

# Flammstop<sup>®</sup>

Gelcoat  
Filler

WELA

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## THE EP-GELCOAT SYSTEMS

### WELA fire protection systems with reactive and non-reactive filling materials for epoxy resin high-performance composite materials

WELA fire protection solutions make high-performance compounds of epoxy resin, vinyl ester resin and also phenol resin into composite materials with excellent fire protection properties.



The WELA-Flammstop® system was developed principally for use in rail vehicles on the public transport network. Other applications are being worked on. It fulfils various national and international fire protection standards while at the same time maintaining the stipulated processing technologies. Nationally tested in accordance with DIN 54837 [draft 01.91] observing the "Principles for testing and classifying the fire behaviour of materials and components in rail vehicles in accordance with DIN 5510, Part 2" [draft 06.01]. The requirements for S4, SR2 and ST2 are fulfilled with sufficient safety for various fibre composite systems with WELA-Flammstop®. The

Flammstop® system was tested in the NBS smoke density chamber in accordance with ASTM 662, and the demand for low-toxicity smoke gases was met. The demands of Airbus regarding smoke density as defined by FAR Part 25.853 (d) and ABD 0031 and toxicity as defined by ABD 0031 are fulfilled.

Following application and gelling-on of the WELA-Flammstop® EP gel coat, work can continue without a solid flame protection agent (e.g. with the RTM method) if the viscosities of the EP and VE resins are adjusted. Phenol resins such as WELA Phenodur should be worked using the film or vacuum pressure injection method. Working is also possible with the normal EP prepregs available on the market. To achieve greater flame protection efficiency combined with high material characteristic values, it is possible to use reactive liquid flame protection agents. Good bonding of the epoxy resin onto the EP gel coat has been proven in tests. A sprayable bonding primer is available for the most exacting demands.

If WELA-Flammstop® is used as the top coat, the fire load performance of the fibre composite material is improved still further.



*Fibre compounds with the WELA-Flammstop® system are*

- halogen-free
- flame retardant
- self-extinguishing
- non-drip
- have low smoke gas contents and display low toxicity
- very resistant to burning through
- and greatly hinder the progress of fire

## Fire protection standards

### Binding European standards

	DIN 5510 Part 2	NFP 92-501	BS 6853 / BS 476 Part 6/7
<b>Paint-on WELA EP-Gelcoat 547/28</b> Comp. A with flame protection 547 Comp. B without flame protection WELA hardener 28	S4 SR2 ST2	for orientien- tation	Tested  Class 1
<b>Sprayable WELA EP-Gelcoat SG1/SH2</b> Component A with flame protection SG1 Component B with flame protection SH2	S4 SR2 ST2	for orientien- tation	Tested  Class 1

### European fire protection standard prEN 45545-2

	Set of requirements Number	GRP- laminat + WELA- Flammstop®	Category	* WELA- Flammstop® + BS prepreg	Category	** SG1/SH2	Category	*** Phenol resin Phenodur	Category
<b>ISO 5658-2 Critical Heat Flux (CHF)</b>	R1							32.7	HL3
	R2							32.7	HL4
<b>ISO 5659-2 Smoke density D<sub>s</sub>(4)</b>	R1, R2, R5, R10, R11, R19	25	HL4			246	HL3	73	HL4
	R6, R7, R8, R12	25	HL4			246	HL4	73	HL4
<b>ISO 5659-2 Smoke density VOF4</b>	R1, R2, R5, R10, R11, R19	154.5	HL4			411.7	HL3	109	HL4
	R6, R7, R8, R12	154.5	HL4			411.7	HL4	109	HL4
<b>ISO 5659-2 Smoke gas toxicity (CIT)</b>	R1, R2, R5, R10, R11, R19	0.07 (240 s)	(HL4)			0.129	HL4	0.075	HL4
<b>ISO 5660-1 Heat release rate</b>	R1			68	HL3	84.5	HL3	56.9	HL4
	R2, R7			68	HL4	84.5	HL4	56.9	HL4

\* WELA-Flammstop® 547/28 + fire protection prepreg TA 121 +EP-glass yarn laminate without flame protection (s=3.0 mm)

\*\* WELA-Flammstop® SG1/SH2 + Laminate made of phenol resin Phenodur VPW 9340/Additol VXK 9335 (s=4.0 mm)

\*\*\* WELA-Phenodur VPW 9340/Additol VXK 9335 - fibre composite (s=3.5 mm)

At the time of going to press, not all tests had been completed. Details of the fire characteristic values in accordance with prEN 45545-2 are available on request.

The coating thickness should be **0.8 mm to maximum 1.3 mm**. The recommended laminate structure with a high fibre component must be observed.

After gelling-on of the WELA-Flammstop® system, start with the form coating, the first layer of glass yarn fabric, quality WELA 1039-163 TF 970; Other layers follow with WELA 1102-290 TF970. It is possible to work selected matrix resins without a flame protection agent and – for more exacting requirements – matrix resins *with* flame protection agents in the laminate. Painting over is possible, but test with the respective painting system.

# SPRAYABLE EP GELCOAT SG1/SH2

## Production method

The CL 52 B 60/30 mixing and dosing system made by the Tartler company is suitable for spraying the EP Gelcoat with high filling material contents. The system is applied using a spray gun employing the Airassist method. With an optimised nozzle geometry, a flat jet is created that gives a good spray pattern thanks to the supporting air. The outside air entering the system must be free of oil and condensation water.

The coating thickness of the Gelcoat should be at least 1.0 mm and maximum 1.3 mm. This is achieved by 2 spraying runs crosswise with a discharge capacity of 1.5 kg/min. The gelling time for this coating thickness is approximately 100 minutes (room temperature 25 °C, moulded part temperature 25 °C). The ambient temperature for working with WELA Flammstop should be 20 °C to maximum 28 °C. The maximum relative humidity in the spraying room should be 60 %.



Tartler CP 52 B 60 spraying and casting system with two 60 l tanks



Tartler spray gun LC 53

The resin and hardener components are combined in the mixing head (e.g. LC 5/3) by means of a dynamic static mixer in the following mixing ratios:

### Weight ratio:

Component A (SG1) : Component B (SH2) = 100 : 32.3

### Volume ratio:

Component A (SG1) : Component B (SH2) = 100 : 35.0

## Mixing viscosities, reaction time and reaction temperature

Laboratory formulations with 100 g EP Gelcoat SG1/SH2 were used to determine the mixing viscosities. To reduce the viscosity, both components can be separately heated to 60 °C and then sprayed using a spraying system.

Viscosity / temp.	Spindle / torque	SG1/SH2 (mPa s)	Reaction time / T <sub>max</sub>	Thermometer guided by hand
20 °C	6/20	33500	50 min/43 °C	70 min 57 °C
50 °C	4/10	13600	11 min/80 °C	16 min 94 °C
60 °C	4/20	7000	6 min/70 °C	7 min >100 °C

Reaction time and reaction temperature at 20 °C room temperature: 50 min, 45 °C

## Properties

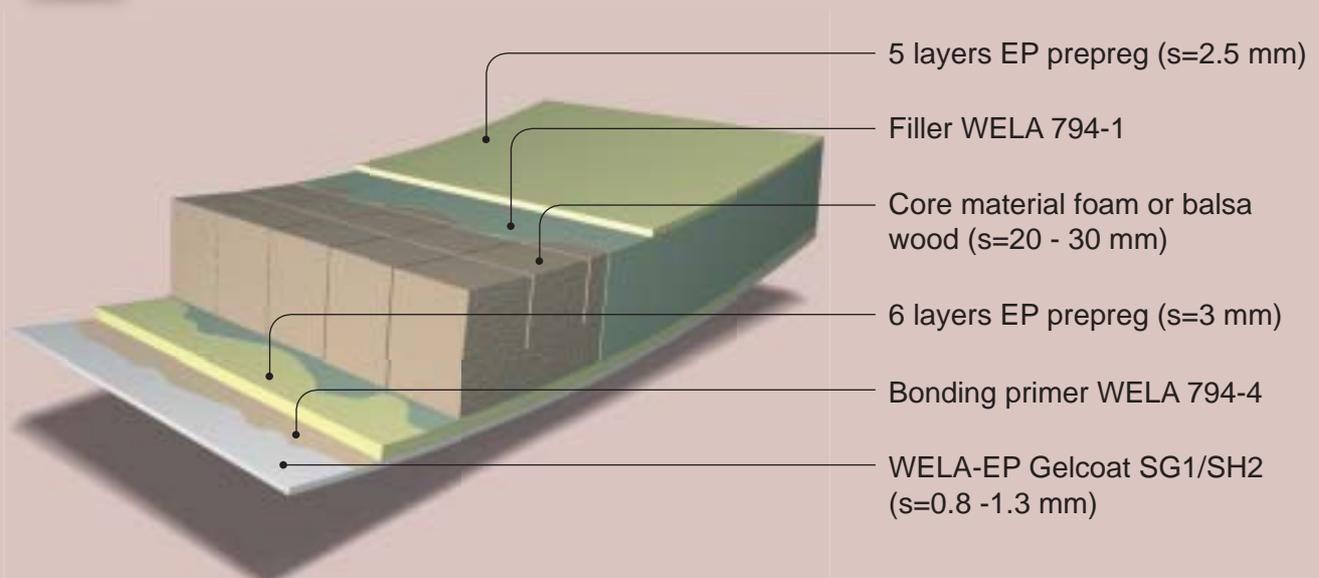
The formulated EP/EH system displays little shrinkage. The high proportion of filling material consisting of flame protection additives further reduces the shrinkage. This almost eliminates the tendency towards stress cracking. The EP Gelcoat splits off no low-molecular reaction products. This means that the micro-porosity is very low in the Gelcoat layer. The density of the WELA Flammstop system is 1.4 g/cm<sup>3</sup>.

## Delivery form

Both EP components are currently supplied in 30 kg hobbock.



### EP sandwich laminate with WELA-Flammstop® SG1/SH1



- S4, SR2 and ST2 approval, tested in accordance with DIN 54837 [E1/1991], classified in accordance with DIN 5510, Part 2
- fulfils the requirements of Airbus in accordance with ABD 0031 and the regulations for smoke density and toxicity in accordance with FAR 25.853 (d) and ABD 0031



This is achieved by painting on crosswise in two work steps. The coating thickness can be checked with a coating thickness measuring device, e.g. measuring comb.

The gelling time for the above coating thickness is 2 hours.

Working temperature: 20 °C (same as moulded part) to maximum 28 °C  
Relative humidity: maximum 60 %

Commence mould assignment after the Flammstop system has gelled on (fingernail test).

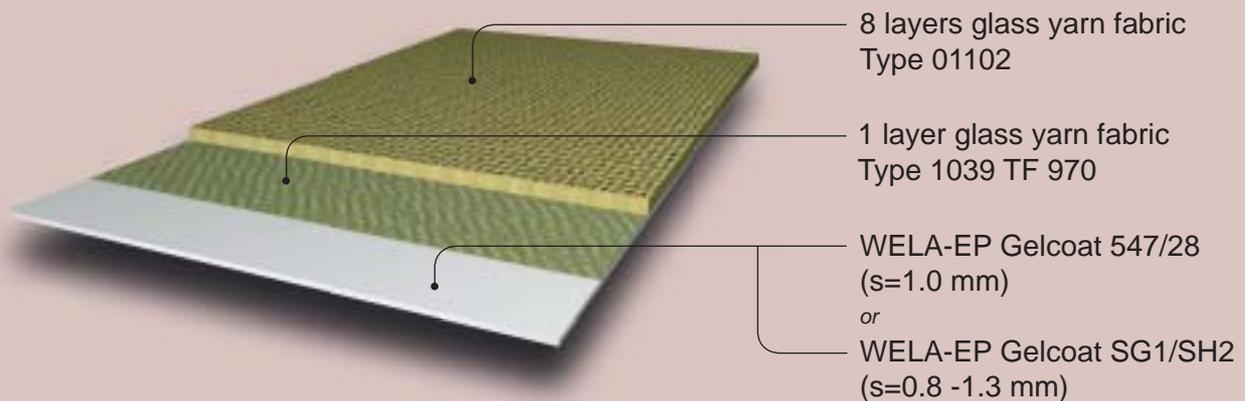
The EP Gelcoat 547/28 can also be used as a top coat, because it hardens non-sticky.

## Delivery form

Both EP / EH components are currently supplied in 30 kg hobbocks.



### EP wet laminate with WELA-Flammstop® 547/28



- S4, SR2 and ST2 approval, tested in accordance with DIN 54 837 [E1/1991 ], classified in accordance with DIN 5510, Part 2
- Fulfils the requirements of Airbus in accordance with ABD 0031 and the regulations for smoke density and toxicity in accordance with FAR 25.853 (d) and ABD 00310031
- Can be worked by hot hardening (3 h at 120 °C or h at 80 °C) or per cold hardening with WELA special hardener (e.g. WELA 04/28 without flame protection additive)

Details of the laminate structure and characteristic variables in accordance with prEN 45545-2 are available on request.

# EP FILLERS

## General properties

The EP fillers are based on a EP/EH resin system guaranteed by tests, which has proven successful for various applications in bonding technology.

The following are available as special hardeners:

- a) a latent hardener for **hot hardening**, which is already part of the formulation recipe
- b) two external EP hardeners, WELA 28 and WELA 21 for **cold hardening**.

All fillers are halogen-free, very flame retardant and give off little smoke gas. The toxicity of the smoke gases is extremely low, because no low-molecular reaction products are split off.

Our selected filling material system with its superb fire-retardant properties also contributes to this. The shrinkage is further reduced by the high proportion of filling material.

Thanks to the structure of the filling materials, i.e. a small grain size with a corresponding grain size distribution, the mechanical characteristic values of the filler (particularly the bonding strength) are improved and the cracking tendency is reduced.

Our recipes are formulated with network and dispersing additives in line with the state of the art.

## Low-viscosity EP filler 794-1

The filler 794-1 in the inherent colour grey was developed for sandwich structures and is for filling joints and slots in support material core materials, compensating for production tolerances, levelling out structurally-related connections and plate butts and for closing cavities during production.

If the amount of filler is sufficient, thin material webs form which, for example, securely bond the foam cube structures to each other. This increases the buckling stability of every sandwich shell.

The filler is very well suited for connecting the flat surfaces of foams to glass fibre-reinforced EP/VE resin top coats (RTM method or similar), which are then hot-hardened.

It also provides excellent binding to WELA EP Gelcoat coatings.

The increased adhesive tensile strength is attributable to free hydroxyl groups in the filling material that are found on the edges of the rough platelet structure. The consistency of the filler is malleable and pliable. It can be mechanically worked. The density of the filler is 1.57 g/cm<sup>3</sup>.

## Hardening conditions

WELA 794-1 is a hot-hardening filler in which a special hardener with an H-active equivalent of 53 g/mol has already been formulated. The filler requires an activation energy higher than 75 °C.

For an EP resin such as WELA 01 with an epoxy equivalent weight of 190 g/mol and the special hardener, typical working times are:

- 60 min at 80 °C
- 40 min at 100 °C
- 30 min at 120 °C

Glass transition temperature:  $T_g=85$  °C

After 45 min at 80 °C, the filler is hardened to a thickness of 1 mm to 3 mm and can be easily sanded after it has cooled down.

The filler must be conditioned in closed 30 kg drums at room temperature, preferably at 25 °C and stored for at least 48 h in order to again obtain the necessary consistency for working (see storage conditions).

## Storage conditions

If the storage conditions are verifiably adhered to, it is possible to work the filler after

- 1 month at room temperature < 23 °C
- 6 months at -18 °C in the cooling container

The recipe of a 150 kg formulation of WELA 01 : Special hardener : Aerosol = 100 : 28 : 2 is recommended as the testing condition for determining the POT LIFE from the first month at 42 °C.

## Delivery form

The filler WELA 794-1 is supplied in 30 kg hobbocks.

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For technical enquiries, please consult us.

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