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APM Epicol 284281

Product Description	
Systeme:	2-Part-Epoxy or 1 Part-Frozen-Epoxy
Colour:	grey
Consistency:	flowable thixotropic Liquid
Solid:	100% / solvent free
Pot Life:	45 minutes
Curing:	Room Temperature or Oven Curing
Temp.-Range:	- 55 °C to +85 °C, seals until +175°C

Features / Specifications	
NASA/ESA Outgassing:	< 1 % TML
	< 0.05 % CVCM
Biocompatibility:	ISO 10993-05 and -12
Fungus Resistance:	Class I accepted
MIL-Specification:	DOD-A-82720 Flexible Epoxy
Directive 2011/65/EG:	RoHS compatibel
EG - No. 1907/2006:	REACH conform

APM Epicol 284281 is a flexible Epoxy Adhesive. The product is available as two component set or as frozen one component adhesive. Epicol 284281 may be used for low stress bonds where high shear and peel strengths is needed. Plastics, metal or glass material, typically in the field of optical instruments, many customers know this adhesive as "grey lens glue" or gray prism adhesive, can be bonded. The bonding line is typically 0.15 mm thick, however due to the thixotropic behaviour it can be varied from 0.05 to 1.0 mm, depending on the dimension of the joined parts, specified temperature range of product and difference in coefficient of thermal expansion. Epicol 284281 is often used to glue glass or plastic windows in metal or plastic frames as well as adhesive and/or potting material in electronics equipment or sensors. The adhesive gives excellent bonding results for various materials as plastic, rubber, glass, ceramic, metal, wood and concrete.

Typical Uncured Physical Properties	
Colour Base A:	white
Colour Hardener B:	grey
Base Component:	Epoxy Resin
Hardener Component:	Modified Amine
Viscosity Base (25°C):	70 - 80 Pa.s
Viscosity Hardener (25°C):	45 - 50 Pa.s
Viscosity Mixture (25°C):	40 - 50 Pa.s
Mixing Ratio A/B:	5 : 7 by weight
Mixing Ratio A/B:	2 : 3 by Volume
Pot Life at 25 °C:	45 minutes

Surface Treatment / Cleaning
The surfaces to be bonded must be dry and clean, free of dust, oils, mold release agents and all other surface contaminations. The method of the surface treatment depends on the required performance (cleanliness, bonding strength, aging resistance). A mechanical abrasion like grinding or sandblasting for metals, in some cases also for non metallic surfaces can improve the liability of the bonded parts. Glass surfaces can be cleaned in waterbased ultrasonic cleaning machine with increased soap temperature. Metallic surfaces can be cleaned with waterbased cleaners or with organic solvents.

The pretreatment of the surfaces using oxygen plasma has proved itself for various materials, particularly for plastics. Low pressure plasma treatment dries the surface and the wetting properties improves that is an advantage for a good adhesion of the adhesive. The surface is also modified chemically for plastics, primarily difficult surfaces can become bondable using the optimised parameters and gas. Primers are not a substitute for the surface treatment or cleaning. The liability and the aging resistance can be improved by application of primers.

Mixing Adhesive

The two adhesive components are weighed in the correct mixing ratio into the clean mixing cup. The components must be automatically mixed (using Speedmixer) or hand mixed using a stainless steel spatula without mixing air bubbles inside. A good quality of the mixture can be produced by mixing a amount of adhesive between 10 g and 50 g of the adhesive. Colour should be a uniform grey.

Bonding with Frozen Adhesive

The frozen cartridge/syringe is taken out from the freezer at -40 °C to room temperature. After removing from the freezer, the cartridge should be kept in a vertical position. This towing procedure needs a few minutes depending on the size of the cartridge. As soon as the cartridge does not get wet any more from condensate water and the adhesive is liquid, the application of the adhesive can start with the dispensing process.

Application

The optimum processing temperature is between 20 °C and 28 °C , the viscosity is reduced and the pot life shortened at higher temperature. The adhesive is usually dispensed from a cartridge using a time/pressure dispenser. However, the adhesive can be applied also using a spatula or a brush.

Optimal bonding strengths are obtained at 0.05 to 0.15 mm adhesive thicknesses, optimal performance depends on the temperature range of parts as well as the thermal expansion coefficient of the bonded materials. A uniform adhesive thickness can be secured with spacers, such as glass fibres or plastic balls or by a specific part design or by using a fixture tool. The parts are joined together and fixed by brackets or devices against moving during the curing time.

Curing of Adhesive

Room Temperature	25 °C	18 hours
Oven	40 °C	8 hours
Oven	60 °C	90 minutes
Oven	85 °C	15 minutes

After curing the adhesive the parts can be handled or processed. The optimal strength and resistance of the bond line will be reached after some days only.

Physical Properties of Cured Adhesive

Colour:	grey
Shore D Hardness (25 °C):	55 – 65
Tensile Strength (25 °C):	24.0 N/mm^2
Fracture Elongation (25 °C):	70 %
E-Modulus (25 °C):	680 N/mm^2
Thermal Conductivity:	0.40 W/mK
Thermal Expansion ($0-40\text{ °C}$)	$\alpha = 100 \times 10^{-6} / \text{K}$
	($-40-0\text{ °C}$) $62 \times 10^{-6} / \text{K}$
	($40-85\text{ °C}$) $172 \times 10^{-6} / \text{K}$
Softening Temperature T_g :	$25 \dots 35\text{ °C}$
Decomposition Temperature:	375 °C
Outgassing:	TML 0.95 %
	CVCM 0.03%
Dielectric Strength:	16.0 kV/mm
Dielektric Constant 25 °C :	5.5 bei 1.0 KC
	60 °C : 14.2 bei 1.0 KC
Dissipation Factor 25 °C :	0.112 bei 1.0 KC
	60 °C : 0.422 bei 1.0 KC

Removal of Cured Adhesive

Overflow of not hardened adhesive on the substrate and processing equipment can be removed or cleaned using a solvent like IPA or Acetone. Organic solvents on plastic parts can lead to destruction of the component or Environmental Stress Cracking. Therefore aggressive solvents like Acetone, MEK and Acetate shall be avoided. Refer to material safety data sheet for health and safety regulation before using organic solvents.

Cured adhesive surplus can be removed only mechanically. The adhesive gets very soft at temperatures above 100° degrees Celsius.

Thermal Properties

The typical temperature range of the adhesive is from -55 °C to +85° C. The product can be used below -55 °C for some applications, however, becomes very brittle at these temperatures, what can lead to destruct the bonded parts or to debond from the substrate. At temperatures above + 85°C softens the adhesive, what can be an advantage, depending on the mechanical load. The softer adhesive can compensate the different thermal extensions of the substrate without the damage of the bonding. After cooling down to room temperature it turns back to the usual properties. A thermal destruction of the adhesive happens only at temperatures above 150°.

Lap Shear Strength / Test Temperatur

Etched Aluminum at - 75 °C	13.5 N/mm ²
Etched Aluminum at - 55 °C	13.8 N/mm ²
Etched Aluminum at + 25 °C	17.2 N/mm ²
Etched Aluminum at + 85 °C	2.5 N/mm ²

Tensile Shear Strength / Material

The Lap shear test in accordance to DIN EN 1465 shows a good adhesion on various materials.

Lap Shear Strength

Aluminum anodized	12.8 N/mm ²
Stainless Steel	13.1 N/mm ²
Copper	7.2 N/mm ²
Brass	6.0 N/mm ²
Nitril Rubber on Steel	1.5 N/mm ²
ABS Plastic	6.8 N/mm ²
PVC Plastic	6.5 N/mm ²
PC Polycarbonate	8.0 N/mm ²
PMMA Acrylics	7.6 N/mm ²
Glass Fiber reinforced	11.4 N/mm ²
PPO Polyphenyleneoxid	4.2 N/mm ²

Aging Resistance of Bondings

The typical temperature range of Epicol 284281 is between -55°C and +85°C. Within this temperature range are the bondings very aging resistance. The cured adhesive shows an excellent temperature resistance, humidity resistance and solvent resistance.

Lap Shear Strength after Aging

Aluminum etched at +25°C	
7 days cured at RT	17.2 N/mm ²
Heat Chamber 40 Days at +70°C	32.1 N/mm ²
Heat Chamber 40 Days at +150 °C	34.0 N/mm ²
50 °C / 100 % rH / 15 days	20.3 N/mm ²
50 °C / 100 % rH / 30 days	13.7 N/mm ²
50 °C / 100 % rH / 90 days	10.4 N/mm ²
in water at 25°C after 15 days	21.5 N/mm ²
in water at 25°C after 30 days	20.3 N/mm ²
in water at 25°C after 90 days	14.3 N/mm ²
Synthtic Oil at 25 °C after 30 days	17.2 N/mm ²
Aliphatic hydrocarbon solvent	22.5 N/mm ²

PMF Cartridges (Pre-Mixed-Frozen)

The processing of Two-Part Adhesives involves risks in the final bonding quality. In most critical applications such as Aerospace, Electronics or for Medical Devices such risks are not acceptable. The single component of the adhesive can crystallize during storage or the filler segregates from the resin, the mixing ratio may be wrong, the mixture is inhomogeneous or the mixed adhesive contains air bubbles.

Small amounts of adhesives (up to 55 cm³ in a cartridge) with a pot life which is not too short (> 30 minutes) the mixed adhesive can be Pre-Mixed-Frozen. Using PMF adhesives avoids all these risks in the mixing process. Using the frozen PMF Version of the same adhesive, the adhesive components cannot crystallize, filler does not separate. The adhesive is degassed, properly mixed and without air bubbles in the cartridge.

These PMF frozen adhesives can be stored at a temperature of below -40 °C without loss of quality between two months and one year.

The bonding process using PMF Adhesives is easy because the adhesive is processed as a One-Part Adhesive with a limited pot life. PMF Adhesives are used where the quality of the bond must be granted and the needed amount of adhesive does not justify an inline Two-Part adhesive mixing machine.

Compliance

Epicol 284281 adhesive and all of its ingredients meet the requirements according to RoHS and REACH directives. Refer to Product Label and Material Safety Data Sheet for health and safety information before using this Adhesive.

Precautionary Information

Avoid skin and eye contact. Always wear gloves and goggles during applying this product. In case of skin contact, wash affected skin (hands) with warm water and soap, never use solvent and dry them well. The liquid adhesive is irritating to eyes by contact and may cause permanent damage to the eye. Always follow the Material Safety Data Sheet before use this Adhesive.

Storage and Shelf Life

The optimum storage temperature for this adhesive in original, unopened containers is between 15 °C and 25 °C. When stored at this recommended temperatures in the original, unopened containers, the shelf life of the two parts is at least 24 months from manufacturing date. Higher temperatures shorten the shelf life. Lower temperatures cause temporarily a higher viscosity of the product.

The PMF Adhesive (Pre-Mixed-Frozen Adhesive in cartridges) must always be kept at a temperature of lower than -40 °C during shipping and storage! The shelf life of the PMF Adhesive is 2 months at -40 °C. Lower storage temperature can extend the shelf life. The cartridges must never be thawed, otherwise the pot life is shorter, the viscosity is higher or the adhesive is already cured. Shipping of the PMF Adhesive has to be done in dry ice at -78 °C.

Packaging

2-Part Adhesive APM Epicol 284281 is available in Sets with 600 g (Base A: 250 g/Hardener B: 350 g) or Bipak B/A with an amount of 8 g / Set.

The PMF Adhesive (Pre-Mixed-Frozen) is available in Cartridges or Syringes of each 3 / 5 / 10 / 30 oder 55 cm³. Special Packaging upon request.

Disposabel Considerations

The liquid parts of the adhesive must not be disposed with the household garbage. Do not allow the liquid parts to reach sewage system, hand it over to hazardous waste disposers. The cured adhesive is to dispose as other plastics waste, depending on local legal requirements with domestic garbage or disposed as hazardous waste. Do not mix and cure larger amounts (> 100 g) of the components, since the curing process is highly exothermic and therefore leads to a dangerous warming of the mixture.

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