

**Technical File
AEC Polymers
Rail Industry**



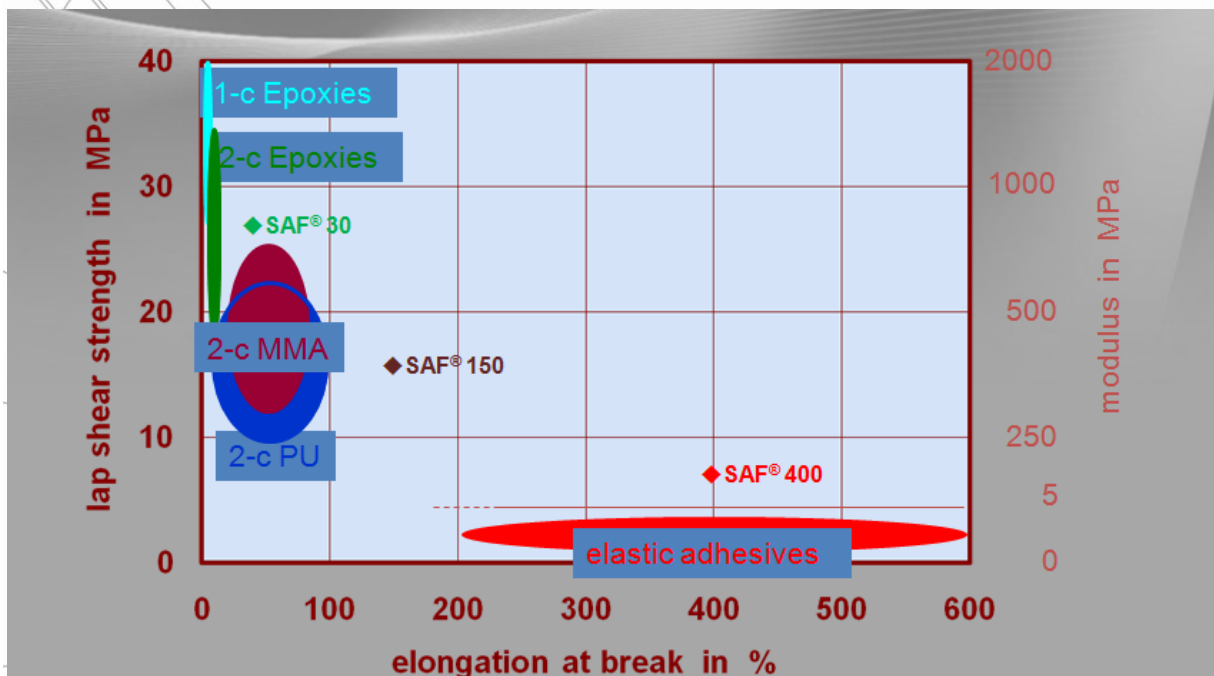
I. Selected products

A. Two-c structural methacrylate adhesives

Structural methacrylate adhesives here presented come from our patented range SAF[®]. From hyperstructural (30 % of elongation - 25MPa) to a more flexible version (400 % of elongation - 8MPa), these structural adhesives could be adapted to fit each application with an open time from 2 to 20 min (and until 120 min with our SAF[®] 30 LOT).

Special Features of SAF[®] (Strengths Are Flex)

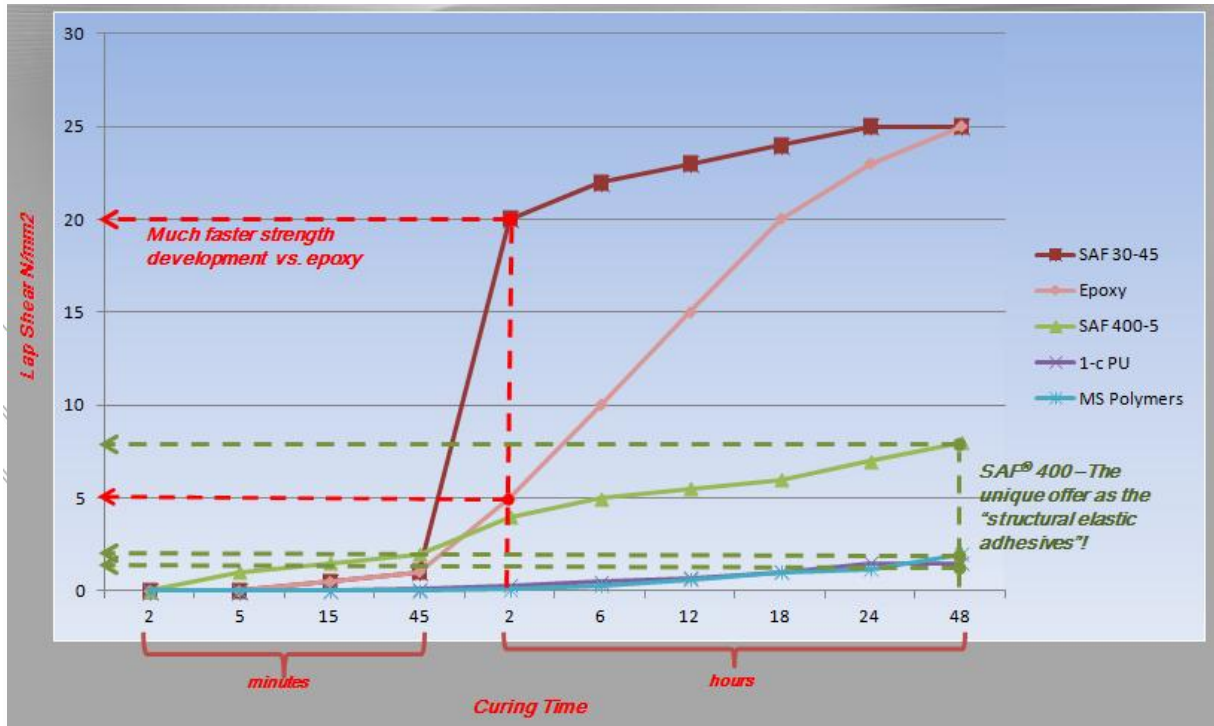
1. Perfect Combination of Strength and Flexibility



P. 1

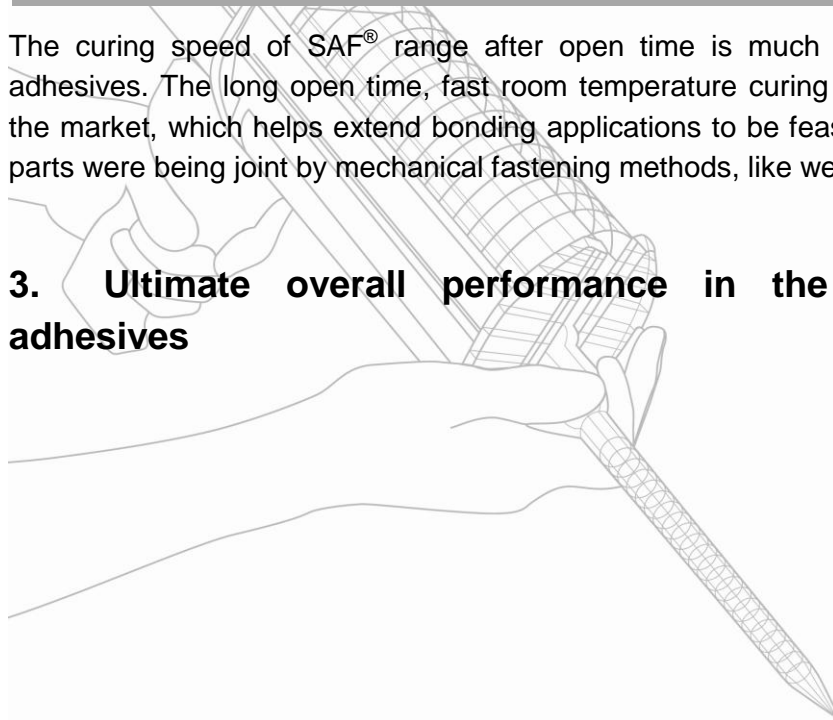
From the chart above we can see SAF[®] Range are superior against conventional structural and elastic adhesives in terms of bond strength (shear and peel), modulus and flexibility.

2. Best ratio in terms of curing speed and open time



The curing speed of SAF[®] range after open time is much faster than traditional epoxy adhesives. The long open time, fast room temperature curing adhesive is now available to the market, which helps extend bonding applications to be feasible in many new area when parts were being joint by mechanical fastening methods, like welding, riveting, soldering etc.

3. Ultimate overall performance in the field of structural adhesives



	2-c PU	Epoxy	SAF [®]
primerless adhesion on a wide variety of substrates	Requires surface pretreatment	Requires surface pretreatment	No sandblasting and primer is needed 🍑
modulus	<10 N/mm ²	>10 N/mm ²	2-15 N/mm ²
elongation	10 - 150%	< 5%	30 - 400% 🍑
bond strength (LSS)	5 - 15 N/mm ²	15 - 30 N/mm ²	5 - 25 N/mm ²
Peel strength	Mid. - High	Low	High 🍑
Vibration Absorption	Medium	Poor	Excellent 🍑
temperature resistance	-40°C - 100°C	-40°C - 120°C	-40°C - 150°C
weather resistance and general durability	Poor	Excellent	Excellent
UV-resistant (non-yellowing, non-cracking)	Cracks under sunlight or UV	Yellowing under sunlight or UV	Excellent in UV and sunlight resistance 🍑
Shrinkage after cured	<5%	<1%	<1%
Curing Speed	Slow in curing, needs 48 hrs for full cure	Slow in curing, needs 48 hrs for full cure	Can achieve 80% of full cure within 2 hrs 🍑

Compared with the traditional structural adhesives like 2-c polyurethane and epoxy system, SAF[®] offers the best overall performance:

- ✓ High in strength in terms of lap shear, peel and also vibration absorption
- ✓ Totally primerless applications
- ✓ No plasticizer in the formulation which helps on the performance in various ageing conditions, like UV, high/low temperature and weathering.
- ✓ Low shrinkage during and after curing (less than 1% !)
- ✓ Can achieve 80% of full curing strength within 2 hours of curing under ambient conditions.

Below we will introduce the three core members of our SAF[®] ranges into further details:

1. SAF® 30

a) Advantages :

With a high Tg (86°C), SAF® 30 provides exceptional high-temperature properties. This structural adhesive can be used to bond assembled parts which will then be powder coated and heated at more than 200°C. It is perfect to bond with a wide range of material, SAF® 30 offers very high modulus with a high elongation at break (30 %).

After several tests like humid cataplasms and D3 cycle, SAF® 30 has shown that it is perfectly resistant to weathering and ageing effects.

Available with four different open times, SAF® 30 is perfectly adapted to fast process and to assembly big parts.



Train Body - Aluminium/Aluminium assembly

b) Application :

SAF® 30 could be used to bond metals, composites and other thermoplastics of any size. Its application can be made in filled joint or flat bonding and its high modulus allows SAF® 30 to be used as cold welding for metals.

Data sheet : See attachment n°1

2. SAF® 150

a) Advantages :

SAF® 150 is the perfect compromise between flexibility and resistance. With a lap shear strength of 16MPa and its morphology nano-structured, SAF® 150 provides a 150% elongation and allows possibility of use for every kind of assembly.

Different setting times offer an easy industrialization.

Able to resist in extreme temperatures from -40°C to +180°C, and in humid cataplasms, SAF[®] 150 can be used on outdoor assemblies.

Its formulation provides to this product an exceptional elongation, even preserved after ageing and weathering, because it is free of plasticizer like rubber. SAF[®] 150 is the best multi-use reference on the market.



Structural seats assembly - Application on Aluminium (6060)

b) Application :

Designed to bond on a wide kind of classic substrates like metals, composites and thermoplastics, SAF[®] 150 can also be used with primer for PEI, PA, PPO, PPA plastics and for galvanized, chromized, electro zinc coated metals.

SAF[®] 150 can be applied in flat bonding, or even in filled joint. Usable on short and long lengths, it can even bond numerous substrates under water.

SAF[®] 150 is an answer to all the applications of structural bonding in the rail industry.

Data sheet: See attachment n°2

3. SAF[®] 400

a) Advantages :

SAF[®] 400 is the ultra flexible reference of our SAF[®] range. With its exceptional elongation of 400 %, it is the only two component structural adhesives that can offer such performance without equivalent in the market.

Its elongation allows it to resist in considerable efforts of peel and offers an excellent resistance to impacts on metals assembly. It can also bear cycles of minus temperatures (lower than -40°C), wet heat and humid cataplasms.

SAF[®] 400 bonds glass without primer and is UV resistant for the assembly of windscreen. It is also used for parts in the solar renewable energy industry with its modified version SAF[®] 400 WS.

With various open times to select, SAF[®] 400 is perfectly adapted to all the difficult to bond industrial applications.



Bonding glass without primer nor surface preparation

b) Application :

SAF[®] 400 can be used on composites, metals and some thermoplastics. SAF[®] 400 is particularly adapted to bond glass, thanks to its fast adhesion without primer.

Its flexibility is a decisive factor of choice for assemblies that exposed to shocks, or for couples of substrates with differences in coefficient of expansion.

SAF[®] 400 could be applied exclusively for flat bonding, on small and complex sets.

The modified version, SAF[®] 400 WS, is specially designed to be used for windscreen bonding in the aftermarket section. Thanks to its structural bonding performance with exceptionally fast curing capability, when compared against the conventional 1-c PU adhesives that are being used, SAF[®] 400 WS is superior in terms of curing speed, ease of application, minimal risk of toxicity, and longer service lifetime after repair and maintenance. Below is the table to summarize the value creation of SAF[®] 400 WS in windscreen bonding application:

Customer Needs	Weight of Importance	Current Issues	Our Next Best Alternative	Benefits to customer	Value Type for Customer
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Faster Process	40%	Bottleneck on waiting for curing (24hrs)	Only need 2 hrs to achieve an even stronger bond strength!	Immediately increase working capacity	Revenue
Simpler Process	30%	Needs Primer	Totally primerless solution	1. Easier Process 2. Saving cost of primer	Cost to Serve
Toxicity Concern	20%	Toxicity of PU	No isocyanate exist, much safer to use	Safer working environment	Cost to Serve
Minimal Call Back	10%	Poor durability of PU, will increase no. of call back	Offer 2-c structural bonding adhesives	Much stronger and much more durable windscreen system	Price

Data sheet: See attachment n°3

B. Two-c structural polyurethane adhesive

1. P 720

a) Advantages :

The reference P 720 provides an excellent adhesion on every kinds of material and with an excellent ageing resistance. It is 1/1 in volume ratio, and is available in cartridges, buckets or drums.

It offers an excellent weathering resistance, so that it can be employed for indoor and outdoor assemblies.

With flexible open times and personalized colors (depends on volume used), P 720 is a good solution for an aesthetic use.



Aluminum Honeycomb on Stainless steel

b) Application :

P 720 bonds metals and composites. It can be used for Honeycomb assemblies with metal and/or composite substrates.

It can be applied by using filling-knife for large surfaces or in caulking for aesthetic joints.

Data sheet: See attachment n°4

C. One-c structural MS Polymer adhesives

1. BLACK MAMBA® range

a) Advantages :

The references Black Mamba® are MS polymer sealants/glues of registered trademark by AEC POLYMERS. The exceptional performance of these products, in strength, setting time and environmental friendly characteristics are unique on the market.

With skin formation time varies from 10 to 50 minutes, Black Mamba® MS polymer bond numerous materials without preparation of surface nor primer. The High Tack version offers an immediate set, ideal for the assembly of big and/or heavy parts, that are positioned vertically or for roofing applications.

Packed in cartridges, sausages or in buckets, they are available in black, grey and white colour. (personalized colors according to the volumes).

The Black Mamba® range resists to low temperature cycles (lower than -40°C) and humid catapasm, while on the other hand it also resist in powder coating post curing until 200°C.



Full surface application on composite

b) Application :

The Black Mamba® range is ideal to bond joints, to create immediate bonding (High Tack), for glazing assemblies, floor panel bonding and all full surface applications. They can be applied with filling-knife and be smoothed.

Black Mamba® can be used to bond/seal metals, composites, some plastics and glass.

Nowadays Black Mamba® is widely used for bonding blind-line flooring along the train station platform. Every day the off-service time for train station is only limited to 3-4 hours in between midnight to dawn, the job for replacing blind-line floor tiles require fast setting adhesives. Black Mamba® High Tack is the modified formulation of MS Polymer that can provide high initial tackiness with non sagging feature. Due to this the application can now be easily done without worrying about joint movement even the adhesive is not yet fully cured.



Data sheet: See attachment n°5

II. Approval certificates

A. Fire/smoke resistance certificate

Products below received approval by Eurailtest, trial organization of SNCF (French national railway company) and RATP (public transport system of Paris).

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Reference		Norm	Fire Classification	Smoke Classification
MS 60 Black Mamba®	227/24/132E	NFP 92-501 NF F 16-101 STM-S 001	M1	F0
P 720	227/24/132C	NFP 92-501 NF F 16-101 STM-S 001	M1	F1
SAF® 150	227/24/132A	NFP 92-501 NF F 16-101 STM-S 001	M1	F1
SAF® 400	227/24/132B	NFP 92-501 NF F 16-101 STM-S 001	M1	F1

Thus, these products could be used in rail applications as products that are not propagating fire and products with low toxicity of smokes released during combustion.

B. Reference listing

All the defined structural products are used in the rail industry worldwide. It is however better to carry out preliminary trials in order to validate bonding performance on each substrate and to identify what kinds of surface preparation is necessary for each type of assembly.

A meeting with one of our technicians is compulsory before any use to respect the good protocol of assembly and use of products.

Methacrylate and MS Polymer products are among others referenced in the STMX 011 of the SNCF :

STM X 011		
Products used by Manufacturers and Contractors		
AEC POLYMERS	SAF 30	METHACRYLATE TWO-C
AEC POLYMERS	SAF 150	METHACRYLATE TWO-C
AEC POLYMERS	Hardener SAF Range	METHACRYLATE TWO-C
AEC POLYMERS	Black Mamba FHG MS 60	MS POLYMER ONE-C
AEC POLYMERS	Black Mamba FHG MS HT	MS POLYMER ONE-C
X	X	BUTYL GRIS 9 x 3,5 mm
X	X	BUTYL GRIS 12 x 3.4 mm
X	X	BUTYL GRIS 15 x 3 mm
X	X	BUTYL GRIS 15 x 4 mm
X	X	BUTYL GRIS 15 x 5 mm
X	X	BUTYL GRIS d 16 mm

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1. SNCF :

These products are for the knowledge and for the appreciation of the SNCF. They can be used in all the rail industry applications after trials validated by the concerned persons.

Contact : Mr François Maillet - Email : francois.maillet@snf.fr

2. ALSTOM :

These products are for the knowledge and for the appreciation of ALSTOM. They can be used in all the applications rails, in subcontracting after trials validated by the concerned persons.

Contact : Mr. Philippe Girard - Email : philippe.girard@transport.alstom.com

3. BOMBARDIER :

These products are for the knowledge and for the appreciation of BOMBARDIER. They can be used in all the applications rails, in subcontracting after trials validated by the concerned persons.

Contact : Mrs. Patricia Agopian - Email : patricia.agopian@fr.transport.bombardier.com

III. Toxicity

All our products follow the REACH directives. They are made in Europe following our protocol in the course of ISO certification 9001, ISO 14001 and OHSAS18001.

Products satisfied the occupational medicines of several railroad organizations in their complete formulation.

A. SAF[®] Range

The methacrylates of the SAF[®] range is classified as not Toxic. These products do not contain dangerous substance of carcinogenic type nor solvent.

They have a characteristic odor due to the low rate of methacrylate in the air (some ppm) during the extrusion of the product which possesses a very low olfactive threshold. To avoid being bothered, it is better to use EPI described in the FDS.

The organization of safety in the work, occupational medicine of several companies such as SNCF, analyzed the compositions of our products and joined them into their panel.

B. Black Mamba[®] Range

The MS Polymer of the Black Mamba[®] range was specially formulated to be without danger and without impact on the environment.

The FDS of the Black Mamba[®] range is totally non dangerous, none of the products which constitute formulation which are notified as dangerous. In other words, these products present no pictogram of danger.

Black Mamba[®] contains, no solvent, no isocyanate, no plasticizing like phtalate. It is enough to use EPI described in FDS.


The organization of safety in the work, occupational medicine of several companies analyzed the compositions of our products and joined them into their panel.


FDS SAF[®] 30 ; SAF[®] 150 ; SAF[®] 400 ; P720 ; Black Mamba[®] : See attachment n°6

III. How to use

Videos of how to use our product are available on internet www.youtube.com, by searching via the keyword « AEC POLYMERS ».

In order to guarantee the quality of assemblies, it is necessary to respect protocols scrupulously and follow the index cards of uses of products. The technicians of AEC POLYMERS are able to train the operators and to verify the procedures of assemblies as below.






Company:

Contact:

Product use form


Two component adhesives



Hygiene and safety

Before use, be sure that:


- The room is ventilated or equipped with extractor hood.
- You wear gloves (in nitrile for the acrylic bonds and in latex for the epoxies).
- You wear goggles.
- You learn about the Material safety datasheet.



The Bonding

Before bond (metal and thermoplastics):

- Dust and remove grease marks with the AEC T700 and a non-fluffy duster.
- Pulverize the T700 at the place where you want to bond and clean with the duster
- If the substrate is in aluminum just dust with the duster.



Use/preparation of a bi-component cartridge

- Remove the lid (photo1)
- Put the cartridge in the gun (photo2)
- Put the pistons at the right level by starting up the gun until the two components go out at the same time (photo3).
- Fit together the mixer and the cartridge thanks to the lid (photo4).
- Drain 5 to 6 cm of bond in order to obtain a good mixing, you have to do it at each mixer change (photo5).












Photo1
Photo 2
Photo 3
Photo 4
Photo 5

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