



DEVELOPMENT AND SUBSTITUTION ACTIVITIES FOR ANTICORROSION PRIMERS AND ADHESIVES



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Expertise, testing and analysis



Adhesives



High performances materials and composites

Development of industrial products



Coatings

Development of Rescoll's functional products ranges



Structural and debondable adhesives



Conductive adhesives



Coatings
(anticorrosion, easy to clean ...)



Conductive polymers

Coatings

- Adhesion primer
- Cr free anticorrosion primer

Adhesives

- Examples of impacted substances
- Some related adhesives developments

Coatings

- **Adhesion primer**
- Cr free anticorrosion primer

Adhesives

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REVÊTEMENTS INNOVANTS DE NOUVELLE GÉNÉRATION (RING)

Project: RING



Aeronautical Factory of the Future (UAF) platform

Formulation of a Sol-Gel adhesion promoting primer



REVÊTEMENTS INNOVANTS DE NOUVELLE GÉNÉRATION (RING)

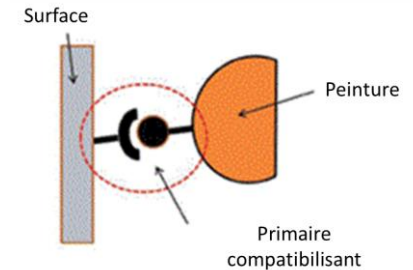
Context

Current process: Reactivation of primers by sanding (on metals and composites)

- Damage risk of the composite beneath the primer,
- Potentially toxic dust generated (Cr based paints),
- (re)Deposit of dust due to the sanded layer,
- Source of pollution,
- Set up of specific suction systems (and filtration systems),
- Use of PPE specific to sources of contamination
- Time consuming process

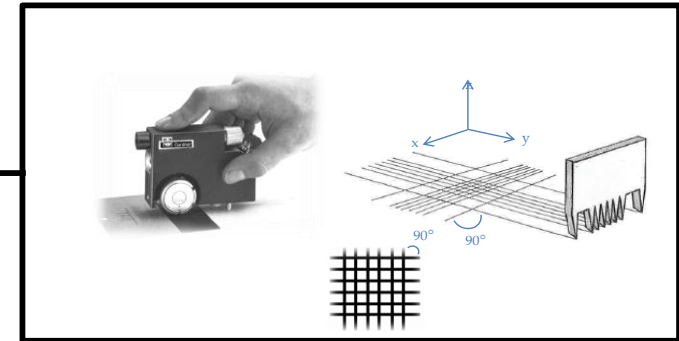
Objective: Replacement of the sanding step with a sol-gel adhesion primer by automated spray

- Reduction of the number of steps in the process,
- Automation of the process,
- Less risk for operators,
- Environment friendly solution.



REVÊTEMENTS INNOVANTS DE NOUVELLE GÉNÉRATION (RING)

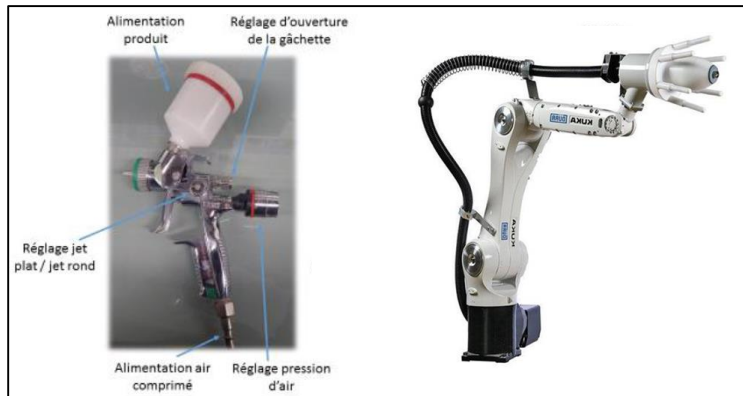
Criteria	Targets
HSE	No product targeted by Airbus Helicopters or impacted by REACH
Adhesion	$\leq$ GT1 (ISO 2409)
VOC	$\leq$ 420 g/L
Process	Robotic spray painting
Polymerization	$T_{\max} = 80\text{ }^{\circ}\text{C}$, $t_{\max} = 4\text{ h}$ (ideally $60\text{ }^{\circ}\text{C}$, 1 h)
Thickness	$\leq 5\text{ }\mu\text{m}$
Coloring	Visually observable



Painting architectures:

- 2 primers
- 3 top coats

6 types of rivets



Spray painting



Colored primer



REVÊTEMENTS INNOVANTS DE NOUVELLE GÉNÉRATION (RING)

Current results

Criteria	Targets	Results
HSE	No product targeted by Airbus Helicopters or impacted by REACH	OK
Adhesion	$\leq$ GT1 (ISO 2409)	OK for 50% of architectures (pending)
VOC	$\leq$ 420 g/L	Under improvement
Process	Robotic spray painting	OK
Polymerization	$T_{\max} = 80\text{ }^{\circ}\text{C}$, $t_{\max} = 4\text{ h}$ (ideally $60\text{ }^{\circ}\text{C}$, 1 h)	60 °C, 1 h
Thickness	$\leq 5\text{ }\mu\text{m}$	OK
Coloring	Visually observable	OK 



Coatings

- Adhesion primer
- **Cr free anticorrosion primer**

Adhesives

- Examples of impacted substances
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ECO-PROTECT

Development of an **ECO**-friendly **PROTECT**ion for aerospace aluminium parts

Objectives: validation and improvement of REACH compliant alternative coatings (including the pre-treatment, also a crucial step) that can replace the currently Cr(VI) surface treatments for protection of aerospace Al alloys:

This project has received funding from the CDTI under the Eurostars-Eureka research and innovation program under project ID 11890

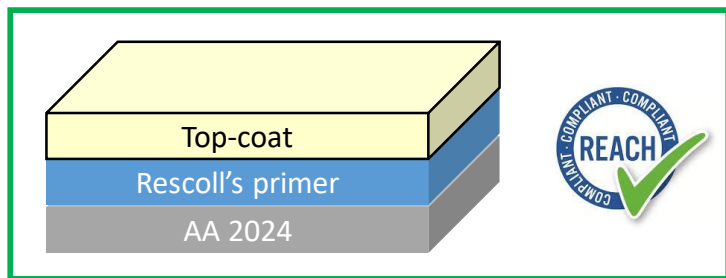
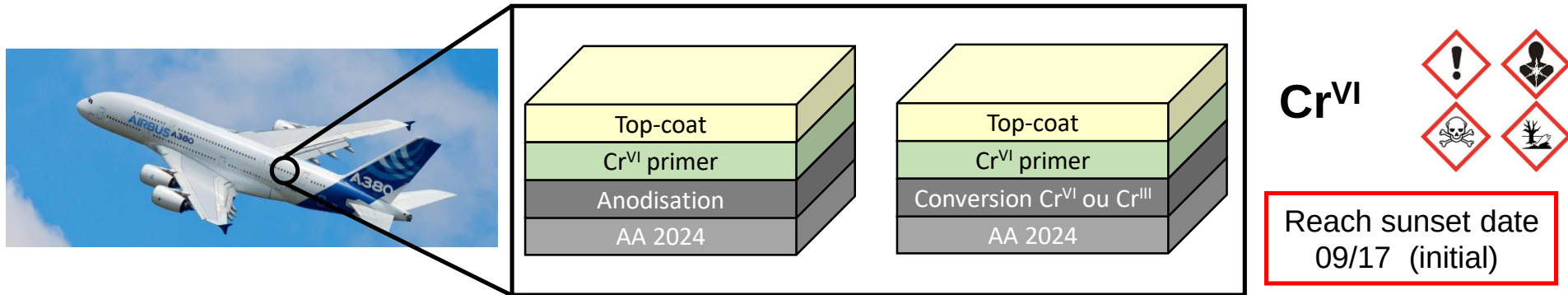
For more information:

<https://www.eurostars-eureka.eu/project/id/11890>



ANTICORROSION COATING BACKGROUND

Aircraft's current system

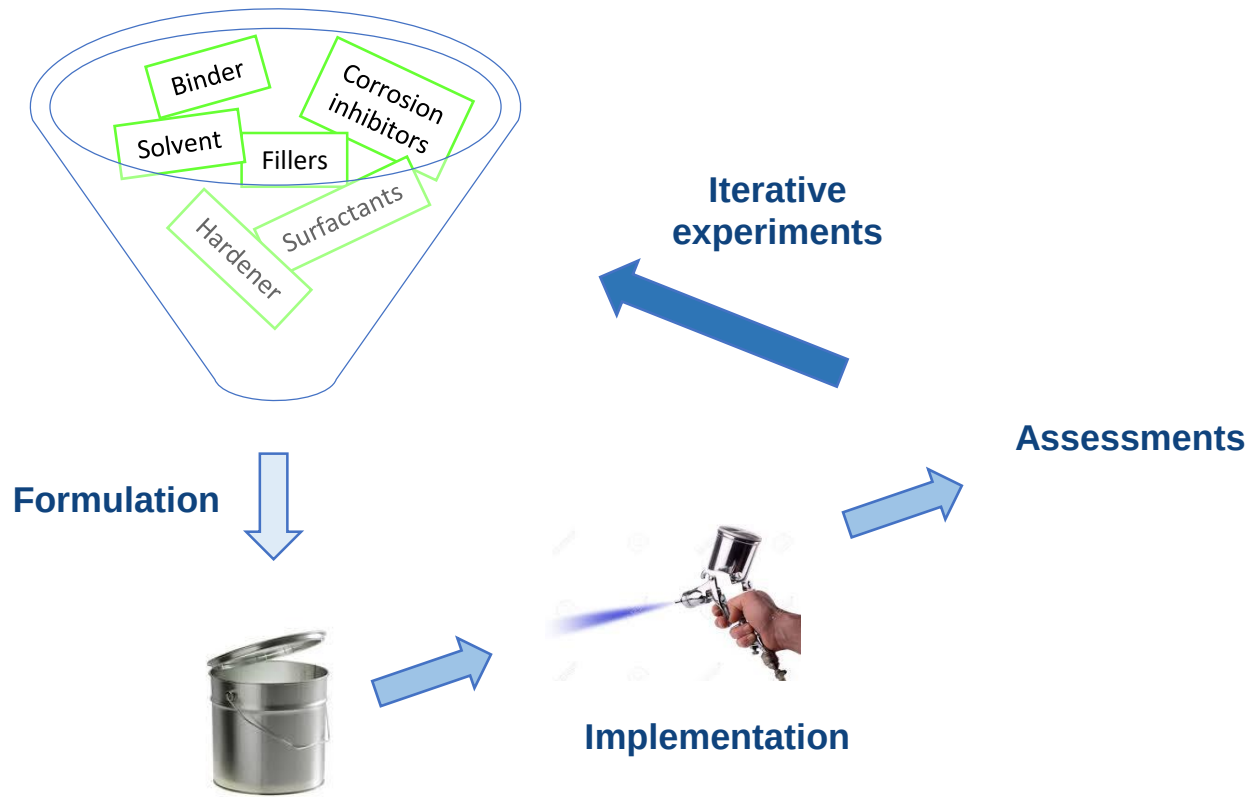


Objectives

- ✓ Green coating
- ✓ Reduction of layers
- ✓ Lightweight system
- ✓ Improvement of fatigue resistance
- ✓ Iso performance (vs current system)

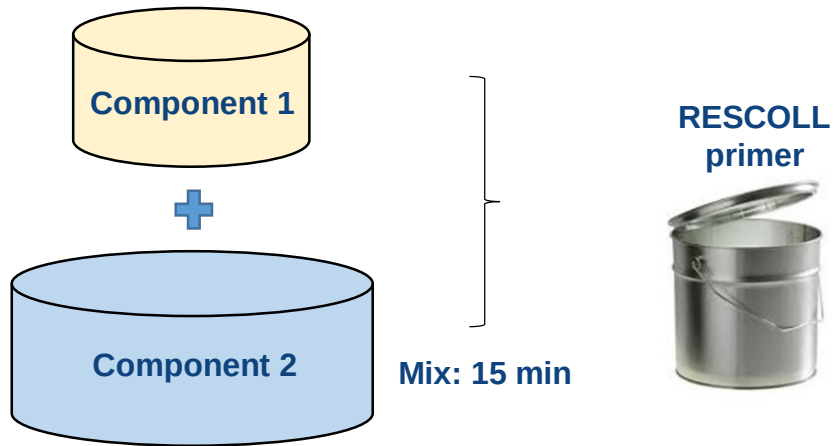
Properties	Standards	Targets
Thickness		10 – 20 µm
Adherence	ISO 2409	GT0
Scratch resistance	ISO 1518	= 1 500g
Bending	ISO 1519	Ø 2 mm
Water Resistance	ISO 2812	- No cracks, blisters, delamination - GT1
Humidity Resistance	ISO 6270	- No cracks, blisters, delamination - GT1
Skydrol Resistance	ISO 2812	- No cracks, blisters, delamination - GT1
Neutral salt spray	ISO 9227	3 000 h
Filiform corrosion	EN 3665	≤ 2 mm (1 000h)

ROAD-MAP FOR ANTICORROSIVE COATING DEVELOPMENT

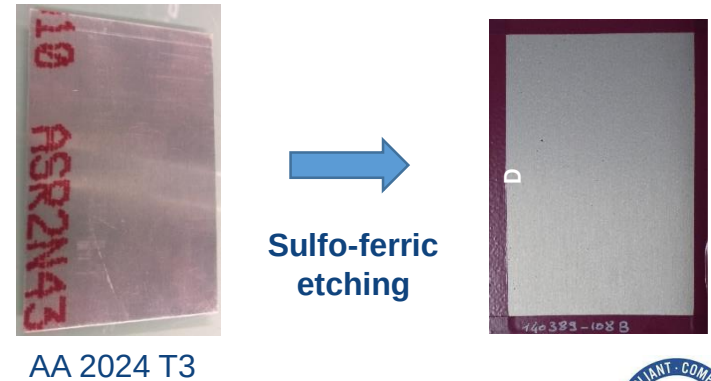


ANTICORROSION COATING FORMULATION

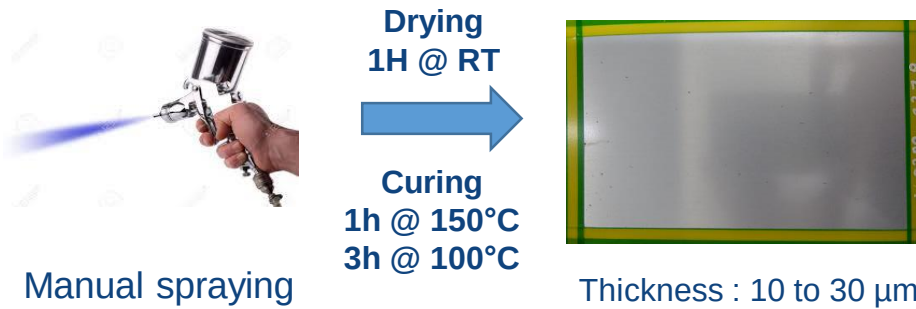
Varnish preparation



Surface treatment



Coating deposition



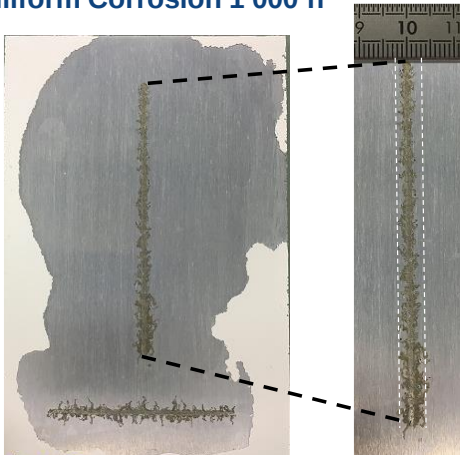
ANTICORROSION COATING PROPERTIES

Salt Spray 2 300 h



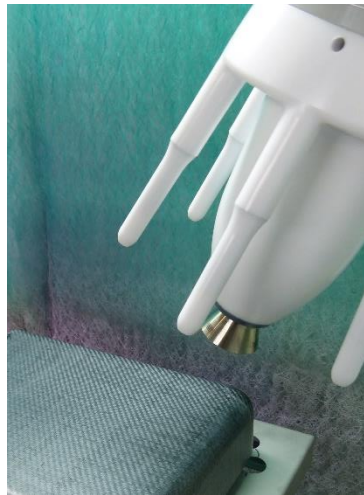
Properties	Standards	Targets	RESCOLL coating	
Thickness		10 – 20 µm	17 µm	✓
Adherence	ISO 2409	GT0	GT0	✓
Scratch Resistance	ISO 1518	≥ 1 500 g	OK	✓
Flexibility	ISO 1519	Ø 2 mm	KO	✗
H ₂ O Resistance	ISO 2812	No cracks, blisters or delamination ≥ 1 200 g (ISO 1518) GT1 (ISO 2409)	OK	✓
Solvent Resistance	ISO 2812	No cracks, blisters or delamination ≥ 1 200 g (ISO 1518) GT1 (ISO 2409)	OK	✓
Humidity Resistance	ISO 6270	No cracks, blisters or delamination ≥ 1 200 g (ISO 1518) GT1 (ISO 2409)	OK	✓
Neutral Salt Spray	ISO 9227	No pit (3 000 h)	Ongoing (2 300 h OK)	✓
Filiform Corrosion Resistance	EN 3665	≤ 2mm (1 000 h)	≤ 2mm	✓

Filiform Corrosion 1 000 h



NEXT STEPS

- Validate neutral salt spray test performance
- Validate Skydroll resistance
- To study components shelf life
- To scale up
- To spray the formulation via 6 axis robot with a rotary atomizer technology



Rescoll automatic painting platform

Coatings

- Adhesion primer
- Cr free anticorrosion primer

Adhesives

- **Examples of impacted substances**
- Some related adhesives developments



Adhesive bonding is a special process

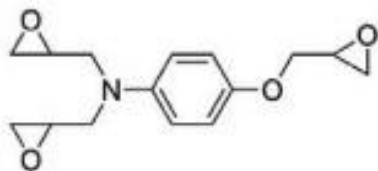
- Qualified method/processes and materials
- Trained operators
- Dedicated tools

Risks of REACH regulation evolution

- Requalified new version of adhesive
- Obsolescence
- Upgrade safety equipment/procedure

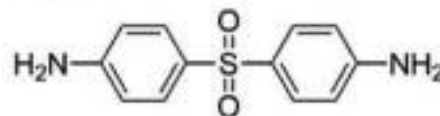
Examples of current epoxy based precursors

TGPAP



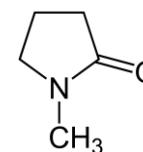
H341 : Suspected of causing genetic defects

44DDS



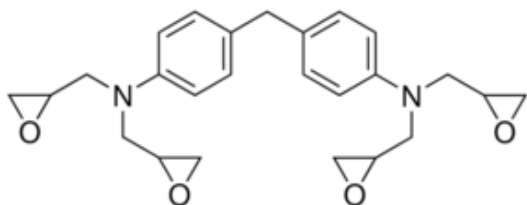
Possibly endocrine disrupting
Included in CoRAP

NMP



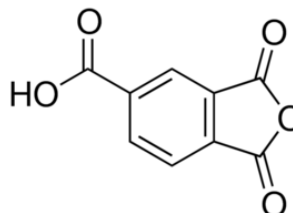
H360 : May damage fertility or the unborn child
SVHC
Candidate list for authorization
Restricted under Annex XVII

TGDDM



H341 : Suspected of causing genetic defects
**genetic toxicity in vivo*

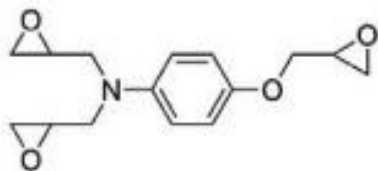
Trimellitic anhydride



SVHC
Candidate list

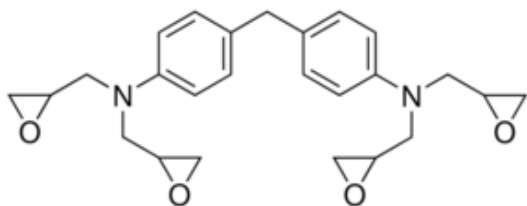
CMR epoxy resin for space application

TGPAP



H341 : Suspected of causing genetic defects

TGDDM



H341 : Suspected of causing genetic defects
*genetic toxicity in vivo



Hysol® EA 9394

Epoxy Paste Adhesive

Bond Strength Performance

Tensile Lap Shear Strength - tested per ASTM D1002 after curing for 5 days @ 77°F/25°C. Adherends are 2024-T3 bare aluminum treated with phosphoric acid anodized per ASTM D3933.

Typical Results

Test Temperature, °F/°C	Typical Results	
	psi	MPa
-67/-55	3,300	22.7
77/25	4,200	28.9
180/82	3,000	20.7
200/93	2,900	20.0
250/121	2,300	15.8
300/149	1,600	11.0
350/177	1,200	8.3
400/204	600	4.1

3. COMPOSITION / INFORMATION ON INGREDIENTS

Hazardous components	CAS NUMBER	%
Aluminum not powder, dust or fume	7429-90-5	30 - 60
Tetraglycidyl diaminodiphenylmethane	28768-32-3	30 - 60
Epoxy resin	Proprietary	10 - 30
Modified epoxy resin	Unknown	5 - 10
Treated fumed silica	67762-90-7	1 - 5

Coatings

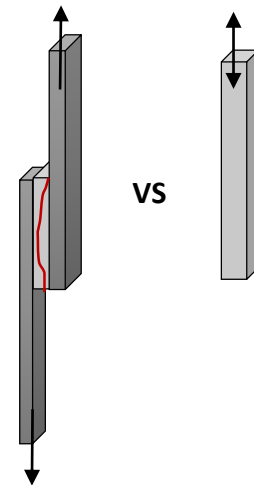
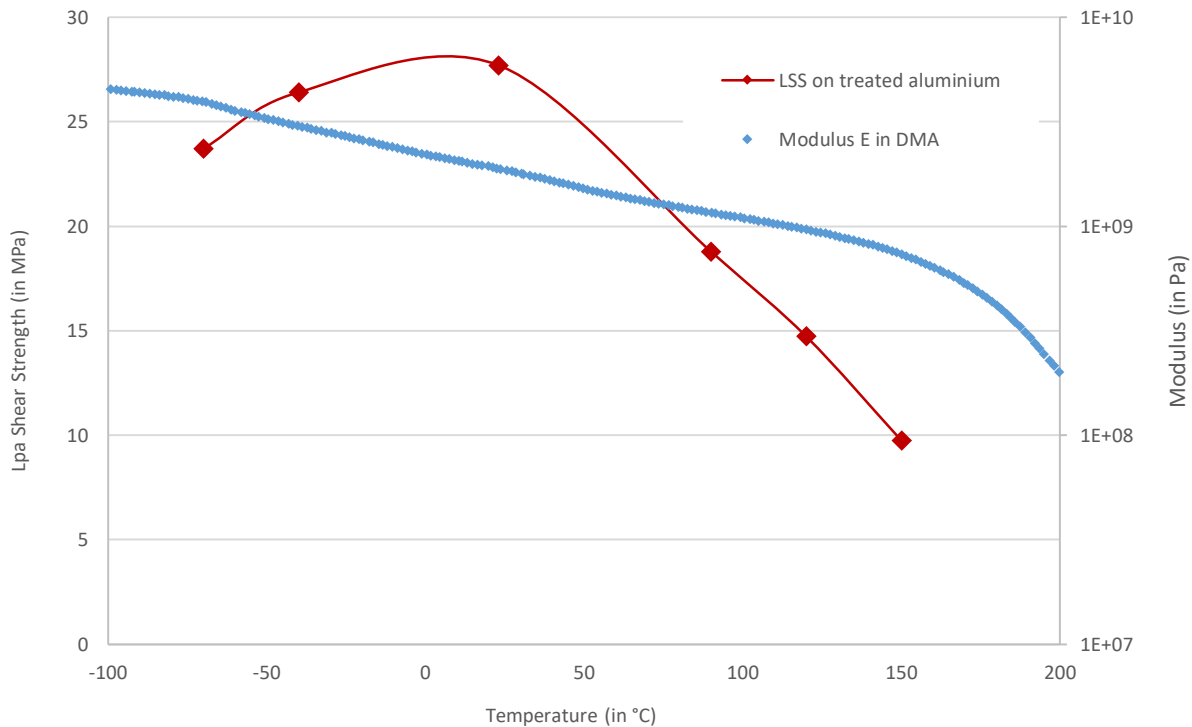
- Adhesion primer
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Adhesives

- Examples of impacted substances
- **Some related adhesives developments**

CMR-Free high temperature epoxy adhesive

Mechanical properties in temperature in bonding assemblies VS thermomechanical properties in DMA



Cohesive failure **CF**

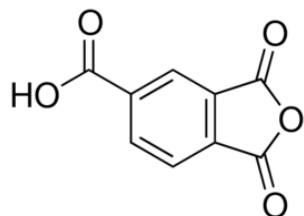


Superficial cohesive failure **SCF**

superficial
SCF

Examples of current epoxy based precursors

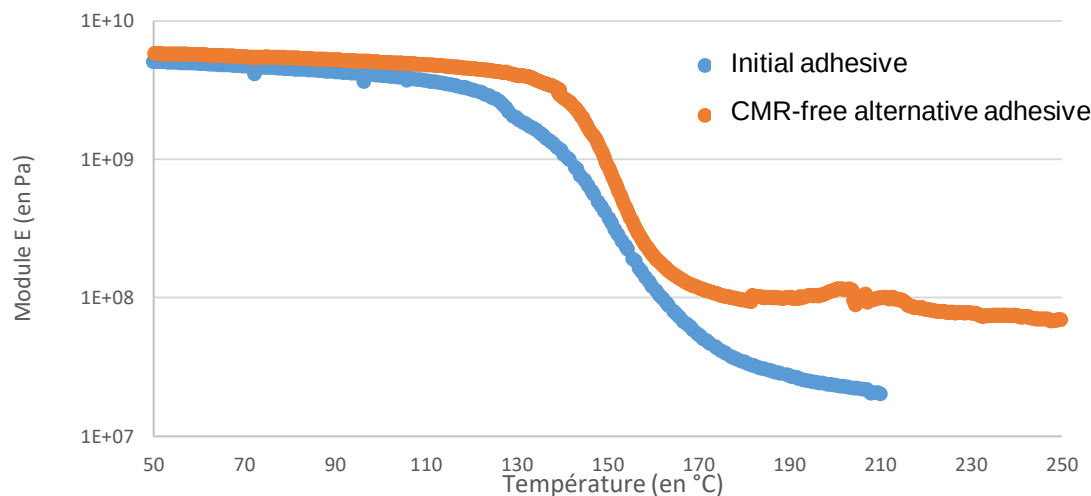
Trimellitic anhydride



SVHC
Candidate list



Properties	Initial adhesive	CMR-free alternative adhesive
Tg (DSC)	130°C	144°C
Young Modulus E (DMA)	5GPa	6GPa
Lap shear strength on aluminum 2024 (sand blasted)	>4MPa	8MPa (AF)
Hardness (Shore D)	> 85 Shore D	91 Shore D

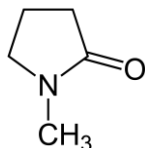


Benefits :

- CMR-free epoxy/anhydride adhesive
- Higher properties than initial adhesive
- Less viscous

Examples of current epoxy based precursors

NMP



H360 : May damage fertility or the unborn child
SVHC
Candidate list for authorization
Restricted under Annex XVII

ABLEBOND 71-1

Electrically conductive high temperature adhesive for electronic and semiconductor applications

3. COMPOSITION / INFORMATION ON INGREDIENTS

Hazardous Component(s)	CAS Number	Percentage*
Silver	7440-22-4	60 - 100
N-Methyl-2-pyrrolidone	872-50-4	10 - 30

ABLEBOND 71-1
MSDS – Revision: 15.10.2015

Properties	Initial adhesive	CMR-free alternative adhesive
Tg (DSC)	>300°C	365,5°C
Volume resistivity	3,8 x 10 ⁻⁴ Ω.cm	5,3 x 10 ⁻⁴ Ω.cm



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