

Data sheet Purocoat 17/02 (Purosolve 71/00, Purocoat 17/10)

The Purocoat 17/02 surface coating is a ready-to-use, clear liquid of a fluoroacrylate polymer (fluoropolymer, exact name: Tridecafluorohexylethyl mathacrylate) which is dissolved in a Purosolve 71/00 hydrofluoroether solvent.

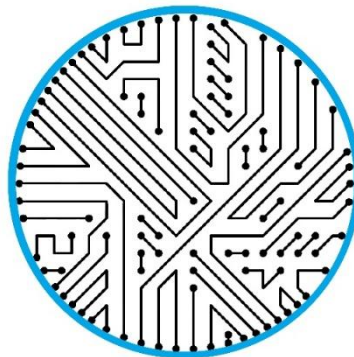
The coating creates a surface with good anti-moisture, anti-surface diffusion and anti-corrosion properties. With a surface energy of 8 to 12 mN/m, liquids such as water, heptane and toluene, but also lubricating oils and silicones, can run off the surface while the protective film remains intact.

For applications in electronics, metallic contacts still working in spite of the coating. Test probes can usually be used on all contacts. Masking of contact areas is usually not necessary.

Purocoat is not electrically conductive in the liquid or in the dried state, so even button cells can be coated without any problems under voltage.

The use of Purocoat 17/02 requires control of the fluoropolymer concentration. Puretecs GmbH offers calculation aids and the necessary equipment for measuring the fluoropolymer concentration to ensure that the fluoropolymer concentration remains within the range in which the required layer thickness is achieved.

The dipping process usually takes between 15 and 60 seconds until all surfaces are completely wetted. If a fluoropolymer concentration of 2% (Purocoat 17/02) is adhered within +/- 0.2% fluoropolymer concentration, the result is a coating with a thickness of approx. 500 nm. This is the film that remains on the module when it emerges from the liquid. To change the fluoropolymer concentration, Purocoat 17/10 concentrate with 10% fluoropolymer content is used to increase the concentration and Purosolve 71/00 thinner to decrease the concentration. Puretecs GmbH coating systems ensure that the coated modules come out of the system dry and that the solvent vapor are recondensed and fed back again. The drying process only takes a few minutes.



The use of Purocoat coatings in body-invasive assemblies is not permitted! Purocoat must not be used for products that are introduced into the human body (for medical purposes), such as syringe needles.

Purocoat contains fluorine; Sale and use is only for professional, commercial users! Not intended for private use! Purocoat is a PFAS-material.

Purocoat as liquid for application

Typical physical properties

Appearance	Clear, colorless, bright liquid
Fluoropolymer percentage	0 — 10% mass (0% for Purosolve 71/00; 2% for Purocoat 17/02 ; 10% for Purocoat 17/10)
Fluoropolymer percentage typical for application	2.0% mass
Fluoropolymer percentage upper limit for application	2.2% mass
Fluoropolymer percentage lower limit for application	1.8% mass
Solvent:	HFE Purosolve 71/00
Specific density at 23 °C	1.47 — 1.52 g/cm ³
Viscosity at 23 °C	0.66 — 0.91 cP (0.45 — 0.6 cSt)
Boiling point of the solvent	56 — 61 °C
Freezing point	-94 — -135°C
Vapor pressure at 25°C	26.8 — 31.4 kPa
Flash point	Not flammable
Solubility of water in Purocoat	95 — 900 ppm mass

Environmental properties

Ozone depletion potential ¹ (ODP)	0.0 (for solvent Purosolve 71/00)
Global warming potential ² (GWP)	297 — 540 (for solvent Purosolve 71/00)
Atmospheric lifetime	4.1 years (for solvent Purosolve 71/00)
Identification	No hazardous substance
Dangerousness	Not toxic
Exposure of people to solvent vapors in the air	max 750 ppm (8 hours average)

¹ CFC-11 = 1.0

² GWP 100 years integrated time horizon (ITH) Multiples of the CO₂ equivalent

Processing instructions

Method	Dipping in liquid
Dipping time	No minimum time, wait for no bubbles coming up
Ascent rate	Minimum 10mm/s
Drying time	approx. 2-10 minutes. Depend on the shape
Particularities	Avoid scooping components
Fluoropolymer concentration control	Weighing a test quantity or density measurement



Natural change in concentration

Purocoat 17/02 is supplied in a ready-to-use concentration of 2%. By filling Purocoat into a container or bath that is not tightly closed, the solvent content in the Purocoat is lost over time through evaporation. The contained solvent Purosolve 71/00 evaporates very easily and quickly.

Fluoropolymers are also removed from Purocoat during application in order to finally coat the modules, but in most cases the proportion of the evaporating solvent Purosolve 71/00 by far predominates. This means that over time the concentration increases from the original 2% fluoropolymer content to higher values. The total amount of Purocoat liquid becomes less.

Concentration measurement manually

What do we use?

1. Precision balance with a display accuracy of 0.001 g
2. Weighing dish - disposable items made of aluminum foil with a diameter of approx. 70 mm
3. 5 or 10 ml withdrawal syringe, reusable



How do we proceed?

1. The balance is turned on for at least 5 minutes. Without loading the tare display, press 0.000 g.
2. Place the dish and empty syringe and note the weight. (Result 2)
3. Fill the syringe, place it on the scale together with the dish and note the total weight. (Result 3)
4. Carefully empty the contents of the syringe into the dish and set the syringe aside.
5. Let the dish dry out for about 10 hours - preferably overnight - at room temperature.
6. Place the dry dish and syringe back on the zeroed scale and note the weight. (Result 6)

How do we get the result?

The calculation is carried out in such a way that the tare weight from result 2 is deducted from the gross weights from result 3 and result 6, and the two results are set in relation to one another in order to determine the percentage.

$$\frac{\text{result 6} - \text{result 2}}{\text{result 3} - \text{result 2}} \times 100 = \text{Percentage of the solid content } w$$

When emptying the syringe into the dish, a little liquid tends to splash over the edge of the dish. To avoid this, you can pierce a small hole in the top of the syringe and then pull the syringe plunger up over the hole to allow the liquid to drain slowly into the dish.



! The automated measurement device „MST-2.0“ is not compatible with Purocoat 17/02 .

Refilling of Purocoat in an existing coating bath

After the current concentration w has been determined, an existing coating bath can be adjusted to the desired target concentration of 2% by refilling with Purocoat 17/10 (10% concentrate) or Purosolve 71/00 (pure solvent).

- If the value is lower than the desired target concentration of typically 2%, then Purocoat 17/10 (10% concentrate) is refilled to add more fluoropolymer solids to the existing coating bath and raise the value:

nk: Amount of Purocoat 17/10 (concentrate) to be refilled in liters

b: Amount of the existing coating bath in liters

w: Value of the concentration in the existing coating bath in %

z: Target concentration (typical 2) in %

$$nk = b * \frac{z - w}{10(\%) - z}$$

- If the value is higher than the desired target concentration of typically 2%, then Purosolve 71/00 (pure solvent) is refilled to dilute the existing coating bath and lower the value:

nv: Amount of Purosolve 71/00 (thinner) to be refilled in liters

b: Amount of the existing coating bath in liters

w: Value of the concentration in the existing coating bath in %

z: Target concentration (typical 2) in %

$$nv = b * \left(\frac{w}{z} - 1 \right)$$

If you measure the weight with a scale instead of the calculated volume with a liter measure for refilling, note that 1 liter corresponds to ≈ 1.52 kg!

Consumption of Purocoat 17/02 during coating

During coating, the fluoropolymer content in the Purocoat is consumed because it is deposited on the surfaces of the module and thus becomes less and less in the immersion bath. In addition, solvent is consumed as it evaporates into the environment. Evaporation also occurs to a lesser extent without coating if Purocoat is not stored in closed containers.

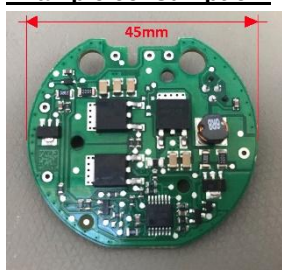
The consumption of the fluoropolymer content depends solely on the surface to be coated. If many modules with a large surface are coated, the fluoropolymer content is consumed much faster.

The consumption of the solvent depends on many factors, such as the size of the tank opening, air movement, cooling capacity of the machine, etc.

Arithmetically, an area of 23m² can be coated with 1 kg of Purocoat 17/02 .

In practice, it has been shown that calculating the surface of the module is too imprecise to determine the actual consumption. It is better to weigh several modules before and after coating with accuracy of 1mg and calculate an average value to determine the consumption of the solid fluoropolymer content of the Purocoat.

Example consumption:



Mixed equipped module with 45mm diameter.
Production: 4500 pieces per work day.

Weight before coating: 7,938g

Weight after coating with Purocoat 17/02 : 7,946g

Consumption of solid fluoropolymers: 0,008g (difference)

When dip coating in a machine:

Consumption of solid fluoropolymers per module	0,008 g
Modules per work day	4500
Consumption of solid fluoropolymers per work day	36 g
Solvent consumption per work day	1000 g
Solvent base losses of the machine per day	100 g
Typical factor of solvent consumption in relation to fluoropolymer consumption (Statistic value)	25
Consumption Purocoat 17/10 per work day	360 g
Consumption Purosolve 71/00 per work day	676 g
Work days per month	21
Purocoat 17/10 7kg-bottle	1,08 pieces
Purosolve 71/00 7kg-bottle	2,16 pieces

36g of fluoropolymers are used per day to coat this module. This leads to a monthly consumption of approx:

- 1 piece Purocoat 17/10 7kg (10% concentrate)
- 2 pieces Purosolve 71/00 7kg (solvent)

With this amount of material, a total of 94,500 of these modules can be coated over a month.

Preparation of the modules to be coated

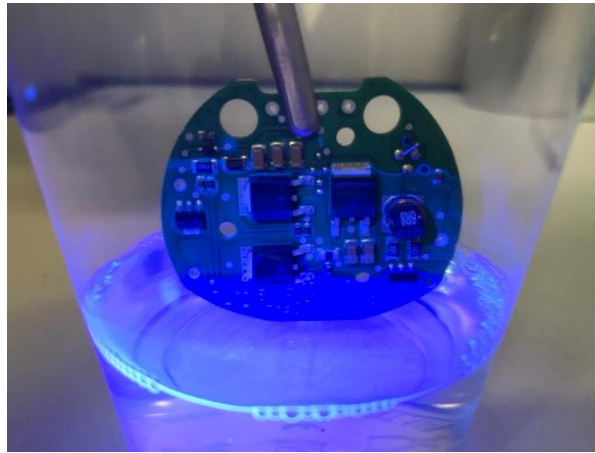
In general, no special preparation of the modules is required. It makes sense to clean the modules before coating, as it increases the quality, but is not absolutely necessary. Purocoat's adhesion is good enough to adhere to almost any type of surface and form a coating.

However, avoid coating modules that contain lubricants (on mechanically moving parts), especially silicone lubricants, as these dissolve in Purocoat and contaminate it.

Applicate Purocoat without machine

Purocoat 17/02 (2%) can not only be used in the machines of Puretecs GmbH; for sporadic applications but also in containers. Stainless steel, glass and almost all common plastics are best. The container should have a tightly fitting lid, as the Purosolve 71/00 solvent is very volatile and otherwise evaporates very quickly. Make sure to keep the container open only during use. If the Purocoat is not to be used for a long time, it is best to store it in the original bottles.

Immerse the complete module in the Purocoat and make sure that all air bubbles can escape. You can then take the module out of the Purocoat again and ideally let it drip off over the corner of the module. Pay attention to nests in the module from which the Purocoat liquid may not be able to drain; E.g. plug sockets without drainage channels. In such a case, tilt the module accordingly. If no more drops fall, the coating is largely dry and the module can be processed further immediately. Make sure there is adequate ventilation as the coating will continue to evaporate for a while. Pay attention to the fluoropolymer concentration. The concentration of the Purocoat can be adjusted again by adding Purosolve 71/00 solvent. Occasionally remove dirt from the surface of the Purocoat and from the edge of the container. Purocoat can also be easily cleaned with a paper filter.



Minimize evaporation when used in manual process

Make sure you only have Purocoat in open containers for as long as is absolutely necessary. Immediately after use, pour it back into the original bottles and close the cap tightly.

In any case, avoid any kind of draft, open windows, fans or active suction. Moving air increases evaporation by a multiple. Use a container that is as tall and narrow as possible, the smaller the opening at the top, the smaller the evaporation losses. Whenever possible, immerse electronic assemblies vertically and not flat.

(Purocoat can remain permanently in coating machines from Puretecs GmbH.)

Purocoat as dried coating layer

Typical physical properties

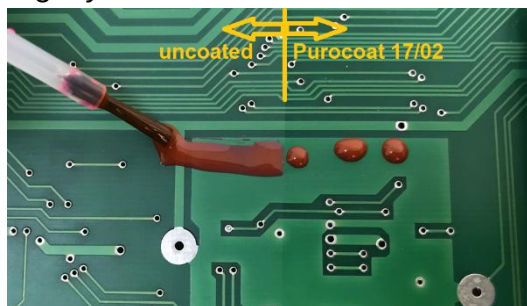
Heat stability of the dried coating	-50°C to +175°C Maximum 1 hour at 250°C
Surface energy of the dried coating	8-12 mN/m
Contact angle	115° (water), >55° (oil)
Glass transformation point *	+75°C
(*A layer with a thickness of only about 500 nm is nevertheless permanently flexible and does not break even when moved)	
Layer thickness /Coating thickness (dipping process)	~ 500 nm
Dielectric constant at 30% RH, 25 °C at 1 kHz	3.0
Dielectric strength at 35% RH, 25 °C	0.0089
Electric breakdown strength	59 V/500 nm , 35% RH
Aging and UV resistance	Very good; minimum 10 years
Refractive index	1.34
Flammability according to UL-94	V-0 (listed E541242)

Handling of the coated modules

Modules coated with Purocoat 17/02 are covered with an approx. 500 nm thin protective film. This is permanently flexible and to a certain extent also mechanically resilient. After it has completely dried (a few minutes), the module can easily be touched by hand or held with clamping tools. Avoid scratching, vigorous rubbing and bulk material.

There is no curing or post-curing time, the assemblies can already be fully loaded after drying.

Test the coating layer



A simple test of whether the coating has been applied can be made with a test ink. The test ink is set to a specific surface energy and shows whether the surface is above or below this value. Use a test ink with a value of 28mN/m in order to have a good distinction between the uncoated and coated surface.

Use the brush to apply some of the test ink to the surface.

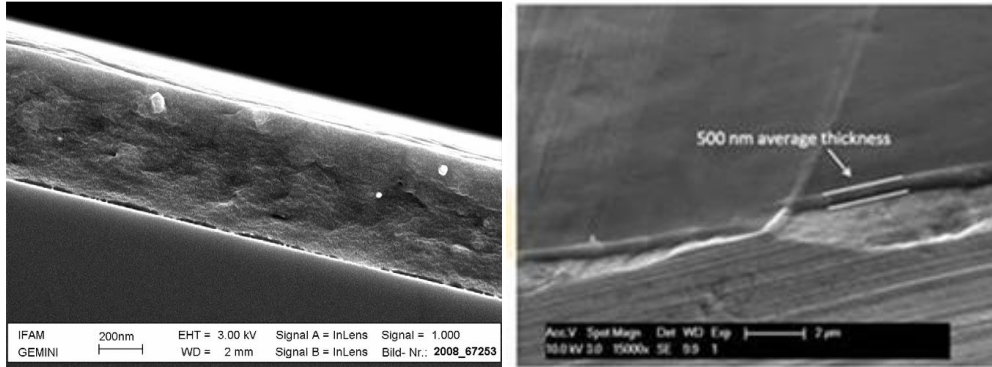
- If the test ink contracts and cannot form a closed film, the surface is coated
- If the test ink remains on the surface as a closed film, the surface is not coated

The test ink can then simply be wiped off with a dry, soft cloth.

Layer thickness measurement

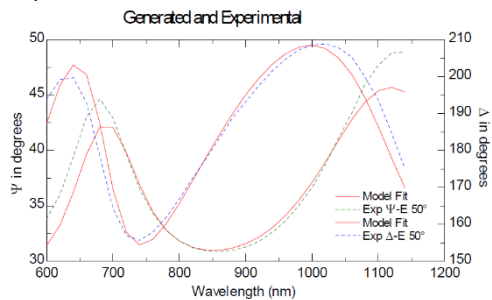
A dried layer of Purocoat 17/02, which was applied in an immersion bath with a 2% fluoropolymer concentration, has an average layer thickness of 500 nm. The layer thickness is not exactly the same everywhere, but varies between about 400 and 600 nm. This is mainly due to the run-off effects when withdrawing from the dipping bath.

Scanning Electron Microscopy (SEM):



Scanning electron microscopy (SEM) can be used to create images of the very thin layer. To do this, the coated carrier must be frozen and broken (kryo-fracture) in order to be able to reproduce a broken edge with the dried layer of Purocoat 17/02. Please note that the layer thickness is influenced by the REM measurement method and may shrink slightly. The photos (picture above) show the average layer thickness of a dried Purocoat 17/02 layer of 500nm.

Ellipsometric thickness determination:



The layer thickness can also be determined by ellipsometric thickness determination with an appropriate measuring device. When measuring with ellipsometry, it must be noted that this can only be carried out on a defined surface (not on a PCBA) on an area of around 1mm². Compared to SEM, the process is much less complex.

In practice (manufacturing), it has proven useful not to measure the layer thickness, as this is too time-consuming and expensive. Since there is a direct relationship between the layer thickness and the fluoropolymer concentration of the Purocoat 17/02, **it is entirely sufficient to continuously monitor the fluoropolymer concentration as a process variable.**

UL listing

Purocoat 17/02 is as coating listed at UL under E541242.

Project:

4791391867 Testing, Final Certification - Recognition for Permanent Coating Grade [...] **Purocoat 17/02**



IPC Compliance

Purocoat is compliant with IPC-CC-830C (Revision C) as Type UT (Ultra-Thin Coatings).

Electrical contactability

Purocoat 17/02 forms a protective layer that is designed to protect well against environmental influences, but still allow contact with plugs, switches, relays, needle adapters, etc. In general, all types of metallic contacts do not pose a problem in terms of contactability after coating.



On typical plugs such as USB plugs, post connectors and jack plugs, no increased contact resistance can be measured.

To ensure contactability, you still have to test your module once with the Purocoat 17/02 coating to rule out rare eventualities.

The following connections can generally be problematic:

- Elastometric connector
- Rubber key pads
- Edge card connectors

Repairability and re-coating

Coatings with Purocoat 17/02 can be soldered through without any problems. The strong heating of the soldering iron partially destroys the coating, the combustion products can be slightly toxic. Always use a suction device when soldering through.

To apply a new coating with Purocoat, use the same process as for the first coating, but increase the dipping time to at least 60 seconds, ideally 180 seconds. As a result, the existing coating layer dissolves again completely and a completely new, evenly thick coating layer is created when it dries.

Remove Purocoat

The coating is a polymer film and can be easily removed using fluorinated solvents. Purocoat coatings can be removed without leaving any residue by immersion or better by exposition to solvent vapor (ideally with Purosolve 71/00). Purosolve 71/00 evaporates at 61°C. The process is therefore not associated with high temperature stress.

General

Purocoat disposal

Liquid Purocoat 17/02 must be disposed of properly. It must not be discharged into sewage or water. Remnants, Purocoat mixtures without a sufficient fluoropolymer concentration and discharged solvents from the drying zone of the coating systems will be taken back by the supplier. The Purocoat mixtures can always be topped up. A complete replacement is not necessary, the material does not age. This means that there are no large amounts of material to be disposed of. Water from the water separator contaminated with Purocoat or solvents can be disposed of by evaporating it in an open container. Dried up Purocoat can be disposed of with the residual waste.

Packaging and bottles disposal

The packaging and bottles are recyclable. Please dispose of the outer cardboard packaging with the waste paper and the aluminum bottles with the aluminum or non-ferrous metal scrap.

Please note that Puretecs cannot refill the bottles. Unfortunately, the return transport, checking and rinsing of the bottles is uneconomical. However, the bottles can be used to store Purocoat 17/02 at a later date, e.g. when a machine is emptied.

Safe handling of the material

Before using the material Purocoat 17/02 electronics surface coating and Purosolve 71/00 solvent, please read the relevant current safety data sheet. Follow all precautionary information given there.

Before using the material, please make sure that it is suitable for your intended purpose.

Containers and storage

Name	Content	Amount (calibrated according to mass)
Purocoat 17/02	2% Fluoropolymer solvent	1kg / 658ml / Aluminum security bottle
Purocoat 17/02	2% Fluoropolymer solvent	7kg / 4.605ml / Aluminum security bottle
Purocoat 17/02	2% Fluoropolymer solvent	15kg / 9.868ml / Aluminum security bottle
Purocoat 17/10	10% Fluoropolymer concentrate	1kg / 658ml / Aluminum security bottle
Purocoat 17/10	10% Fluoropolymer concentrate	7kg / 4.605ml / Aluminum security bottle
Purocoat 17/10	10% Fluoropolymer concentrate	15kg / 9.868ml / Aluminum security bottle
Purosolve 71/00	0% pure HFE solvent	1kg / 658ml / Aluminum security bottle
Purosolve 71/00	0% pure HFE solvent	7kg / 4.605ml / Aluminum security bottle
Purosolve 71/00	0% pure HFE solvent	15kg / 9.868ml / Aluminum security bottle



The bottles can be closed again.
It can be stored in the bottles.
The storage room should be ventilated.
The shelf life of the material is not limited in time.
Avoid heating above 55°C (boiling point).
Purocoat is not flammable!
No dangerous goods storage!

Shelf life of the container: 5 years (because of the seal)
Purocoat 17/02 never has to be completely replaced when applied in dipping bath.

Material performance Purocoat 17/02

	Purocoat 17/02
Surface energy of the dried film	8-12 mN/m
Contact angle	115° (water)
Dielectric strength	59 V/500 nm , 35% RH

Purocoat 17/02 is highly repellent to water and other liquids. This results in a high protective effect.

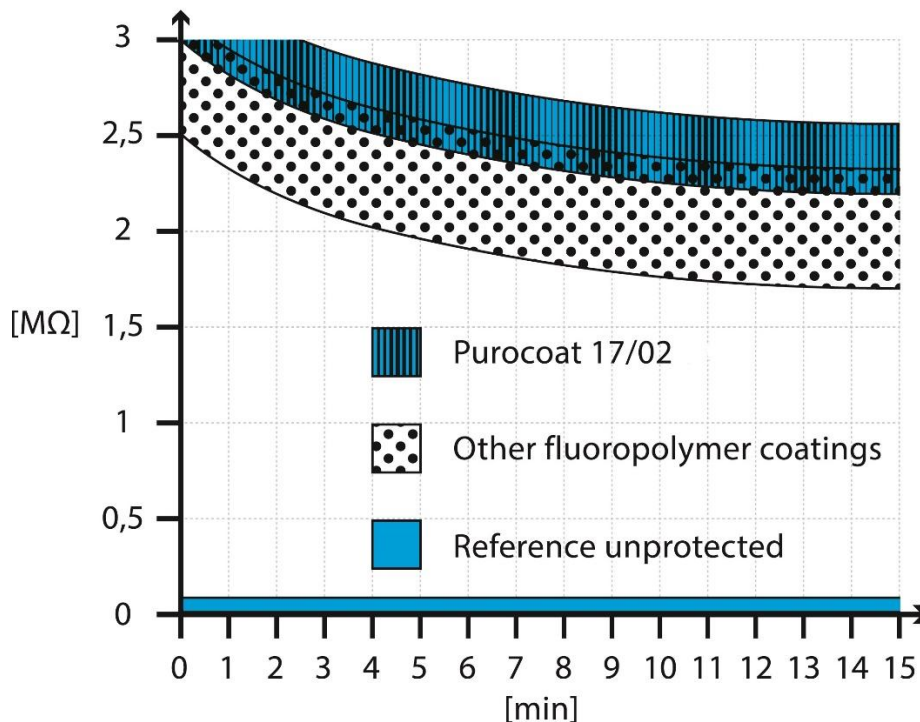
Puretecs drop on board test (PDB Test):



A 0.5 ml drop of drinking water is placed on the comb structure E of the IPC test board with the pipette and the electrical resistance is then measured over a period of 15 minutes.

The measurement is carried out cyclically every 2 seconds with a test voltage of 2.13587V.

The measurement result is a resistance curve that decreases slightly over time. A high value corresponds to a high protective effect.



A good protective behavior is shown for Purocoat especially in comparison to other fluoropolymers. The area marked as "Reference unprotected" shows a board without any protective coating as a reference.

If you have any questions about the material and its processing, please contact:

Puretecs GmbH

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