

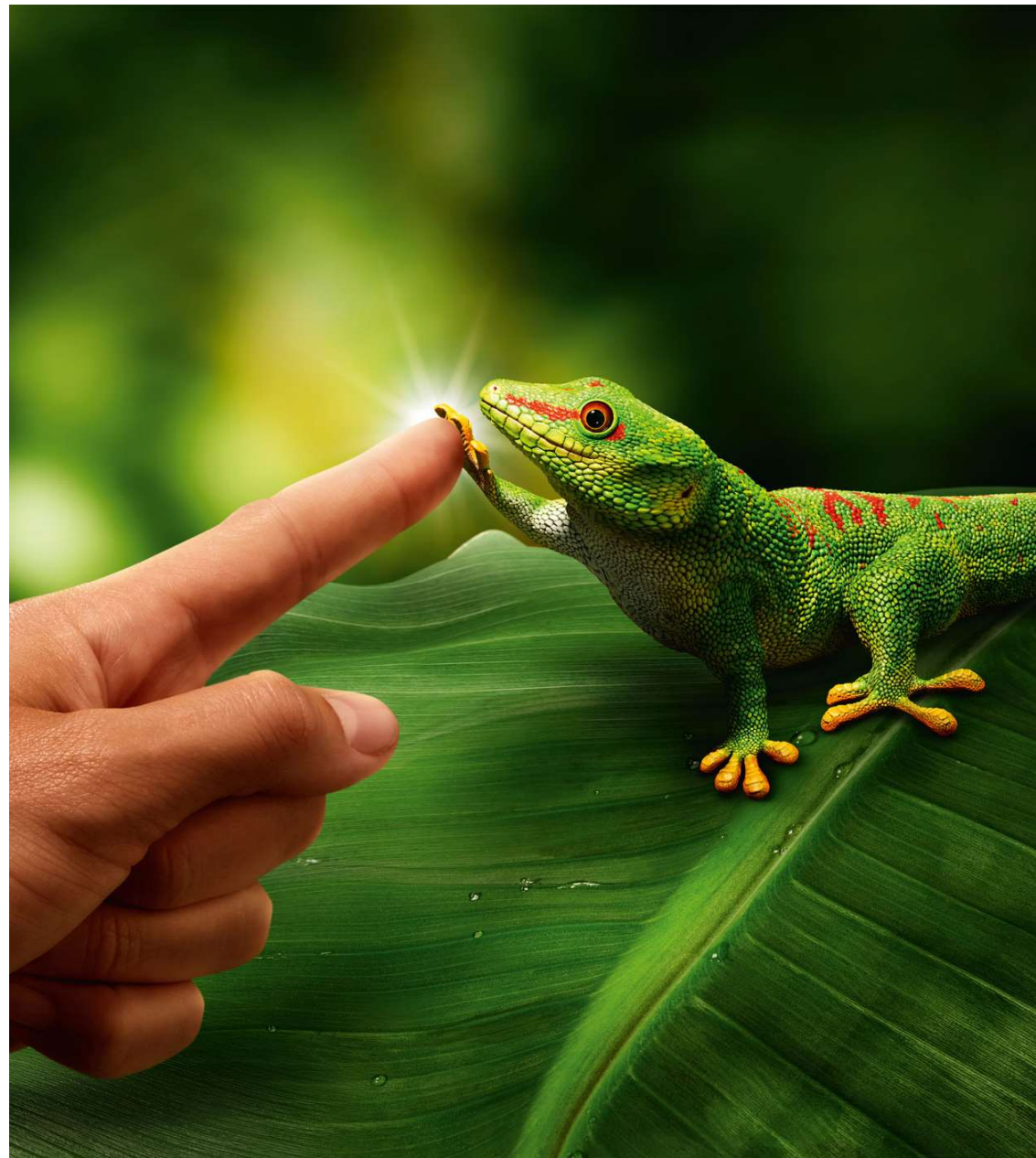


ATTACHED TO YOUR WORLD

Bostik MMA

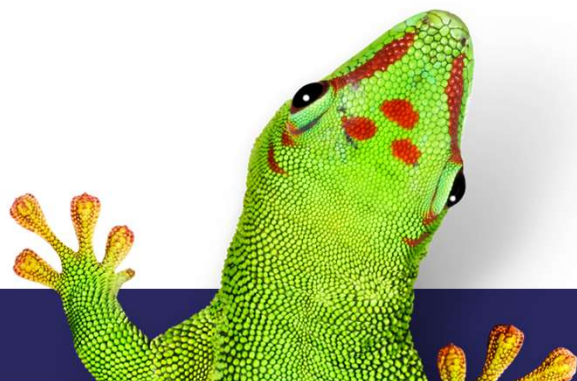
www.bostik.com

Adhesive solutions by **ARKEMA**





Bostik MMA a Structural Adhesive range



Structural Adhesives and MMAs

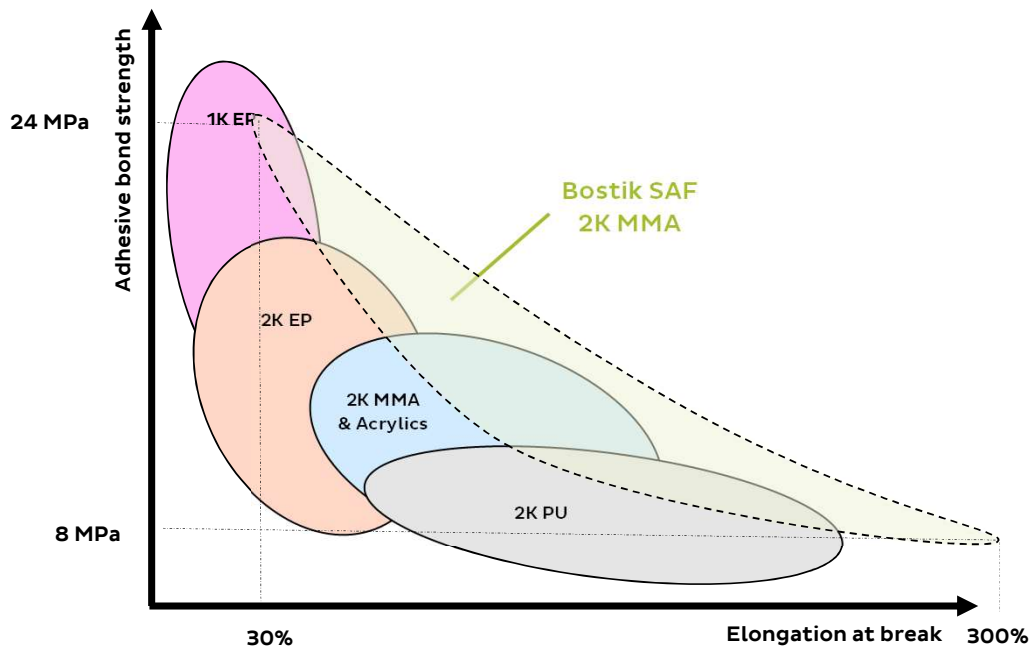
Any type of adhesive used to bond a load bearing joint necessary for the structural integrity of a product

- Most important bonds in a product and add strength to final bonded part
- Durable, reliable
- Commonly used to replace other traditional fixing methods
- Improve fatigue and aesthetics

METHYL-METHACRYLATE (MMA) ADHESIVES

MMA adhesives provide a unique balance of high strength, impact and fatigue resistance, flexibility, elongation, shear and peel strength, and are usable within a wide range of temperature. MMA adhesives are 2 components adhesives, 100% reactive with 10 to 1, 4 to 1 and 1 to 1 mixing ratios. MMA allows low to no surface preparation depending the material and permits to bond plastics, composites, metals. MMA adhesive cure at ambient temperature and have controlled cure speed with appropriate mixing but tolerate off ratio mixing up to 10%. MMA adhesives are not sensitive to moisture, resists to water and chemicals.

Structural Bonding – MMA Adhesives



Room-temperature curing adhesives

Properties	2K EP	2K PU	2K MMA
RT curing	Slow	Slow	Fast
Surface preparation	Required	Required	Minimal or not required
Rigidity	Rigid	Flexible	Rigid or Flexible
Bond strength	Very High	Medium	High
Chemical resistance	Good	Limited	Good
Fatigue resistance	High	High	High

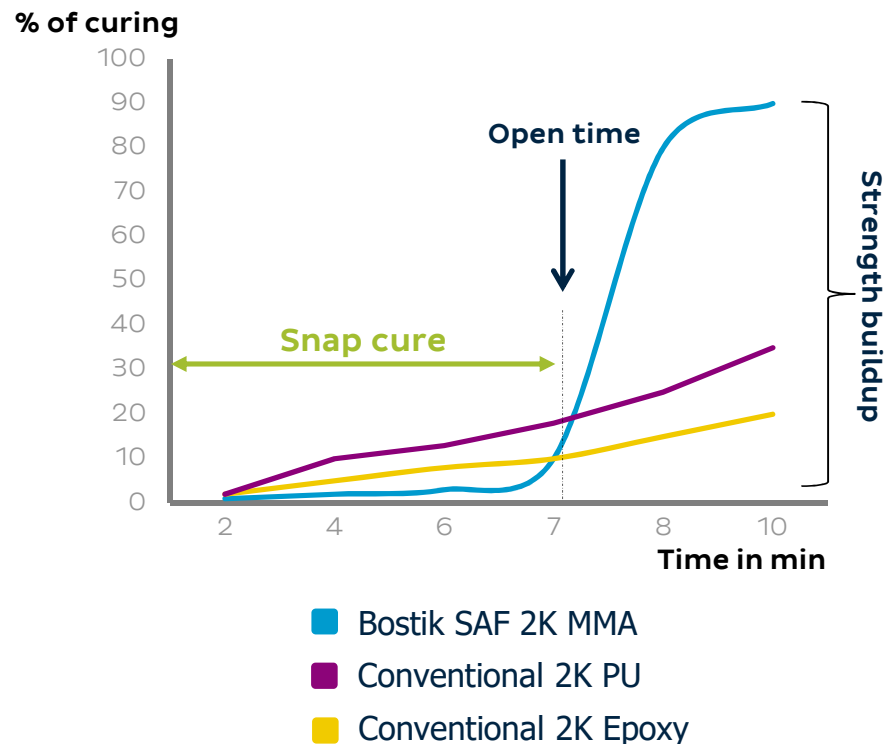
EP: EPoxy
MMA: Methyl MethAcrylate
PU: PolyUrethane



BOSTIK MMA vs other structural techno

Curing of Bostik MMA vs. Epoxy and PU

For same open-time, SAF adhesives are faster to provide part fixture



Adhesive	Open time at 23°C [min]	Fixture time at 23°C [min]
SAF 2K MMA	7	15
2K PU	7	45-50
2K Epoxy	7	60

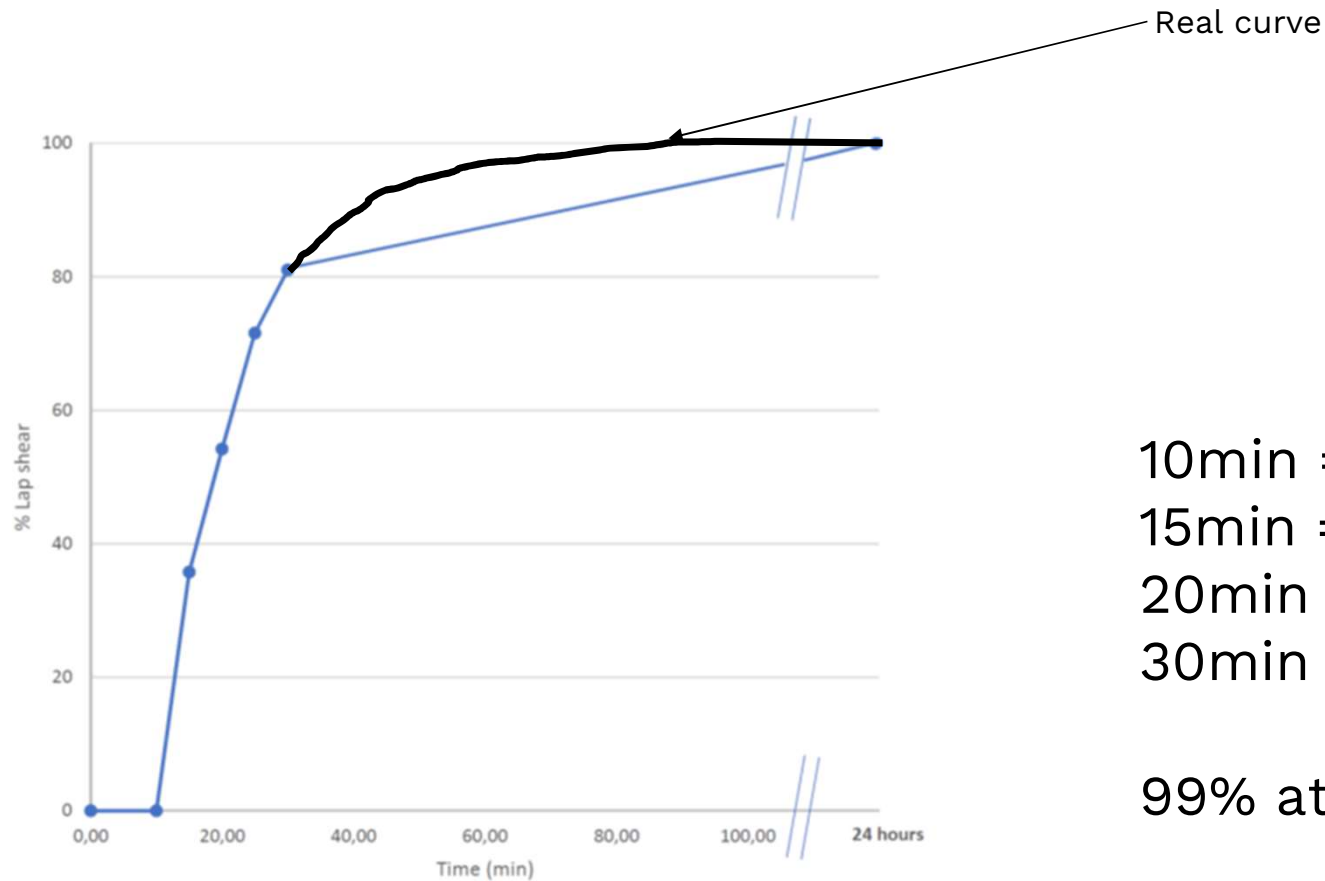
- ✓ **Open time:** limit to create a joint with at least 80% of the bond strength of an ideal joint assembled at 0 min (start time is the glue dispense)
- ✓ **Fixture time:** duration needed by the adhesive to reach a bond strength of 0.3 MPa (start time is the glue dispense)

Bostik MMA : Fast curing, long OT – fast HT



Ex strength buildup

Lap shear strength evolution x time @23°C



Faster
process

10min = 0,3MPa (handling strength)

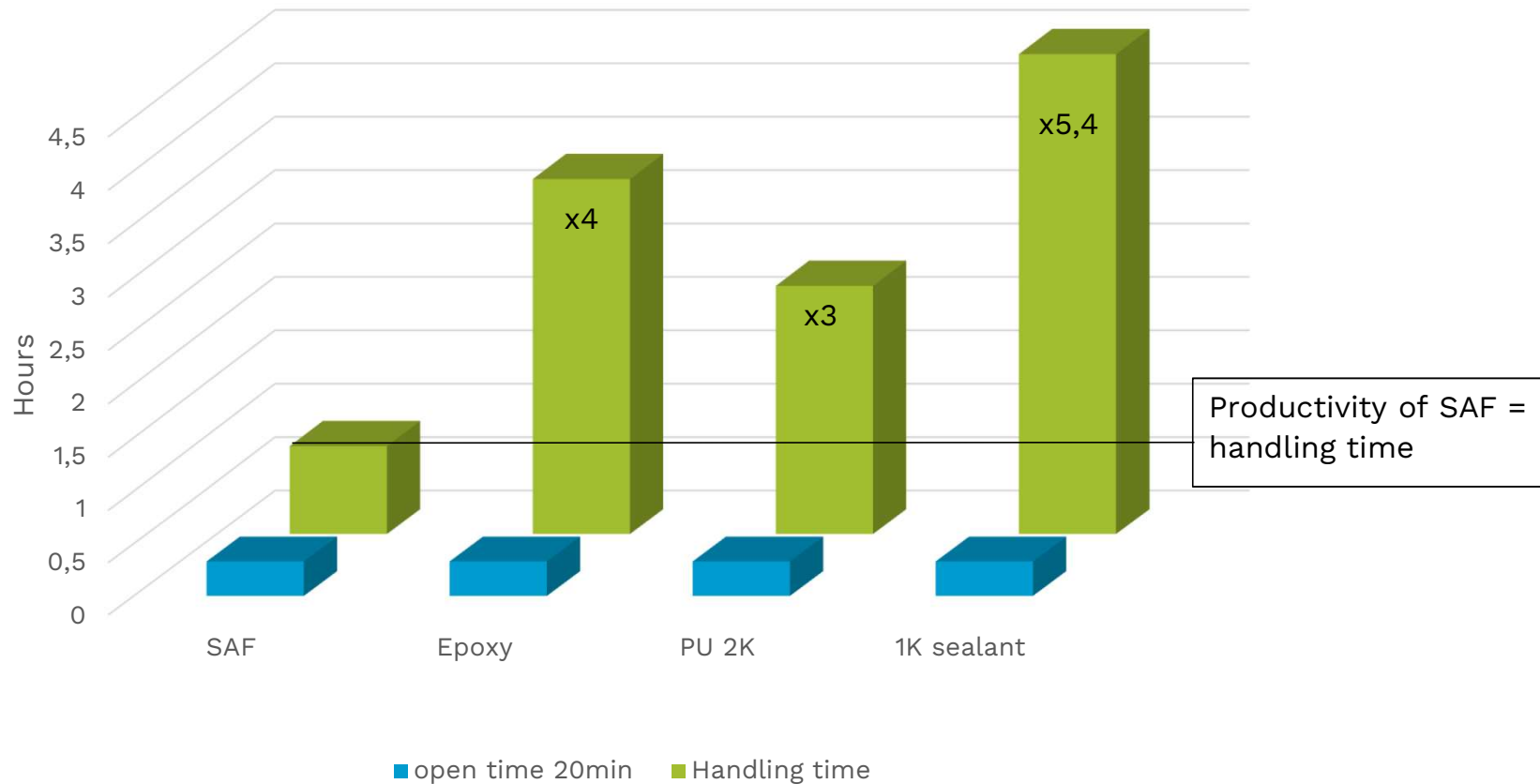
15min = 35% of max strength

20min = 55%

30min = 82%

99% at 1h after dispensing

Kinetic vs EP & PU

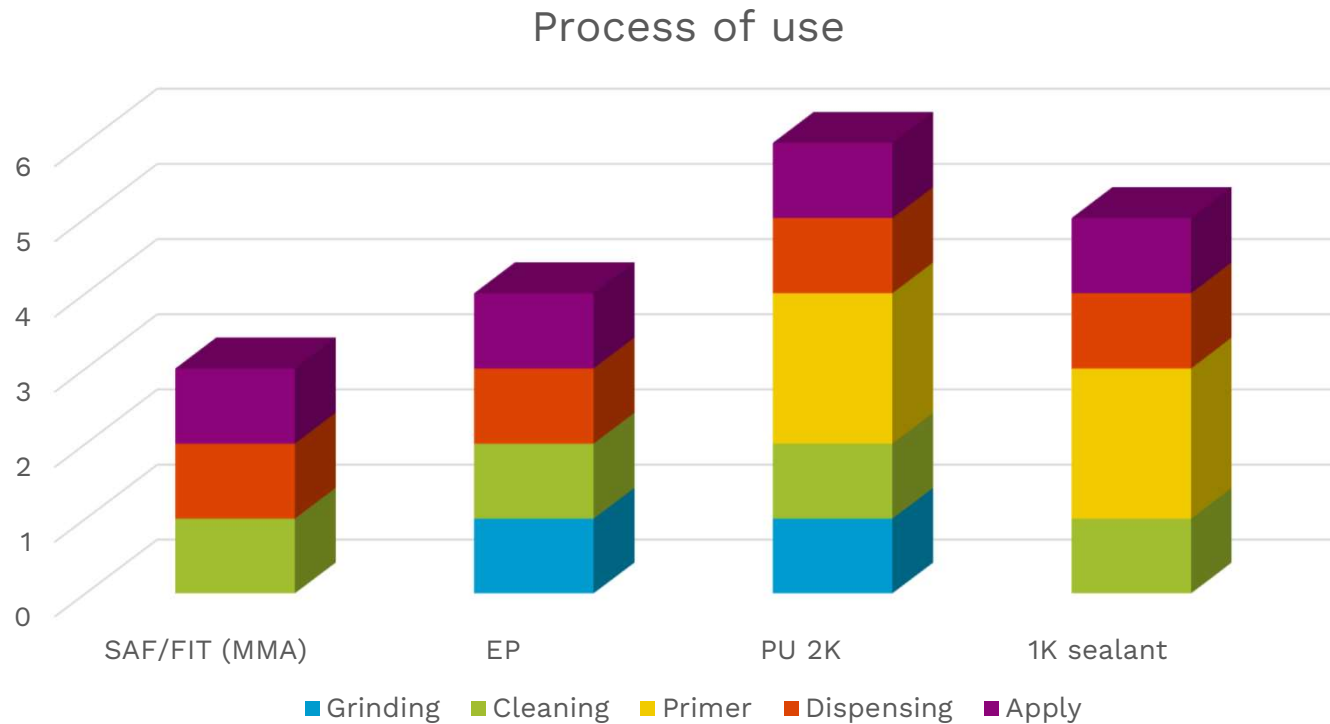


Strong
productivity gain
with MMA



Faster
proceductivity

Process efficiency



Easier
Workability

Easy process
with MMA
Less steps to
assembly



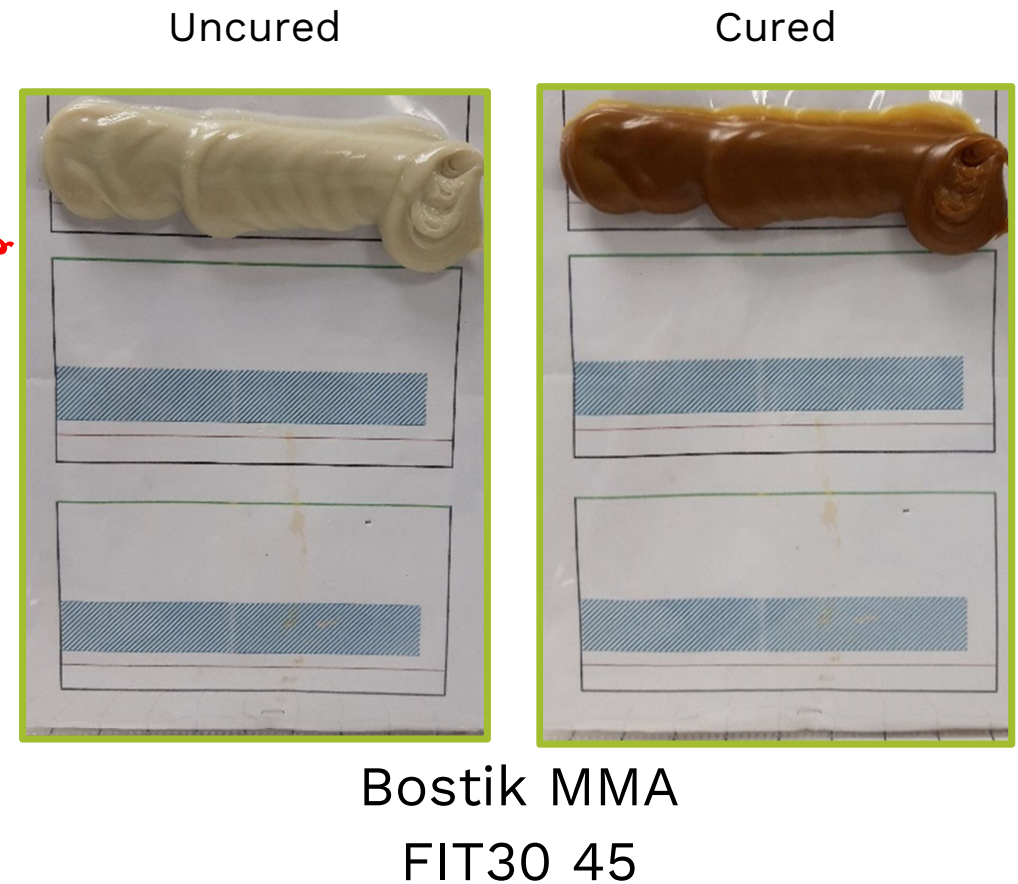
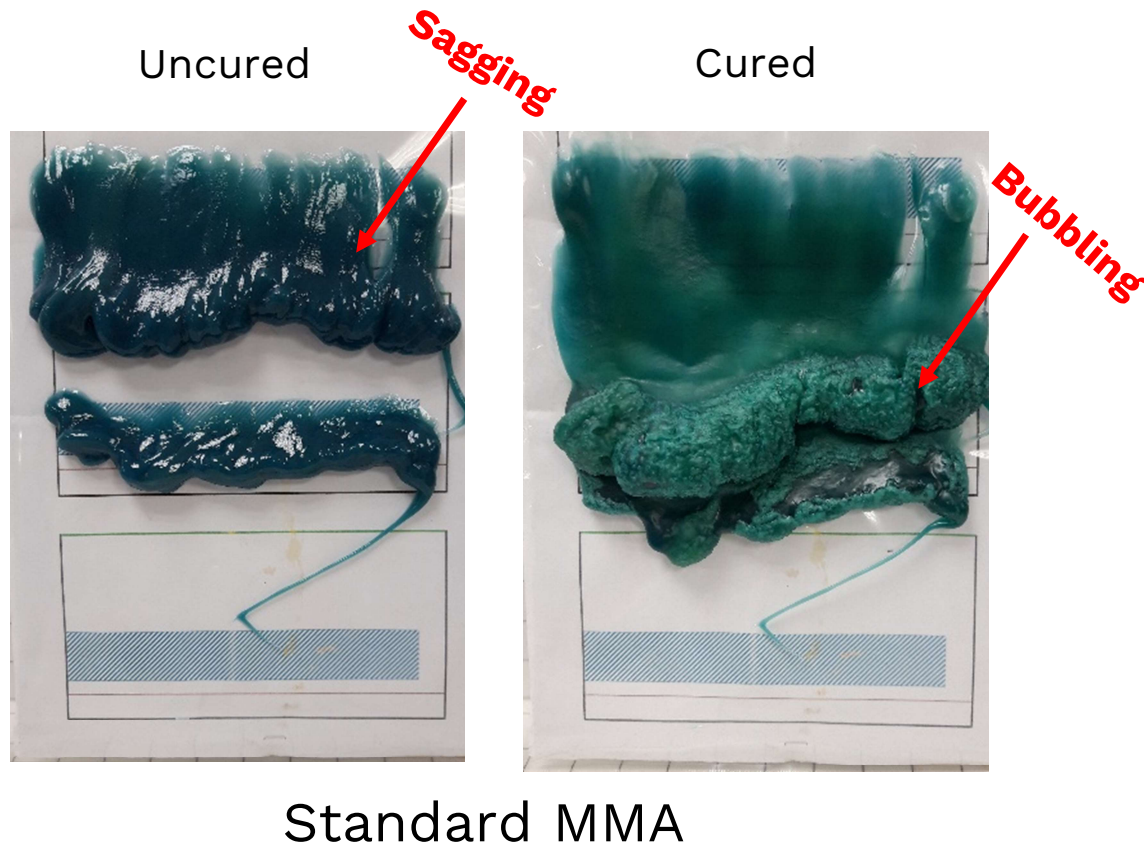
BOSTIK MMA

Key Advantages

Bostik MMA : Better Rheology & flow

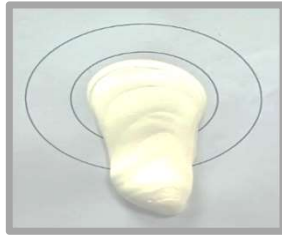


Bostik MMA : Better Rheology

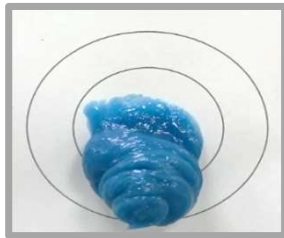


Bostik MMA vs competition

Standard MMA 1
3,5 g/s



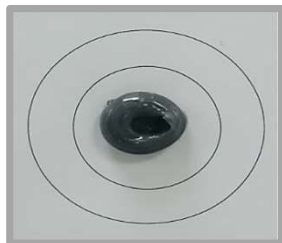
Standard MMA 2
5,7 g/s



Standard MMA 4
10,9 g/s



Standard MMA 3
1,0 g/s



FIT30 45
16 g/s



FIT30 15
20 g/s



SAF30 15
25 g/s



SAF30 LOT
10 g/s



Bostik MMA : Higher flow

Difficult to dispense large quantities of standard MMA.



Standard MMA 1



Standard MMA 3

00:00:00:00

Bostik MMAs dispense quickly and easily



SAF30 LOT



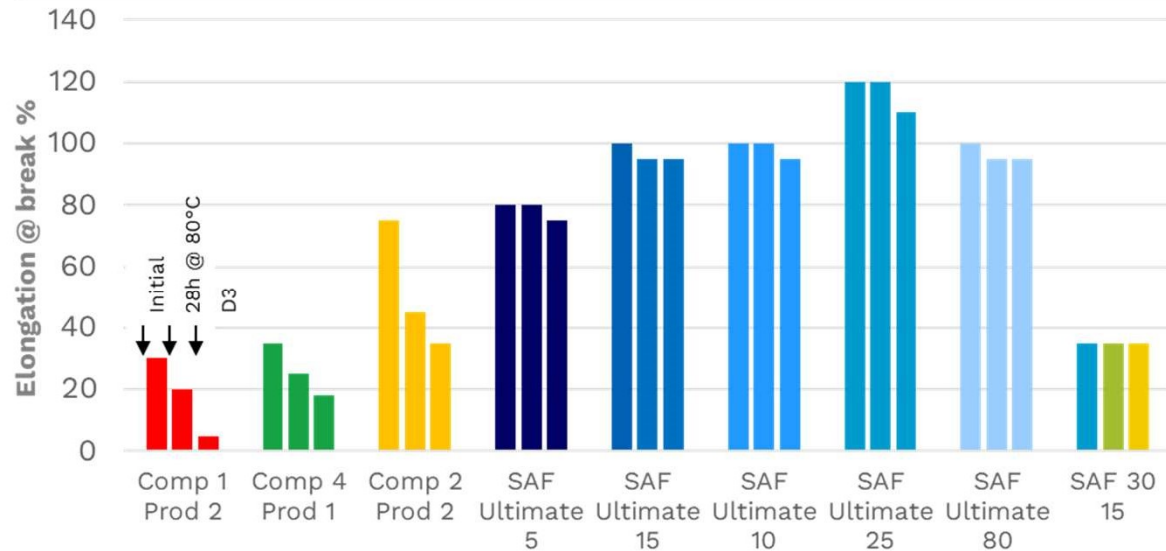
FIT30 90

Bostik MMA : Elongation & durability

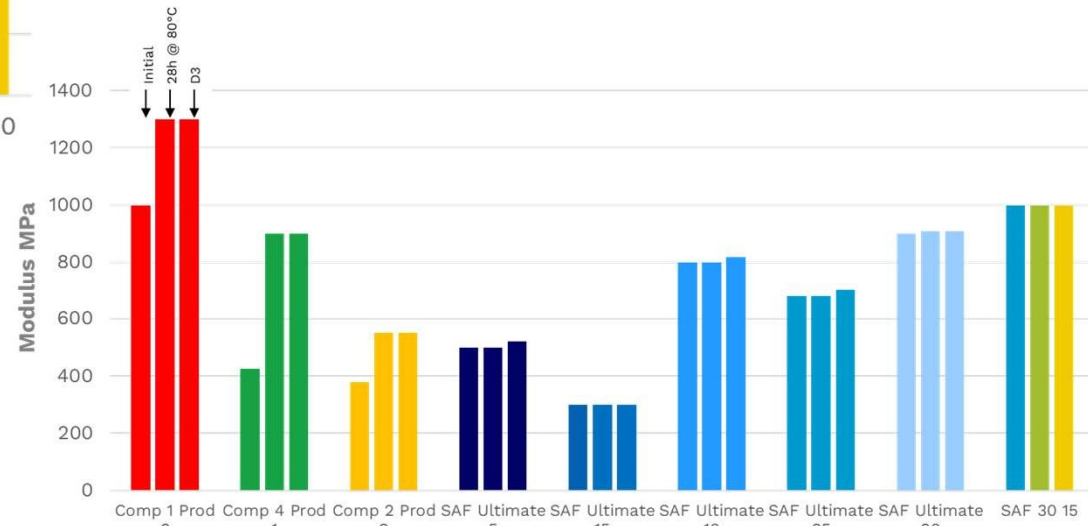
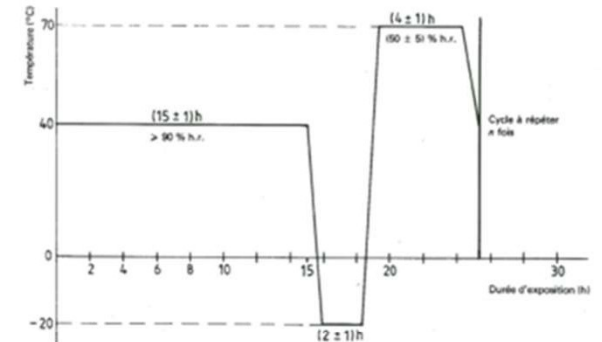


Durability Elongation & Modulus

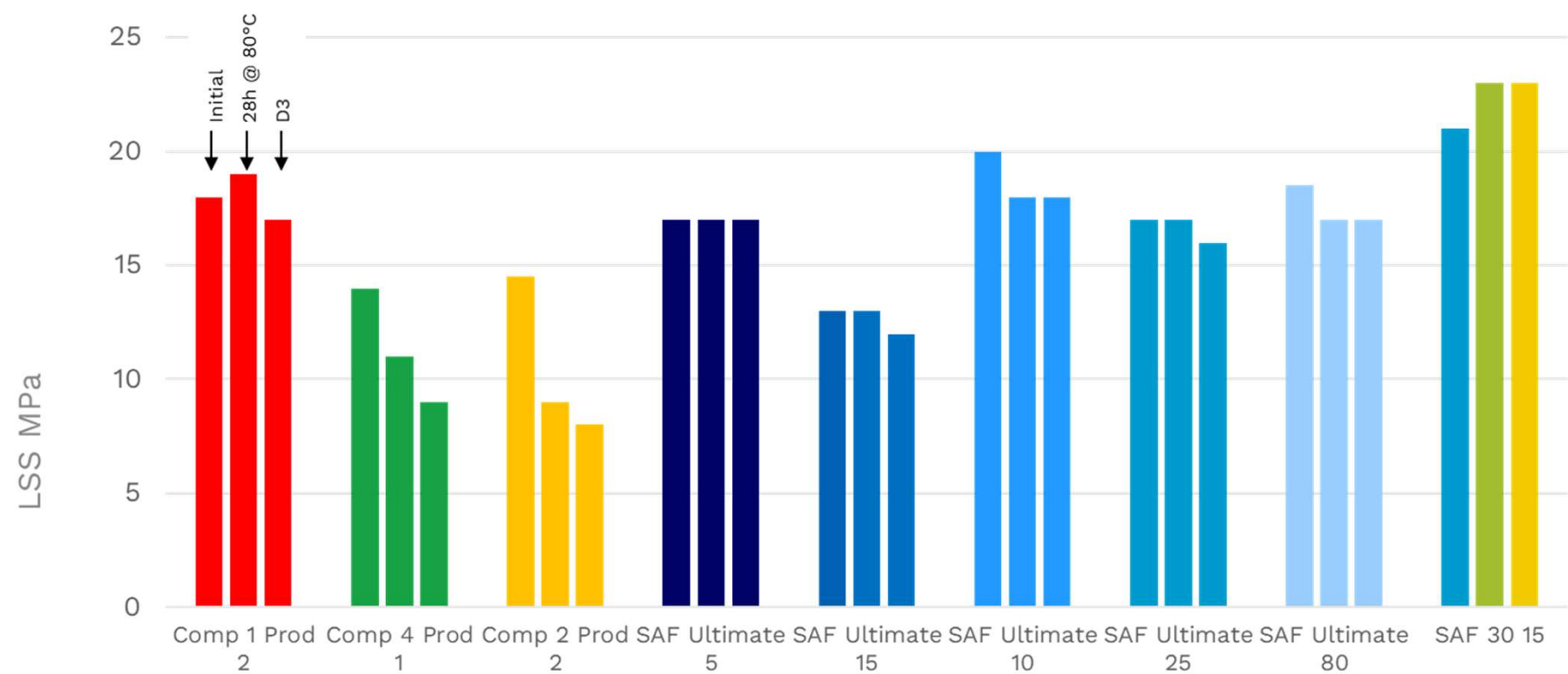
- Among impact resistant grades, SAF Ultimate serie best retain elongation after D3



No print through on plastic and thin AL

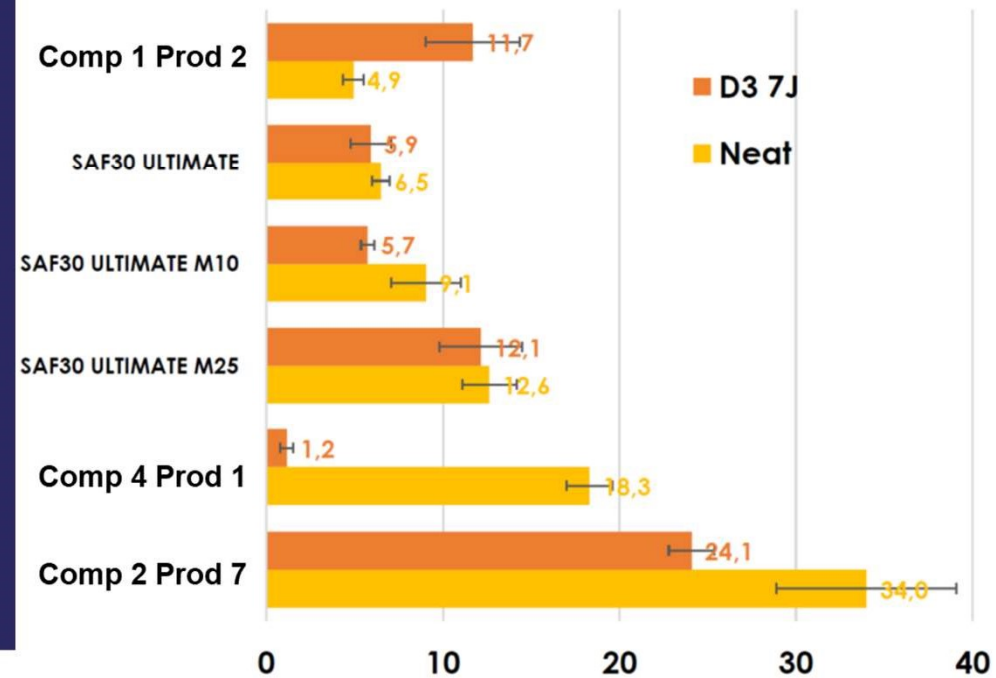


Durability LSS



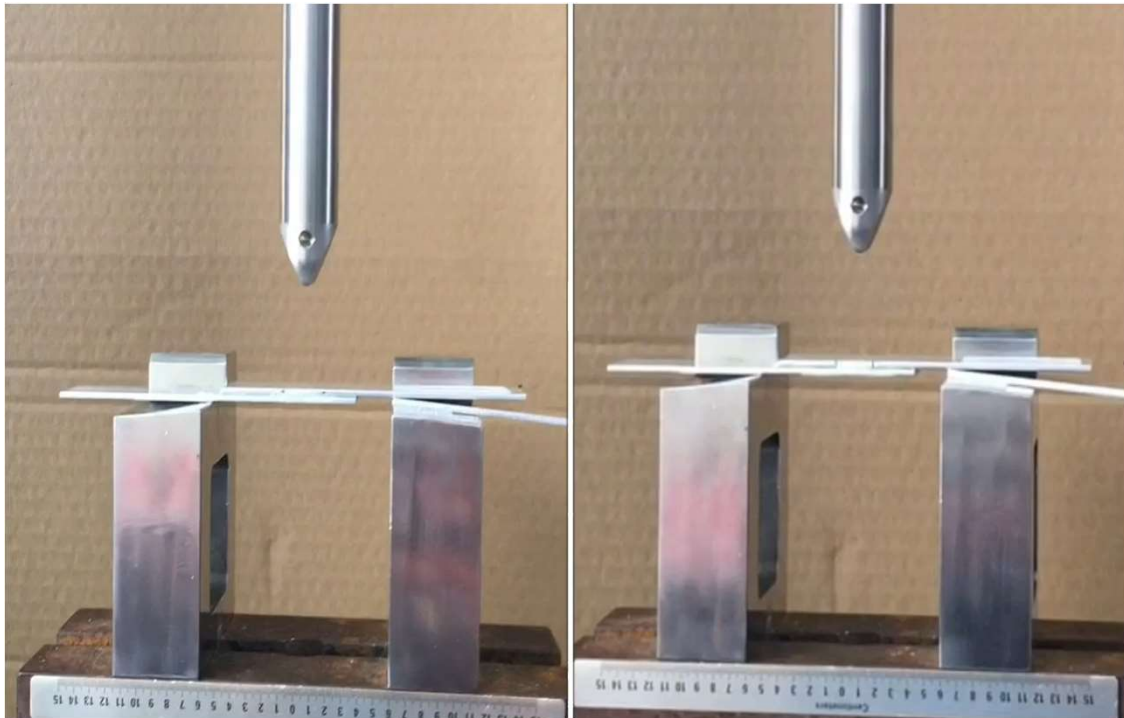
Bostik MMA : impact resistance

High speed flexural test - kJ/m²



Strong Impact resistance

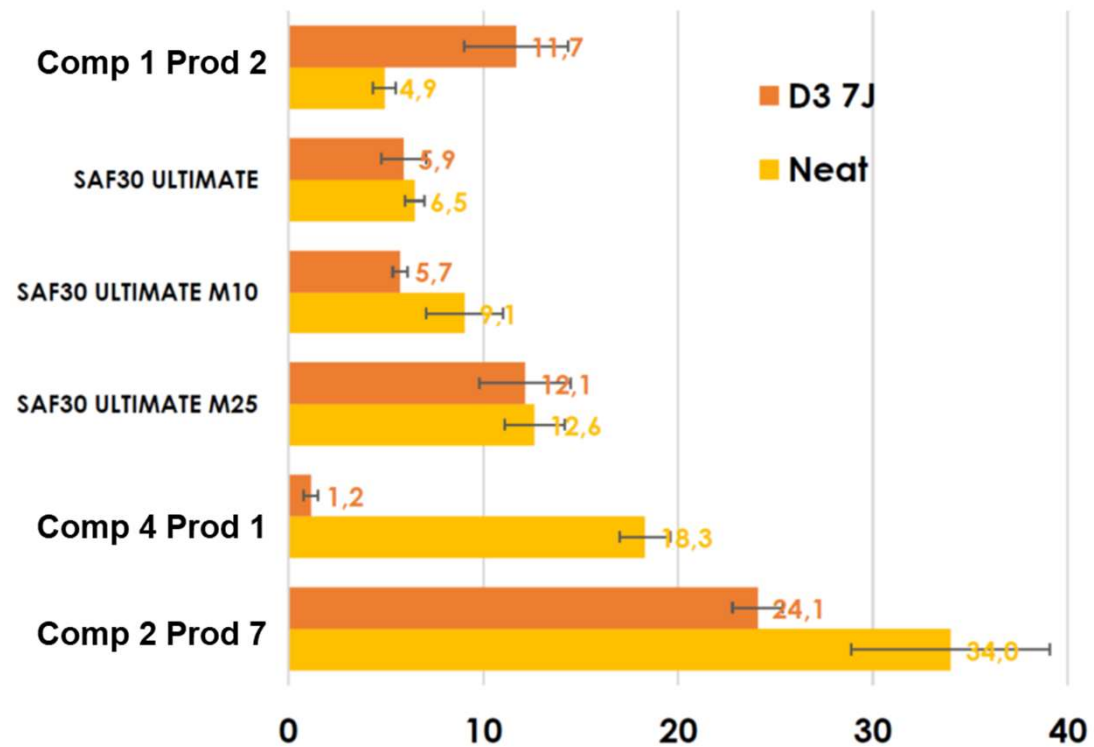
High Speed Impact Test (GRL)



Non impact Resistant
SAF30 45

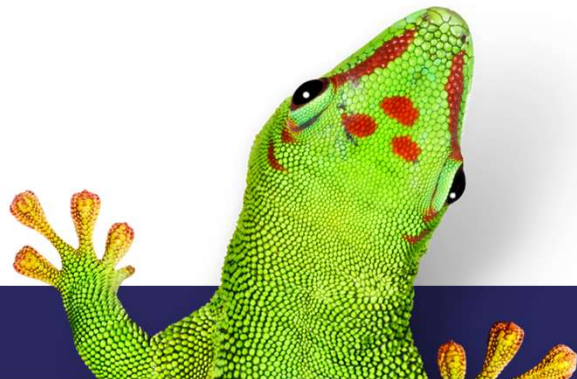
Impact Resistant
SAF Ultimate range

High speed flexural test - kJ/m²





Structural adhesive vs mechanical fastening



Adhesive vs welding, rivets, screws

No corrosion, deformation, finishing, fumes and sparks

No cracks, no stress in the metals

Better aesthetic. Easier design

Continuous links : gives better constraints distribution and stress.

Better aging of the finished part

Dissimilar substrates assembly possible

Gaskets

Lighten the parts

General economy economy



Joint design guidelines / Designs

One of the most important aspects of joining using structural adhesives, beyond adhesion, is the design of the joint.

Design for shear and compressive loading; avoid peel and high tensile loading.

Use bond widths of at least $\frac{3}{4}$ ".

Use strategic placement of welds or mechanical fasteners in areas of unavoidable peel loads. Interlocking extrusions or sheet –into extrusion combinations greatly enhance performance and ease of assembly.

Design for production in fixtures if possible. This not only builds the best part, but can also serve to optimize production rate

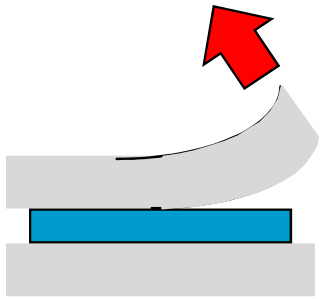
Attempt to maintain thin bond-lines (0.010" to 0.050") over the majority of the part

Once the parts are mated, do not re-open the bondline to reposition, rather, slide the part into position

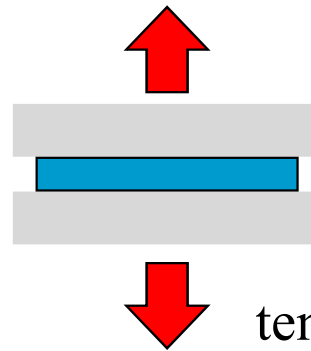
Consider the cure speed of the adhesive and its dependence on the ambient temperature



Type of stresses



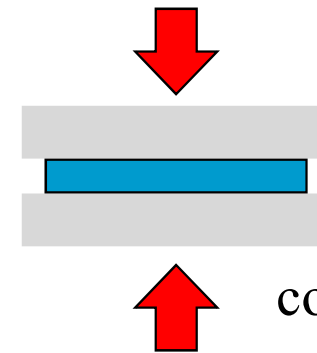
peel



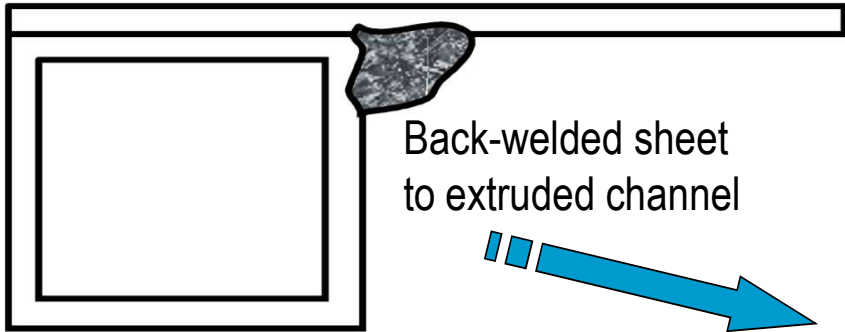
tension



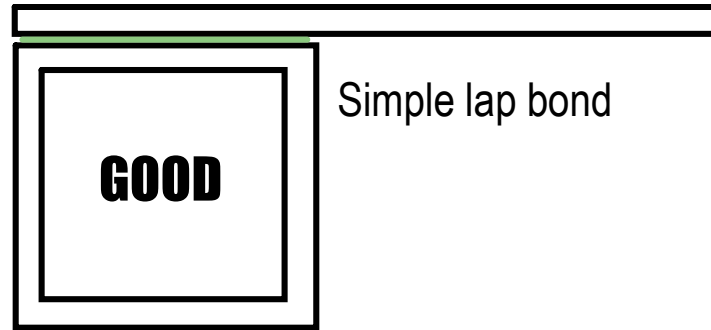
shear



compression

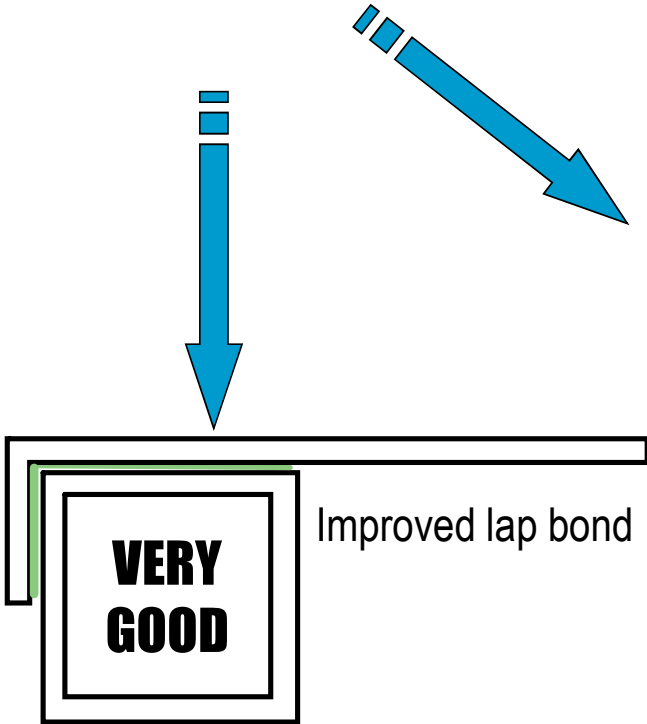


Back-welded sheet
to extruded channel



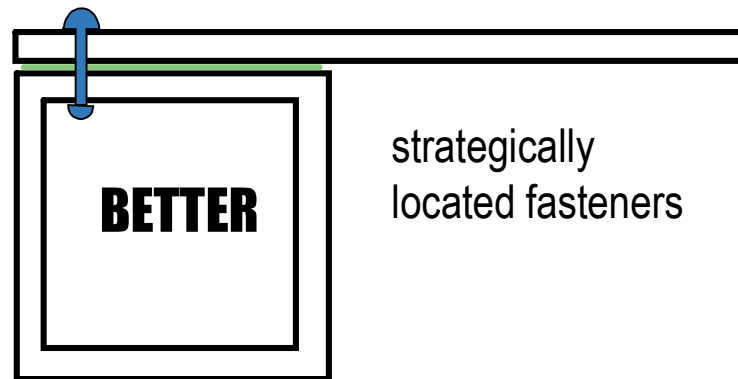
Simple lap bond

GOOD



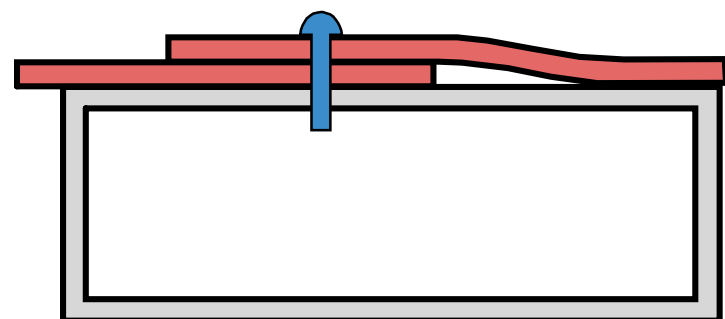
Improved lap bond

**VERY
GOOD**

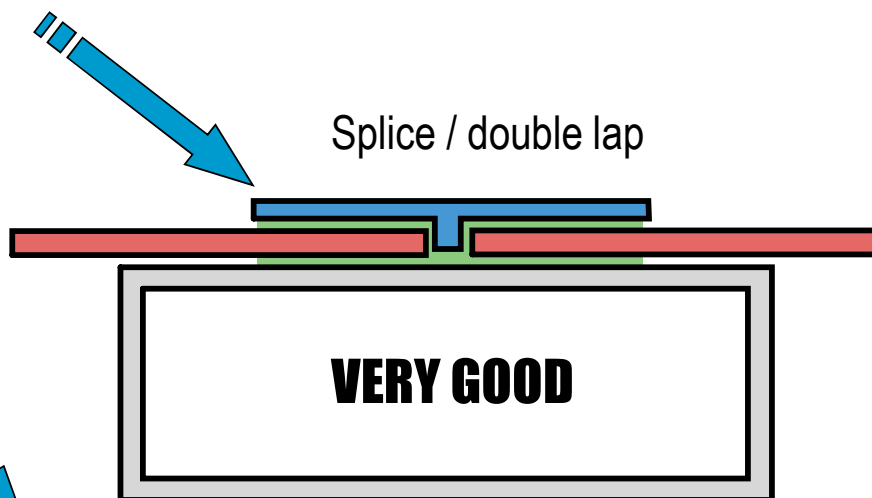


strategically
located fasteners

BETTER

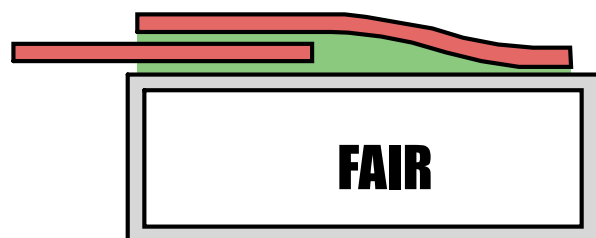
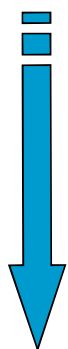


Riveted sheet overlap on channel

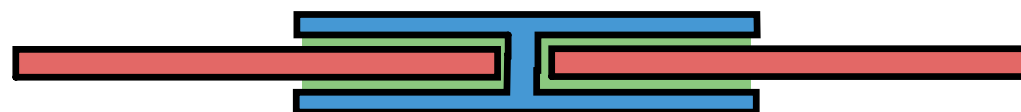


Splice / double lap

VERY GOOD



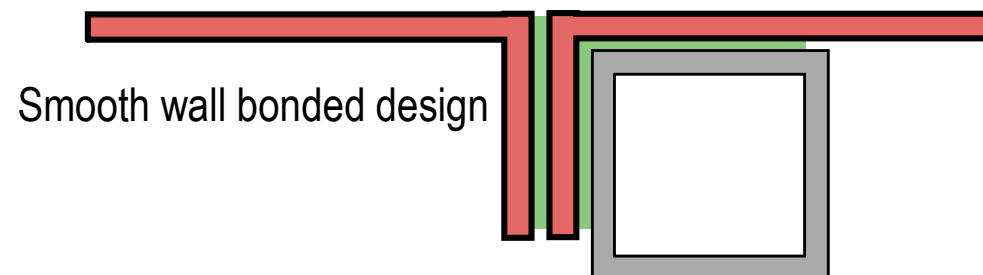
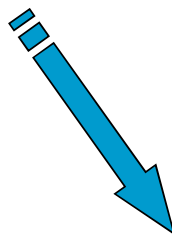
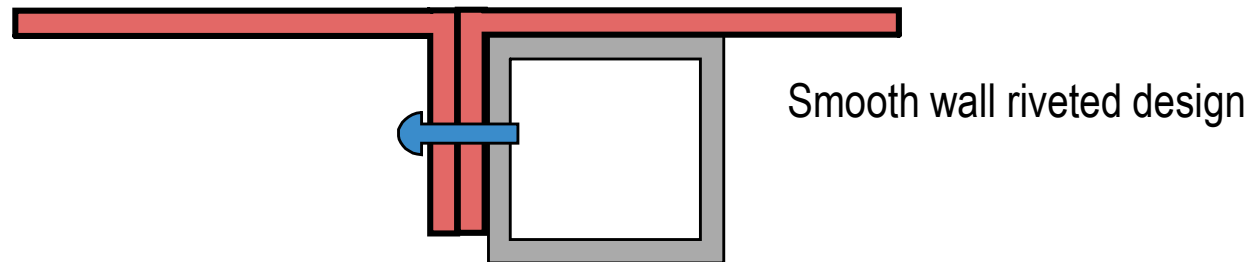
FAIR

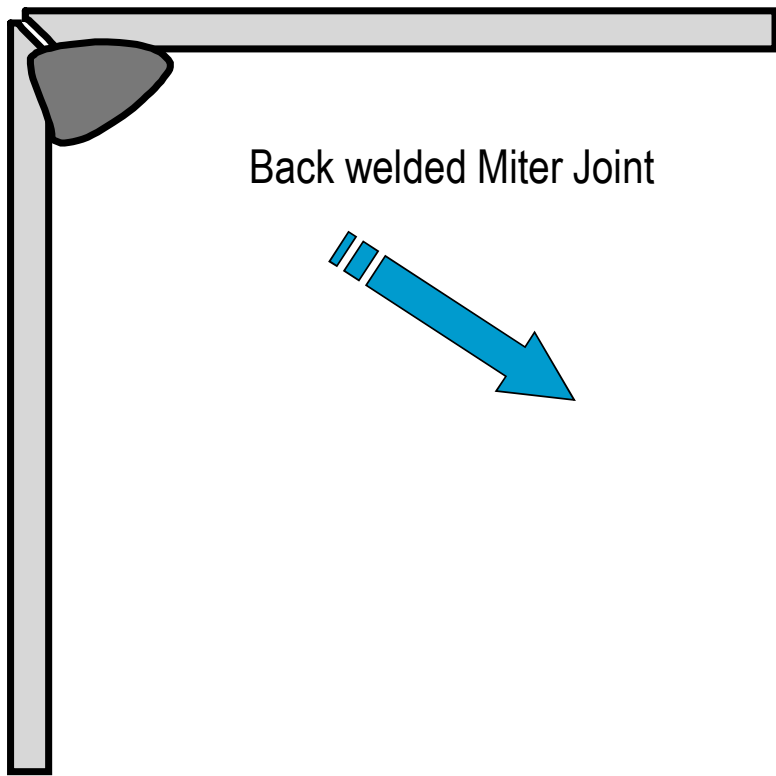


Double splice

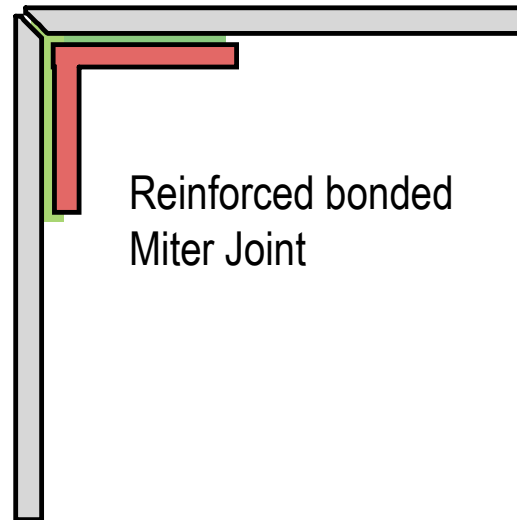
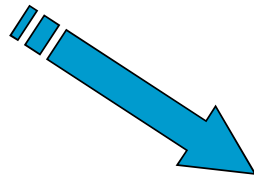
VERY GOOD

Bonded lap with transition





Back welded Miter Joint



Reinforced bonded
Miter Joint

SAF vs. mechanical fastening

Mechanical test ISO 4785

Values in N (N/mm ²)	Tape**	Spot weld	Welding	Rivets (5mm)
Aluminum*	125 (0,5)	2000 (8)	5800 (23,2)	5000 (20)
Steel*	188 (0,75)	4200 (16,8)	12000 (48)	5250 (21)
Stainless Steel*	219 (0,88)	4800 (19,2)	17300 (69)	4350 (17,4)
Equivalent in glue in cm ² for SS (SAF Ultimate 10)	0,11 	2,53	9,1 	2,29 

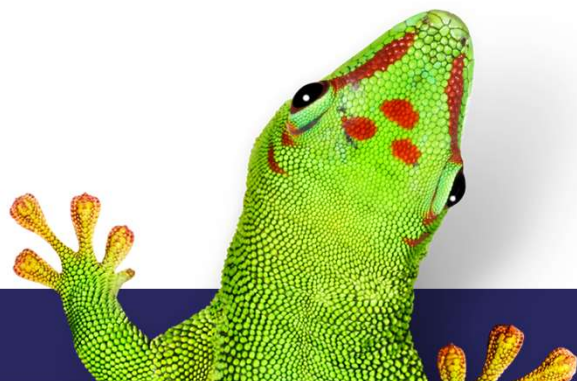
* All prepared sanded, cleaned

** VHB, cleaned with IPA size of the bonding 25x12,5mm

Size of the samples 100x25mm



SAF and FIT Range



Bostik ranges



Value proposition Portfolio SAF

	SAF RANGE											
	COMPOSITES/METALS				PLASTICS			METALS/PLASTICS				
	30 5	30 15	30 45	30 LOT	150 15	150 45	400 15	Ultimate 5	Ultimate 10	Ultimate 15	Ultimate 25	MIB
Mix Ratio	10:1	10:1	10:1	10:1	10:1	10:1	10:1	10:1	10:1	4:1	10:1	10:1
Rheology	Non sag	Non sag	Non sag	Non sag	Non sag	Non sag	Non sag	Non sag	Non sag	Non sag	Non sag	Non sag
Open time (min)	2-3	7	20-25	90	7	20-25	7	2-3	5	10	18	15
Fixture (min)	7	15	45	120	15	45	15	6	10	15	25	25
Elongation (%)	30	30	30	60	150	150	250	80	100	120	120	50
Elastic Modulus (MPa)	900	900	900	450	400	400	5	500	750	250	650	500
LSS (MPa)	22	22	22	16	17	17	8	18	18	12	17	17
Advantages	3 MPa @ 100°C non sag Ageing resistance			very High Gap fill	High elongation Ageing resistance Sprayable		Elastic structural	High Impact Resistant No read-through No stress cracking on plastic				Multi purpose difficult substrates

Attention to TDS



Value proposition Portfolio FIT

FIT RANGE

COMPOSITES / METALS

30 5	30 15	30 45	30 90	30 120
------	-------	-------	-------	--------

Key Features	Very fast setting	Versatillity	Gap fill	High gap fill	High gap fill
Mix ratio	10:1	10:1	10:1	10:1	10:1
Rheology	Non sagging	Non sagging	Non sagging	Non sagging	Non sagging
Flow rate (g/min ⁻¹)	850	800	1000	1200	1000
Open time (min)	2-3	5-7	20-30	55-65	90-110
Fixture Time (min)	5-6	12-15	30-60	90-110	120-150
Elongation (%)	30%	30%	30%	30%	30%
Elastic Modulus (Mpa)	1000-1200	1000-1200	1000-1200	1000-1200	800-900
LSS (Mpa)	19	20	18	15	18

Markets

Mainly Marine

composites application



Bostik MAM – Pliogrip 1000c

CARTRIDGES/DRUMS/PAIS	PLIOGRIP 1005c	PLIOGRIP 1010c	PLIOGRIP 1020c	PLIOGRIP 1035c
	1003LVM/1202G	1002LVM/1202G	1002LVM/1201	1001LV/1201
Open Time (min)*	4 – 6	8 – 12	17 – 23	30 – 40
Fixture time (min)*	8 – 12	16 – 24	34 – 46	60 – 80

*Open time and Fixture time were determined at 73°F (23°C) with diameter of 0.400 in (10mm bead). Actual results will vary and depend on temperature, bead size and mass, mix ratio, mix quality, storage history, and bond configuration. Fixture time must be adjusted to account for any unused open time.

Property	Value	Test Method
Tensile strength @ 73°F (MPa @ 23°C)	2,900 (20)	ASTM D-638
Young's Modulus @ 73°F (MPa @ 23°C)	58,000 (400)	ASTM D-638
Elongation, %	60 – 80	ASTM D-638
Poisson Ratio, @ 73°F (23°C)	NA	ASTM E-132
Water Absorption, %	0.8	ASTM D-570
Shore Hardness, D	55	ASTM D-2240
CLTE, 10 ⁻⁶ /°C @ -0°C to 50°C	140	ISO MAT-2208
CLTE, 10 ⁻⁶ /°C @ 100°C to 150°C	300	ISO MAT-2208
Glass Transition Temperature, °F (°C)		
G' Onset	-121 (-85)	ASTM E-1640
G'' Peak	-42 (-41)	ASTM E-1640
Tan Delta Peak	180 (82)	ASTM E-1640

Adhesive System	PLIOGRIP 1000c (testing performed using 1020c)
Substrate	AROPOL 8028 FRP laminate
Surface Preparation	Dry wipe
Cure	24 hours at room temperature
Post Cure	None
Bond Sample Configuration	0.125 inches (3.175 mm) thick bond on 1x4 in (254 x 100 mm) lap shear coupons with 1 in ² (645 mm ²) bond area
Crosshead Speed	0.5 inches/min (12.7 mm/min)

Bonded Sample Condition	73°F (23°C) Test	212°F (100°C) Test	10 days in 131°F (55°C) Salt Water	20 days in 122°F (50°C) Water Soak	7 days in 73°F (23°C) Gas Soak
Lap Shear strength, psi (MPa)	840 (5.8)	827 (5.7)	537 (3.7)	667 (4.6)	682.7)
Fiber tear	100%	100%	100%	100%	100%

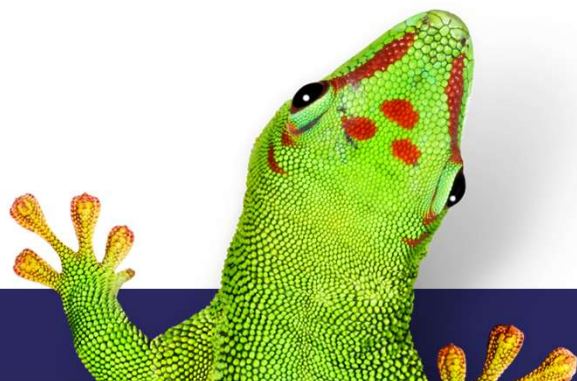
Other Overlap Shear Strength*	Pliogrip 1000c (testing performed using 1020c)
Surface Preparation	None
Cure	24 hours at room temperature
Post Cure	None
Bond Line Thickness	0.400 inches (10 mm)
Stainless Steel, psi (MPa)	2,100 (14.5) / Cohesive Failure
Aluminum, psi (MPa)	2,100 (14.5) / Cohesive Failure
Colled Rolled Steel, psi (MPa)	2,100 (14.5) / Cohesive Failure

*Reference ASTM 1002. Substrates were tested without preparation.

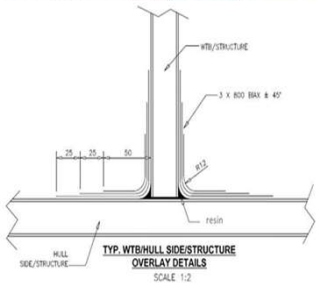




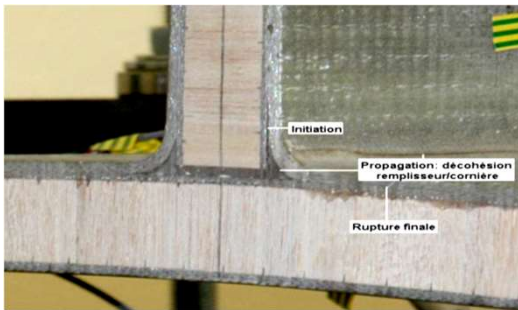
Case Studies



Marine

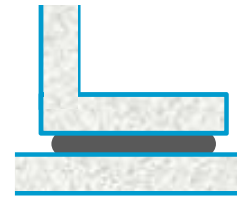


Stratification



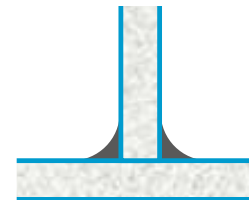
Stratification vs structural bonding for bulkheads

- Faster operation assembly (min vs. Hours)
- Weight saving
- Easier working conditions
- Money saving



Lap joint

Structural Bonding



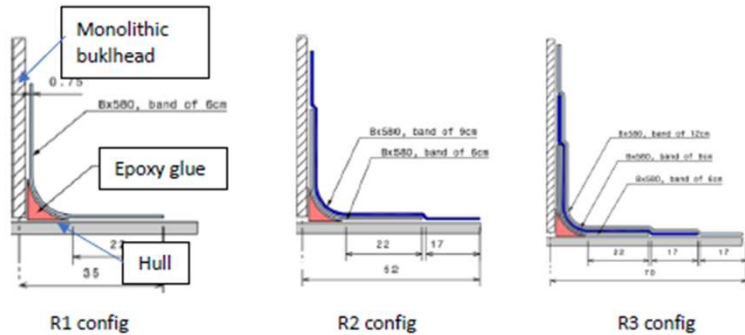
Fillet joint

Structural Bonding



Fillet joint test vs classical composite assembly

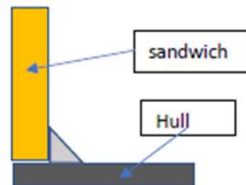
HAND LAMINATION



For **R5**, add on R3
2x 8x580 (1x band of 16cm 1 x band of 20cm)

- R1 = Ep glue +1 layer of carbon
- R2 = EP glue 2 layers of carbon
- R3 = EP glue + 3 layers of carbon
- R5 = EP glue + 5 layers of carbon
- R6 = MMA adhesive with different diameters on sandwich + monolithic
- R7 = Epoxy adhesive with different diameters on sandwich + monolithic
- R8 = MMA adhesive with different diameters on monolithic
- R9 = Epoxy adhesive with different diameters on monolithic

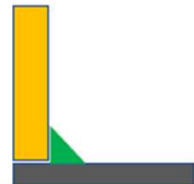
GLUED with MMA SAF Bostik



R6 config:

- 5mm radius
- 10mm radius
- 15mm radius
- 20mm radius
- 25mm radius
- 35mm radius

GLUE with current glued



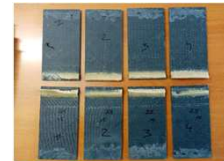
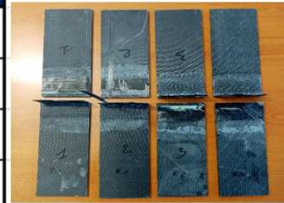
R7 config:

- 10mm radius
- 20mm radius
- 35mm radius

Test config		Sample number
R1		3
R2		3
R3		3
R5		3
R6 (SAF bostik)	5mm radius	3
	10mm radius	3
	15mm radius	3
	20mm radius	3
	25mm radius	3
	35mm radius	3
R7 (current glue)	10mm radius	3
	20mm radius	3
	35mm radius	3
Total		39

Fillet joint results

	Ref	Taille de joint en mm	Valeur max en N
Epoxy + Lamination	R1		3200,0
	R2		4700,0
	R3		2700,0
	R5		2500,0
MMA on sandwich + monolithic	R6	10,0	3600,0
	R6	20,0	3300,0
	R6	30,0	3500,0
	R6	40,0	3800,0
Epoxy on Sandwich + monolithic	R7	10,0	2700,0
	R7	20,0	3400,0
	R7	30,0	3300,0
	R7	40,0	2400,0
MMA on monolithic	R8	10,0	800,0
	R8	20,0	2300,0
	R8	30,0	3200,0
Epoxy on monolithic	R9	10,0	1000,0
	R9	20,0	2600,0
	R9	30,0	3600,0



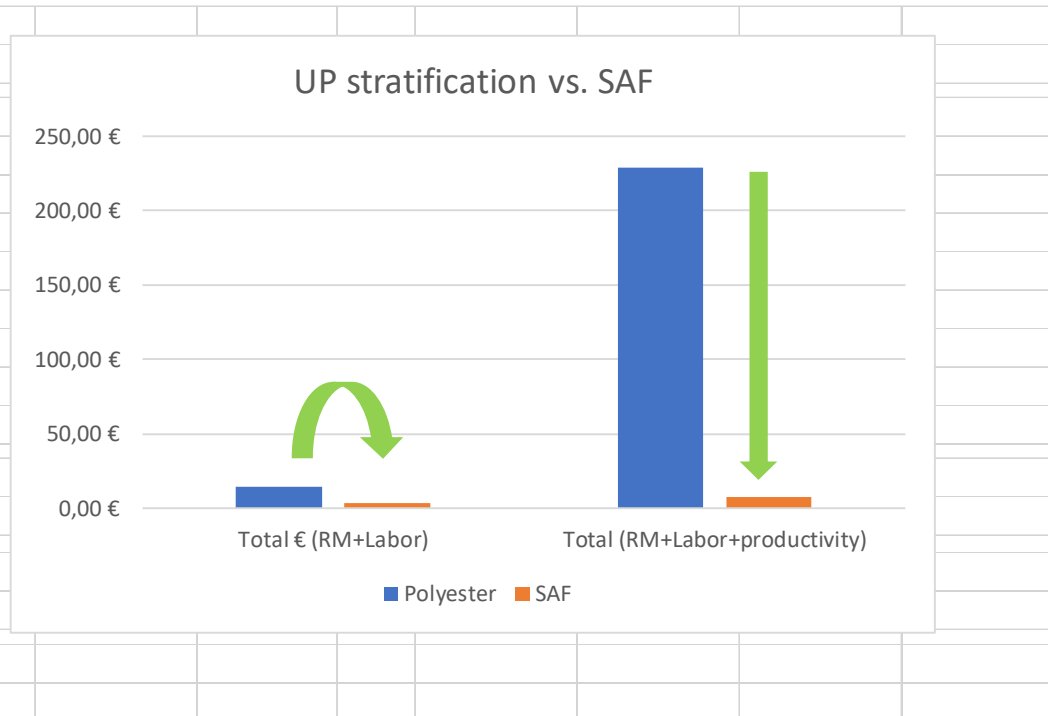
MMA shows better performances than epoxy + lamination 1, 2, 3, 5 layers
MMA as similar performances as epoxy glue

Advantages of MMA

- Better displacement due to higher elongation
- Lighter parts
- Faster process vs lamination
- Faster curing vs epoxy adhesive

MMA joint vs standad lamination gain

Salary/month	2 700 €	hours/month	
Salary/hours	17,88 €	151	
polyester+fiber	3 €		
SAF price kg	20 €	Liter	
	bead R (dcm)	Volume for 1m (L)	
	0,15	0,1125	
	Application 1m		
Statification	Polyester	SAF	
time work (min)	40	3	
Cost	11,92 €	0,89 €	
Raw Materials	3 €	2,25 €	
Total € (RM+Labor)	14,42 €	3,14 €	
Diference	-78,20%		
Curing (h)	12	0,25	
productivity	214,57 €	4,47 €	
Total (RM+Labor+pr	228,99 €	7,61 €	
Difference	-96,67%		



Vs. Other technology

- 84% vs. Epoxy lamination
- 50% vs. PU filled gap

Marine



Vinyl ester adhesive to FIT30 45



Application

- Anchor box
- Tray for fuel tank
- Main cabin interior panels
- Deck to hull
- Roof to wheel house
- Storage box

Advantages

- Easy use & clean with cartridges vs hand mix
- Ratio mix not stable
- No wastage
- Less shrinkage
- No print-through



Marine



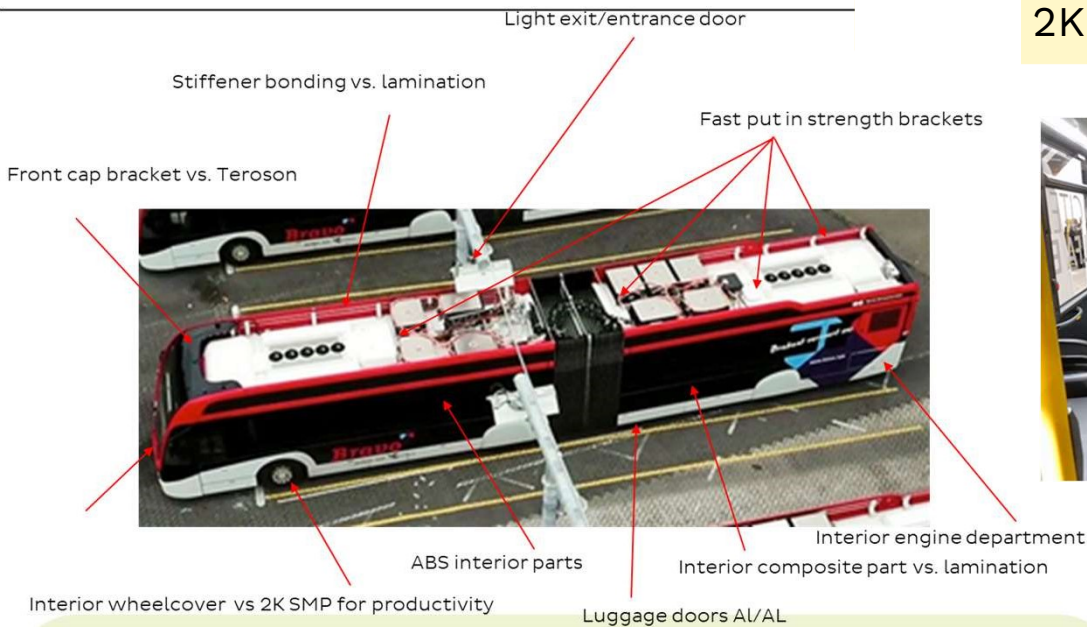
Application

- Module structural assembly
- Structural bulck head
- Engine bed
- Roof bulkhead & roof
- ...

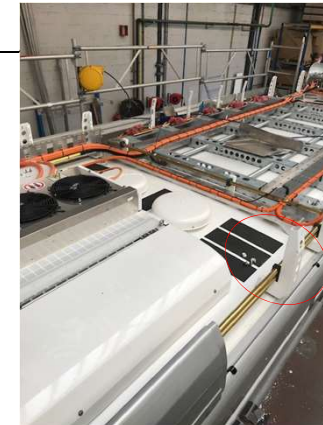
Advantages

- Easy use & clean with cartridges
- Ratio mix not stable
- Long open time
- Fast dispensing (30s for 1 cart.)
- No print-through

Bus composite parts



2K SMP to SAF U10



Application

- SS Brackets for battery support
- SS Bracket for
- SS Brackets for
- Interior parts ABS

Advantages

- Faster process with fast strength buildup
- Higher load resistance
- Good ageing
- No grinding
- Better labelling no CMR

Truck plastic parts

to SAF Ultimate 15AP



Application (Interior and exterior)

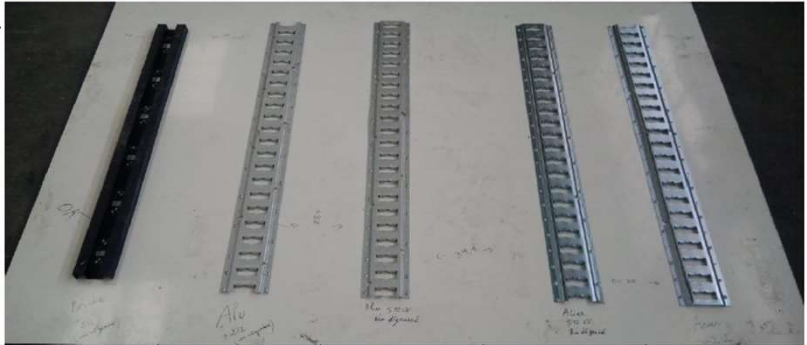
- SS brackets to ABCPC & ABSPC to ABSPC
- Bumpers
- Aerodynamic parts
- Wheel arches
- Dashboard

Advantages

- Blue color after mix
- Fast cure (10min handling time)
- Better aging (ISO 6270-2-CH = 240h in 100%HR)
- No print-through with flexible product
- Blue primer for SS (in process)

Trailer (composite parts)

Matériel testé



Rail Bricks ABS	Rail alu	Rail alu	Rail acier	Rail acier
Collé 212 vissé	Collé 212 vissé	Collé 512 UV vissé	Collé 512 UV vissé	Collé 212 vissé

Résultats de tenue à la traction

Tenue 350 kg	Tenue 250 kg	Tenue 250 kg	Tenue 350 kg	Tenue 350 kg
-----------------	-----------------	-----------------	-----------------	-----------------

Application

- Rail profile bonding in trailers
- Stainless
- ABS

SAF U10



Matériel testé



7	5	2	1
Rail Bricks ABS	Rail acier	Rail Bricks ABS	Rail acier
Collé 70 03 (sans vis)	Collé 70 03 (sans vis)	Collé Ultimate 15 (sans vis)	Collé Ultimate 15 (sans vis)

Résultats de tenue à la traction

Tenue 110 kg	Tenue 150 kg	Tenue 550 kg	Tenue 370 kg
-----------------	-----------------	-----------------	-----------------

Advantages

- Faster process vs Sika PU
- No screw used = No damages on the parts
- Cleaner
- Higher load resistance

Rail (exterior)



SAF U10



Application
Sliding door for train
AL to AL

Advantages
Structural integrity
High strength, vibration and choc resistance
AL bonding

Rail (interior)



Citadis roof (painted metal)



TGV Interior parts (FRP/stainless)



TGV Handling bar (FRP/stainless)



Alstom Citadis X05



Dashboard (FRP/Stainless) Germany Alstom

Advantages
Homologated Alstom
EN45 545



Roof ABSPC



Auto Exterior



Application

- Spoiler Tesla Model 3
- ABS to ABS
- SAF150 15

Advantages

- Spayable on large surface
- High elongation & Flexibility
- Less shrinkage
- No print-through

Auto Exterior– spoilers

SAF U5 or U15 AP in tests



Application

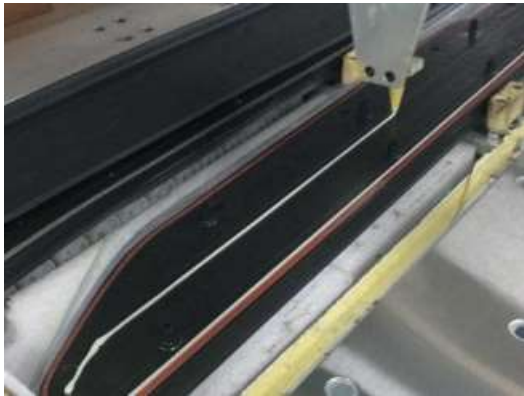
- Spoiler bonding
- ABSPC to ABSPC
- Vacuum formed parts
- Customer : KIA & Hyundai

Advantages

- Good adhesion and ageing
- Same color possible
- Faster curing with SAF U5
- Strong adhesion on paint

Auto Exterior– Range Rover

SAF30 MIB with T732 primer



RANGE
ROVER



Application

- Stepper
- TPU to Aluminum
- Automatic dispensing
- 30g per stepper (60g per car)

Advantages

- Only MMA to resist to humid cataplasms
- Only MMA to bond this TPU
- Global presence

Auto Interior



Application

- Interior decorative parts
- Epoxy carbon
- SAF150 15 & 45
- Model X & S

Advantages

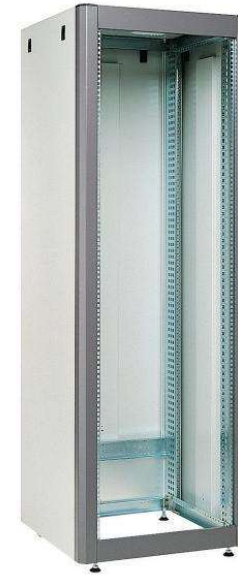
- Fast strength build-up
- No print (deformation) on the surface
- Good temperature resistance
- Strong durability

Assembly electrical cabinets



Application

- Mineral Glass to painted metal
- Fully automated
- SAF15010 RAL9001



Advantages

- Open time 1,5min @23°C
- 4MPa in 10min
- 150% elongation
- Taylor made color RAL9001

Building Application



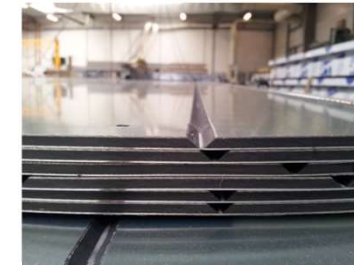
Application

- SMC Solar tiles
- Fully automated
- 600g dispensed in 3min

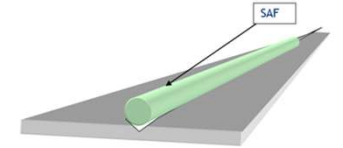
Advantages

- Thermal resistant
- Glycol 40% resistant
- High pressure resistance

Building

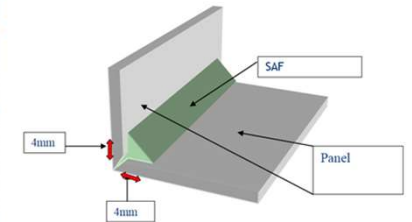


1) Apply a bead of SAF with a 6 to 10mm diameter bead before bending.



2) Bend

3) Smooth SAF with a sound or straight spatula in order to obtain a circular or straight section coming at 4mm on each side.



Application

- Doors
- Window
- Facade

High number of customer

Advantages

- Open time 1,5min @23°C
- 4MPa in 10min
- 150% elongation
- Taylor made color RAL9001

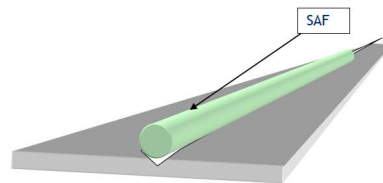
Facades with Aluminum composite



Product: SAF 30 Ultimate range

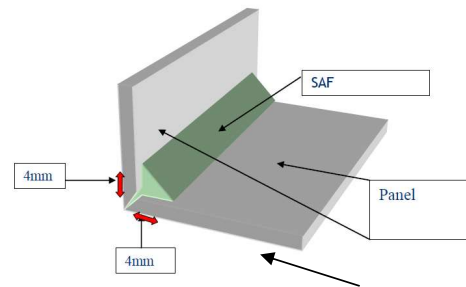
- Up to 200% elongation & 19 Mpa
- High Flexibility
- High Bonding performance
- High temperature resistance
- Aesthetics, no rivets
- Fast setting

1) Apply a bead of SAF with a 6 to 10mm diameter bead before bending.

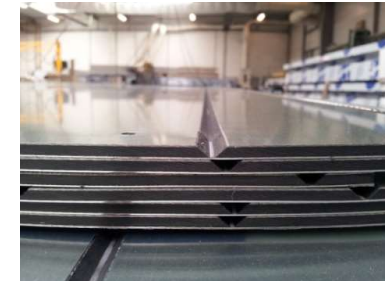


2) Bend

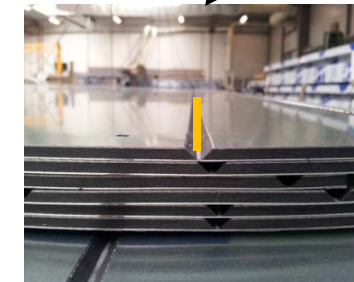
3) Smooth SAF with a sound or straight spatula in order to obtain a circular or straight section coming at 4mm on each side.



Bending



Machining



Dispensing adhesive