetric method in accordance with the specifications of the EN 10346 standard

Surface finish

LightProtect® fal is available with a skin-passed “A” finish:

Example of a skin-passed A finish

Surface treatment and protection

To provide temporary protection from moisture during transportation and storage, LightProtect® fal is available with chemical surface treatment and/or oiled.
The following finishes are available:

- Chemically passivated (C)
- Chemically passivated, micro- or lightly oiled (CO)
- Micro- or lightly oiled (0)

Tolerances

Dimensional and shape tolerances to EN 10143

Mechanical properties

The coating on LightProtect® fal has a much greater effect on the results of mechanical property measurements than is the case with hot-dip aluminized sheet fal. This applies mainly to the measurement of elongation (A_{80}), vertical anisotropy (r_{90}) and strain hardening exponent (n_{90}):

1. Example measurement with coating (base material thickness 0.26 mm plus coating thickness of 0.02 mm on each side)

d = 0.30 mm with coating	R_e [MPa]	R_m [MPa]	A_{80} [%]	r_{90}	n_{90}
DX56D	153	314	31.5	0.94	0.188

2. Example measurement without coating (base material thickness 0.26 mm)

d = 0.26 mm without coating	R_e [MPa]	R_m [MPa]	A_{80} [%]	r_{90}	n_{90}
DX56D	156	314	40.5	1.58	0.24

For this reason, the properties set out in EN 10346 Table 6 for tests with coatings are not applicable for LightProtect® fal. However, decreasing the minimum values stated in EN 10346 Table 6 by the following amounts provides suitable reference values for measurements on coated samples:

- A_{80} minus 8 %
- r_{90} minus 0.8 units
- n_{90} minus 0.03 units

Information on application and processing

Forming

With regard to forming, LightProtect® fal behaves in the same way as hot-dip aluminized sheet fal. All common forming processes used for cold-rolled sheet can be used for LightProtect® fal provided die geometry and surface are matched to this material. The aluminum coating exerts a decisive influence on the tribology of the forming process. In particular, the radii of the die should be as smooth as possible and the surfaces should ideally be coated. This minimizes abrasion of the LightProtect® fal coating and thus also the risk of stick-slip effects in the die. The general influence of die radius and drawing gap can be seen in the following images:

Non optimal processing parameters

thickness 1.50 mm
Drawing gap 1.80 mm
Die radius 2.50 mm

Optimal processing parameters

Sheet thickness 1.50 mm
Drawing gap 3.50 mm
Die radius 5.00 mm

It should also be noted that, like hot-dip aluminized sheet fal, LightProtect® fal reacts very sensitively to consecutive tensile/compressive stresses and consecutive tensile stresses offset by 90°. This must be taken into account when designing the components and producing the dies.

Joining

All thermal and mechanical joining processes, bonding and sealing may be used. However, in some joining processes the special physical properties of the aluminum coating require modified processing parameters compared with those for uncoated sheet. Where possible, the use of gentle joining processes is recommended to ensure the corrosion protection is not compromised. Processes tailored to the special properties of the hot-dip coated sheet have been developed. When joining LightProtect® fal with other materials, possible differences in electrochemical behavior must be taken into account as the corrosion protection properties of the coating may be compromised by unfavorable metal pairings.

Welding

With resistance spot welding and roll seam welding, the reduced contact resistance caused by the aluminum coating results in a higher electrode force and requires a higher welding current than uncoated sheet. The welding time must be increased by 20 – 30%. Spot welding with dome electrodes made of CuCrZr alloys offers the longest electrode life. Use of a stepper control system has also been proven to extend electrode life. To avoid the formation of impurity layers on the electrodes during roll seam welding, particularly intensive electrode cooling is necessary. To ensure constant working conditions, use of a knurled roller drive and integration of profile rolls or a scraper are recommended. Roll seam welding with wire electrodes has proven suitable as a special process. The copper wire alloys with the coating but, as the wire is constantly replaced, good contact ratios are always ensured at the weld point. The MAG shield gas welding process commonly used for uncoated sheet is subject to limitations. The heat input must be increased to ensure sufficient leading heat to remove the coating before the welding bath.

The welding speed must be reduced in order to minimize pore formation and spatter. Mixed gases should be preferred to pure CO_2; damage to the coating alongside the weld can be minimized by using short and pulsed arc techniques. Plasma butt welding produces the best results. Additional wire should be used when welding lap joints. Plasma-welded joints exhibit even welds with minimal pores and spatter. The strength of the welded joints is commensurate with that of the base material. The weld surface and directly adjacent material exhibit reduced or no corrosion protection. If the weld area is to be exposed to highly corrosive stresses, aluminum-rich paints should be applied for protection.

Thermal stress resistance

LightProtect® fal offers excellent resistance to oxidation at elevated temperatures and, thanks to its shiny surface, displays outstanding heat-reflecting properties. Parts made of LightProtect® fal can withstand long-term thermal stresses of up to 700°C. However, higher temperatures may cause oxidation processes and a reaction between the alloy coating and steel base material which negatively impacts the coating.

Corrosion protection

LightProtect® fal can be used in all situations where the good processing properties of cold-rolled steel, strong corrosion resistance and very high heat resistance are required for thin-walled parts.

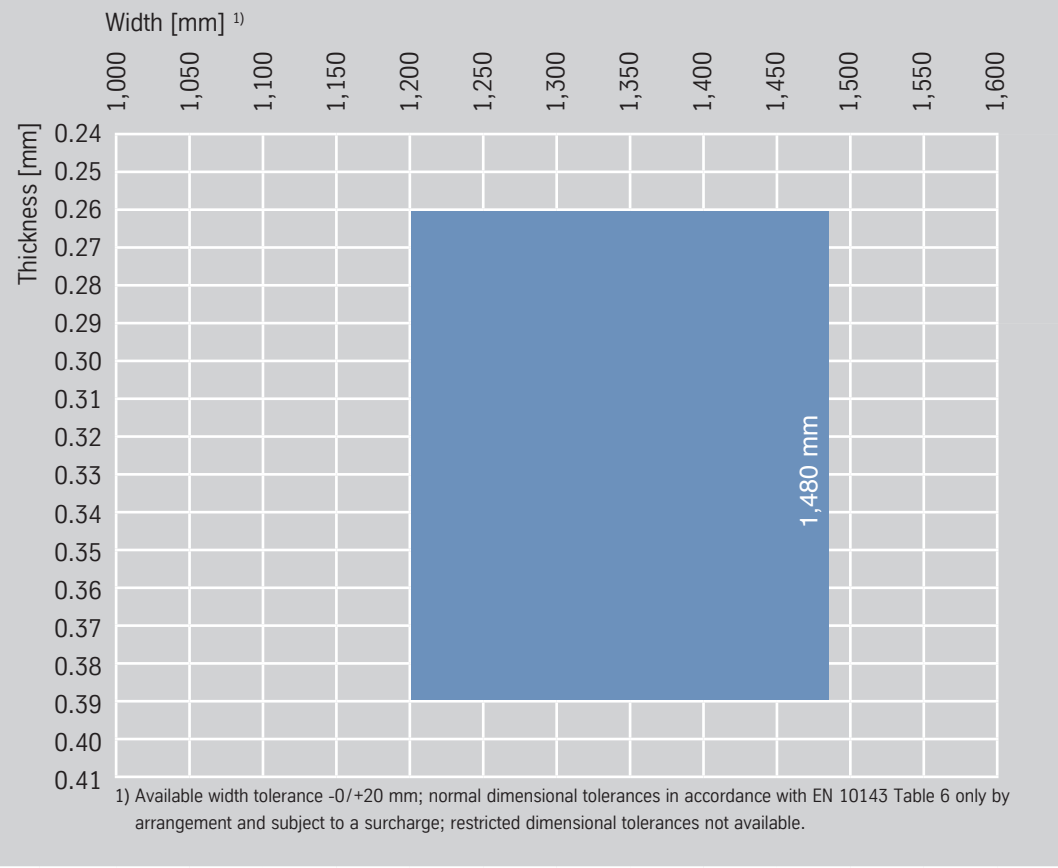
The coating mainly protects the steel sheet passively through the barrier effect of the dense aluminum coating and formation of a oxide layer with low water solubility which prevents aggressive media from reaching the steel substrate.

By contrast with prevailing theory, a certain level of cathodic protection can even be observed in saline media (e.g. seawater with a pH value of 7.5). This protection results from the significantly lower potential of aluminum in the “practical electrochemical series” compared with the “standard electrochemical series”.

Long-term, comprehensive tests have demonstrated the excellent resistance of LightProtect® fal to aggressive (“acidic”) media. The coating is less resistant to highly alkaline media.

Available shapes and sizes

DX52D, DX53D, DX54D, DX56D



1) Available width tolerance -0/+20 mm; normal dimensional tolerances in accordance with EN 10143 Table 6 only by arrangement and subject to a surcharge; restricted dimensional tolerances not available.

The maximum coil weight currently available is 11 t; coil weights up to 13 t are only available on request.

Application example

Heat shield

Further information can be obtained from our technical customer service.

We update our product information on an ongoing basis. The latest version can be found at:
http://www.thyssenkrupp-steel-europe.com/en/publikationen

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