# Permabond® Adhesive Guide


*Our science... your success*



**Permabond®**

Engineering Adhesives

# Permabond Adhesives

ISO 9001:2015 Certified
Our Science ... Your Success

**Adhesives for • Design • Manufacturing • Assembly • Maintenance • Repair & Overhaul**

Permabond's history of developing and manufacturing engineering adhesives spans **four decades** and three continents. Today, Permabond Engineering Adhesives Ltd (Europe & Asia) and Permabond LLC (Americas) provide technological solutions to engineers all over the world, with offices and facilities in America, Asia and Europe, backed by a high-tech **ISO 9001:20015** certified production plant in Europe.

• **Technical** – Our chemists and technicians are available to provide application assistance, custom formulation, in-house prototype testing, joint product development programs and much more.

• **Training** – Permabond's knowledgeable sales group will provide your staff with the information they need to maximize the efficiencies, cost savings, and safety benefits Permabond products generate.

• **Sales** – From preliminary project appraisals and product needs assessments through to process reliability analysis, Permabond's knowledgeable sales group will support you from product concept through to production.


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# Contents

# Adhesive Selection

## Adhesive Selection

**Selecting the most appropriate adhesive for an engineering application requires consideration of a number of factors:**

Surfaces | Joint Design | Service Conditions | Production Processes | Adhesive Recommendations

### Surfaces:

- Can the substrate(s) be bonded?
- Which adhesive works best on the substrate?
- What are the surface preparation requirements?
- Reactivity of the substrate affects adhesive cure-speed.

The table to the right shows how **anaerobic adhesive** cure is affected by surface reactivity.

| Super Active (V. fast cure) | Active (Fast cure) | Inactive (Slow cure) | Passive (Activator required) |
|---|---|---|---|
| Brass<br>Copper<br>Magnesium | Steel<br>Nickel<br>Iron<br>Aluminium<br>Zinc | Anodized aluminium<br>Cadmium finishes<br>Chrome finishes<br>Passivated metals<br>Stainless steel<br>Titanium | Ceramics<br>Glass<br>Plastics<br>Painted finishes<br>Lacquered finishes |

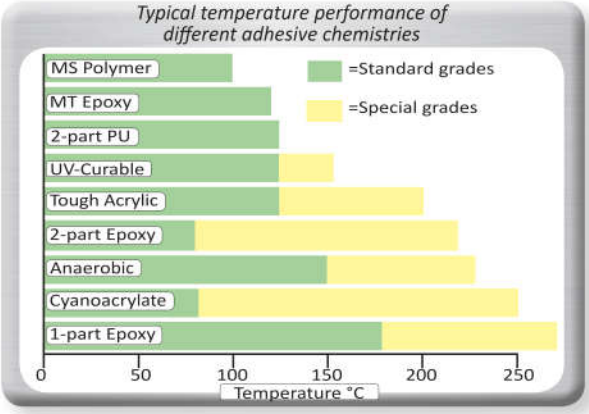
| Substance | Viscosity (mPa.s) | Substance | Viscosity (mPa.s) |
|---|---|---|---|
| Water | 1 | Maple syrup | 5,000 |
| Milk | 3 | Honey | 10,000 |
| SAE 10 Motor oil | 85-140 | Choc. syrup | 25,000 |
| SAE 20 Motor oil | 140-420 | Ketchup | 50,000 |
| SAE 30 Motor oil | 420-650 | Mustard | 70,000 |
| SAE 40 Motor oil | 650-900 | Sour cream | 100,000 |
| Castor oil | 1,000 | Peanut butter | 250,000 |

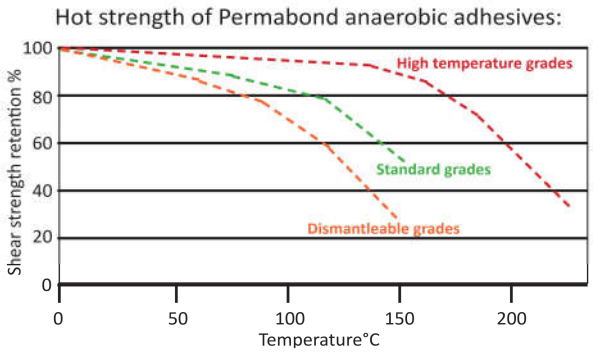
### Gap fill and adhesive viscosity:

Viscosity of adhesive and gap fill capability are closely related - the higher the adhesive viscosity, the larger the gap filling capability. To help "get a feel" for viscosity measurements, the list on the left shows everyday substances and their approximate viscosity.

### Service conditions:

Chemical exposure and environmental conditions affect adhesives, therefore it is important to consider not only the type of chemical the adhesive will be exposed to, but the concentration and temperature of that chemical, the loading of the joint and whether the joint design leaves adhesive vulnerable to attack.

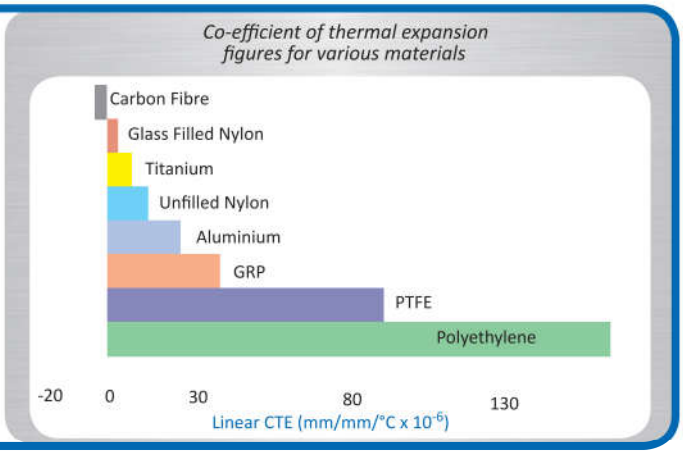



The temperature range the joint will be exposed to is an important factor in deciding which adhesive to use. Adhesive strength reduces as temperature increases, as demonstrated in the graphs to the left and above. Provided adhesives are kept within their recommended temperature range, full strength should be regained upon returning to room temperature.

### Adhesive considerations:

Bonding dissimilar materials together requires special consideration, particularly in an environment subject to temperature change. This is because differential thermal expansion and contraction between materials can induce stress into the substrates and into the joint. For this reason slightly flexible, toughened adhesives can be better than rigid methods of fixture - such as mechanical fastenings. The chart on the right shows just a few materials and how they might react to thermal expansion.

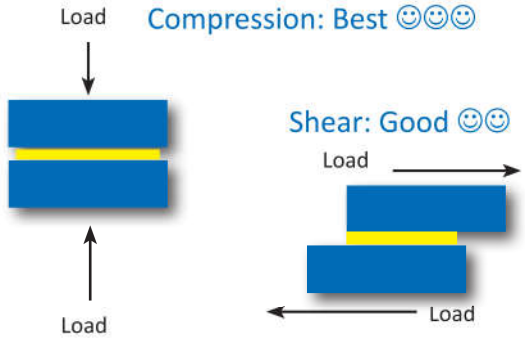


# Joint Design

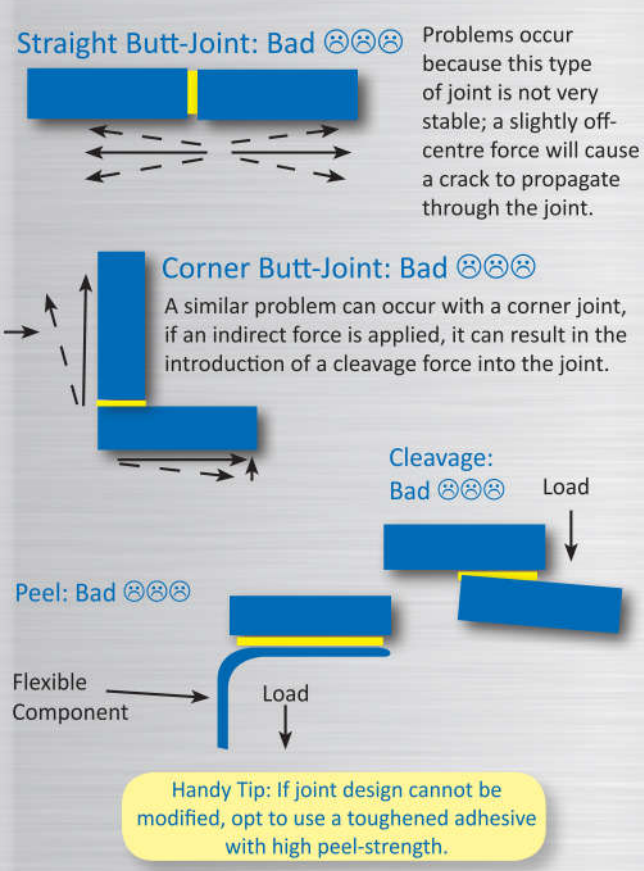
There are three basic joint types; co-axial, lap and butt joints. Anaerobic adhesives are usually most suitable for co-axial type joints (where one part slots into another) or for threaded parts. Whether or not the joint needs to be dismantled will determine the strength of adhesive to use.

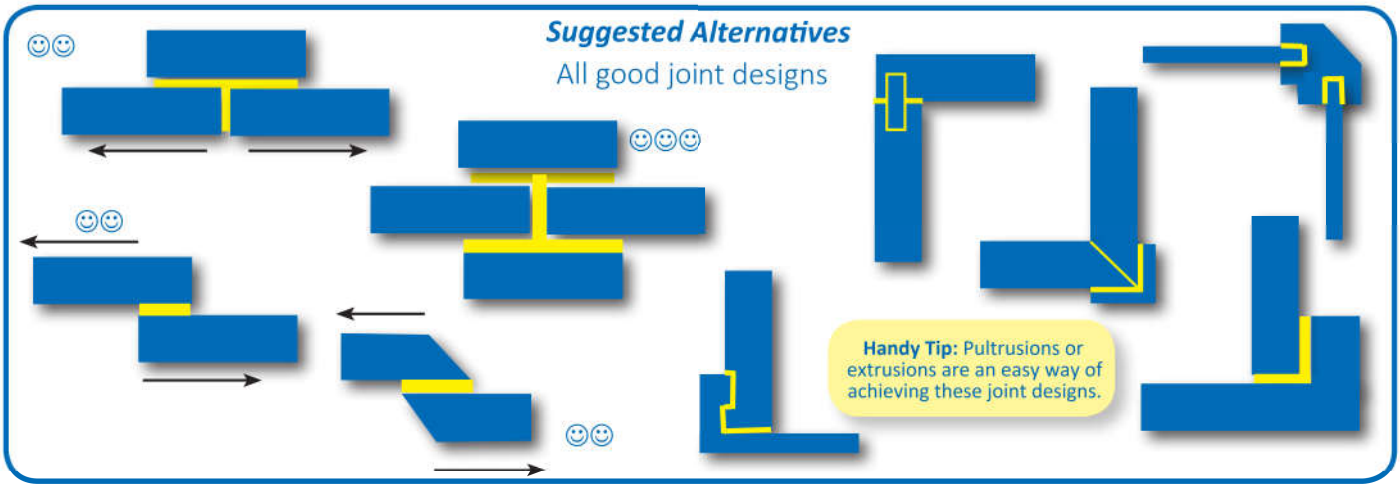
It is vital to consider joint configuration in the early stages of your product design to achieve maximum performance. Joints that have originally been designed to be welded may need to be redesigned to obtain optimum performance with adhesives. The engineer also needs to consider the loading of these joints and where the forces occur. The diagrams on this page explain which joints are good, which to avoid and some suggested alternative joint designs.

## These are examples of good adhesive joint design.




## These are examples of bad adhesive joint design.




# Coverage

### Usage Estimator

The number of free flow drops per container (cyanoacrylate):

| Container Size | Number of Drops | Container Size | Number of Drops |
|---|---|---|---|
| 3g | 45 | 10ml | 150 |
| 20g | 300 | 50ml | 750 |
| 28g (1 oz) | 420 | 75ml | 1125 |
| 30g | 450 | 250ml | 3750 |
| 300g | 4500 | 300ml | 4500 |
| 454g (1lb) | 6810 | 500ml | 7500 |
| 500g | 7500 | 750ml | 11,250 |
| 2kg | 30,000 | 1 litre | 15,000 |

***Flat bond (any adhesive):***
Length (cm) x Width (cm) x Gap (cm) = Volume (ml)
To get an answer in ml, convert all your dimensions to cm first.

***Potting a cylinder:***
3.14 x radius $(cm)^2$ x length of cylinder (cm) = ml.
Radius is half the diameter.

**Handy Tip:** 1 litre of adhesive covers 1 square metre at a thickness of 1 mm i.e. if only 0.5 mm thick, 1 litre will cover 2 square metres.

### 50ml of adhesive will go how far?

| Bead Diameter | Length of Bead | Glue line thickness (over 25mm width) |
|---|---|---|
| 1.5mm | 25m | 0.075mm |
| 3mm | 6m | 0.3mm |
| 6mm | 1.5m | 1.2 mm |

### Usage Estimator - Threaded Fasteners

| Metric size | Imperial size | Volume of adhesive per fastener | How many pipe-joints per bottle? | |
|---|---|---|---|---|
| | | | 50ml | 200ml |
| 3mm | 1/8" | 0.07ml | 700 | 2,800 |
| 6mm | 1/4" | 0.1ml | 500 | 2,000 |
| 9mm | 3/8" | 0.12ml | 400 | 1,600 |
| 12mm | 1/2" | 0.14ml | 340 | 1,360 |
| 19mm | 3/4" | 0.193ml | 260 | 1,040 |
| 25mm | 1" | 0.242ml | 200 | 800 |

# Production Line Considerations

### *Substrate preparation on a high-speed production line*

It is helpful to receive substrate components in a consistent condition with little variation in surface finish. We would recommend checking this regularly as sometimes component suppliers switch materials, cutting oils or release agents which could necessitate changes in surface preparation technique. For large batch production, components can be degreased via large-scale jet washes on a conveyor system. It is important that such systems are not overloaded and that parts can drain off to give a consistently clean/dry surface afterwards.

Grit blasters offer a quick and easy way to abrade metal surfaces to remove oxide layers. It is important to change grit regularly to keep it sharp and free from contamination.

Surface activators, such as the Permabond CSA (for cyanoacrylates) and A905 (for anaerobics), are available in bulk for batch dipping of components. This helps to ensure a clean, reactive surface for the corresponding adhesive to bond to.

### *Dispensing methods*

For a rapid production line, high-speed dispensing systems can easily be introduced. These can range from semi-automatic (e.g. a system which delivers a metered dose to the component after a person triggers the dispensing valve via foot pedal), to fully automatic where minimal human intervention is required. Permabond offer adhesive products in bulk packaging to fit most dispensing equipment around the world.
Two-part adhesives require more consideration to ensure the metered dose of resin and hardener is correct and that mixing is adequate. Upon installation the equipment must be properly calibrated to ensure the correct mix ratio of adhesive is being dispensed.

### *Automation*

For high-speed production lines conveyors, robotics and X-Y machines can greatly aid increased production rates. Adhesives can easily be incorporated into highly automated systems with minimal cost.

### *Clamping / jigging & cure speed*

It is important bonded parts are not disturbed during the curing process, at least until they have reached handling strength. Otherwise components could end up wrongly aligned or could result in a lower bond strength. To keep clamping time to a minimum, choose one of Permabond's rapid curing adhesives to speed up production rates.

- UV-curables - cure in 1-2 seconds on exposure to high-intensity UV-light
- Cyanoacrylates - cure to handling strength in 1-30 seconds
- Structural acrylics - quick curing grades reach handling strength in 1-4 minutes
- Two-part polyurethanes - rapid gel time between 2-20 minutes
- Anaerobics - range from two minutes up 1 hour depending on substrates
- Two-part epoxies - can range from 5 minutes to several hours depending on grade
- Single-part heat-cure epoxies - dependent on cure temperature / heating method
- MS-polymers take days to cure - even weeks depending on glue line thickness

### *Curing Equipment*

Permabond UV adhesives have been developed to cure quickly and easily, even with low powered lamps. This makes it a lot easier for trialling adhesives or for small users to use UV-curables without having to invest in high-tech equipment. We recommend the use of professional UV-lamps where possible, particularly for regular production items and where consistent results are essential.
Single-part epoxies require heat input either by oven, infra-red lamp, hot air gun or induction heating. Two-part epoxy cure can also be accelerated by heating bonded parts.
***Please contact Permabond for further information on equipment suppliers.***

# Surface Preparation

| Surface | Preparation Method | AA | CA | ET | ES | MS | PT | TA | UV |
|---|---|---|---|---|---|---|---|---|---|
| ABS (Acrylonitrile-Butadiene-Styrene) | Bond as received. | OK - use A905 | Good | Good | Plastic may deform during cure | OK | Good | Good | OK* |
| Acetal (POM) | Acetal can be very difficult to bond; abrading the surface may show very slight improvement in mechanical bond strength. | OK - use A905 | Best especially with POP Primer | Poor | Poor | Poor | OK | Poor | Poor |
| Acrylic (PMMA) | Bond as received. Remove excess uncured adhesive immediately to prevent stress cracking. | Not suitable | Good | Good | Plastic may deform during cure | OK | Good | Good | Good* |
| Aluminium | Abrade & degrease.<br>Alternatively, etch with phosphoric acid. | Good<br>A905 may be needed to speed up cure. | OK | Good | Good | Good | Good | Very good - especially MMA products | Good* |
| ASA (Acrylic-Styrene-Acrylonitrile) | Bond as received. | OK - use A905 | Very good | OK | Plastic may deform during cure | OK | Good | OK | Good* |
| Brass | Abrade & degrease.<br>Alternatively, etch with 25% ammonium persulphate solution. | Good | OK | Good | Good | OK | Good | Some very good, Check with PB | Good* |
| Butyl Rubber | Degrease. | Not suitable | Good | Not suitable | Not suitable | Not suitable | Not suitable | Not suitable | Not suitable |
| CAP (Cellulose Acetate Propianate) | Bond as received. | Not suitable | Good - use 79X surface insensitive grades | Good | Not suitable | OK | OK | OK, pre-mix product better | Good* |
| Carbon Fibre | Can be abraded and degreased. | Not suitable | Good - esp. 737 | Good | Good | Good | Good | Good | Not suitable |
| Cast Iron | Abrade & degrease. | Good | OK<br>Use 910 | Good | Good | OK | Good | Good | Not suitable |
| Ceramic | Glaze should be removed by abrasion or gritblasting, loose particles should then be removed. Degrease with isopropanol or suitable solvent. Surface should be clean and dry before bonding. | OK - use A905 | Poor | Good | Good | OK | Good | Good | Good* |
| Chrome | Degrease.<br>Bonding chrome can be difficult because of its mirror-finish ultra-smooth surface. | Good - use HM163 or HM165 | OK - use 910 | OK | Good | OK | OK | OK | Good* |
| Composite | Most can be lightly abraded and degreased. | Not suitable | Good - esp. 737 | Good | Good | Good | Good | Good | Not suitable |
| Concrete | Remove large particles of dust and debris with a stiff brush. Ensure surfaces are as dry and clean as possible and free of oil. | Not suitable | Poor | Good - use high viscosity | Not suitable | Good | OK | OK, use pre-mix MMA | Not suitable |
| Copper | Abrade & degrease.<br>Alternatively, etch with 25% ammonium persulphate solution. | Good | OK | Good | Good | OK | Good | Some very good, Check with PB | Good* |
| Corian | Can be lightly abraded and degreased. | Not suitable | OK | Very good | Not suitable | Good | Good | Good | Not suitable |
| DAP (Diallyl Phthalate) | Can be bonded as received. Light abrasion may help increase mechanical bond strength. | Not suitable | Very good | Good | Plastic may deform during cure | OK | Good | OK | Good* |
| Diamond | Degrease. | Not suitable | Poor | OK | Very good | Not suited | OK | OK | Good* |
| EPDM Rubber | Degrease. | Not suitable | Use 105 or POP+any CA | Not suitable | Not suitable | Poor | Not suitable | TA46XX range only | Not suitable |
| Ferrite | Degrease. | OK - May need to use A905 | Good - 737 is 1st choice | Good | Good | Poor | Good | Very good | Good* |
| Formica | Can be lightly abraded and degreased. | Not suitable | OK | Very good | Not suitable | Good | Good | Good | Not suitable |
| FRP (Fibre Reinforced Plastic) | Abrade and degrease. | Not suitable | Good - esp. 737 | Good | Not suitable | Good | Good | Good | Not suitable |

*Beware shadow areas

Key: AA=Anaerobic CA=Cyanoacrylate ET=2-Part Epoxy ES=Heat-Cure Epoxy MS=MS-Polymer
TA=Structural Acrylic PT=Two-Part Polyurethane UV= UV Curable

# Surface Preparation

| Surface | Preparation Method | AA | CA | ET | ES | MS | PT | TA | UV |
|---|---|---|---|---|---|---|---|---|---|
| Galvanised Zinc | Degrease. | OK | OK - 737 best | OK - MT grades best | OK - use toughened grade | Good | OK | Good | Not suitable |
| Glass | Degrease. | Not suitable | Poor | OK -Prime with 2K Primer | Not suitable | Good - esp. MS359 Clear | OK | Good - esp. TA4204 & TA4205 | Very good* |
| GRP (Glass Reinforced Plastic) | Abrade and degrease. | Not suitable | Good - esp. 737 | Good | Good | Good | Good | Good | Not suitable |
| Gyprock | Remove large particles of dust and debris with a stiff brush. Ensure surface is dry & clean and free of oil. | Not suitable | Not suitable | OK | Not suitable | Very good | OK | OK - use pre-mix | Not suitable |
| HDPE (High Density Polyethylene) | Flame / Corona / Plasma treat (then most adhesives will bond well apart from CAs as these treatments dry out polyethylene) | Not suitable | Poor | Good | Not suitable | OK | Good | Good | Good* |
| | Untreated. | Not suitable | POP + 105 or 2050 | Not suitable | Not suitable | Not suitable | Not suitable | TA46XX range | Not suitable |
| HIPS (High Impact Polystyrene) | Can be bonded as received. Light abrasion may help increase mechanical bond strength. | Not suitable | OK | Not suitable | Not suitable | OK | Not suitable | Not suitable | OK* |
| Ionomer | Can be bonded as received. Light abrasion may help increase mechanical bond strength. | Not suitable | Good - use 79X surface insensitive grades | Good | Not suitable | OK | OK | OK, pre-mix product better | Good* |
| Laminate | Can be lightly abraded and degreased. | Not suitable | OK | Very good | Not suitable | Good | Good | Good | Not suitable |
| LCP (Liquid Crystal Polymer) | Can be bonded as received. Light abrasion will remove surface layer and give a much stronger bond. | Not suitable | Good | Good | Not suitable | OK | Good | Good | Very good* |
| LDPE (Low Density Polyethylene) | Flame / Corona / Plasma treat (then most adhesives will bond well apart from CAs as these treatments dry out polyethylene). | Not suitable | Poor | Good | Not suitable | OK | Good | Good | Good* |
| | Untreated. | Not suitable | POP + 105 or 2050 | Not suitable | Not suitable | Not suitable | Not suitable | TA46XX range | Not suitable |
| Magnet | Degrease. | OK - May need to use A905 | Good - 737 is 1st choice | Good | Good | Poor | Good | Very good | Good* |
| Marble | Remove large particles of dust and debris with a stiff brush. Ensure surface is dry & clean and free of oil. | Not suitable | Poor | Good | Not suitable | Good | Good | OK beware initiator staining | OK* |
| MDF | Can be lightly abraded. Remove large particles of dust and debris with a stiff brush. Ensure surface is dry & clean and free of oil. | Not suitable | OK. May need CSA activator | Very good | Not suitable | Good | Good | Pre-mix better | Not suitable |
| MDPE (Medium Density Polyethylene) | Flame / Corona / Plasma treat (then most adhesives will bond well apart from CAs as these treatments dry out polyethylene). | Not suitable | Poor | Good | Not suitable | OK | Good | Good | Good* |
| | Untreated. | Not suitable | POP + 105 or 2050 | Not suitable | Not suitable | Not suitable | Not suitable | TA46XX range | Not suitable |
| Mild Steel | Abrade & degrease. | Good | Good - esp. 910 | Good | Very good | Good | Good | Good | Good* |
| Natural Rubber | Degrease. | Not suitable | Use 105 or any CA+POP | Not suitable | Not suitable | Poor | Not suitable | Not suitable | Not suitable |
| Neoprene Rubber | Bond as received or degrease. | Not suitable | Very good | Not suitable | Not suitable | Poor | Not suitable | Not suitable | Not suitable |
| Nitrile Rubber | Bond as received or degrease. | Not suitable | Very good | Not suitable | Not suitable | Poor | Not suitable | Not suitable | Not suitable |
| Nylon (PA - Polyamide) | Dry out at 60°C for several hours or overnight. Unfilled Nylon doesn't usually bond well, glass filled is much better. Abrade surface to allow extra mechanical bonding. Degrease. | OK - use A905 | Poor durability | OK | OK | OK | OK | OK | OK* |
| Passivated Zinc | Degrease. | Good | OK | Good | Good | OK | Good | Good | Good* |
| PBT (Polybutylene Terephthalate) | Bond as received. | Not suitable | POP + 105 or 2050 | Poor | Use ES574X grades | Poor | Poor | TA46XX range | Not suitable |
| PEEK (Polyeth-eretherketone) | Bond as received. | Not suitable | Poor | OK | Poor | Poor | Poor | Poor | Good* |
| PET (Polyethylene Terephthalate) | Bond as received. Flame, corona or plasma treatment may help to improve bond strength. | Not suitable | OK | Poor | Poor | OK | Poor | Poor | OK* |

*Beware shadow areas

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TA=Structural Acrylic PT=Two-Part Polyurethane UV= UV Curable

# Surface Preparation

| Surface | Preparation Method | AA | CA | ET | ES | MS | PT | TA | UV |
|---|---|---|---|---|---|---|---|---|---|
| PET - G | Depending on the type of PET - G, chemistries marked "OK" may be used. Check with Permabond. | Not suitable | OK | Poor | Poor | OK | Poor | Check with PB | OK* UV6302 only |
| Phenolic | Bond as received. | Not suitable | Good | Good | Good | OK | Good | Good | Good* |
| Plaster | Remove large particles of dust and debris with a stiff brush. Ensure surface is dry & clean and free of oil. | Not suitable | Not suitable | OK | Not suitable | Very good | OK | OK - use pre-mix | Not suitable |
| Polycarbonate | Bond as received. Beware stress cracking. | Not suitable | Good | OK | Not suitable | OK | OK | Good | Good* |
| Polyethylene | Flame / Corona / Plasma treat (then most adhesives will bond well apart from CAs as these treatments dry out polyethylene). | Not suitable | Poor | Good | Not suitable | OK | Good | Good | Good* |
| | Untreated. | Not suitable | POP + 105 or 2050 | Not suitable | Not suitable | Not suitable | Not suitable | TA46XX range | Not suitable |
| Polypropylene | Flame / Corona / Plasma treat (then most adhesives will bond well). | Not suitable | Good | Good | Not suitable | OK | Good | Good | Good* |
| | Untreated. | Not suitable | POP + 105 or 2050 | Not suitable | Not suitable | Not suitable | Not suitable | TA46XX range | Not suitable |
| Polystyrene | Bond as received. Beware stress cracking. | Not suitable | OK-may attack | OK | Not suitable | OK | Good | Good | Good* |
| PPS (Polyphenylene Sulfide) | Can be bonded as received. Light abrasion may help increase mechanical bond strength. | Not suitable | OK - use 79X surface insensitive grades | Good | Not suitable | OK | OK | OK | Good* |
| Polyurethane | Elastomeric PU or TPU: can be bonded as received. | Not suitable | OK-use POP / 74X flexi' grades | Not suitable | Not suitable | Not suitable | Not suitable | Not suitable | Not suitable |
| | Rigid PU: abrade and degrease. Some PUs resist abrasion. | Not suitable | OK | Good | Not suitable | OK | Good | Good | OK* |
| PTFE (commonly known as Teflon) | Untreated. | Not suitable | POP + 105 or 2050 | Poor | Poor | Poor | Poor | TA46XX range | Poor* |
| | Chemical etch (e.g. TetraEtch). | Not suitable | Good | Good | Good | OK | OK | TA46XX range | OK* |
| PVC (Polyvinyl Chloride) | Rigid: Can be bonded as received. Light abrasion may help increase mechanical bond strength. | Not suitable | Good | Good | Not suitable | Good | Good | Good | Good* |
| | Flexible / plasticised: Degrease. | Not suitable | Good | Poor | Not suitable | OK | Poor | Poor | Poor* |
| SAN (Styrene Acrylonitrile) | Can be bonded as received. Light abrasion may help increase mechanical bond strength. | Not suitable | Good | OK | Not suitable | OK | OK | TA46XX range | OK* |
| Silicone | Degrease. | Not suitable | POP + 731, 2050 or 105 | Not suitable | Not suitable | Not suitable | Not suitable | Not suitable | Not suitable |
| SMC (Sheet Moulding Compound) | Abrade and degrease. | Not suitable | OK | OK | Not suitable | Good | OK | OK | Not suitable |
| Stainless Steel | Degrease. Abrasion or shot blasting is necessary to remove the oxide film which has a low surface energy. Power tools can heat the metal causing it to re-oxidise instantly so keep metal cool. 2K Primer is effective with abrasion. Mirror-finish stainless steel can be particularly problematic. | OK - Use HM135 or HM163. A905 may be needed. | Good - use 910 or 73X | Good - use ET539X range | Good | Good | Good | Good - use TA4207 | Good* |
| Steel | Abrade & degrease. | Good | Good - esp. 910 | Good | Very good | Good | Good | Very good | Good* |
| Stone | Remove large particles of dust and debris with a stiff brush. Ensure surface is dry & clean and free of oil. | Not suitable | Poor | Good | Not suitable | Good | Good | OK beware initiator staining | OK* |
| Tufnol | Bond as received. | Not suitable | Good | Good | Good | Good | Good | Good | Not suitable |
| Tungsten Carbide | Degrease (allow ample time for solvent to evaporate from pores). Can be shotblasted or etched with concentrated nitric acid. | OK | Poor | Good | Very Good | Poor | Poor | Good | Not suitable |
| Viton | Bond as received or degrease. | Not suitable | Good | Not suitable | Not suitable | Poor | Not suitable | Not suitable | Not suitable |
| Wood | Can be lightly abraded and degreased. | Not suitable | Good - CSA may be needed | Very good | Not suitable | Good | Good | Good | Not suitable |
| Zinc | Degrease. | Very good | OK | Good | Good | OK | Good | Good | Good* |

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# Surface Preparation

## *Surface Preparation Techniques:*

**Degrease.** Several different solvents can be considered:
- Acetone: suitable for metals, too aggressive for most plastics
- Isopropanol: suitable for most surfaces *(Advice: patch test)*
- Permabond Cleaner A: suitable for most surfaces *(Advice: patch test)*

Do not use methylated spirit, white spirit: these can leave residue.

**Abrade:** Degrease before abrading contaminated parts, otherwise dirt will become ingrained. Abrasion can be carried out using:
- Carborundum (grit) paper - typically 320 grade
- Red Scotchbrite™
- Grit /sandblaster with fresh grit *(Advice: be cautious of contamination)*
- If there is a lot of rust to remove then a wire brush or wire wool may be appropriate.

Degrease again after abrasion to remove debris. Bond components as soon as possible after treatment to prevent re-oxidation.

**Chemical Etching:** The solution will depend on the substrate being etched. Further details and "recipes" are available on the Permabond distributor website.

**Flame Treatment:** Certain low surface energy plastics respond well to flame treatment. This is where components are quickly passed over or through the hottest part of the flame. Success will depend on the size and shape of the parts and normally require specially designed equipment and careful set-up to ensure optimal treatment *(Advice: over treatment can be just as bad as under treatment)*.

Check out page 25 for our range of surface preparation products

**Plasma and Corona Treatment:** These help modify the surface energy of hard-to-bond plastics and can also improve difficult surfaces such as stainless steel. Plasma treatment is ideal for awkward 3D objects and very effective at increasing the surface energy of stainless steel. Equipment can be a significant investment although lower cost plasma pens are now available.

**2K Primer:** is ideal for preparing metal, glass, plastic and composite materials ready for bonding with engineering adhesives. It contains an adhesion promotor which increases adhesion strength. It also gives a visible indication of whether a surface is "wetting out" properly (i.e. ready for bonding - see bottom of page) or if further surface preparation is required. Permabond 2K Primer helps to protect metal surfaces, thus improving durability in harsh conditions.


### *SURFACE WETTABILITY*

A "wettable" surface is one which is said to be "high energy". Liquid can be spread across the surface without the bunching of droplets. Low surface energy materials which do not "wet out" leave liquid droplets standing proud - imagine a freshly waxed car sprayed with water droplets - the drops bunch up at a steep angle to the paintwork.

Good wetting - high surface energy

Poor wetting - low surface energy

Surface energy is normally measured in mJ/m² or Dynes. Generally to be able to bond a material it needs to have a surface energy of >36 mJ/m² (although this can still be quite hard to bond to). By modifying the surface (by chemical etching, flame, corona or plasma treatment) the wettability can be improved significantly.

Table showing surface energy values of common engineering materials. Figures in mJ/m².

| Metals/ Other Materials | High Surface Energy Plastics | Low Surface Energy Plastics |
|---|---|---|
| Aluminium: 850 | ABS: 42 | Acetal: 36 |
| Copper: 1100 | Acrylic: 38 | EVA: 33 |
| Glass: 250-500 | Kapton: 50 | PE (Polyethylene): 31 |
| Lead: 450 | Noryl resin: 38 | PP (Polypropylene): 29 |
| Tin: 500 | Nylon: 46 | Polystyrene: 36 |
| Zinc: 750 | Phenolic: 46 | PTFE (Teflon®): 18 |
| | Polycarbonate: 42 | PVA: 37 |
| | Rigid PVC: 39 | PVF: 28 |

# Chemical Compatibility

| Liquid Compatibility of Anaerobics<br>NB High temperatures and highly concentrated solutions may degrade adhesives. | |
|---|---|
| Acetic Acid | Low concentration only |
| Acetone | OK |
| Alcohol | OK |
| Ammonia | Use high strength grade |
| Animal Fat | OK |
| Battery Acid | Use high strength grade for low concentrations only |
| Bleach | OK |
| Bromine | Not suitable |
| Carbolic Acid | Low concentration only |
| Carbonic Acid | Low concentration only |
| Cement | OK |
| China Clay | OK |
| Chromic Acid | Use high strength grade |
| Copper Sulphate | OK |
| Creosote | OK |
| Cyanide Solution | Low concentration only |
| Detergents | OK |
| Dielectric Fluid | Depends on brand |
| Diesel | OK |
| Dye Stuffs | Depends on solvent |
| Ethyl Acetate | OK |
| Ferric Chloride | Low concentration only |
| Fertilizer | Depends on brand |
| Formaldehyde | Use high strength grade |
| Glycerine | OK |
| Hexane | OK |
| Hydrochloric Acid | Use high strength grade for low concentrations only |
| Ink | OK |

| Liquid Compatibility of Anaerobics<br>NB High temperatures and highly concentrated solutions may degrade adhesives. | |
|---|---|
| Insecticide | Depends on brand |
| Isocyanate Resin | OK |
| Jet Fuel | OK |
| Kerosene | OK |
| Lactic Acid | OK |
| Nitric Acid | Not suitable |
| Oil (hydraulic) | OK |
| Oil (linseed) | OK |
| Oil (lubricating) | OK |
| Oil (mineral) | OK |
| Paraffin | OK |
| Perfume | OK |
| Petrol | OK |
| Petroleum Jelly | OK |
| Photo Developer | OK |
| Phosphoric Acid | Use high strength grade for low concentrations only |
| Sewage | OK |
| Shellac | OK |
| Sodium Hydroxide | Use high strength grade for low concentrations only |
| Starch | OK |
| Sugar | OK |
| Sulphuric Acid | Use high strength grade for low concentrations only |
| Sulphurus Acid | Use high strength grade |
| Toluene | OK |
| Trichloroethane | OK |
| Turpentine | OK |
| Water (fresh/sea) | OK |
| Xylene | OK |

| Gas Compatibility of Anaerobics<br>NB High temperatures and highly concentrated solutions may degrade adhesives. | |
|---|---|
| Air | OK |
| Carbon dioxide | OK |
| Carbon monoxide | OK |
| Chlorine | Not suitable |
| Freon | Use high strength grade |
| Helium | OK |
| Methane | OK |
| Natural gas | OK |
| Pure oxygen | MH052 only |
| Ozone | Not suitable |
| Propane | OK |
| High pressure steam | Not suitable |

| *Chemistry* | *Polar Solvents* | *Non-Polar Solvents* |
|---|---|---|
| Anaerobic | Excellent | Excellent |
| Cyanoacrylate | Poor | Good |
| 2-Part Epoxy | Very Good | Very Good |
| 1-Part Epoxy | Very Good | Very Good |
| UV-Curable | Good | Good |
| 2-Part PU | Good | Good |
| MS Polymer | Very Good | Good |

Resistance of adhesives chemistries against solvents (general guideline).

# Anaerobics

The Permabond range of anaerobic adhesives is formulated to provide superior performance benefits in applications with self-supporting or closely-mating metallic components such as retaining bearings, threadlocking, flange sealing, gasketing and sealing pipe work.

## How do Permabond anaerobic adhesives work?

Permabond anaerobic adhesive formulations are designed to cure when air is absent and metal surfaces (both ferrous and non-ferrous) are present. The liquid adhesive fills imperfections in the metal surfaces and gaps between the mated parts. The adhesive then rapidly cures to an inert acrylic adhesive/sealant creating a solid 100% mechanical surface-to-surface contact and physical lock.

## Retaining Compounds:

Retaining adhesives are for the permanent bonding of co-axial joints. Typical applications include:

- Bearings into housings
- Bushes
- Keyways and splines
- Gears
- Rotors
- Pulleys
- Cylinder linings

Benefits of using retaining adhesive include rapid, quick and easy assembly of parts. Tolerances can be relaxed, reducing machining times and eliminating the need for interference fits. Adhesive strength is usually higher than alternative methods of fixture. Adhesives have a better fatigue life as they prevent metal fretting (which can be an issue with interference fits).

**Handy Tip:** Apply adhesive to leading edges of both components and assemble with a rotating action. Take extra care to prevent adhesive entering mechanisms and bearing races!

## Threadlocking:

Permabond threadlocking anaerobic adhesives enable you to lock screws, nuts, bolts and studs to protect against loosening caused by vibration.

### Benefits

- Prevents nuts rusting on to bolts.
- Permabond offer a range of strengths - low strength for large parts which may require future disassembly, medium strength and high strength permanent threadlockers to prevent theft and vandalism.
- Stops nuts and bolts working loose through vibration.
- More cost-effective than using mechanical fastenings.
- Machining tolerances can be increased.
- Lubricates for easier assembly.
- Seals against leaks.

**Handy Tip:** For blind holes, apply the adhesive directly into the bottom of the hole, not the fastener. If there is a void then apply the adhesive to the internal thread instead.

## Pipe Sealing

Permabond pipesealing anaerobic adhesives are designed to replace traditional thread sealing materials such as hemp, PTFE tape, Boss White® and Boss Green® (for potable water).

### Benefits

- No loose particles to clog valves.
- Will not shred, creep or relax over time.
- Easy to apply, allows accurate positioning of pipes and fittings.
- Lubricates for easier assembly.
- Seals to the burst pressure of the pipe when fully cured.
- Suitable for water, gas, air and hydraulic systems.
- Resistant to a wide variety of chemicals.

**Handy Tip:** Pipe joints sealed with low-strength pipesealants can be dismantled using normal tools. Heating parts with a hot air gun or blow torch will help weaken adhesive and make parts easier to undo. Before re-using, clean pipe joints with a wire brush & chemically clean / degrease.

## Gasketing

Permabond gasketing anaerobic adhesives are designed to replace traditional cork, wood, rubber, paper & silicone gaskets.

### Benefits

- No relaxation or shrinkage so no need to retighten over time.
- One adhesive will replace many pre-cut gasket shapes.
- No need to handle fragile gaskets.
- No disintegration so no leaks or blockages.
- Vibration proof.
- No long-term embrittlement.
- Easy to dismantle with normal tools.
- Less machining - surfaces need not be so smooth.
- 100% metal to metal contact = better stress distribution.


Not only do liquid gasketing adhesives give 100% contact between metal parts, but they also allow the engineer to cut down the amount of surface-finish machining, therefore reducing costs & increasing production rate.


# Anaerobic Product Chart

| Use | Grade | Features | Colour | Viscosity (mPa.s) | Max. Gap Fill (mm) | Handling Time (mins) | Shear Strength* (MPa) | Torque Strength (Nm)* | | Service Temp. (°C) | Availability |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Breakaway | Prevail | | |
| Threadlocking | A011 | Low strength. | Red | 500 | 0.12 | 15 | 5 | 4 | 5 | -55 to +150 | Standard |
| | A113 | General purpose. | Blue | 500 | 0.12 | 15 | 12 | 12 | 7 | -55 to +150 | Standard |
| | A1042 | Rapid cure. | Blue | 2rpm: 8,000<br>20rpm: 1,700 | 0.12 | 5 | 12 | 16 | 8 | -55 to +150 | Standard |
| | HH131 | High temperature. | Red | 2rpm: 23,000<br>20rpm: 7,500 | 0.3 | 15 | 17 | 27 | 54 | -55 to +230 | Standard |
| | HM071 | CoSHH friendly. | Green | 500-600 | 0.12 | 25 | N/A | 22 | 40 | -55 to +150 | Niche |
| | HM129 | Permanent. | Red | 500 | 0.15 | 10 | 17 | 33 | 58 | -55 to +150 | Standard |
| | MM070 | CoSHH friendly. | Blue | 2rpm: 5,500<br>20rpm: 2,500 | 0.12 | 25 | N/A | 20 | 12 | -55 to +150 | Niche |
| Retaining | A025 | High temperature. | Orange | 750 | 0.2 | 15-30 | 8 | 13 | 23 | -55 to +200 | Standard |
| | A118 | Low viscosity. | Green | 400 | 0.12 | 15 | 21 | 33 | 58 | -55 to +150 | Standard |
| | A126 | Wicking. | Green | 10-30 | 0.05 | 15 | 10-20 | 14 | 34 | -55 to +150 | Standard |
| | A134 | High viscosity. | Green | 2rpm: 70,000<br>20rpm: 8,000 | 0.5 | 15 | 21 | 30 | 50 | -55 to +150 | Standard |
| | A140 | Sealing gas fittings. | Green | 2rpm: 37,500<br>20rpm: 10,000 | 0.5 | 10-25 | 21 | 33 | 58 | -55 to +150 | Niche |
| | F200 | Toughened. | Brown | 150 | 0.1 | 10-25 | 30 | 28 | 30 | -55 to +100 | Niche |
| | F201 | Toughened. Good for copper piping. | Brown | 2rpm: 9,000<br>20rpm: 2,500 | 0.2 | 15 | 30 | 28 | 30 | -55 to +100 | Standard |
| | F202 | Toughened. | Brown | 2rpm: 135,000<br>20rpm: 20,000 | 0.5 | 15 | 30 | 28 | 30 | -55 to +100 | Standard |
| | A1024 | Wicking. | Yellow | <10 | 0.05 | <20 | 21 | N/A | N/A | -55 to +150 | Niche |
| | A1046 | Rapid cure. | Green | 2rpm: 9,000<br>20rpm: 2,500 | 0.25 | 5-10 | 25 | 30 | 50 | -55 to +150 | Standard |
| | A1062 | Dual cure AA/UV. | Green | 10-20 | 0.05 | 20 | 7 | N/A | N/A | -55 to +150 | Niche |
| | HH167 | Metal repair. | Silver | 2rpm: 500,000 P<br>20rpm: 90,000 | 0.5 | 15 | 32 | 45 | 32 | -55 to +150 | Standard |
| | HM135 | Rapid cure. | Green | 700 | 0.2 | 5-10 | 30 | 31 | 50 | -55 to +200 | Standard |
| | HM162 | High temperature. | Green | 1,000 | 0.2 | 5 | 30 | 32 | 57 | -55 to +200 | Standard |
| | HM163 | For stainless steel. | Green | 3,500 | 0.2 | 5 | 28 | 30 | 55 | -55 to +150 | Niche |
| | HM165 | High temperature. | Green | 2rpm: 25,000<br>20rpm: 10,000 | 0.3 | 15-20 | 20 | 35 | 50 | -55 to +230 | Standard |
| Threadsealing | A129 | Medium strength. | Orange | 2rpm: 65,000<br>20rpm: 20,000 | 0.5 | 15 | 12 | 12 | 7 | -55 to +150 | Standard |
| | A131 | Low strength. | White | 2rpm: 40,000<br>20rpm: 6,000 | 0.5 | 45 | 6 | 10 | 7 | -55 to +150 | Standard |
| | A1044 | High strength. | White | 2rpm: 70,000<br>20rpm: 9,000 | 0.5 | 15 | 17 | 20 | 10 | -55 to +150 | Standard |
| | A1058 | Very slow set. | White | 300,000 P | 0.5 | 90 | 8 | 8 | 6 | -55 to +150 | Niche |
| | MH052 | For oxygen pipework & stainless steel. | Yellow | 2rpm: 65,000<br>20rpm: 25,000 | 0.5 | 15 | 10 | 20 | 11 | -55 to +150 | Standard |
| | MH072 | CoSHH friendly. | Yellow | 2rpm: 65,000<br>20rpm: 25,000 | 0.5 | 30 | N/A | 18 | 8 | -55 to +150 | Niche |
| Gasketing | A136 | General purpose, Toughened. | Red | 2rpm: 75,000<br>20rpm: 18,000 | 0.5 | <30 | 12 | 10 | 8 | -55 to +150 | Standard |
| | LH197 | Flexible. | Green | 2rpm: 50,000<br>20rpm: 20,500 | 0.3 | 20 | 5 | 10 | 5 | -55 to +150 | Standard |
| | MH196 | High temperature. | Red | 2rpm: 500,000 P<br>20rpm: 100,000 | 0.5 | 15 | 10 | 20 | 23 | -55 to +200 | Standard |
| | MH199 | High temperature. | Red | 2rpm: 225,000<br>20rpm: 75,000 | 0.5 | 20 | 8 | 20 | 12 | -55 to +200 | Standard |
| | A905 | Surface activator | Green | ~ 0.7 | - | - | - | - | - | - | Standard |

*P=Paste / *Tests done on mild steel*

*NB. Niche products may be subject to MOQ and special lab approval required for samples.*

# Cyanoacrylates

Permabond cyanoacrylate adhesives bring a wide variety of performance benefits to the production environment. These benefits include joining dissimilar and hard-to-bond materials, quick curing with very strong adhesion and a wide range of viscosities. Permabond one-part cyanoacrylates are a versatile solution for even the most demanding manufacturing and assembly applications.

### How do Permabond cyanoacrylate adhesives work?

Permabond cyanoacrylate adhesives are one-part adhesives that cure by reacting with minute traces of moisture on the surface of the material being bonded. Permabond cyanoacrylates cure in seconds at ambient temperatures and have been formulated to bond flexible or rigid surfaces made from a wide range of plastics, rubbers and metals.

Permabond cyanoacrylates are available in a range of viscosities and material adhesion capabilities. These adhesives have been developed to bond a variety of porous and non-porous surfaces and to bond rigid or flexible materials.

### Typical applications include:

- Electronics wire tacking
- Bonding blue-tooth headsets
- Hose clips onto automotive tubes
- Bonding automotive interior trim
- Tacking parts during assembly process (temporarily)
- Joining silicone O-rings
- Disposable medical device bonding
- Bonding mobile phone casing, antennae & keypads
- Sealing batteries
- Glazing applications
- Sealing transformer laminates

### Permabond low and medium viscosity cyanoacrylate formulations provide:

- Superior bonding to plastic, wood and rubber.
- Excellent bond strength when joining metal to plastic, or rubber to metal.
- Inherent corrosion resistance; protects part assembly from degradation.

### Permabond high viscosity cyanoacrylate adhesives provide:

- Formulations for use in vertical applications or on porous surfaces.
- Gap filling ability up to 0.5mm.
- Fast cure time; speeds production rates.
- High-strength adhesion, up to 25MPa; shear strength exceeds that of many substrate materials.

## Benefits

- One-part adhesive chemistry speeds preparation and application.
- Join dissimilar materials, such as rubber to metal, with no compromise in bond strength.
- Cures in seconds at room temperature; eliminates need for costly jigs or ovens; accelerates assembly rates.
- Gap fill up to 0.5mm.
- Solvent free; non flammable.
- Superior bond strength; often exceeds that of substrate material.
- Low odour non-blooming products available
- High-temperature resistance (up to 250°C).


**Handy Tip:** 'Less is more' - cyanoacrylates are very efficient so only small drops are required to obtain a high-strength bond.

# Cyanoacrylate Product Chart

| Grade | Features | Viscosity (mPa.s) | Max. Gap Fill (mm) | Shear Strength * (MPa) | Handling Time (seconds) | | | Service Temp. (°C) | Availability |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Rubber | Phenolic | Steel | | |
| 101 | Low viscosity, penetrating grade. | 2-3 | 0.05 | 19-23 | 2-5 | 5-10 | 3-5 | -55 to +80 | Standard |
| 102 | General purpose. | 70-90 | 0.15 | 19-23 | 5-10 | 10-15 | 10-15 | -55 to +80 | Standard |
| 105 | Difficult rubbers (e.g. EPDM). | 30-50 | 0.1 | 18-22 | 5-10 | 5-10 | 10-15 | -55 to +80 | Standard |
| 240 | High viscosity, slow cure. | 1,200-2,500 | 0.4 | 21-25 | 15-20 | 15-20 | 15-20 | -55 to +80 | Standard |
| 731 | Toughened. | 100-200 | 0.15 | 24-30 | 15-20 | 15-20 | <30 | -55 to +120 | Standard |
| 735 | Toughened, black. | 100-200 | 0.15 | 24-30 | 10-15 | 5-10 | 30-50 | -55 to +120 | Standard |
| 737 | Toughened - impact and peel resistant. Black. | 2,000-4,000 | 0.5 | 19-23 | 10-15 | 5-10 | 15-20 | -55 to +120 | Standard |
| 741 | Highly flexible, colourless, fast setting, low viscosity, elongation: 125%. | 2-3 | 0.05 | 6-8 | 2-7 | N/A | 1-5 | -55 to +80 | Standard |
| 743 | Highly flexible, colourless, high elongation: 400%, low strength threadlocker. Low viscosity, flexible & soft. | 2-3 | 0.05 | 0.5-1.5 | 2-7 | N/A | 2-5 | -55 to +80 | Standard |
| 743HT | Highly flexible, colourless, high elongation: 350%, thixotropic, flexible & soft. | 20rpm: 2,000-5,000<br>2rpm: 10,000 - 20,000 | 0.3 - 0.012 | 1-2 | 2-5 | N/A | 2-5 | -55 to +80 | Standard |
| 748 | Highly flexible, colourless, higher strength on metals, thixotropic gel, elongation: 65%. | 20rpm: 2,000-8,000<br>2rpm: 30,000 - 50,000 | 0.5-0.02 | 8-12 | 2-5 | N/A | 8-12 | -55 to +80 | Standard |
| 791 | Ultra fast cure, low viscosity. | 15-50 | 0.1 | 18-22 | 2-3 | 2-3 | 2-3 | -55 to +80 | Standard |
| 792 | Ultra fast cure, general purpose. | 60-125 | 0.15 | 18-22 | 2-3 | 2-3 | 2-3 | -55 to +120 | Standard |
| 801 | High temperature resistance. | 10-15 | 0.05 | 19-23 | 10-15 | 10-15 | 10-15 | -55 to +130 | Standard |
| 802 | High temperature resistance. | 90-110 | 0.15 | 19-23 | 10-15 | 10-15 | 10-15 | -55 to +160 | Standard |
| 820 | High temperature resistance. | 90-110 | 0.15 | 19-23 | 10-15 | 10-15 | 10-15 | -55 to +200 | Standard |
| 910 | Metal bonding. | 70-90 | 0.15 | 23-29 | 10-15 | 10-15 | 10-15 | -55 to +90 | Standard |
| 920 | Highest temperature resistance. | 70-90 | 0.15 | 19-23 | 10-15 | 10-15 | 15-20 | -55 to +250** | Standard |
| 940 | Low odour, low bloom. | 3-10 | 0.05 | 16-20 | 2-5 | 10-15 | 10-15 | -55 to +80 | Standard |
| 941 | Low odour, low bloom. | 10-20 | 0.08 | 16-20 | 2-5 | 10-15 | 10-15 | -55 to +80 | Standard |
| 943 | Low odour, low bloom. | 90-110 | 0.15 | 16-20 | <5 | 5-10 | 10-15 | -55 to +80 | Standard |
| 947 | Low odour, low bloom. | 900-1,500 | 0.25 | 16-20 | 2-5 | 10-15 | 20-30 | -55 to +80 | Standard |
| 2010 | Very fast cure, thixotropic. | 20rpm: 2,000-2,500<br>2rpm: 10,000-20,000 | 0.5 | 19-23 | 10-15 | 10-15 | 10-15 | -55 to +80 | Standard |
| 2011 | Non-drip, non sag gel. | Gel | 0.5 | 20-24 | 5-10 | 5-10 | 5-10 | -55 to +120 | Standard |
| 2012 | Low-odour gel. | 20rpm: 10,000-25,000<br>2rpm: 50,000-150,000 | 0.5 | 16-20 | <30 | <30 | <30 | -55 to +80 | Niche |
| 2013 | High-temperature gel. | 20rpm: 8,000-13,000<br>2rpm: 35,000-50,000 | 0.5 | 21-22 | <30 | <30 | <30 | -55 to +160 | Niche |
| 2050 | High viscosity, flexible. | 1,200-1,800 | 0.2 | 16-20 | 5-10 | 5-10 | 10-15 | -55 to +80 | Standard |
| CPP621 | Fingerprinting grade. | 1-3 | 0.05 | N/A | <10 | <5 | <15 | -55 to +80 | Niche |
| 3D90 | 3D Print infiltrant. | 4 | - | 16-20 | 2-5 | 10-15 | 20-30 | -55 to +80 | Niche |
| 4C10 | Medical device bonding. | 30-50 | 0.1 | 18-22 | 5-10 | 5-10 | 10-15 | -55 to +80 | Niche |
| 4C20 | Medical device bonding. | 400-600 | 0.25 | 20-22 | 10 | 10 | 10 | -55 to +80 | Niche |
| 4C30 | Medical device bonding. | 1,500 | 0.38 | 20-22 | 15 | 15 | 15 | -55 to +80 | Niche |
| 4C40 | Medical device bonding. | 2,000 | 0.43 | 20-22 | 5-10 | 5-10 | 5-10 | -55 to +80 | Niche |
| POP | Polyolefin surface primer. | 0.6 | For priming PE, PP, Silicone, PTFE before bonding with CA | | | | | | Standard |
| CA Solvent 2 | Cyanoacrylate solvent remover. | <20 | For debonding and removing cyanoacrylate | | | | | | Niche |
| CSA | Surface activator. | 0.7 | When using the cyanoacrylate adhesives to bond to acidic or porous surfaces, the use of Permabond CSA prior to bonding may be beneficial. Post assembly application of CSA-NF may also assist in the curing of adhesive fillets outside the bond area or in preventing the 'blooming' phenomenon sometimes associated with the use of this type of adhesive. | | | | | | Standard |
| CSA-NF | Non-blooming surface activator. | 1 | | | | | | | |


*NB. Niche products may be subject to MOQ and special lab approval required for samples.*

**Post cure required*

# Structural Acrylics

Permabond structural acrylic adhesives are suitable for bonding a wide variety of materials. The rapid, room-temperature cure coupled with high strength and durability, make these adhesives ideal for demanding applications where speed and ease of application of the adhesive is important.

## *Permabond structural acrylic adhesives are suitable for a variety of applications*

They are ideal for structural bonding of metals, composites, plastics, glass, wood and other materials. Permabond's structural acrylic adhesives offer excellent durability and resist tensile, peel, cleavage and impact forces. They resist the stresses of differential thermal expansion when bonding dissimilar materials.

Permabond structural acrylics are formulated with chemical resistance in mind, so are suitable for applications that involve exposure to oils, greases, moisture and weathering.

## *Typical applications include:*

- Magnet bonding (particularly for electric motors)
- Metal & glass furniture manufacturing
- Street signs
- Rear view mirror attachment
- Structural bonding - e.g. aluminium stiffeners
- Shopfittings and facias

## *Permabond offers several types of structural acrylic adhesive:*

**No-Mix Adhesive & Initiator**
Initiator is applied to one of the bonding surfaces and the adhesive to the other. Suited to bonding close fitting parts, this system provides a long open time and a short cure time.

**Bead on Bead Part A & Part B**
A bead of one part is applied directly over a bead of the other part. No hand mixing is required. When the two components are pressed together, enough mixing will take place to cure the adhesive.

**2-Part Pre-Mix Resin & Hardener**
Adhesive is supplied in convenient 1:1 cartridges for use with a dispensing gun. Adhesive is dispensed via a static mixing nozzle directly onto the substrate material.

**Single Component - No mixing required**
These adhesives are simple to apply and cure with or without an activator (activator can be used to reduce cure times to seconds and to cure through larger gaps).


# Benefits

- Room temperature cure - eliminates ovens & other equipment.
- Rapid cure - increases daily output to reduce production costs.
- Non-flammable & solvent-free formulations available - provides a safe and comfortable work environment.
- Versatile - suitable for bonding a wide variety of substrates to increase design freedom.
- Technical support- application specialists available for assistance with joint design, adhesive selection & production process.

# Structural Acrylic Product Chart

| Grade | Features | Colour (Mixed) | Viscosity (mPa.s) | Max. Gap Fill (mm) | Fixture Time* | Working Strength* | Shear Strength (MPa) | Service Temp. (°C) | Availability |
|---|---|---|---|---|---|---|---|---|---|
| TA430 & Initiator 41 | Very high strength on metals, plastics, ceramics & wood. Fast cure on close fitting parts. | Resin: Amber<br>Initiator: Brown<br>Mixed: Amber | 20rpm: 20,000<br>2.5rpm: 50,000 | 0.5 | 1-2 mins | 40-60 mins | 15-25 | -55 to +120 | Standard |
| TA435 & Initiator 41 | Very high strength on metals, ferrites and thermoplastics. High impact applications. | Resin: Amber<br>Initiator: Brown<br>Mixed: Amber | 20rpm: 30,000<br>2.5rpm: 70,000 | 0.5 | 1-2 mins | 30-60 mins | 15-25 | -55 to +120 | Standard |
| TA436 & Initiator 43 | Very high strength on metals, ferrites & hard plastics. High impact & high temperature app's. | Resin: Amber<br>Initiator: Green<br>Mixed: Green | 20rpm: 25,000<br>2.5rpm: 60,000 | 0.5 | 20-30 secs | 30-60 mins | 15-25 | -55 to +150 | Standard |
| TA437 | 1-part. For ferrites & metals in high temp' applications. Initiator 41 (I41) accelerates cure. | Resin: Orange<br>Initiator: Brown<br>Mixed: Dark orange | 20rpm: 40,000<br>2.5rpm: 130,000 | 0.5 | 5-10 mins<br>20-30 secs +I41 | 60-120 mins<br>30-60 mins (+ I41) | 14-20 | -55 to +200 | Standard |
| TA439 & Initiator 43 | Methacrylic acid free structural adhesive for magnet bonding. Ideal for sealed electric motors. High temperature resistance. | Resin: Amber<br>Initiator: Green<br>Mixed: Green | 1,000 | 0.15 | 20-40 secs | 3-5 mins | 20-25 | -55 to +165 | Standard |
| TA440 | Bead on bead for rapid bonding of metal, glass, wood and rigid plastics. | Resin: Amber<br>Initiator: Green<br>Mixed: Green | Mixed: 10,000 | 0.5 | 15-30 secs | 30-60 mins | 15-25 | -55 to +120 | Standard |
| TA452 | Low-odour, fast curing with excellent adhesion to metals. | Part A: Red<br>Part B: Green<br>Mixed: Burgundy | Mixed: 4,500 | 0.5 | Nozzle life: 2-3 mins | Handling time: 6-9 mins | 20-24 | -55 to +130 (continuous) +150°C (peak) | Standard |
| TA459 & Initiator 43 | High viscosity version of TA439. | Resin: Clear<br>Initiator: Green<br>Mixed: Green | 20rpm: 20,000<br>2.5rpm: 80,000 | 0.5 | 20-40 secs | 3-5 mins | 20-25 | -55 to +165 | Standard |
| TA4246 & Initiator 46 ** | No-mix resin & initiator for high strength bonding of metal, glass, composites and plastics. | Resin: Amber<br>Initiator: Brown<br>Mixed: Amber | 23,000 | 0.5 | 1-2 mins | 15-30 mins | 33-35 | -40 to +120 | Standard |
| TA4200 ** | 2-part 1:1 rapid curing, gap filling, toughened. Ideal for structural bonding. | Part A: Cream<br>Part B: Cream<br>Mixed: Cream | Mixed: 45,000 | 2 | 7-10 mins | 25-35 mins | 23-25 | -40 to +150 (continuous +180°C peak) | Standard |
| TA4202 ** | 2-part 1:1 very rapid cure, can be applied bead on bead, multipurpose. | Part A: Pink<br>Part B: Green<br>Mixed: Grey | Mixed: 4,000 | 0.5 | 2-3 mins | 20-25 mins | 24-25 | -40 to +150 (continuous +180°C peak) | Standard |
| TA4204 ** | Crystal clear, very rapid cure. Can be applied bead on bead. Suitable for galvanised steel. | Part A: Clear<br>Part B: Clear<br>Mixed: Clear | Mixed: 55,000 | 3 | 90-150 secs | 20-25 mins | 19-21 | -40 to +150 (continuous +180°C peak) | Standard |
| TA4205 ** | Slightly slower version of TA4204. | Part A: Clear<br>Part B: Clear<br>Mixed: Clear | Mixed: 100,000 Thixo gel | 3 | 3-4 mins | 25-30 mins | 19-21 | -40 to +150 (continuous +180°C peak) | Niche |
| TA4207 ** | Multi-purpose, 2-part 1:1 adhesive. Excellent shear strength on many substrates with little surface preparation. | Part A: Straw<br>Part B: Yellow<br>Mixed: Straw | 2,500 | 0.5 | 8-10 mins | 25- 30 mins | 25-29 | -40 to +150 (continuous +180°C peak) | Standard |
| TA4210 ** | 2-part 1:1 longer handling time than TA4200, gap filling, toughened. Ideal for aluminium. | Part A: Cream<br>Part B: Cream<br>Mixed: Cream | Mixed: 45,000 | 2 | 20-25 mins | 50-60 mins | 23-25 | -40 to +150 (continuous +180°C peak) | Niche |
| TA4522 | Low odour, fast curing with excellent adhesion to plastics. | Part A: White<br>Part B: Green<br>Mixed: Green | Mixed: 4,500 | 0.5 | Nozzle life: 4-7 mins | Handling time: 10-15 mins | 21-23 | -55 to +130 (continuous) +150°C (peak) | Standard |
| TA4590 & Initiator 44 | Methacrylic acid free, for sensitive electronic components. Prevents corrosion of copper parts. | Resin: Blue<br>Initiator: Green<br>Mixed: Turquoise | 20rpm: 20,000<br>2.5rpm: 90,000 | 0.5 | 15-30 secs | 2-3 mins | 20-25 | -55 to +165 | Niche |
| TA4592 | Use with external mix equipment for high speed production lines. Rapid cure speed, no mixing nozzles. | Resin: Blue<br>Initiator: Yellow/green<br>Mixed: Turquoise | 20rpm: 9,000<br>2.5rpm: 32,000 | 1.0 | <30 secs | 3-5 mins | 20-25 | -55 to +120 | Niche |
| TA4605 | 2-part 1:1 for low surface energy plastics (PP/PE). | Part A: Off-white<br>Part B: Translucent<br>Mixed: Off-white | Mixed: 125,000 | 1.0 | 5-10 mins | 2-4 hrs | PP: 5-8<br>PE: 3-6 | -55 to +100 | Standard |
| TA4610 | 2-part 1:1 for low surface energy plastics (PP/PE) Slower version of TA4605. | Part A: Off-white<br>Part B: Translucent<br>Mixed: Off-white | Mixed: 210,000 | 1.0 | 12-15 mins | 6-8 hrs | PP: 5-8<br>PE: 3-6 | -55 to +100 | Standard |
| TA4611 | 2-part 1:1 for low surface energy plastics (PP/PE) No spacer beads for smaller gaps. | Part A: White<br>Part B: Translucent<br>Mixed: Off-white | Mixed: 18,000 | 0.05 | 10 - 16 mins | 6-8 hrs | PP: 5<br>PE: 3.5 | -55 to +100 | Standard |
| TA4620 | 2-part 1:1 for low surface energy plastics (PP/PE) slowest cure for large applications. | Part A: White<br>Part B: Translucent<br>Mixed: Off-white | Mixed: 125,000 | 1.0 | 20-25 mins | 24- 72 hrs | PP: 3-5<br>PE: 3-5 | -55 to +100 | Standard |

*NB. Niche products may be subject to MOQ and special lab approval required for samples.*


** Based on 0mm gap.*

***MMA Methyl Methacrylate*

# 2-Part Epoxies

Permabond 2-part epoxy adhesives are suitable for bonding a wide variety of materials. Available with a range of different cure speeds, Permabond epoxies have been developed to offer a high standard of performance for demanding bonding applications.

### Substrates
Permabond 2-part epoxy adhesives will bond most engineering materials. They form excellent structural bonds to a wide variety of materials including metals, composites, wood and some plastics.

### Durability
Their excellent chemical and water resistance makes them suitable for harsh environmental conditions. These epoxies are an excellent choice for high-strength structural bonding.

### Applications
Epoxies are widely used in the marine, automotive, aerospace, appliance, general assembly and construction industries. Applications are diverse and include bonding aerospace structures, motor housings and mounting brackets, tools and kitchen counter tops amongst many others.

### Material selection
The high strength and durability achieved using these adhesives provides designers with greater design freedom in their selection of substrate materials.

### Process
1:1 and 2:1 mix epoxies can be easily dispensed with a static mixing nozzle - no measuring or hand mixing is needed. Heat cure is not needed as the adhesives will cure at room temperature. Heat can be used to accelerate the speed of cure quoted on the chart opposite.

### Joint Design
Joint design possibilities are greatly improved by the high shear and peel strength of joints bonded with these adhesives and by the increased stress distribution that they offer.


# Benefits

- High peel strength increases design versatility.
- Easy mix ratio of most Permabond 2-component epoxies reduces equipment costs.
- Durability increases material choices.
- Rapid cure increases production rates.
- Room temperature cure reduces equipment & energy costs.
- Solvent free formulation improves workplace safety.
- Low odour improves workplace environment.

# 2-Part Epoxy Product Chart

| Grade | Features | Colour (Mixed) | Viscosity (mPa.s) | Max. Gap Fill (mm) | Pot Life | Handling Time | Shear Strength * (MPa) | Service Temp. (°C) | Availability |
|---|---|---|---|---|---|---|---|---|---|
| ET500 | Very fast curing, clear. | Clear, transparent | 13,000 - 24,000 | 2.0 | 3-4 mins | 5-8 mins | 12-18 | -40 to +80 | Standard |
| ET5011 | Slower curing version of ET500. | Clear, transparent | 40,000 - 80,000 | 2.0 | 10-25 mins | 25-30 mins | 6-12 | -40 to +100 | Niche |
| ET505 | Tough, structural multipurpose adhesive for bonding a wide variety of materials. | Amber | 12,000 - 27,000 | 2.0 | 1-2 hrs | 3-5 hrs | 18-21 | -40 to +80 | Standard |
| ET510 | Rapid curing and flexible for excellent impact & peel resistance. | Amber | 22,000 - 39,000 | 2.0 | 10-20 mins | 20-40 mins | 8-12 | -40 to +80 | Standard |
| ET513 | Clear, low viscosity. | Clear, transparent | 5,500 | 0.25 | 45 mins | 3.5 hrs | 25 | -40 to +80 | Standard |
| ET514 | Toughened structural epoxy. Faster curing version of ET538. | Grey | Thixo | 2.0 | 30-50 mins | 60-120 mins | 18-20 | -40 to +80 | Standard |
| ET515 | Clear and flexible, with excellent peel & impact resistance. | Clear, transparent | 12,000 - 22,000 | 2.0 | 10-20 mins | 20-30 mins | 8-12 | -55 to +100 | Standard |
| ET530 | Clear, low viscosity potting compound. | Clear, transparent | 400 - 700 | N/A | 3g: 90-150 mins 150g: 60 mins | 8-12 hrs | 10-12 | -40 to +100 | Niche |
| ET536 | Toughened, thixotropic, excellent gap fill and flow control. | Grey | Thixo | 5.0 | 50-80 mins | 90-120 mins | 15-24 | -40 to +80 | Standard |
| ET538 | Toughened, thixotropic, excellent gap fill & flow control. Long pot life for large assemblies. | Grey | Thixo | 5.0 | 120-150 mins | 3-5 hrs | 18-20 | -40 to +100 | Standard |
| ET540 | Toughened, thixotropic, high temperature resistance. Full cure at room temperature. | Amber | Thixo | 5.0 | 120-150 mins | 150-180 mins | 14-18 | -40 to +120°C (continuous) +150°C (peak) | Niche |
| ET5143 | Controlled flow, FDA compliant, for food & beverage applications. | Grey | Thixo | 2.0 | 60-80 mins | 3-5 hrs | 18-22 | -40 to +80 | Niche |
| ET5145 | Controlled flow, FDA compliant for food & beverage applications. | Off-white | Thixo | 2.0 | 50-80 mins | 3-5 hrs | 19-21 | -40 to +80 | Niche |
| ET5147 | High temperature resistant FDA compliant for food & beverage applications. | Off-white | Thixo | 2.0 | 40-60 mins | 3-5 hrs | 18-20 | -40 to +120 | Niche |
| ET5364 | Non-drip and easy to apply. Excellent shear strength & chemical resistance on aluminium & steel. | Grey | Thixo | 2.0 | 2 hrs | 8 hrs | Steel: 24-26 Al: 28-30 | -40 to +80 | Standard |
| ET5365 | WRAS approved. Will cure at low temperatures with good shear and impact strengths. | Grey | Thixo | 2.0 | 20 mins | 2-4 hrs | Steel: 10-14 | -40 to +120 | Standard |
| ET5390 | Exceptional adhesion to many substrates including stainless steel. Good gap fill and flow control. | Black | Thixo | 3.0 | 2-4 hrs | 8-12 hrs | Steel: 17-22 | -40 to +120 | Standard |
| ET5392 | Stainless steel bonder, semi-toughened, high peel strength, with good gap fill & long pot life. | Grey | Thixo | 4.0 | 2 hrs | 8-12 hrs | 22-25 SS:23-33 | -55 to +120 | Standard |
| ET5393 | Fully-toughened, stainless steel bonder, very high peel strength, rapid cure. | Green | Thixo | 2.0 | 15-25 mins | 2-3 hrs | 18-23 SS:16-26 | -55 to +80 | Standard |
| ET5401 | Toughened, thixotropic, excellent gap fill and flow control, improved temperature resistance. | Grey | Thixo | 5.0 | 10-12 mins | 60-90 mins | 20-30 (heat cured) | -40 to +140°C (continuous) +180°C (peak) | Standard |
| ET5411 | High temperature resistant. Low viscosity. | Grey | Light thixo | 2.0 | 16 hrs | Heat cure required | 18-22 (heat cured) | -40 to +230°C (continuous) +300°C (peak) | Niche |
| ET5428 | Composite bonding grade with rapid cure speed. | Cream or charcoal | Thixo | 5.0 | 10-20 mins | 30-45 mins | 18-22 | -40 to +120 | Niche |
| ET5429 | Composite bonding grade with longer pot life. | Charcoal | Thixo | 5.0 | 2-4 hrs | 6-10 hrs | 18-22 | -40 to +120 | Niche |
| ET5441 | High temperature resistance, thermally conductive. | Dark Grey | 10,000 - 15,000 | 2.0 | 150 mins | 8 hrs | 20 | -40 to +150 (Heat cure) | Niche |


*NB. Niche products may be subject to MOQ and special lab approval required for samples.*

# Single-Part Epoxies

Permabond single-part epoxy adhesives are suitable for bonding a wide variety of materials. They are available with a range of different viscosities and characteristics. Permabond epoxies have been developed to offer a high standard of performance for demanding applications.

### Substrates
Permabond single-part epoxy adhesives will bond most engineering materials. They form excellent structural bonds to a wide variety of materials including metals, composites, ferrites and some plastics.

### Durability
These adhesives offer excellent performance at high temperatures and harsh environmental conditions, having superb resistance to many aggressive chemicals.

### Applications
Single-part epoxies are ideal for use in heavy wear-and-tear applications such as bonding tungsten carbide tools & machinery. They are ideal for replacing welding and brazing and can significantly reduce assembly production costs. For this reason their use is widespread in the heat exchanger bonding market for sealing heat exchanger tubes and end-plates.

### Material selection
By replacing welding or brazing, the designer can have greater freedom of choice of manufacturing materials and can bond dissimilar substrates together. This can help reduce component cost and weight as well as improve performance.

### Process
These adhesives are available in cartridge form or in bulk to dispense via automated dispensing equipment. They fully cure rapidly when exposed to heat via the use of an oven, induction coil, infra-red or hot air gun.

### Joint Design
Joint design possibilities are greatly improved by the high shear and peel strength of joints bonded with these adhesives and by the increased stress distribution that they offer.

## Benefits

- High peel strength increases design versatility
- No requirement for weighing or mixing material
- Durability increases material choices
- Rapid full cure increases production rates
- Solvent free improves workplace safety
- Low odour improves workplace environment
- Excellent high temperature resistance and can withstand harsh environmental conditions
- An effective alternative to welding or brazing

# Single-Part Epoxy Product Chart

| Grade | Features | Colour | Viscosity (mPa.s) | Max. Gap Fill (mm) | Cure Schedule | Strear Strength* (MPa) | Service Temp. (°C) | Availability |
|---|---|---|---|---|---|---|---|---|
| ES550 | Toughened, non-sagging at curing temperature, high strength, good thermal conductivity. | Silver-grey | 1,000,000 - 2,000,000 | 5.0 | 130°C: 75 mins<br>150°C: 60 mins<br>170°C: 40 mins | 27-41 | -40 to +180 | Standard |
| ES558 | Toughened, free flowing at curing temperature, high strength, good thermal conductivity. | Silver-grey | 100,000 - 300,000 | 0.5 | 130°C: 75 mins<br>150°C: 60 mins<br>170°C: 40 mins | 27-41 | -40 to +180 | Standard |
| ES560 | Unfilled, self levelling & free flowing for potting and encapsulation. No gun required as low viscosity. | Transparent when cured. | 1,000 - 3,000 | 0.1 | Refer to TDS for potting or bonding cure schedules | 14-20 | -40 to +180 | Niche |
| ES561 | Unfilled, self levelling & free flowing, no gun required. | Amber | 8,000 - 14,000 | 0.2 | 120°C: 30 mins<br>150°C: 15 mins | 15 | -40 to +180 | Niche |
| ES562 | Free flowing & self levelling at curing temperature, no gun required. | White | 15,000 - 30,000 | 0.25 | 130°C: 60 mins<br>150°C: 45 mins<br>160°C: 20 mins | 20-35 | -40 to +180 | Standard |
| ES566 | Lower temperature curing grade. Good adhesion to Nylon & PBT. | Grey | 20rpm: 60,000-120,000<br>2rpm: 150,000-300,000 | 2.0 | 90°C: 75 mins<br>100°C: 40 mins<br>120°C: 25 mins<br>150°C: 10 mins | 18-22 (Cured at>100°C) | -40 to +180 | Niche |
| ES568 | Rapid curing, general purpose with good adhesion to a variety of surfaces. | Ivory | 20rpm: 40,000-65,000<br>2rpm: 45,000-75,000 | 0.5 | 135°C: 35 mins<br>150°C: 20 mins<br>170°C: 10 mins | 20-25 | -40 to +180 | Niche |
| ES569 | High strength bonding, non-sagging at curing temperature. | Black | 250,000 - 500,000 | 5.0 | 130°C: 75 mins<br>150°C: 60 mins<br>170°C: 40 mins | 27-41 | -40 to +180 | Standard |
| ES578 | Good thermal conductivity, high strength, excellent electrical insulation. Meets UL94 V-0 requirements. | Black | 600,000 - 800,000 | 5.0 | 130°C: 75 mins<br>150°C: 60 mins<br>170°C: 25 mins | 27-41 | -40 to +180 | Standard |
| ES579 | Good thermal conductivity, excellent electrical insulation, high strength, cures at low temperature. | Ivory | 60,000 - 90,000 | 2.0 | 100°C: 240 mins<br>120°C: 60 mins<br>150°C: 45 mins<br>180°C: 20 mins<br>180°C: 20 mins | 27-41 | -40 to +180 | Niche |
| ES5504 | Exceptionally high temperature resistance. | Grey | Paste | 2.0 | 150°C for 1 hrs plus 200°C for 1 hrs | Al: 18-22 | -40 to +275 (continuous) +300 (peak) | Niche |
| ES5675 | Non-flowing. Ideal for bonding filter seams. Low temperature cure. | Grey | 20rpm: 150,000-250,000<br>2rpm: 350,000-450,000 | 3.0 | 90°C: 180 mins<br>100°C: 90 mins<br>120°C: 45 mins | 20-25 | -40 to +180 | Niche |
| ES5681 | Composite & metal bonding. High strength on carbon fibre & steel. | Black | 40,000-60,000 | 0.5 | 135°C: 35 mins<br>150°C: 20 mins<br>160°C: 15 mins | Steel:30-35<br>FRP glass/ epoxy: 14-16<br>Carbon: 18-22 | -40 to +180 | Niche |
| ES5691 | UV-Fluorescing for easy in-line QC inspections. High wet & dry strength, non-stringing formulation ideal for bonding electrical components. | White | 20rpm: 80,000-150,000<br>2rpm: 350,000-700,000 | 5.0 | 130°C: 90 mins<br>150°C: 70 mins<br>160°C: 15 mins | Steel: 27-41<br>Al: 17-31 | -40 to +180 | Niche |
| ES5741 | Ideal for bonding PBT and other difficult plastics. Rapid low temperature cure. | Orange | 20rpm: 20,000-40,000<br>2rpm: 50,000-100,000 | 0.5 | 90°C: 60 mins<br>100°C: 45 mins<br>120°C: 30 mins<br>150°C: 10 mins | Al: 12-15 | -40 to +180 | Niche |
| ES5722 | Gap filling, ideal for bonding mesh screens. | Grey | 2rpm: 150,000-300,000<br>20rpm: 40,000-100,000 | 5.0 | 130°C: 60 mins<br>150°C: 45 mins | 20-30 | -40 to +180 | Niche |

*NB. Niche products may be subject to MOQ and special lab approval required for samples.*

# UV-Curable Adhesives

Permabond UV-curable adhesives are single part, cure on demand adhesives suitable for bonding a wide variety of substrates. Upon exposure to UV light, Permabond UV curables will cure to a high strength in a matter of seconds.

### *Permabond UV curable adhesives are suitable for a variety of applications.*

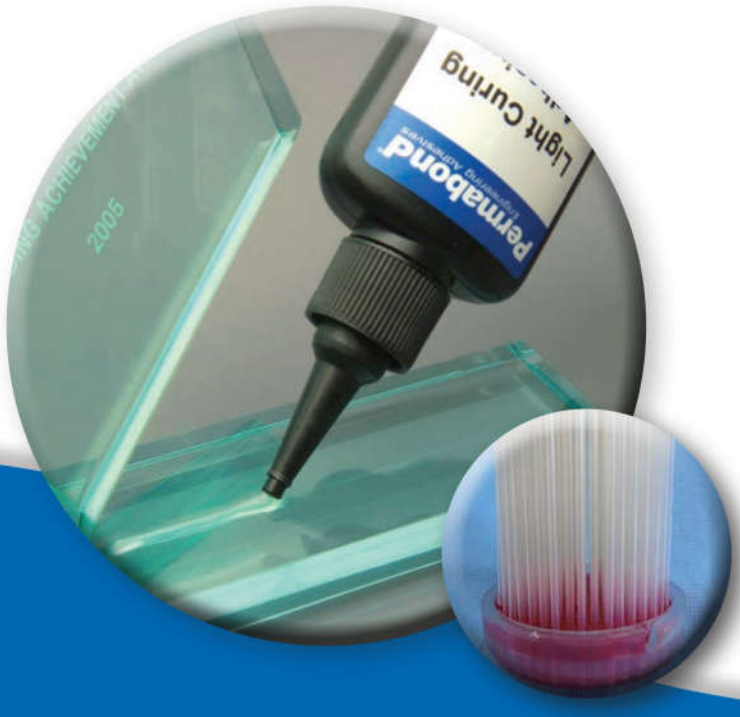
They are excellent for bonding glass to glass or glass to metal and form very high strength bonds for load bearing joints, such as those found in glass furniture and display cases.

Flexible and stress absorbing, Permabond UV curable adhesives are suited to applications where substrates with different thermal expansions need to be bonded.

Permabond UV curable adhesives bond a wide variety of plastics. Some clear plastics contain UV stabilizers that block the transmission of UV light, but they can still be bonded with visable light curing adhesives. Permabond's technical staff can help you identify the UV characteristics of the plastic you are using.

### *Typical applications include:*

- Bonding glass furniture
- Glass to metal structural bonding
- Acrylic display racks
- Lenses
- Solar panels
- Trophies and glass ornaments




### *Permabond UV curable adhesives form strong and durable bonds.*

Permabond UV curable adhesives cure during exposure to ultra violet light. The adhesives contain photo-initiators that react to specific wavelengths, causing the curing process to begin.

UV adhesives do not dissolve, melt or weaken the two components. They form strong chemical bonds between the two substrates and provide a high strength alternative to other joining methods.

Lamps are available in a variety of intensities from small inexpensive hobby type lamps to larger high intensity units for high speed production. Permabond will help you select the equipment best suited to your specific application.

**Handy Tip:** Cure speed of UV-curable adhesives.
There are a number of factors which determine the cure speed of UV-curable adhesives (not just the reactivity of the adhesive itself):

*- Intensity of UV-light*
*- Distance from the source*
*- Type of UV bulb: there are a variety of bulb types and LEDs with different power outputs and spectra*
*- Age of the UV bulb: UV output of bulbs reduces with age*
*- Light transmittance of the materials being bonded: many plastics have UV-stabilisers which block UV rays.*

## Benefits

- Cure on demand - allows proper alignment of components before bonding.
- Cure speed - increase production by simply adding more lamps to the line.
- Non-flammable and solvent-free - provides a safe and comfortable work environment.
- Single part product - No mixing required.
- 100% solids equal no waste and no VOCs
- Save energy and space - UV lamps require less electricity and space compared to ovens.
- Appearance - Clear adhesive gives quality results.
- Technical support- application specialists available for assistance with joint design, adhesive selection and production process.

# UV-Curables Product Chart

| Grade | Features | Appearance | Viscosity (mPa.s) | Tensile Strength (MPa) | Lap Shear Strength (MPa) | Shore D Hardness | Service. Temp. (°C) | Availability |
|---|---|---|---|---|---|---|---|---|
| UV605 | Very low viscosity. | Clear, colourless | 50-100 | 14 | Steel to glass 10-14 | 65-75 | -55 to +120 | Niche |
| UV610 | High strength bonding for glass to metal. | Translucent | 600-1,300 | 17 | Steel to glass 13-16 | 65-75 | -55 to +120 | Standard |
| UV612 | Bevel bonding grade with slow cure & easy clean-up. | Clear, colourless | 450-650 | >5 | Steel to glass 8-12 | 30-40 | -55 to +120 | Niche |
| UV620 | General purpose, optically clear, excellent resistance to yellowing. | Clear, colourless | 2,200-2,900 | 16 | Steel to glass 9-10 | 60-75 | -55 to +120 | Standard |
| UV625 | Non-drip gel for larger gaps & vertical applications. | Clear, colourless | 20rpm: 30,000-55,000 2rpm: 120,000-250,000 | 16 | Steel to glass 6-10 | 60-70 | -55 to +120 | Standard |
| UV630 | Low viscosity, plastic bonding. | Clear, colourless | 200-300 | 14 | PC to PC >9* | 60 | -55 to +120 | Standard |
| UV632 | Particularly good for bonding acrylic substrate material. | Clear, colourless | 200-400 | 13 | PC to PC >7* | 55-75 | -55 to +120 | Niche |
| UV634 | Excellent thermal & environmental resistance, good for plastics & glass. | Translucent | 2,000 | 6 | Glass to PC 4 | 70 | -55 to +120 | Standard |
| UV640 | Medium viscosity, plastic bonding. | Clear, colourless | 20rpm: 3,000-5,000 2.5rpm: 12,000-25,000 | 13 | PC to PC >9* | 55-75 | -55 to +120 | Standard |
| UV645 | Plastic bonding. Good adhesion to acrylic. | Clear, colourless | 20rpm: 8,000-10,000 2.5rpm: 30,000-60,000 | 11 | PC to PC >9* | 50-65 | -55 to +120 | Standard |
| UV648 | High viscosity, excellent adhesion to acrylic substrates. | Clear, colourless | 20rpm: 20,000-40,000 2rpm: 120,000-180,000 | 11 | PC to PC >7* | 50-65 | -55 to +120 | Niche |
| UV6361 | PET bonding. | Clear, colourless | 4,000 - 6,000 Thixotropic | 3-5 | PET: >5 | 30 | -55 to +120 | Niche |
| UV6363 | Flexible PET bonding. | Clear, Colourless | 20rpm: 2,000 - 5,000 2.5rpm: 10,000 - 20,000 | 0.3 - 0.5 | Acrylic: >1 PET: >1 | 40-60 Shore A | -55 to +120 | Niche |
| UV649 | Plastic bonding gel. | Clear, colourless | 20rpm: 20,000-30,000 2rpm: 80,000-150,000 | 15 | PC to PC >9* | 50-65 | -55 to +120 | Standard |
| UV670 | Flexible for metal & metallised plastics. | Clear, colourless | 2,000-3,000 | 12 | Steel to glass 6-10 | 50-60 | -55 to +120 | Standard |
| UV675 | For crystal clear bonding of glass. | Clear, colourless | 500-800 | 16 | Steel to glass 8-12 | 60-70 | -55 to +120 | Niche |
| UV681 | Tack-free coating UV. Ideal for encapsulation. | Clear, colourless | 80-120 | 10-12 | N/A | 50-65 | -55 to +120 | Niche |
| UV683 | Tack-free UV for encapsulation or doming applications. | Clear, colourless | 1,000-1,600 | 12-14 | N/A | 50-65 | -55 to +120 | Niche |
| UV685 | Tack free, ideal for doming. | Colourless | 20rpm: 4,000 - 8,000 2.5rpm: 10,000 - 20,000 | 8 - 15 | N/A | 50-65 | -55 to +150 | Niche |
| UV6160 | Bond remains clear even in high-stress structural bonding situations (where other UVs can start to appear hazy). | Clear, colourless | 1,000-2,000 | 15-25 | Steel to glass 11 | 65-75 | -55 to +120 | Standard |
| UV6231 | Enhanced durability in high-humidity environments. | Clear, colourless | 5,000-8,000 | 10 | 10 | 45-50 | -55 to +120 | Standard |
| UV6302 | Low viscosity enabling capillary action, high shear strength and no solvents. | Colourless | 60-100 | >10 | PC >7* | 60-70 | -55 to +150 | Niche |
| UV7141 | UV and anaerobic curing. For bonding ceramic coated glass, mirrors, glass & metal. | Clear, colourless | 1,000-1,700 | 20 | Steel to glass 14-17 | 60-70 | -55 to +150 | Standard |
| UV7148 | UV/AA dual cure product for curing in shadow areas on metal parts. | Red | 20 rpm: 1,000-2,000 2.5rpm: 4,000-7,000 | N/A | N/A | 80 | -55 to +150 | Niche |


*NB. Niche products may be subject to MOQ and special lab approval required for samples.*

**=Substrate failure*

# Other Adhesives

## MS Polymers

Permabond MS-Polymers are single-part moisture cure "sealant"-type products. They cure slowly from the outside in to form tough, yet flexible, bonded joints. Products are available either as gap filling pastes or lower viscosity self-levelling compounds suitable for potting or for bonding close-fitting substrate materials.

### Substrates

Permabond MS-Polymers can be used to bond most materials including wood, metal, glass, plasterboard and a wide range of plastics. As they rely on moisture for the cure, cure speed will depend on humidity and moisture in the air and on the substrate surface.

### Applications

Ideal for use in the building construction industry, bathrooms and glazing. Permabond MS359 CLEAR offers an excellent aesthetic finish on glass.

### Benefits

- Soft & flexible - impact and vibration resistant.
- No requirement for weighing or mixing material.
- Can be dispensed with low-cost caulking gun.
- Do not contain silicone or isocyanates.
- Can be painted.
- Low shrinkage and does not leave witness marks.
- Instant grab and fast skin-over time.
- Excellent environmental resistance.

### Durability

MS Polymers have excellent resistance to harsh environmental conditions including cyclic temperature conditions and water submersion - in fact the adhesives strengthen in wet conditions. They work well on substrates where differential expansion and contraction could be an issue.

| Grade | Features | Colour | Viscosity (mPa.s) | Skin-over Time | Approximate Cure Rate | Tensile Strength (MPa) | Service Temp. (°C) | Availabilility |
|---|---|---|---|---|---|---|---|---|
| MS359 GREY | Single-part moisture curing low-modulus. Bonds most materials, ideal for building construction applications. | Grey | Non-sagging paste | 10-20 mins | 5mm every 24 hours | 2-3 | -40 to +100 | Standard |
| MS359 CLEAR | Clear, transparent single part moisture curing sealant. Ideal for bonding glass, composite, metal, wood and plastics. | Transparent, colourless | Non-sagging paste | 10-20 mins | 4mm every 24 hours | 0.7-1.5 | -40 to +100 | Standard |
| MS359A GREY | Self-levelling lower viscosity version of MS359 GREY | Grey | 10,000-25,000 | 10-20 mins | 3-4mm every 24 hours | 0.5-1.5 | -40 to +100 | Standard |

## 2-Part Polyurethanes

Permabond 2-part polyurethane adhesives are fast-setting structural adhesives ideal for bonding a wide range of substrate materials, in particular composites and metal. They have high strength performance due to a toughened matrix and excellent temperature resistance and durability.

### Substrates

Permabond 2-part PUs can be used to bond most materials including metal, composite materials, wood and a variety of different plastics.

### Durability

Permabond 2-Part polyurethanes have a higher service temperature range than standard 2-Part epoxy adhesives and offer excellent environmental resistance.

### Benefits

- High peel strength and good impact resistance.
- Easy 1:1 mix ratio.
- Available in cartridges.
- Rapid setting time.
- High temperature resistance.

### Applications

Ideal for use on carbon fibre automotive parts, structural bonding applications, as well high speed production items such as electronic chip / component bonding or potting.

| Grade | Features | Colour | Viscosity (mPa.s) | Max. Gap Fill (mm) | Pot Life | Shear Strength (MPa) | Service Temp. (°C) | Availabilility |
|---|---|---|---|---|---|---|---|---|
| PT321 | Very rapid curing 1:1 PU. Ideal for bonding composites, metals, plastics and woods. | Grey | 3500-7000 | 5.0 | 60-90 seconds | 18-25 | -40 to +120 | Standard |
| PT326 | Slower setting version | Grey | 3500-7000 | 5.0 | 4-7 minutes | 12-20 | -40 to +120 | Standard |
| PT328 | Even slower setting version | Grey | 3500-7000 | 5.0 | 15-20 minutes | 12-18 | -40 to +120 | Standard |

# Epoxy Hybrids

Permabond epoxy hybrids are 2-part adhesives, combining epoxy curing characteristics with the flexibility of an RTV-type silicone. Their high elongation and truly flexible nature, means they perform well in applications where impact or peel stresses may be present, or where differential expansion & contraction may occur. They are ideal for a wide variety of plastics, metals and composites.

### Substrates

Permabond epoxy hybrid adhesives have excellent adhesive capabilities on Nylon, ABS, polycarbonate, carbon fibre, mild steel, aluminium as well as many other plastics and metals.

### Applications

Ideal for use in the electronics industries for potting, encapsulating and for bonding heat sinks. Special grade features include fire retardancy and thermal conductivity.

## Benefits

- Soft & flexible - impact and vibration resistant.
- Excellent adhesion to plastics.
- Will bond a wide variety of substrates.
- Easy to apply.
- Full cure at room temperature.
- Good gap fill abilities.
- UL94 V-0 Compliant (MT3826 only).
- Thermally conductive (MT3826).

### Durability

Permabond's epoxy hybrids may be soft but they are strong and incredibly flexible even in temperatures as low as -40°C (substrates permitting). Excellent resistance to chemicals and harsh environmental conditions and ideal for applications where there could be thermal shock.

| Grade | Features | Colour (mixed) | Viscosity (mPa.s) | Max. Gap Fill (mm) | Pot Life | Handling Time | Shear Strength (MPa) | Service Temp. (°C) | Availability |
|---|---|---|---|---|---|---|---|---|---|
| MT382 | Modified epoxy hybrid, low modulus, self levelling. Ideal for bonding composites or potting applications | Charcoal | 13,000 - 30,000 | 0.5 | 20-50 mins | 105-120 mins | 4-7 | -40 to +120 | Standard |
| MT3821 | High viscosity version of MT382 | Black | Thixo | 5.0 | 10-20 mins | 60-90 mins | 4-7 | -40 to +120 | Standard |
| MT3826 | Thermally conductive epoxy hybrid | Cream | Thixo | 5.0 | <25mins | 2-3 hrs | 3-5 | -40 to +120 | Niche |

*NB. Niche products may be subject to MOQ and special lab approval required for samples.*

# Other Products

Permabond also supply a range of surface preparation & cleaning products to ensure you get the best result possible.


### Permabond Cleaner A

For general use with any Permabond adhesive, Cleaner A is a general purpose industrial cleaner for degreasing / cleaning surfaces prior to bonding. It is formulated to minimise the attack on certain plastics however; it is advisable to test for compatibility in your application prior to use.

### CA Solvent 2

Using a blend of organic esters, Permabond CA Solvent 2 can be applied to remove cured cyanoacrylate adhesive from surfaces and clothes or to debond parts. It is non-flammable and non-hazardous however; we would advise against using it with strong oxidising materials - always do a compatibility test before use.

### Permabond 2K Primer

Ideal for preparing metal or glass for bonding, 2K Primer is great for increasing surface energy and improving the integrity of a bond. More information can be found on page 10 of this guide.

### Isopropanol Wipes

Handy, individually packed, one-use wipes containing 70% Isopropanol and water. Ideal for cleaning parts before bonding; removing grease and grime.

| Grade | Features | Availability |
|---|---|---|
| Permabond Cleaner A | General purpose surface cleaner | Standard |
| Permabond 2K Primer | Silane surface pretreatment | Standard |
| CA Solvent 2 | Cyanoacrylate de-bonder | Standard |
| Isopropanol Wipes | For dissolving cured cyanoacrylate adhesive | Standard |

# Basic Approvals / Standards List

Permabond have many products that comply with various approvals. Below is a quick-search list of our products and which approval they meet, however; if you don't see what you are looking for please do contact us as, our knowledgeable chemists and engineers will be able to provide you with the help and guidance you may need for your specific application.

| Approval | Grades with Approval |
|---|---|
| BAM (Bundesanstalt für Materialforschung und -prüfung) Oxygen | MH052 |
| Customer specific | Check with Permabond |
| DVGW (Deutscher Verein des Gas- und Wasserfaches) | A1046, HH131, MH052, A140 |
| FDA (Food and Drug Administration) | ET5143, ET5145, ET5147 formulated with FDA compliant raw materials |
| ISO10993 Cytotoxicity | 4C10, 4C20, 4C30, 4C40, 4UV80, 4ES70, 731, 820, UV630, 920, POP |
| KIWA Gastec | A131 |
| MIL SPEC | Listed on www.permabond.com |
| NSF - Non food contact | 2011, 792 |
| NSF61 (National Sanitation Foundation) | LH050PURE, MM115PURE, HH040PURE |
| REACH (Registration, Evaluation, Authorisation and restriction of Chemicals.) | Most products comply, letter available - check with Permabond |
| RoHS (Restriction of Hazardous Substances) | All products comply; letter available |
| UL94 (Underwriter's Laboratory) (Flame Retardant) | ES578, ET5272, TA4392, MT3826 compliant. Permabond letter available |
| WRAS Drinking water (cold water and hot water up to 85°C) | A011, A025, A113, A115, A118, A130, A131, A134, A136, A140, A1042, A1044, A1058, F200, F201, F202, A1084, HM135, MH052 |
| WRAS Drinking water (cold water use only) | 102, 105, 240, 2010, ET5365 |

# Conversion Tables

### Weight

| | |
|---|---|
| 1 kilogram (kg) | = 1000 grams (g)<br>= 2.2 pounds (lbs) |
| 1 pound (lb) | = 16 ounces (oz)<br>= 453.6 grams (g) |
| 1 ounce (oz) | = 28.35 grams (g) |
| 1 gram (g) | = 1,000 milligrams (mg) |

### Length

| | |
|---|---|
| 1 metre (m) | = 100 centimetres (cm)<br>= 1000 millimetres (mm)<br>= 3.28 feet<br>= 39.37 inches |
| 1 inch | = 2.54 centimetres (cm)<br>= 25.4 millimetres (mm)<br>= 1000 mil (thou) |
| 1 centimetre (cm) | = 0.39 inches<br>= 10 millimetres (mm) |
| 1 millimetre (mm) | = 1,000 microns (µm) |
| 1 mil (thou) | = 40 microns |

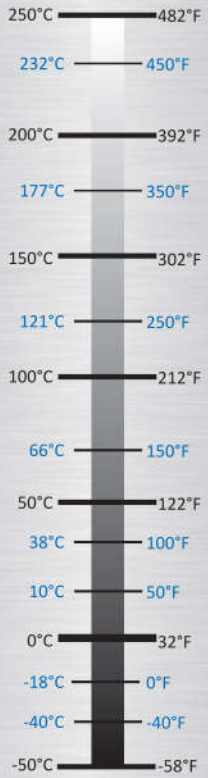
### Volume

| | |
|---|---|
| 1 US gallon | = 8 US pints<br>= 3.79 litres<br>= 4 US quarts<br>= 0.83 UK gallons |
| 1 Imperial gallon | = 8 UK pints<br>= 4.55 litres<br>= 4 UK quarts<br>= 1.2 US gallons |
| 1 litre | = 1000 millilitres (ml)<br>= 0.22 UK gallons<br>= 0.26 US gallons<br>= 1.76 UK pints<br>= 2.11 US pints<br>= 33.81 fluid ounces |
| 1 US pint | = 473 millilitres (ml) |
| 1 UK pint | = 568 millilitres (ml) |
| 1 millilitre (ml) | = 1 cubic centimetre (cc) |
| 1 cubic inch | = 16.39 cubic centimetres |
| 1 microlitre | = 0.001 millilitres |

### Pressure

| | |
|---|---|
| 1 MPa | =145 psi |
| 1 psi | =0.0069 MPa |
| 1 MPa | =1 N/mm² |
| 1 bar | =14.50 psi |
| 1 psi | =0.069 bar |

### Temperature



# Glossary

Activator (or accelerator) A substance which accelerates the cure rate of adhesive.

Adhesion Failure Failure of the adhesive to the substrate. No adhesive is left on the substrate. Improving surface preparation can help avoid this.

Ageing Adhesives can age from the effects of heat, chemical exposure and humidity. Accelerated ageing tests can be carried out in extreme environments for a quick indication as to the longevity of the adhesive.

Blooming A phenomenon associated with cyanoacrylate adhesives seen as a white powdery residue on substrate material.

Capillary Action Low viscosity adhesives will seep into narrow gaps which makes them suitable for post-assembly application.

Coefficient of Expansion A measure of the extent to which a material expands. Linear coefficient expansion units commonly used are mm/mm/°C x $10^{-6}$. This is an important factor to bear in mind when bonding dissimilar materials in a temperature-changing environment.

Cohesive Failure Failure within the adhesive. On examination of failed parts, adhesive should be visible on both components.

Corona Treatment A method of surface preparation, mainly used for hard-to-bond plastics. High voltage discharge across substrate surfaces produces active electrons, helping raise the surface energy and 'wettability' to allow the material to be bonded.

Cyclic Ageing A harsh method of accelerated ageing, ideal for dissimilar materials. This usually involves heat ageing with cyclic temperatures so the effects of differential thermal expansion and contraction can be assessed.

Density The specific gravity of a material measured in g/cm³. Water is the benchmark at 1.0 (at 4°C).

Differential Thermal Expansion & Contraction This occurs when dissimilar materials are bonded together. They are likely to have different coefficients of expansion. Using a toughened or flexible adhesive can help reduce stress on components.

Elongation How much a material 'stretches', usually measured as a percentage.

Fillet The meniscus of adhesive that can be seen on the outside of a joint. When cured, this can help increase strength and protect joints against chemical and moisture ingress.

Flame Treatment A method of surface preparation, mainly used for hard-to-bond plastics. Briefly exposing surfaces to a flame increases surface electron activity, helping raise the surface energy and 'wettability' to allow the material to be bonded.

Glass Transition Temperature (Tg) The temperature at which a normally rigid, brittle "glass-like" structure changes to a soft, elastic material. This can help determine operating temperature limits.

Handling Time / Speed the time at which adhesive has cured to a sufficient strength to allow unclamping and gentle handling of the part.

Inhibition The presence of a chemical that can cause incomplete cure of adhesive. This could be oxygen preventing full cure of an anaerobic adhesive or chemicals within a substrate which could interfere with adhesive cure.

Modulus of Elasticity Determines the point at which a material becomes deformed under tension.

Open Time The length of time freshly applied adhesive is optimal for bonding (after which strength could be compromised).

Outgassing The release of gaseous molecules from adhesive.

Oxidation This commonly occurs in metals such as aluminium and iron (seen as rust) where surface electrons are stolen. Removal of weak oxide layers prior to bonding is recommended.

Passive Surface An unreactive metal surface that is highly resistant to chemical attack. Zinc and chrome are good examples. Use of surface activator, A905 helps cure anaerobic adhesives.

Plasma Treatment A method of surface preparation, mainly used for hard-to-bond plastics. It is a mixture of electrons and positive ions in a gas which is passed over the substrate, helping raise the surface energy and 'wettability' to allow the material to be bonded.

Pot life The maximum amount of time adhesive can be used after it has been mixed (in a pot!) before it starts becoming semi-cured and too difficult to apply.

Primer A substance that improves the adhesion of adhesives to components and can help improve environmental resistance.

Refractive Index How much a beam of light alters its angle as it passes through a material. Glass is approximately 1.4 to 1.6.

Relative Humidity How saturated air is with moisture (maximum 100%). Low humidity (usually in cold environments) can affect cyanoacrylate cure.

Rheometry How a material flows, slumps etc.

Room Temperature 23±1°C (as specified by DIN/ISO). Viscosity and strength measurements are taken at this temperature.

Shadow Cure This relates to UV-curable adhesives, UVs that have a single UV- cure mechanism will not cure in areas not reached by UV light.

Shore Hardness A scale set up to asses the hardness of a material. Materials measured on the Shore A scale are soft elastomers, Shore D are tough, harder materials. The test is done with a spring-weighted pin that measures depth of penetration (units are 0-100 Sh, the higher the number, the harder the material).

Substrate Failure Failure of the substrate. This is observed as the adhesive joint remains in tact and the substrate either breaks or the surface of the substrate delaminates.

Surface Tension / Surface Energy An example of a surface with low surface energy is a freshly polished car bonnet sprayed with water droplets. The water droplets stand proud. This is how hard-to bond materials such as polypropylene behave. Increasing surface energy makes the surface more 'wettable' and able to be bonded. Adhesives are developed to have as low a surface tension as possible to 'wet-out' on difficult surfaces.

Tensile Strength The strength of an adhesive joint pulled apart in tension.

Thixotropy The flow behaviour of an adhesive that causes the viscosity to reduce when stirred, mixed or dispensed but will then thicken upon standing (preventing slump and run-off).

Toughened Adhesives Can be rubber toughened to allow better flexibility, higher peel strength and better impact resistance. They are ideal for bonding dissimilar substrates where differential thermal expansion and contraction could be an issue.

Torque Strength Measurement of adhesive strength on threaded nuts and bolts. Breakout, prevailing and maximum strength can be measured to assess the 'lockability' of the adhesive. Units are usually Newton-metres (Nm) or in/lb.

Viscosity Measurement of how much a flowable substance flows. This can be measured with a spindle spinning to measure resistance, on an electronic rheometer or with a 'U' tube measuring time taken for material to flow from A to B.

Wettability / Wetting out If a substrate is 'wettable' it will allow liquid (such as adhesive) to be spread across it without droplets bunching up. If droplets do bunch up then the material could be difficult to bond and surface pretreatment may be required.

Working Time / Strength The time at which a newly bonded joint can be put into operation. The joint will have developed approximately 60% of its final strength so can be subjected to normal loading.

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