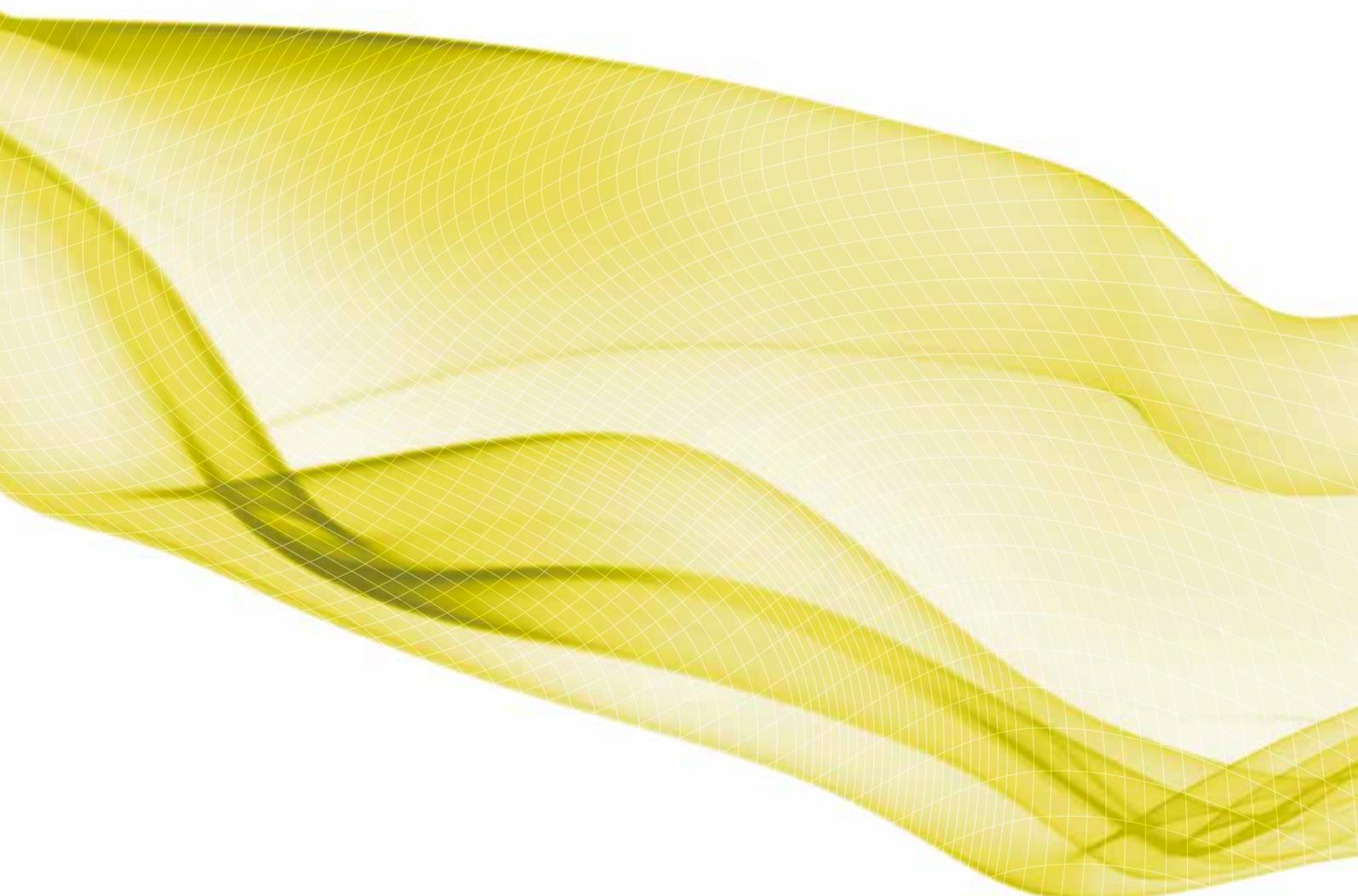


Encapsulation Resins

Meeting the challenge of challenging environments



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Encapsulation Resins



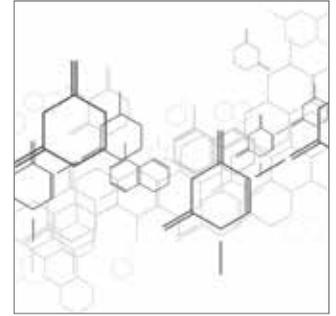
-
- UL approved
 - Potting / encapsulating
 - Sealing and protection
 - Cable jointing
 - Coloured and optically clear
 - Bespoke and ex-stock
-

Resin systems are designed to protect and insulate printed circuit boards (PCBs) and electronic components from the threats of harsh and challenging environments, including; moisture, vibration, thermal or physical shock and general contamination. By encapsulating the entire device, resins can form a complete barrier against such environments offering superior performance under extreme conditions.

Potting and encapsulation resins also offer excellent mechanical protection. Mechanical protection can be identified in a number of ways; superior performance is evident in applications involving prolonged exposure or immersion in harsh chemicals, or those exposed to vibrational, thermal or physical shock, for example. The higher level of protection is achieved through the mass of the resin surrounding the unit. This is different for every application however potting and encapsulating resins always provide a far more substantial covering than that offered by conformal coatings.

Due to the bulk of material surrounding the PCB, potting and encapsulation resins are commonly two-part systems which when mixed together form a solid, fully cured material, with no by-products. In cases where the conditions are not considered extreme, Electrolube offer a range of conformal coatings which provide a combination of protection in humid and corrosive environments with ease of application. They can be used for complete coverage or selective application onto the PCB, thus minimising the weight added as a result of applying a protective material.

Resin Types



The extensive Electrolube product range consists of epoxy, polyurethane and silicone resin systems available for general purpose and customer specific applications. Typically, polyurethanes are used for their flexibility, variable shore hardness and short pot life. In general, epoxy resins are much harder materials, offering superior chemical resistance and physical protection to the polyurethane type. Silicone resins are typically used for high temperature applications and offer excellent protection in extremely harsh conditions.

Epoxy Resins

- Very tough systems
- Easy to apply
- Low coefficient of thermal expansion
- Excellent protection against humidity and harsh chemicals

Polyurethane Resins

- Good flexibility, even at low temperatures
- Ideal for delicate components
- Exceptionally wide range of hardness options available
- Excellent water resistance; formulated products designed specifically for marine applications

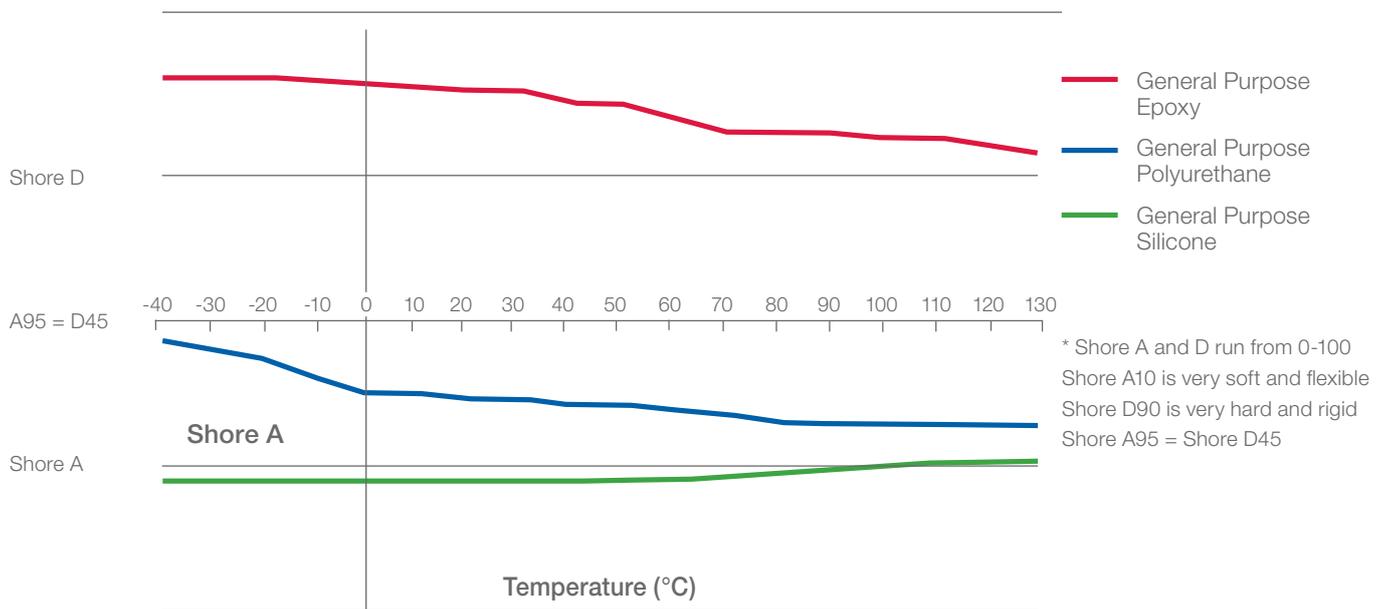
Silicone Resins

- Very wide operating temperature range
- Exceptional performance at high temperatures
- Excellent flexibility
- Optically clear options available, ideal for LED applications

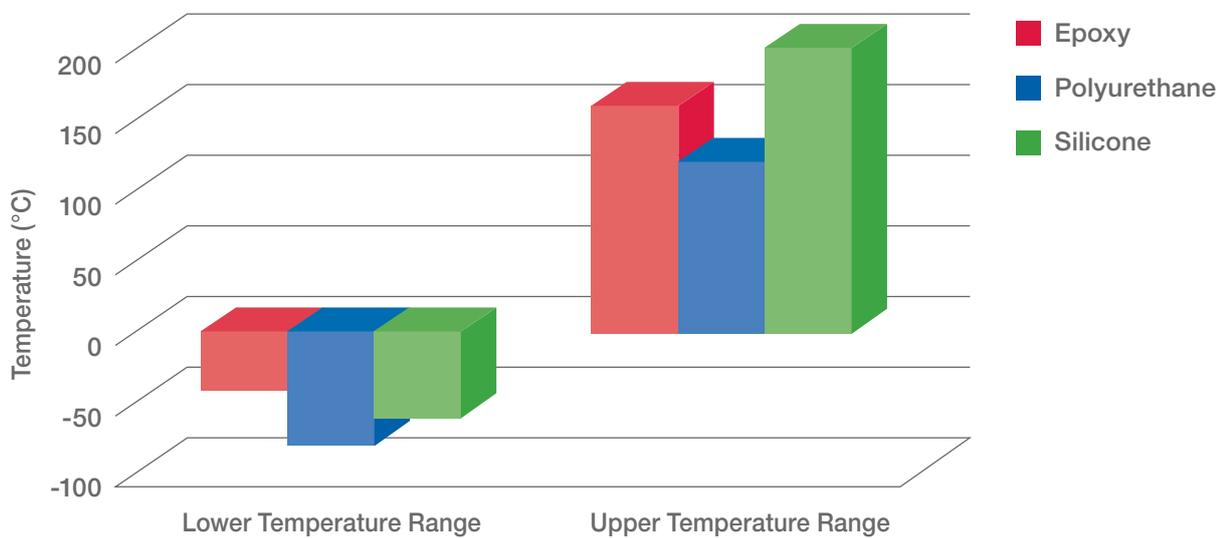
The majority of Electrolube resins are two part systems that when mixed together in the correct ratio, react to form polymeric materials. By careful formulation, the properties of the cured resin can be tailored to meet individual customer requirements. The Electrolube range therefore offers many resins of varying hardness, viscosity and gel time as well as differing electrical and thermal properties. Further products and bespoke materials are available upon request.



Comparison of Shore Hardness vs. Temperature



Comparison of Typical Operating Temperature Ranges



Product Choice



The electronics industry is one of the most rapidly expanding industries to date, with new applications seemingly endless. Printed circuit boards (PCBs) are found in many domestic, industrial, automotive and military devices, to name but a few. In order to ensure reliability of these critical devices it is essential that the PCBs are protected to prevent reduced performance or in the worst case, complete failure.

Electrolube offer a comprehensive range of resins to meet the increasing demands of the electronics industry. Examples of a few applications and suitable product choices are provided as a starting point for selection, however, due to application variances, it is vital that the entire unit is tested in an appropriate environment for its intended end use; this can be exact conditions or carefully planned accelerated testing.

General Purpose Protection

Many applications require the protection level of an encapsulation resin in a general use environment, for example, protection from vibration in standard atmospheric conditions. These applications are diverse however Electrolube offer general purpose resins to fit many such requirements. Example products include:

- ER2188 – General Purpose Epoxy
- UR5604 – General Purpose Polyurethane
- SC2001 – General Purpose Silicone

LED Applications

There are a number of potential requirements for protection compounds within LED applications. Typical examples are optically clear compounds for protecting the LED itself and thermally conductive materials to help dissipate heat away from the LED or unit. With the growth of LED applications there are also a number of other potential requirements for such products, these include UV resistance, colour stability of the resin and minimal colour temperature shift of the LED. Example products include:

- UR5562 – Optically Clear Polyurethane
- SC3001 – Optically Clear Silicone
- ER2220 – Thermally Conductive Epoxy

In addition to offering optically clear systems, Electrolube also offer resins with excellent UV stability. Electrolube have carried out weathering resistance tests on a number of available encapsulation resins. Tests were in accordance with ISO 4892 part 3 cycle 1 'Plastics Methods of Exposure to Laboratory Light Sources' and carried out in a QUV SE Accelerated Weathering Tester. After 1000 hours exposure, the results indicated that Electrolube optically clear polyurethane and silicone resins, UR5562 and SC3001, have superior resistance to UV light, maintaining their clarity throughout the exposure testing. Exposure intensities will vary depending on geographical locations and therefore it is important to establish the correct accelerated exposure time for your region. As an example, this test is roughly equivalent to 4 years weathering resistance in a typical Northern European climate.



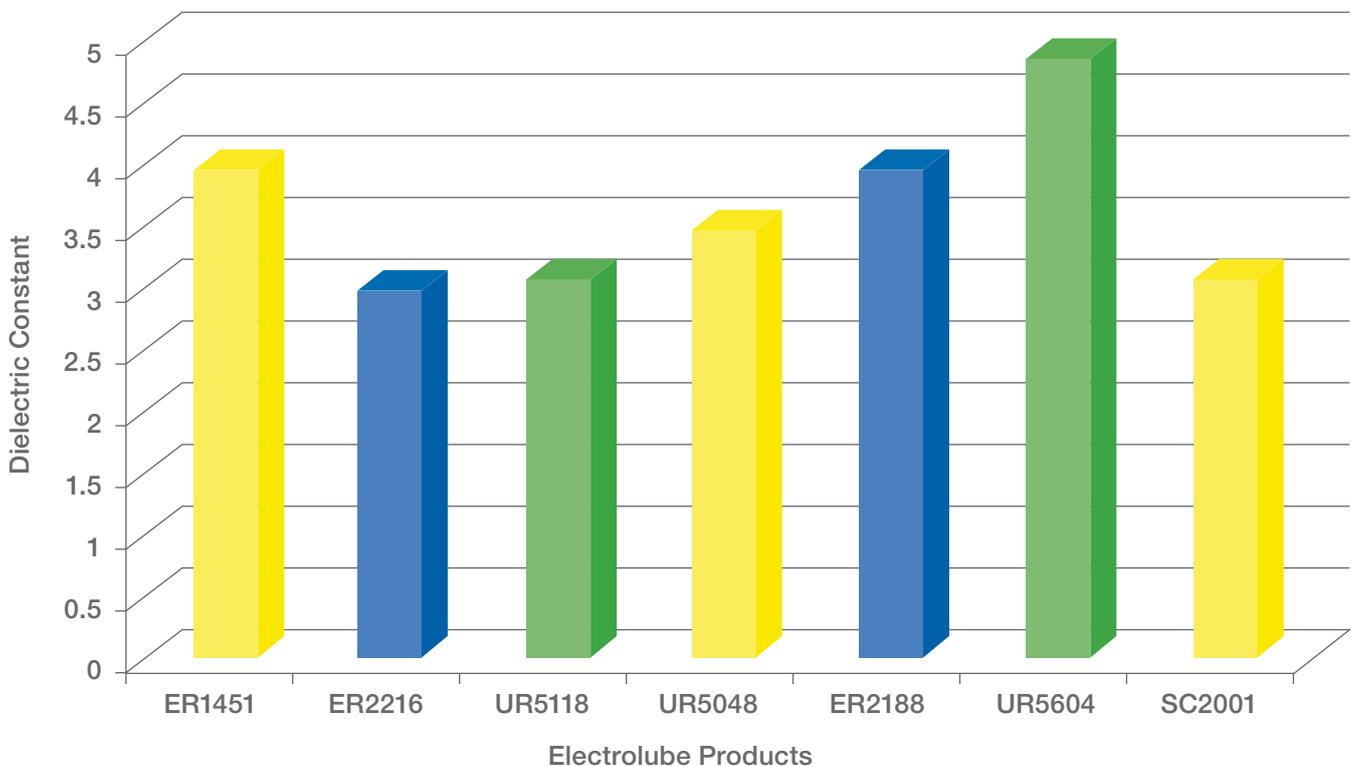
RF Applications

Applications where RF signals are transmitted require encapsulation resins that will not interfere with the information transfer. Such applications are rapidly increasing and the automotive industry is just one example; an increase in intelligent systems has resulted in information being transferring from various sensors positioned on a car to the dashboard display. The key property to refer to in this case is the dielectric constant or permittivity. High frequency devices, for example, would require a low dielectric constant of 3-3.5. These systems may include specialist fillers to obtain the lowest possible value, such fillers can also make the

resin harder to mix and dispense due to the resultant high viscosity, however. Thus, using a specialist formulation and eliminating the fillers to achieve a slightly higher dielectric constant of 4, may result in the best compromise. In any case, it is important to test suggested resins in order to determine the optimum dielectric constant requirement for the application.

- ER1451 – Unfilled Epoxy Resin
- UR5118 – Unfilled Polyurethane Resin
- SC2001 – Silicone Resin

Comparison of Dielectric Constant



Marine Environments



Applications in marine environments require excellent resistance to immersion in salt water; there are often other application requirements that must also be considered, however. Typical applications may include under-water cable jointing, protection of LED lighting on ship decks and protection of various sensor devices. In such cases, clear or coloured resins may be needed and must offer high adhesion and low dielectric constant throughout the lifetime of the device operating in harsh conditions.

- UR5041 – Highly Water Resistant Polyurethane Resin
- UR5083 – Recoverable Polyurethane Gel
- UR5528 – Tough Polyurethane Resin with Excellent Adhesion

Jointing and Adhesive Applications

There are many applications where a high level of adhesion is required, either in terms of bond strength due to potential mechanical forces being applied to the unit or in applications such as cable jointing. Such resins may be directly applied or used in conjunction with a primer. In addition, the surface of the substrate will also affect the adhesion properties of an encapsulation resin; surfaces must be clean and dry and very smooth surfaces will be harder to adhere to. Difficult substrates are those with a very low surface tension, such as PTFE.

- ER1122 – Highly Adhesive Epoxy Resin
- UR5545 – Fast Set Polyurethane Resin
- ER2195 – Flame Retardant Epoxy Resin

Specific Properties



There are also a number of specialist properties that may be required for certain applications. Electrolube offer a range of products to cover a wide variety of requirements, some of which are listed below:

Flame Retardant

A product may be UL94 approved, with V-0 being the highest level of flame retardancy. In addition, Electrolube offer in-house testing to this standard in order to grade non-approved products.

- UL Approved Epoxies – ER2165, ER2188, ER2195
- UL Approved Polyurethanes – UR5044, UR5097, UR5604
- Other UL approved products are also available

Thermally Conductive

Some techniques only measure the sum of the materials' thermal resistance and the material/instrument contact resistance. Electrolube use a version of the heat-flow method that measures both of these values separately, giving a much more accurate bulk thermal conductivity measurement.

- ER2220 – Thermally Conductive Epoxy
- UR5633 – Thermally Conductive Polyurethane
- SC2003 – Thermally Conductive Silicone

Highly Chemically Resistant

Most encapsulation resins in the Electrolube Range will offer protection against short-term exposure to chemicals such as solvents, oils and fuels. In some cases, this exposure may be frequent or for longer periods of time and in this case, specialist materials are needed.

- ER2162 – Chemically Resistant Epoxy
- UR5528 – Tough Polyurethane Resin
- SC2001 – General Purpose Silicone

Very Soft/Re-workable

An encapsulation resin may need to have an extremely low hardness to maintain flexibility at low temperatures, for example. This is particularly critical where devices have sensitive components and may frequently be exposed to rapid changes in temperature. In addition, some devices may need to be reworked; in general encapsulation resins can be difficult to remove however specialist formulations may offer the opportunity to rework by cutting the bulk of resin out of the unit.

- UR5048 – Ultra Soft Polyurethane Resin
- UR5044 – UL Approved, Re-workable Polyurethane
- SC2001 – Soft Silicone Resin

Single-Part Systems

In some cases, it may be more effective to use a single-part system and cure using heat. Applications include 'glob-top', where a select component or area of a PCB is protected with a resin as opposed to encapsulating the entire unit.

- ER2136 – Single-Part Epoxy Resin
- GLR – Single-Part Glob-Top Resin
- ER2219 – Single-Part Flame Retardant Epoxy Resin

Application Considerations



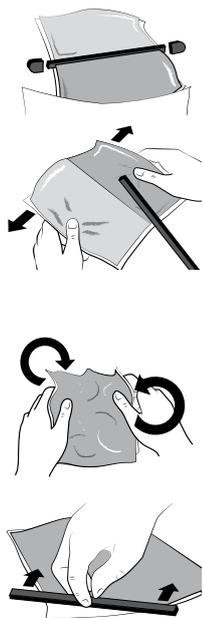
Prior to the application of encapsulation resins it is important to consider what contaminants may be present on the PCB or device. In a 'no-clean' process for example, the residues left on the PCB will be non-corrosive however there may be other possible sources of contamination. Any potentially harmful contaminants left on the PCB before encapsulating with a resin material can result in failure of the device. In addition, some residues may cause issues with adhesion of the encapsulation resin to the PCB or outer casing, in turn, reducing the protection level offered.

Electrolube also offer a range of water and solvent-based cleaning products to ensure all corrosive residues are removed from the printed circuit board prior to any other process. Electrolube therefore offers superior technical support in ensuring the correct application parameters are identified. Please contact us for further information where required.

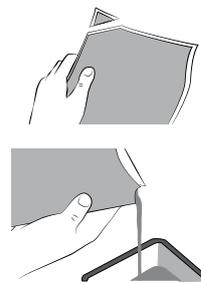
The majority of encapsulation resins are two part systems, therefore both the mixing and dispensing process needs to be considered in order to ensure successful application. Both manual and automatic processes are possible for all resin types and cure times may be reduced by using elevated temperatures.

Manual Processes

Electrolube encapsulation resins are available in resin packs;



1. A pre-weighed pack containing the correct amount of each component, separated by a clip.
2. The resin and hardener are mixed by removing the clip and mixing the contents. To remove the clip, remove both end caps, grip each end of the pack and pull apart gently.
3. Mix the contents by moving them around inside the pack until thoroughly mixed.
4. Using the removed clip, take special care to push unmixed material from the corners of the pack. Mixing normally takes from two to four minutes depending on the skill of the operator and the size of the pack. Both the resin and hardener are evacuated prior to packing so the system is ready for use immediately after mixing.



5. The corner may be cut from the pack so that it may be used as a simple dispenser.

NOTE:

It is important not to remove the aluminium outer wrapping on polyurethane resins until immediately before use; leaving out of the aluminium outer will lead to moisture ingress and insufficient cure when mixed. To open, cut the aluminium outer being very careful not to damage the inner pack; discard the molecular sieve sachets. When mixing the pack, ensure all surfaces are clean and the pack is mixed thoroughly but gently; pack defects from mixing include split and pin hole formation which again lead to moisture ingress, resulting in air bubbles and insufficient cure.

Application Considerations



Bulk Mixing

When mixing, care must be taken to avoid the introduction of excessive amounts of air. Automatic mixing equipment is available which will not only mix both the resin and hardener accurately in the correct ratio but do this without introducing air. Containers of Part A (Resin) and Part B (Hardener) should be kept sealed at all times when not in use to prevent the ingress of moisture. Bulk material must be thoroughly

mixed before use. Incomplete mixing will result in erratic or partial curing. Electrolube work closely with equipment suppliers to ensure the correct selection of equipment and accessories is obtained; it is possible to heat tanks to reduce viscosity, add molecular sieve towers to ensure moisture ingress is kept to a minimum and stirrers to eliminate the problems associated with sedimentation of filled systems.

Curing

Do not heat cure large volumes immediately, they should be allowed to gel at room temperature first. Depending on the product, elevated temperatures can be used to reduce cure times; product data sheets should be consulted for specific information. Encapsulation resins generate a small amount of heat

during the curing process; this is often below 35°C however some materials may exhibit higher exotherm values. The exotherm therefore must be considered to ensure compatibility with all components and to avoid excessive heat generation when considering heat curing.

Important Considerations

It is essential that the inclusion of air during mixing and potting of encapsulation resins is kept to an absolute minimum. In the case of epoxy resins, the introduction of air can lead to voids in the potting compound, thus affecting the protection level offered and creating potential problems with differences in coefficients of thermal expansion.

Polyurethane resins are susceptible to moisture due to the hardener. Typically, polyurethane resins are cured using isocyanates, which will prefer a reaction with moisture over a reaction with the resin. In this case, if moisture ingress has occurred then bubbles will form in the resin following the release of carbon dioxide, possibly resulting in insufficient cure, leaving a soft or tacky resin. It is therefore important to ensure that containers are kept closed at all times when not in use, that molecular sieve towers are fitted to automated

equipment and regularly monitored and finally, that the relative humidity of the mixing, dispensing and curing environments is monitored and ideally kept below 70%.

Silicone resins can be affected by certain materials, chemicals, curing agents or plasticizers for example. These can inhibit the cure of silicone encapsulants and therefore all preparation surfaces and equipment must be kept clean and contact with the following avoided:

- Organotin and other organometallic compounds
- Silicone rubber containing organotin catalyst
- Sulphur, polysulphides, polysulphones or other sulphur containing materials
- Amines, urethanes or amine-containing materials
- Unsaturated hydrocarbon plasticisers
- Some solder flux residues

The Product Range

Epoxy Resins

ER1122 (Clear Amber)

- Excellent adhesion to a wide variety of substrates
- Mix ratio can be altered to vary flexibility
- Good electrical properties
- Can be used as an adhesive or encapsulant

ER1426 (Water white)

- Excellent clarity
- Very low viscosity
- Long useable life
- Ideal for impregnation applications

ER1451 (Clear) and ER1450 (White)

- High water resistance
- Excellent adhesive properties
- Low dielectric constant
- Very low viscosity

ER2162 (Black)

- Exceptional chemical resistance
- Ideal for applications where frequent immersion in fuels may occur
- Good electrical properties
- Flame retardant

ER2183 (Black)

- Good thermal conductivity
- Low viscosity alternative to ER2220
- Enhanced machine mixing and dispensing
- Good all round protection

ER2188 (Black)

- Flame retardant - certified to UL94 V-0
- General purpose potting resin
- Excellent all round protection
- High hardness material

ER2195 (Black)

- Flame retardant - certified to UL94 V-0
- Tough resin with increased durability
- Excellent thermal shock resistance
- For transformers, large castings, rotor arm sealing, pyrotechnical cables, diesel sensors and other automotive applications

ER2218 (Black)

- Low viscosity
- Flame retardant, meets UL94 V-0
- Excellent high temperature stability
- Ideal for applications involving thermal cycling or extreme temperatures for short periods of time, such as reflow applications

ER2219 (Black)

- Single-part epoxy
- Flame retardant
- Heat cure product
- Suitable for dipping and glob-top

ER2220 (Grey)

- Excellent thermal conductivity
- Flame retardant
- No abrasive fillers
- For potting PCBs, power supplies, converters and temperature sensors

Silicone Resins

SC2001 (Dark Grey)

- General purpose silicone resin
- Exceptional flexibility
- Good chemical and water resistance
- Flame retardant

SC2001FD (Dark Grey)

- Fast cure version of SC2001
- Good chemical and water resistance
- Exceptionally wide operating temperature range
- Flame retardant

SC2003 (Dark Grey)

- Highly thixotropic two part potting compound
- A 1:1 ratio for ease of processing
- Flame retardant
- High thermal conductivity

SC3001 (Optically Clear)

- Optically clear, two-part potting compound
- Suitable for use in LED applications or where high level of clarity is required
- Offers exceptional protection for electronics
- Low viscosity – easy to apply even in thin films

Polyurethane Resins

UR5041 (Black)

- Excellent resistance to sea water
- High toughness and tear resistance
- Good adhesion to most substrates
- Properties retained at temperatures down to -60°C

UR5044 (Dark Blue)

- Flame retardant, certified to UL94 V-0
- Soft, re-workable resin
- Flexible even at temperature extremes
- Ideal for prototype circuitry, silicone replacement, and control units

UR5048 (Clear Straw)

- Low viscosity and very low hardness
- Transparent – clear to allow fast fault finding
- Low embedment stress
- Ideal for protecting delicate components from mechanical and thermal shock

UR5083 (Clear Straw)

- Self-healing polyurethane gel
- Low viscosity
- Excellent water resistance
- Ideal for underwater cable jointing

UR5097 (Black)

- Flame retardant, certified to UL94 V-0
- High thermal conductivity
- Low water absorption
- Excellent electrical properties

UR5118 (Black)

- Excellent electrical properties
- Low dielectric constant
- Excellent resistance to sea water
- Very low viscosity

UR5528 (Black)

- Durable with a high degree of toughness
- Excellent adhesion to a wide variety of substrates
- Low viscosity allowing ease of application
- Excellent resistance to acids, alkalis and other aqueous materials

UR5545 (Black)

- Fast-cure system
- Tough, resilient polyurethane resin
- Low viscosity
- Suitable for cable jointing applications

UR5547 (Black) or (UR5581) White

- Semi rigid, flame retardant casting resin
- Water and impact resistant
- Excellent adhesion to a wide variety of substrates
- Ideal for use in potting or cable jointing applications

UR5562 (Optically Clear)

- Water white transparency, ideal for potting LEDs
- Excellent resistance to yellowing when exposed to UV light
- Excellent scratch and mark resistance
- High resistance to weather, acids and alkalis, water and mould growth

UR5604 (Black)

- Flame retardant, certified to UL94 V-0
- Low mixed system viscosity
- Excellent adhesion to a wide variety of substrates
- Good thermal conductivity

UR5608 (Black) or UR5623 (White)

- Flame retardant, certified to UL94 V-0
- Semi-rigid polyurethane resin with exceptional toughness
- Excellent adhesion and chemical resistance
- Fast cure version available

UR5633 (Black)

- Exceptionally high thermal conductivity
- Excellent electrical properties
- Very low water absorption
- Flame retardant

Electrolube also offer an extensive range of bespoke resins, please contact us for further information

Associated Products



OP9020 – Machine and Resin Remover

- Solvent cleaner for general machine maintenance
- Removes epoxy and polyurethane resin in the uncured state
- Fast evaporating
- Does not contain methylene chloride



RST – Resin Stop

- Provides a non-stick coating, excellent for jigs, etc.
- Silicone free
- Dry film – eliminates unwanted transfer
- Reduces the frequency to clean mould tools etc.



PCM – Peelable Coating Mask

- Flexible latex for masking components
- Manual removal, leaving no residue
- Dries at room temperature
- High film strength, does not break easily



The Safewash Range

- Water-based cleaning products for use before encapsulation
- Efficient removal of all flux residues
- Products available for ultrasonic, spray under immersion and dishwasher application
- Products available for stencil cleaning and uncured adhesive removal



PCS – Peelable Coating Mask Synthetic

- Thermal cure
- Ammonia free – no odour
- Manual removal, leaving no residue
- High film strength



ULS – Ultrasolve Cleaning Solvent

- Excellent degreasing properties
- Fast evaporation
- Compatible with most plastics, rubbers and elastomers
- Available in bulk, aerosol and aerosol brush version



RRS – Resin Remover Solvent

- Blend of solvents designed to soften and dissolve cured resins
- Will enable removal of epoxy, polyurethane and other resins from substrates
- Can be used on containers, tools and jigs for example
- Does not contain methylene chloride

Polyurethane Resins

	UR5041	UR5048	UR5044	UR5528	UR5562	UR5633	UR5604
<i>Specialist Property</i>	Water Resistance	Soft, Low Stress	Soft, Re-enterable	Tough, High Adhesion	Optically Clear	Thermally Conductive	Tough, Flexible
Colour (Mixed System)	Black	Clear Amber	Dark Blue	Black	Water White	Black	Black
Cured Density (g/ml)	1.18	0.95	1.49	1.07	1.02	1.65	1.54
Mixed System Viscosity (mPa s @ 23°C)	2500	980	3400	2000	300	30000	2000
Mix Ratio by Weight (by Volume)	3.6:1 (3.9:1)	14:1 (19:1)	13.4:1 (20:1)	2.4:1 (2.9:1)	2.2:1 (2.3:1)	12.2:1 (8.8:1)	5.2:1 (3.9:1)
Usable Life (Minutes @ 23°C)	20	20	25	20	17	15	40
Gel Time (Minutes @ 23°C)	60	40	40	35	22	40	90
Cure Time (Hours @ 23°C/60°C)	24/4	24/4	24/3	24/5	24/4	24/4	24/3
Shore Hardness	A85	A12	A40	D57	A95	A90	A75
Thermal Conductivity (W/m.K)	0.25	0.20	0.25	0.25	0.20	1.24	0.45
Temperature Range (°C)	-60 to +125	-60 to +100	-60 to +120	-50 to +125	-40 to +120	-50 to +125	-40 to +130
Maximum Temperature - Short Term (°C)	+130	+100	+130	+130	+130	+130	+155
Dielectric Strength (kV/mm)	20	18	18	25	11	18	18
Volume Resistivity (Ω-cm)	10 ¹⁵	10 ¹⁴	10 ¹⁰	10 ¹⁴	10 ¹⁴	10 ¹⁴	10 ¹⁴
Flame Retardancy Level	-	-	V-0	-	-	V-0	V-0
UL94 Approval	No	No	Yes	No	No	No	Yes
RoHS Compliant	Yes	Yes	Yes	Yes	Yes	Yes	Yes

For exact calculated ratios please see the technical data sheet.

Epoxy Resin

	ER2188	ER2220	ER2183	ER2218	ER1426	ER1450	ER1122
<i>Specialist Property</i>	General Purpose	High Thermal Conductivity	Low Viscosity, Thermally Conductive	High Temperature Stability	Optically Clear	Very Low Viscosity	Excellent Adhesion
Colour (Mixed System)	Black	Grey	Black	Black	Water white	White	Clear Amber
Cured Density (g/ml)	1.69	2.22	1.95	1.16	1.05	1.10	1.05
Mixed System Viscosity (mPa s @ 23°C)	9000	15000	5000	500	100	250	12000
Mix Ratio by Weight (by Volume)	11:1 (5.5:1)	2.8:1 (8.2:1)	12.8:1 (5.6:1)	3.6:1 (2.8:1)	4:1 (3.4:1)	2.5:1 (2.2:1)	1:1 (0.8:1)
Usable Life (Minutes @ 23°C)	60	120	120	40	120	15	90
Gel Time (@ 23°C)	2.5 hrs	3.0 hrs	7.0 hrs	50 mins	4.0 hrs	30 mins	4 hours
Cure Time (Hours @ 23°C/60°C)	24/2	24/4	24/4	24/4	36/8	12/2	48/4
Thermal Conductivity (W/m.K)	0.91	1.54	1.10	0.28	0.20	0.20	0.20
Temperature Range (°C)	-40 to +120	-40 to +130	-40 to +130	-50 to +150	-40 to +120	-50 to +130	-40 to +120
Maximum Temperature – Short Term (°C)	+140	+150	+150	+245	+130	+150	+140
Dielectric Strength (kV/mm)	10	10	10	10	10	10	12
Volume Resistivity (Ω-cm)	10 ¹⁴	10 ¹⁵	10 ¹⁵	10 ¹⁴	10 ¹⁴	10 ¹⁵	10 ¹⁴
Shore Hardness	D85	D90	D90	D55	D85	D50	D80
Flame Retardancy Level	V-0	V-0	V-0	V-0	-	-	-
UL94 Approval	Yes	No	No	No	No	No	No
RoHS Compliant	Yes	Yes	Yes	Yes	Yes	Yes	Yes

For exact calculated ratios please see the technical data sheet.

Silicone Compounds

	SC2001	SC2001FD	SC2003	SC3001
<i>Specialist Property</i>	High Temperature Resistance	Fast Cure	Thixotropic	Optically Clear
Colour (Mixed System)	Dark Grey	Dark Grey	Dark Grey	Optically Clear
Cured Density (g/ml)	1.40	1.15	1.60	1.04
Mixed System Viscosity (mPa s @ 23°C)	3500	1800	30000	1800
Mix Ratio by Weight (by Volume)	1:1 (1:1)	1:1 (1:1)	1:1 (1:1)	13:1 (12:1)
Usable Life (Minutes @ 23°C)	30	4	40	30*
Gel Time (Minutes @ 23°C)	60	8	80	180*
Cure Time (Hours @ 23°C)	24	4	24	24*
Shore Hardness	A50	A40	A50	A20
Thermal Conductivity (W/m.K)	0.6	0.4	0.8	0.2
Temperature Range (°C)	-50 to +200	-45 to +200	-60 to +200	-60 to +200
Maximum Temperature - Short Term (°C)	+225	+225	+225	+250
Dielectric Strength (kV/mm)	20	21	20	-
Volume Resistivity (Ω-cm)	10 ¹⁵	10 ¹⁵	10 ¹⁵	10 ¹⁴
Flame Retardancy Level	V-0	V-0	V-0	HB
UL94 Approval	No	No	No	No
RoHS Compliant	Yes	Yes	Yes	Yes

*Cure times will be dependent on ambient humidity.
For exact calculated ratios please see the technical data sheet.

ELECTROLUBE

THE SOLUTIONS PEOPLE

China Headquarters / Manufacturing

Building No2, Mauhwa Industrial Park,
Caida 3rd Street, Caiyuan Industrial Zone,
Nancai Township, Shunyi District
Beijing, 101300
Peoples Republic of China

T +86 (10) 89475123
F +86 (10) 89475123
E info@electrolube.co.uk

www.electrolube.com

UK Headquarters / Manufacturing

Ashby Park
Coalfield Way
Ashby de la Zouch
Leicestershire
LE65 1JR
United Kingdom

T +44 (0)1530 419600
F +44 (0)1530 416640
E info@electrolube.co.uk

www.electrolube.com

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