TECHNICAL DATA SHEET

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3MG.002
Epoxy Adhesives

Summary

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Overview

Final Advanced Materials and its partner, Cotronics, offer a range of high temperature epoxy adhesives. They have specially formulated to ensure high-performance bonding for critical applications subjected to extreme conditions.

These special, high-performance adhesives differ from each other by:

- Their number of components (one or two)
- Their potential added filler
- Their curing (at room temperature or by applying heat)

Manufacture

During chemical hardening, curing reactions produce an insoluble and infusible compound thanks to its three-dimensional molecular structure. The hardeners used are:

- Amines: for curing at room temperature
- Acid anhydrides: for curing at high temperature
- BF amino acid complex: for one-component products

It is essential to adhere to the exact mix ratios as the reactions are stoichiometric.

Fillers can be added to the adhesive to vary certain behaviours, such as thermal or electrical conductivity or mechanical strength. For example: products filled with silver are conductors; products filled with aluminium oxide and conduct heat isolate electrical currents.

General Characteristics

Selection criteria according to the adhesive category

The choice of epoxy adhesive depends on specific and essential criteria:

- Final application (series, prototyping, single application, etc.)
- Temperatures to withstand (minimum, peak, max. operating)
- Thermal shock resistance:
  - How long does the adhesive take to go from one temperature extreme to another?
  - What is the frequency of this thermal cycle?
  - Is there any quenching (air, water, oil, etc.)?
- Required level of thermal conductivity
- Required level of dielectric strength
- Acceptable level of thermal expansion
- Chemical environment (vapour, liquid, contaminant, etc.)
- Mechanical constraints (compression, vibration, shock, etc.)
- Electrical constraints
- Surrounding environment (humidity, vacuum, etc.)
- Possible application conditions
- Thermal expansion coefficient of elements in contact
- Type of curing (maximum temperature)

Adhesion

The characteristics of the bonding surface will prove crucial for obtaining the best adhesion. They are defined by the structure of the surface finish and any residual impurities. Generally, the substrate will need to be machined or sanded to obtain a slight roughness and allow the ceramic cements to bond to it.

Thickness of the adhesive layer

At operating temperature, the space between two assembled parts should be between 0.05 and 0.2 mm. If a layer is too thin, it prevents an even distribution of the adhesive; a layer that is too thick could lead to cohesive failures in the mass of the adhesive.

One and two components

Two-component adhesives keep for longer at room temperature. In general, they have superior mechanical properties and offer a wide range of thermal properties.

One-component adhesives are supplied ready for use. However, their consistency (viscosity, thixotropy) slowly changes during storage at room temperature.

A two-component product can be mixed at the time of production, but it must be immediately stored at -40 °C until its expiry date (approximately 1 year).

Pot life

The pot life is the optimal use time of an epoxy adhesive once it has been mixed. The material can be used without any risk of impairing its application process.

In the case of a one-component adhesive, the pot life and storage time are identical. At the outset, certain adhesives partially evaporate and lead to a slight variation in viscosity and thixotropy.

The pot life is passed when the adhesive can no longer be used (measured, weighed, etc.) safely. The preparation and application techniques also affect the possibilities of using an adhesive at its optimal viscosity. Therefore, the pot life does not depend only on the adhesive and its composition, but also on the techniques employed for its use.

These parameters can alter the pot life at room temperature from one hour to one day. The pot lives indicated should there only be used as reference values. In addition, the viscosity of the products can double without presenting a problem with respect to using the product.

The pot life at room temperature of two-component products ranges from a few hours to one day. However, cooling is not recommended at the components could crystallise.

Temperature ranges

Epoxy and polyamide adhesives are organic mixtures that break down and evaporate at high temperature.

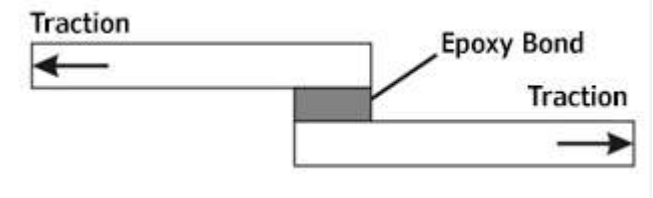
Operating temperature

The maximum operating temperature results in a 2 % weight per 24-hour stretch. Exceeding this temperature reduces the hardness and bond strength of the adhesives. If the bonding is to remain stable for one year and retain all of its properties, it should remain 20 to 80 °C below.

Limit temperature before deformation

The limit temperature before deformation is less than the peak temperature. It provides a reference point in order to anticipate the mechanical deformation of the adhesive.

Tearing strength



Two plates bonded together are subject to traction parallel to their planes until the assembly ruptures. The tearing strength is the maximum force value according to the thickness of the bonding.

Retention of moisture

Moisture resistance indicates the propensity of the cured adhesive to capture water. It allows you to compare the behaviour of different materials in the presence of moisture. This value is measured based on the variation in weight of the adhesive immersed directly in water for a given period of time at a constant temperature.

Consistency

The consistency of epoxides varies from liquid to solid, and from stable, very viscous or thixotropic. In non-filled adhesives, their viscosity indicates their tendency to flow.

For example:

- Water.....1.7 cP
- Glycerine .....1,499 to 1,700 cP
- Oil.....300 to 3,000 cP
- Epoxide.....600 to 50,000 cP

In the case of filled adhesives, this indication is a bit more delicate as the filler increases or reduces the thixotropy to make them paste-like. These thixotropic products exhibit a stable form at rest but become viscous when agitated (movements, decrease in volume). The consistency of filled adhesives is defined according to a type scale: low, medium or high (paste-like consistency) viscosity.

Filler

Thermally conductive adhesives

Epoxy adhesives can be filled with aluminium oxide (the most common), silver, nickel or aluminium. This represents between 60 and 75 % of the weight of the adhesive. A metal filler confers a better thermal conductivity but means that the product can no longer be qualified as an electrical insulator. The choice of filler is determined based on the overall thermal resistance of the assembly and not just the thermal conductivity of the epoxy.

Adhesives with no added filler

Epoxy adhesives with no added filler have a wide range of applications, in particular bonding glass, fibre optics etc.

These bonds retract in heat, causing a loss of volume that can cause strains and tears. The intensity of the strains essentially depends on the type of adhesive used. Ideally, it should not contain any solvents to maintain retraction of less than 1 %). For very thin layers, total peeling can occur during curing.

Selection

Numerous factors need to be taken into account when selecting an epoxy adhesive, but the main things to consider are:

Application technique

These initial criteria help identify the quantities to order and stock, as well as the consistency, viscosity and even the cure cycle.

Considerations: intended application, work rate, maximum recommended temperature of the other parts during curing, etc.

Particular specifications related to the end use

The final choice is often a compromise between all of these requirements.

Considerations: thermal and electrical conductivity, temperatures, mechanical resistance, resistance to moisture, thermal shocks, optical properties, contact materials, etc.

Preparation

Preparation of the adhesive

The epoxide should be mixed prior to application. If there are two components, we advise mixing each of these components individually. Care must be taken to ensure that neither prior agitation nor mixing introduce too many air bubbles, however small they may be.

Heating the adhesive to between 35 and 50 °C significantly reduces its viscosity (it behaves like an engine oil), which can facilitate mixing and kneading. It should be kept in mind that this reduces the pot life and therefore it is important to work quickly in this case.

Surface preparation

Surfaces should be cleaned of all bond residues, dust, traces of oil, grease and dirt before bonding. For oil and grease, the best results are obtained with organic solvents such as acetone, ethanol, MEC (methylethylcetone).

Cleaning the surfaces improves the adhesion of the adhesive. The adhesive generally adheres well to metals (with the exception of chromium and titanium), ceramics and synthetic materials. Among these, it may be necessary, for polyolefins or PTFE-based materials, to allow for an initial impregnation. For example, you can use a mixture of oxygen and sulphur hexafluoride.

Curing

The cure cycle is a set of temperature stages that an adhesive must follow to ensure optimal curing. Different stages combinations are available for each product according to their applications and equipment (air heating, convection oven, heating plate, etc.).

Briefly heating at high temperature ensures complete curing and provides the best resistance to water, gases and other fluids. For conductive adhesives (electricity or heat), these same procedures produce the lowest possible resistances. However, this method of hardening makes the adhesives more brittle.

Conversely, curing using lower temperatures and longer heating times optimises the flexibility and endurance of the adhesive faced with thermomechanical stresses.

The best technique involves progressive hardening which takes time. The results obtained are excellent, even as an initial approach, and regardless of the intended application. This process, suggested on the packaging, represents the best possible first test. The suggested curing stages can be considerably reduced in many industrial applications.

The time/temperature stages indicated should therefore be regarded as suggestions. Variations in heating conditions lead to changes in the properties of the cured product. The optimal curing conditions depend on the intended application, and they are discovered empirically.

The link between the curing time and temperature is by nature exponential: at around 100 °C, lowering the temperature by 10 °C doubles the curing time required to obtain an identical result. Increasing the temperature by 10 °C halves the time.

N.B. : You can never do too much curing!

Heat curing should always start in a cold oven and the temperature should be gradually increased.

Bond removal and repair

Dismantle an assembly:

- With heat
- With mechanical action
- With a special solvent (dichloromethane)

Repairing a bond:

- The most commonly used method is heat:
  - Direct a stream of hot air directly onto the area to repair.
  - This localised heating does not damage the other parts and can be carried out up to 350 °C.

Complete replacement:

- Replace the bond and cure it via local heating

Cleaning

Cleaning tools stained with uncured resin is done using:

- Acetone
- MEK (Methyl-Ethyl-Ketone)

For cured parts, heat, abrasion, and mechanical force will help remove the product.

Specific instructions for refrigerated adhesives

Storage

- A temperature of -40 °C must be maintained!

Warming up

- Open the cartridges before letting them come up to room temperature.
- Condensation water must be kept away from the openings.
- Under no circumstances should the adhesive be refrigerated again!

Delivery

- Cold is guaranteed by the dry ice (-78 °C). At least one kilogram of dry ice should still be present on receipt.
- The adhesive and dry ice should be handled with gloves; direct contact with water or other solvents could destroy the adhesive.

Implementation Guidelines

Epoxy adhesives are most commonly used in the form of thixotropic paste, or to create thinner, liquid adhesive structures. The main techniques for use are as follows:

Serigraphy

- Place the substrate 0.5 – 1 mm underneath the screen.
- Pass the adhesive through a nylon or steel screen using a scraper.
- The underside of the screen acts as a stencil: the grains of adhesive only fill the free spaces.

Adhesives with filler will require the use of a screen with a mesh size of between 70 and 128 links/cm. The choice depends on the grain size of the epoxide used.

Pad printing

The adhesive is applied in several different locations to create a network for assembling parts. The size of the pad is adapted according to the shape of the assembly in order to obtain a perfect bond.

This extremely accurate technique enables production rates of 600 to 800 parts per hour, even when performed manually. Epoxy adhesives are specifically designed so that their

thixotropy and viscosity are suitable for this technique. It is essential that no filament forms caused by stretching if the pad is far away from the adhesive.

Compressed air dosing

- Use a cartridge fitted with a dosing syringe at the end.
- Place a very small amount of adhesive (for example 5 cm^3) in the cartridge.
- Control the volume, flow rate and pressure with the compressed air system.

This technique is used to obtain exact dosing of the amount of adhesive expelled. It is used for manual or automated dosing.

Spatula method

- Apply the adhesive by hand onto the bonding surface using a spatula.

Although imprecise, this method is useful for research, the production of all small series or repairs.

Centrifugation

- Place the part (disc) on a rotating cylinder: the vacuum creates the adhesion.
- Apply the adhesive while the cylinder is rotating at high speed for an even application thanks to the centrifugal force.

Centrifugation is used to coat disk-shaped parts very evenly.

Storage

Two-component

- Maintain the temperature between 20 and 25 °C.
- Keep the packaging closed (volatile compounds)

If these conditions are met, the products will have a shelf life of 6 months, often longer. An adhesive can be used for as long as it can be worked with.

One-component

One-component epoxy adhesives have a 6-month shelf life. However, their shelf life can be considerably extended if they are stored in the fridge at between 2 and 7 °C. They should then be taken out and kept in their sealed packaging at least one day before they are used.

Note: condensation on the lid should be monitored as it can lead to the destruction of the epoxide.

Safety

The legal information and safety guidelines are provided in the safety data sheets available to you.

Avoid contact with the skin. Wear gloves at all times.

In case of contact with the skin:
NEVER clean adhesive on the skin with an organic solvent.
Any contact with adhesive or organic solvent can cause irritation to the skin.

Use soap and water to clean the skin, or, failing that, special hand wash pastes.

Product Range

Electrically conductive adhesives

Duralco™ 120-122-124 – 125-127

The combination of Cotronics adhesives and filled hardeners makes it possible to obtain the electrical conductivity required for certain applications.

General properties

- Electrical conductors
- Excellent resistance to chemicals and solvents

General applications

- Bonding on glass, ceramics, metals and plastics
- Solder replacement in electronics
- Attaching transistors
- Circuit board repair
- Tacking conductor tracks

General implementation

- Cures at room temperature
- Heat curing (accelerated curing) at 120 °C or above

Duralco™ 120

Properties

- Filler: active silver powder, ultra-fine particles
- Operating temperature: -30 to +260 °C

Implementation

- Curing: 24 hours at room temperature
- Post-curing: 1 hour at 120 °C

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Duralco™ 122

Properties

- Filler: nickel
- Max. operating temperature: 260 °C
- Economical

Implementation

- Curing: 24 hours at room temperature
- Post-curing: 24 hours at 120 °C

Duralco™ 124

Properties

- Filler: silver
- The most effective Cotronics adhesive
- Operating temperature: 340 °C

Implementation

- Fast curing: 4 hours to 120 °C
- Post-curing: 4 hours at 177 °C

Duralco™ 125

Properties

- Filler: silver
- Flexible
- Operating temperature: 230 °C

Implementation

- Curing: 8 hours at room temperature
- Fast curing: 30 minutes at 65 °C

Duralco™ 127

Properties

- Filler: graphite
- Operating temperature: 200 °C
- The most economical

Implementation

- Curing: 24 hours at room temperature

Property	Unit	120	122	124	125	127
Operating Temperature	°C	260	260	340	230	200
Colour		silver	silver	silver	silver	black
Components		2	2	2	2	2
Viscosity	cps	25,000	25,000	20,000	50,000	50,000
Filler		silver	nickel	silver	silver	graphite
Thermal Conductivity	$W.m^{-1}.K^{-1}$	7.2	2.16	7.2	5.76	3.6
Resistivity	Ω.m	8.10^{-7}	7.10^{-3}	2.10^{-5}	2.10^{-5}	2.10^{-4}
Cure at Room Temperature		24 hrs	24 hrs	-	8 hrs	24 hrs
Fast Cure		-	-	4 hrs at 120 °C	30 min at 65 °C	-
Post Cure		1 h at 120 °C	24 hrs at 120 °C	4 hrs at 177 °C	-	-

Thermally conductive adhesives
Duralco™ 128-132-133 – 134-135

The combination of Cotronics adhesives and filled hardeners makes it possible to obtain the thermal conductivity required for certain applications.

General properties

- Thermal conductors
- Excellent resistance to chemicals and solvents

General applications

- Bonding to glass, ceramics, metals and plastics
- Electronic components
- Fixing transistors, radiators and coolants
- Photovoltaic components
- Ceramic mounting bases

Duralco™ 128

Properties

- Filler: ceramic
- Operating temperature: 260 °C
- High dielectric strength

Implementation

- Curing: 24 hours at room temperature
- Post-curing: 1 hour at 120 °C followed by 1 hour at 175 °C

Duralco™ 132

Properties

- Filler: aluminium
- Operating temperature: 260 °C
- Excellent thermal exchanger

Implementation

- Curing: 24 hours at room temperature
- Post-curing: 4 hours at 120 °C

Duralco™ 133

Properties

- Filler: aluminium
- Operating temperature: 315 °C with post-curing

Implementation

- Fast curing: 4 hours at 120 °C
- Post-curing: 4 hours at 175 °C

Duralco™ 134

This product is not a bonding product but a non-hardening grease. There is no curing: the product does not harden.

Properties

- Filler: ceramic
- Operating temperature: 260 °C
- Thermally conductive grease
- Non-hardening
- Electrically insulating

Implementation

- Application in layers between components and heat sinks
- Easy replacement thanks to its texture
- No curing

Duralco™ 135

Properties

- Similar to Duralco™ 134 but with better thermal transfer
- Filler: fine aluminium powder
- Operating temperature: 260 °C

Implementation

- Application in layers between components and heat sinks
- Easy replacement thanks to its texture
- No curing

Property	Unit	128	132	133	134	135
Operating Temperature	°C	260	260	315	260	260
Colour		amber	silver	silver	amber	grey
Components		2	2	2	1	1
Viscosity	cps	79,000	15,000	36,500	grease	grease
Filler		ceramic	aluminium	aluminium	ceramic	aluminium
Thermal Conductivity	$W.m^{-1}.K^{-1}$	2.88	5.76	5.76	5.04	5.76
Resistivity	Ω.m	10^{13}	10^{6}	10^{4}	10^{14}	-
Cure at Room Temperature		24 hrs	24 hrs	-	-	-
Fast Cure		-	-	4 hrs at 120 °C	-	-
Post Cure		1 h at 120 °C + 1 h at 175 °C	4 hrs at 120 °C	4 hrs at 175 °C	-	-

Low viscosity adhesives

Duralco™ 4460 – 4461

The Duralco™ low viscosity adhesives are the most fluid formula of the Cotronics polymer systems. They are easy to apply in thin layers and impregnate even the thinnest of bond lines. These products seal porous materials and provide a protective coating.

Duralco™ 4460

Properties

- Operating temperature: 315 °C
- Two-component
- Filler-based product possible
- Tearing strength up to 140 kg/cm² in thin film (15 µm)
- Shear strength 200 °C = 640 kg/cm² in thin film (12 µm)

Examples of applications:

- Bonding a transducer with a thin film of 12 µm, shear strength 200 °C = 640 kg/cm²
- Impregnation of a complex textile part to create an antenna support
- Impregnation of a composite for an aerospace application

Implementation

- Fast curing: 4 hours at 120 °C
- Post-curing: 1 to 2 hours at 175 °C followed by 16 hours at 230 °C

Duralco™ 4461

Properties

- Operating temperature: 260 °C
- Exceptional resistance to chemicals, moisture, high temperatures and electrical phenomena
- No solvents and no volatiles
- Ultra-thin bond lines (0.01 mm)

Applications

- Ultra-thin bond lines
- Ultra-thin encapsulating and coating
- Protection
- Surface impregnation
- Creation of ultra-thin bond lines
- Ideal for electronics
- Adhesion to metals, ceramics, glass and most plastics.

Implementation

- Curing: 24 hours at room temperature
- Post-curing: 4 hours at 120 °C

Examples:

- Coating the end of a cable (composed of 3,000 fibre optics) in a metal connector.
- Protection of optical components from moisture, in particular in signal amplifiers

Property	Unit	4460	4461
Operating Temperature	°C	315	260
Colour		amber	amber
Components		2	2
Viscosity	cps	1,600	3,600
Density	g/cm^3	1.1	1.1
Filler		-	-
Hardness	Shore D	90	90
Tensile Strength at 20 °C	MPa	71	65
Thermal Conductivity	$W.m^{-1}.K^{-1}$	0.57	0.57
Thermal Expansion	$10^{-6}.K^{-1}$	54	54
Dielectric Strength	kV/mm	19.5	17.55
Resistivity	Ω.m	10^{12}	10^{11}
Heat Distortion	°C	260	210
Elongation	%	5	5
Thermal Stability 1,000 hrs at 200 °C	%	0.1	0.2
Shrinkage	%	0.5	0.8
Moisture Absorption 30 days	%	0.1	0.15
Mix Ratio	Adhesive-Hardener	100-80	100-17
Cure at Room Temperature		-	24
Fast Cure		4 h at 120 °C	-
Post Cure		1-2 hrs at 175 °C + 16 hrs at 230 °C	4 hrs at 120 °C

General purpose adhesives

Duralco™ 4463 – 4525 – 4535 – 4700 – 4703

Duralco™ 4463

Properties

- Operating temperature: 260 °C
- Two-component
- Low thermal expansion adhesive
- Excellent chemical, electrical and moisture resistance
- Stability at high temperature
- Thermal shock resistance
- Excellent mechanical properties
- Very low shrinkage
- Very low expansion (up to two times lower than standard adhesives)

Applications

- Excellent adhesion on most glass, ceramics metals and plastics
- Bonding and moulding electronic parts
- Fibreglass bonding
- Assembly of optical components.

Implementation

- Curing: 24 hours at room temperature
- Post-curing: 4 hours at 120 °C

Duralco™ 4525

Properties

- Operating temperature: 260 °C
- Two-component
- High moisture resistance
- Very low shrinkage during hardening
- Excellent electrical properties
- Exceptional resistance to both solvents and chemicals
- Corrosion resistance (tested in hydrochloric, sulphuric and phosphoric acids)
- Resistance to hydrocarbons, atmospheric agents and various types of corrosion
- Machinable

Applications

- Bonding strain gauges, thermocouples, various sensors
- In chemical reactor measuring chambers
- Engines and measuring devices.
- Automotive, aeronautical or naval applications
- Repair of fibreglass tanks

- Storage of acids at high concentration: hydrochloric at 36 %, phosphoric at 29 %, sulphuric at 65 %, nitric at 70 %
- Bonding carbon blocks onto the brake assembly of aircraft wheels

Implementation

- Curing: 24 hours at room temperature
- Post-curing: 1 hour at 120 °C followed by 1 hour at 175 °C

Duralco™ 4535

Properties

- Flexible adhesive
- Excellent vibration resistance
- Operating temperature: up to 230 °C
- Two-components with high colloidal strength
- Resistant to thermal shocks and peeling
- Low shrinkage
- Excellent dielectric coefficient

Applications

- Systems subject to vibrations
- Automotive and electrical sectors
- Measuring instruments
- Engines
- Chemical analysis equipment
- Steel-composite assembly (bonding phenolic-based adhesive, polyester and graphite)
- Assembly of a series of magnets on a structure

Implementation

- Curing: 24 hours at room temperature
- Fast curing: 1 hour at 120 °C

Duralco™ 4700

The Duralco™ 4700 adhesive is the ultimate in high temperature structural bonding.

Properties

- Operating temperature: up to 315 °C
- The highest colloidal strength at high temperature
- Exceptional thermal stability thanks to a cross-linking of inorganic and organic polymers
- Two-component
- Does not release any odours and does not contain any solvents or toxic gases.
- Exceptional electrical resistance
- Satisfactory radiation resistance

Applications

- Excellent adhesion to metals, ceramics, glass and most plastics.
- Bonding in industrial, automotive, electrical, aeronautical and laboratory applications
- Specific assemblies in the nuclear industry
- Protective adhesive on connectors.
- Thermal screen and barrier against moisture and mould.
- Repairing cracks in steel hydraulic circuits (at 250 °C, under 1,450 MPa)
- Sealing thermocouples on electrical resistors.
- Maintains strain gauges on various substrates.

Implementation

- Easy to use and safe
- Fast curing: 4 hours at 120 °C
- Post-curing: 1 to 2 hours at 175 °C followed by 16 hours at 230 °C
- Outgassing cycle of 1 to 2 hours at 175 °C recommended

Duralco™ 4703

Properties

- Operating temperature: up to 343 °C
- Mixed organic/inorganic polymer
- Excellent dimensional stability at high temperatures
- Very low moisture absorption rate
- Can be used at the operating temperature limit of epoxy adhesives
- Retains over 85 % of its tensile strength after 1,000 hours of service at 260 °C

Applications

- Excellent adhesion to metals, ceramics, glass and most plastics
- High-performance bonding.
- Bonding metal parts with 20 MPa bond strength
- Sealing thermocouples for use in corrosive environments at over 280 °C.

Implementation

- Fast curing: 4 hours at 120 °C
- Post-curing: 1 to 2 hours at 175 °C followed by 16 hours at 230 °C

Epoxy Adhesives

Property	Unit	4463	4525	4535	4700	4703
Operating Temperature	°C	260	260	230	315	343
Colour		grey	black	grey	black	black
Components		2	2	2	2	2
Viscosity	cps	176,000	25,000	10,000	40,000	50,000
Density	g/cm^3	1.5	1.7	1.1	1.8	1.8
Hardness	Shore D	75	90	A60-A80	94	95
Tensile Strength at 20 °C	MPa	48	68	41.3	76.5	81.3
Thermal Conductivity	$W.m^{-1}.K^{-1}$	0.72	1.87	1.15	1.87	2.59
Thermal Expansion	$10^{-6}.K^{-1}$	20	33	34	37	39
Dielectric Strength	kV/mm	23.4	17.55	17.55	21.45	17.55
Resistivity	Ω.m	10^{12}	10^{13}	10^{12}	10^{12}	10^{8}
Heat Distortion	°C	210	210	100	300	320
Elongation	%	2	2	12	2	2
Thermal Stability 1,000 hrs at 200 °C	%	0.5	0.05	0.5	0.1	0.02
Shrinkage	%	0.5	0.2	0.2	0.2	0.1
Moisture Absorption 30 days	%	0.3	0.1	0.2	0.02	0.15
Mix Ratio	Adhesive-Hardener	100-6	100-8	100-100	100-28	100-22
Cure at Room Temperature		24 hrs	24 hrs	24 hrs	-	-
Fast Cure		-	-	1 h at 120 °C	4 hrs at 120 °C	4 hrs at 120 °C
Post Cure		4 hrs at 120 °C	1 h at 120 °C + 1 h at 175 °C	-	1-2 hrs at 175 °C + 16 hrs at 230 °C	1-2 hrs at 175 °C + 16 hrs at 230 °C

Special use adhesives

Duralco™ 4400 – 4420 – 4538 – 4540 – NM25 – S5H13

Duralco™ 4400- Thermal conductor

Properties

- Operating temperature: up to 260 °C
- Excellent thermal conductor
- Two-component
- Flexible

Applications

- Adhesion on metal, glass and ceramics
- Bond or insulator between two metals with different expansion coefficients
- Creation of heat exchangers for electrical or electronic components

Implementation

- Cures 24 hours at room temperature
- Post-curing: 1 hour at 120 °C followed by 1 hour at 175 °C

Duralco™ 4420 - One-component

Properties

- One-component
- Operating temperature: up to 230 °C
- Good dielectric qualities
- Unique thixotropic base fills gaps between two vertical surfaces
- Resistance to solvents, fuels, lubricants and most common chemicals

Applications

- Good adhesion to metal, glass and ceramics but also plastic and mica.
- Adhesive bonding of high-performance composites such as glass-epoxy, polyamides-epoxy and phenol-mica.
- Automated industrial applications

Implementation

- No measuring or mixing
- Fast curing: 2 to 4 hours at 120 °C
- Post-curing: 4 hours at 175 °C

Duralco™ 4538 – Téflon™ bonding

Properties

- Super flexible
- Two-component

Applications

- Adheres to plastics, metals, glass, Zytel, Victrex, Téflon™ (treated), poly-phenolsulfones, polycarbonates, phenolics, nylon
- Electronics
- Instrumentation
- Transformers
- Bonding and sealing a glass sight port to a brass housing for use from -75 °C to +235 °C

Implementation

- Curing: 24 hours at room temperature
- Fast curing: 2 hours at 90 °C

Duralco™ 4540 - Aluminium-filled thermally conductive resin

Properties

- Thermally conductive adhesive
- Filler: aluminium
- Operating temperature: up to 260 °C
- Resistant to thermal shocks
- Machinable
- Resistant to most chemicals and solvents

Applications

- Injection moulds
- Filling gaps and voids on metal parts
- Assembly with PTFE derivatives after treatment of the surface to bond

Implementation

- Curing: 24 hours at room temperature
- Post-curing: 1 hour at 120 °C followed by 1 hour at 175 °C

Duralco™ NM25 - Non-magnetic resin

Properties

- Non-magnetic adhesive
- Two-component
- Operating temperature: up to 260 °C

- Free of magnetic particles or conductive fillers

Applications

- Induction heating system
- High performance bonding in magnetic systems
- Bonding stepper motors magnets

Implementation

- Curing: 24 hours at room temperature
- Post-curing: 1 hour at 120 °C followed by 1 hour at 175 °C
- Mix the two components in the recommended mix ratio and apply
- Can be handled after a few minutes

Three different viscosity indexes

- Duralco™ NM25, medium viscosity (12,400 cps)
- Duralco™ NM25 HV, high viscosity (29,000 cps)
- Duralco™ NM25 HT, mixed viscosity (20,000 cps)

Duralco™ S5H13 - Sterilisable bonding and sealing

Properties

- Operating temperature: up to 260 °C
- Does not contain solvents or volatile compounds
- Machinable
- Resistant to corrosion and most solvents and chemicals
- Resistant to repetitive sterilisation cycles

Applications

- Sterilisable bonding and sealing
- Adheres to stainless steel, metals, glass and ceramics
- Medical tools
- Coating, sealing and potting for instrumentation
- Aerospace, automotive and sensitive electronic equipment
- Sealing and coating cauterizing components

Implementation

- Curing: 24 hours at room temperature
- Post-curing: 4 hours at 120 °C

TECHNICAL DATA SHEET 3MG.002

Property	Unit	4400	4420	4538	4540	NM25	S5H13
Operating Temperature	**°C**	260	230	235	260	260	260
Colour		brown	grey	brown	silver	brown	black
Components		2	1	2	2	2	2
Viscosity	**cps**	86,000	Paste	10,000	30,000	20,000	20,000
Density	**g/cm^3**	2.1	1.2	1	1.9	1.9	1.9
Filler		Al_2O_3	Al_2O_3	-	Al	Al_2O_3	Al_2O_3
Hardness	**Shore D**	80	75	-	80	80	85
Tensile Strength at 20 °C	**MPa**	48	48	-	69	68	69
Thermal Conductivity	**$W.m^{-1}.K^{-1}$**	2.88	1.15	1	5.04	1.87	1.87
Thermal Expansion	**$10^{-6}.K^{-1}$**	35	45	-	41	33	33
Dielectric Strength	**kV/mm**	24	15.6	17.55	3.9	19.5	19.5
Resistivity	**Ω.m**	10^{12}	10^{8}	10^{12}	10^{6}	10^{13}	10^{13}
Heat Distortion	**°C**	170	175	75	225	210	210
Elongation	**%**	2	1.5	8	1.2	2	2
Thermal Stability 1,000 hrs at 200 °C	**%**	0.6	0.6	0.5	0.5	0.5	0.5
Shrinkage	**%**	0.4	0.3	0.8	0.1	0.2	0.2
Moisture Absorption 30 days	**%**	0.05	0.5	0.5	0.2	0.2	0.2
Mix Ratio	**Resin - Hardener**	100-5	-	-	100-9	100-8	100-13
Cure at Room Temperature		24 hrs	-	24 hrs	24 hrs	24 hrs	24 hrs
Fast Cure		-	2-4 hrs at 120 °C	2 hrs at 90 °C	-	-	-
Post Cure		1 h at 120 °C + 1 h at 175 °C	4 hrs at 175 °C	-	1 h at 120 °C + 1 h at 175 °C	1 h at 120 °C + 1 h at 175 °C	4 hrs at 120 °C

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Encapsulating resin

Durapot™ 861 – 862 – 863 – 864 – 865 – 868

Durapot™ 861- Low viscosity

Properties

- Translucent and fluid resin
- Operating temperature: 260 °C
- Cures at room temperature

Applications

- Good impregnation of porous or fibrous materials
- Ideal for electronic applications

Implementation

- Curing: 24 hours at room temperature
- Post-curing: 1 hour at 120 °C followed by 1 hours at 175 °C

Durapot™ 862-High temperature

Properties

- Very fluid and translucent
- Operating temperature: 315 °C

Implementation

- Fast curing in 4 hours
- Post-curing: 1 hour at 175 °C followed by 16 hours at 230 °C

Durapot™ 863- High temperature encapsulating

Properties

- Excellent dielectric stability at high temperature.
- Resistant to solvents and moisture.
- Operating temperature: 315 °C

Applications

- Bonding organic materials and minerals

Implementation

- Fast curing in 4 hours
- Post-curing: 1 hour at 175 °C followed by 16 hours at 230 °C

Durapot™ 864-Flexible, cures at room temperature

Properties

- Similar to Durapot™ 863
- Better elasticity
- Better resistance to thermal variations and shocks
- Operating temperature: 230 °C

Implementation

- Curing: 24 hours at room temperature
- Fast curing in 2 hours

Durapot™ 865 – Thermal conductive resin

Properties

- Operating temperature: 260 °C
- Cures at room temperature

Applications

- In electronic components to dissipate heat

Implementation

- Curing: 24 hours at room temperature
- Post-curing: 1 hour at 120 °C followed by 1 hour at 175 °C

Durapot™ 868-High temperature and flexible

Properties

- Resistant to thermal shocks
- Excellent electrical insulation
- Operating temperature: 260 °C

Implementation

- Fast curing: in 2 to 4 hours
- Post-curing: 2 hours at 150 °C

TECHNICAL DATA SHEET 3MG.002

Property	Unit	861	862	863	864	865	868
Operating Temperature	°C	260	315	315	230	260	260
Colour		amber	amber	amber	brown	grey	amber
Components		2	2	2	2	2	2
Viscosity	cps	3,600	1,600	2,000	17,200	30,000	800
Density	g/cm^3	1.2	1.2	1.2	1.1	1.9	1.1
Filler		-	-	-	-	-	-
Hardness	Shore D	80-D	80-D	90-D	60-80-A	95-D	60-80-A
Thermal Conductivity	$W.m^{-1}.K^{-1}$	0.22	0.25	1.3	1	2.9	0.58
Thermal Expansion	$10^{-6}.K^{-1}$	54	54	34	68	38	52
Dielectric Strength	kV/mm	17.6	19.5	21.5	17.6	27.3	19.5
Resistivity	Ω.m	10^{11}	10^{12}	10^{12}	10^{12}	10^{13}	10^{12}
Dielectric Constant		4.15	4.15	3.5	3.5	3.5	4.1
Loss Factor		0.015	0.015	0.01	0.01	0.01	0.015
Chemical Resistance		Excellent	Excellent	Excellent	Good	Excellent	Excellent
Solvent Resistance		Excellent	Excellent	Excellent	Good	Excellent	Excellent
Pot Life	h	0.5	4	8	1	1	2-4
Mix Ratio	Resin - Hardener	100-17	100-80	100-71	100-120	100-5	100-40
Cure at Room Temperature		16 to 24 hrs	-	-	24 hrs	16 to 24 hrs	-
Fast Cure		-	4 hrs at 120 °C	4 hrs at 120 °C	-	-	2 to 4 hrs at 120 °C
Post Cure		1 h at 120 °C + 1 h at 175 °C	1 h at 175 °C + 16 hrs at 230 °C	1 h at 175 °C + 16 hrs at 230 °C	-	1 h at 120 °C + 1 h at 175 °C	2 hrs at 150 °C

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Standard Kits

All of the adhesives are available in low volume test kits and in larger production kits (see table below). Two other pre-measured kit sizes are also available in addition to these standard formats:

Pre-measured kit – Mix and apply

Packaging

- Each box contains a set of 10 units.
- Each unit consists of one jar of adhesive + 1 syringe of hardener.
- Kits of 10 x 10 g and 10 x 25 g

Implementation

- Weigh out the same amount of hardener as adhesive.
- Inject the hardener into the adhesive pot.
- Mix well and apply.

Available items

- EE 128
- EE 132
- EE 861
- EE 4460
- EE 4540
- EE 4525
- EE 4538
- EE 4700

Automatic measuring and injection system

Packaging

- 4 x 60 ml twin pack cartridges

Implementation

- No preparation required
- Directly inject the adhesive/hardener mixture
- Application requires the use of an ETAG applicator gun and one ETMT pack of 10 disposable mixer syringes.

Available items

- 4525N
- 4461N
- 4535N
- 4540N

Packaging

Weights are for information only, Cotronics fills containers by volume.

Item N°	Adhesive		Hardener	
	Volume	Unit	Volume	Unit
120-1	52 g	Tube	4 ml	SRG
122-1	113 g	Tube	4 ml	SRG
122-2	227 g	Tube	8 ml	SRG
122-3	453 g	Tube	16 ml	SRG
122T-1	/	/	10 g	BTL 15 ml
124-1	32 g	Tube	32 g	Pot
125-2	6 g	Double SRG	6 g	Double SRG
125-3	114 g	Pot 120 ml	114 g	Pot 120 ml
125-3A	57 g	Pot 30 ml	57 g	Pot 30 ml
127-1	15 ml	SRG 60 ml	15 ml	SRG 60 ml
127-1A	59 ml	SRG 118 ml	One-component	
127-2	360 g	½ Pint US	325 g	½ Pint US
127-3	700 g	Pint US	640 g	Pint US
128-1	475 g	½ Pint US/	30 g	Pot 60 ml
128-2	900 g	Pint US	60 g	Pot 120 ml
128-3	5.0 kg	Gallon US	250 g	Pot 235 ml
132-1	415 g	½ Pint US	35 g	BTL 2 oz US
132-2	830 g	1 Pint US	70 g	BTL 2 oz US
132IP-1	415 g	½ Pint US	35 g	BTL 60 ml
132IP-2	830 g	Pint US	65 g	BTL 60 ml
132P-1	400 g	½ Pint US	25 g	BTL 90 ml
133-1	350 g	½ Pint US	93 g	BTL 90 ml
134-1	225 g	Pot 118 ml	One-component	
135-1	227 g	½ Pint US	One-component	
135-1A	113 g	Pot 118 ml	One-component	
4400-1	1040 g	1 Pint US	60 g	BTL 60 ml
4400-2	5.2 kg	1 Gallon US	250 g	BTL 240 ml
4420-1	700 g	1 Pint US	One-component	
4420-2	5.4 kg	1 Gallon US	One-component	
4420-3	3x 115 ml	SRG	One-component	
4420-4	550 g	CT 325 ml	One-component	
4460-1	500 g	1 Pint US	400 g	1 Pint US
4460-2	2 kg	½ Gallon US	1.6 kg	½ Gallon US
4460-3	10 kg	3 Gallon US	8 kg	3 Gallon US
4461-1	500 g	1 Pint US	90 g	BTL 90 ml
4461-2	2.95 kg	1 Gallon US	500 g	1 Pint US
4461-3	14.0 kg	3 Gallon US	3.5 kg	Gallon US
4461IP-1	475g	Pint US	128 g	NC
4461-2H	/	/	500 g	Pint US
4461IP-2	2.7 kg	Gallon US	725 g	Pint US
4461IP-3	14.5 kg	5 Gallon US	3.6 kg	Gallon US
4461SS-1	500 g	Pint US	90 g	BTL 120 ml
4461SS-2	3.0 kg	Gallon US	530 g	Quart US
4462-1	350 g	1 Pint US	80 g	BTL 90 ml
4462-2	2.8 kg	1 Gallon US	650 g	BTL 1 Qt US
4463-1	380 g	½ Pint US	25 g	BTL 90 ml
4463-2	760 g	1 Pint US	50 g	BTL 90 ml
4463-3	4.5 kg	Gallon US	275 g	Pint US
4463-4	22.7 kg	5 Gallon US	1.3 kg	½ Gallon US
4525-1	850 g	1 Pint US	75 g	BTL 90 ml
4525-2	4.8 kg	1 Gallon US	400 g	1 Pint US
4525-3	24 kg	5 Gallon US	1.8 kg	½ Gallon US

TECHNICAL DATA SHEET 3MG.002

Item N°	Adhesive		Hardener	
	Volume	Unit	Volume	Unit
4525IP-1	850 g	Pint US	75 g	Pot 90 ml
4525IP-2	4.5 kg	Gallon US	400 g	Pint
4525IP-3	24 kg	5 Gallon US	1.8 kg	½ Gallon US
4525IPEHV-1	725 g	Pint US	155g	Pot 90 ml
4535-1	275 g	½ Pint US	275 g	½ Pint US
4535-2	2.25 kg	½ Gallon US	2.25 kg	½ Gallon US
4535-4	11.3 kg	5 Gallon US	11.3 kg	5 Gallon US
4538-1	350 g	1 Pint US	425 g	1 Pint US
4538-2	1.8 kg	½ Gallon US	2.17 kg	1 Gallon US
4538-3	9 kg	5 Gallon US	10.9 kg	5 Gallon US
4538-1A	/	/	425 g	Pint US
4540-1	500 g	1 Pint US	50 g	BTL 90 ml
4540-2	4 kg	1 Gallon US	375 g	1 Pint US
4540-3	20 kg	5 Gallon US	1.8 kg	½ Gallon US
4540-1	450 g	Pint US	50 g	Pot 90 ml
4540-2	4.1 kg	Gallon US	375 g	Pint US
4700-1	800 g	1 Pint US	225 g	½ Pint US
4700-2	4 kg	1 Gallon US	1.12 kg	1 Qt US
4700-3	20.4 kg	5 Gallon US	5.5 kg	Gallon US
4703-1	850 g	Pint US	180 g	½ Pint US
4703-2	4.5 kg	1 Gallon US	1 kg	1 Qt US
4703-3	22.7 kg	5 Gallon US	5 kg	Gallon US
NM25-1	850 g	1 Pint US	75 g	BTL 90 ml
NM25-2	4.5 kg	Gallon US	400 g	Pint US
NM25HT-1	850 g	Pint US	225 g	½ Pint US
NM25HT-2	4 kg	Quart US	900 g	Quart US
NM25HV-1	850 g	Pint US	75 g	Pot 90 ml
S5H13-1	850 g	1 Pint US	90 g	BTL 90 ml
S5H13-2	4.8 kg	1 Gallon US	650 g	1 Qt US
861-1	445 g	1 Pint US	90 g	BTL 120 ml
861-2	2.94 kg	1 Gallon US	500 g	1 Pint US
861-3	18.6 kg	5 Gallon US	2.7 kg	Gallon US
861-1H	/	/	90 g	Pot 90 ml
861-2H	/	/	500 g	Pint US
861IP-1	500 g	Pint us	90 g	Pot 90 ml
861IP-2	2.7 kg	Gallon US	725g	Quart US
861IP-3	14.9 kg	5 Gallon US	3.7 kg	Gallon US
863-1	445 g	1 Pint US	350 g	1 Pint US
863-2	2.2 kg	1 Gallon	1.58 kg	½ Gallon US
863-3	10.9 kg	5 Gallon US	7.7 kg	5 Gallon US
864-1	350 g	1 Pint US	425 g	1 Pint US
864-2	1.8 kg	½ Gallon US	2.17 kg	1 Gallon
864-3	10.9 kg	5 Gallon US	10.9 kg	5 Gallon US
865-1	1040 g	1 Pint US	60 g	BTL 60 ml
865-2	5.2 kg	1 Gallon US	250 g	BTL 240 ml
865-3	25.9 kg	Gallon US	1.4 kg	½ Gallon US
865-1H	/	/	60 g	BTL 60 ml
865-2H	/	/	250 g	BTL 240 ml
865IP-1	1.0 kg	Pint US	60 g	BTL 60 ml
865IP-2	5.0 kg	Gallon US	250 g	BTL 240 ml
865IP-3	26 kg	5 Gallon US	1.36 kg	½ Gallon US
868-1	375 g	1 Pint US	150 g	BTL 120 ml
868-2	2.7 kg	1 Gallon US	1.08 kg	1 Quart US

BTL : bottle / Qt = quart / SRG : syringue / CT : cartridge

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