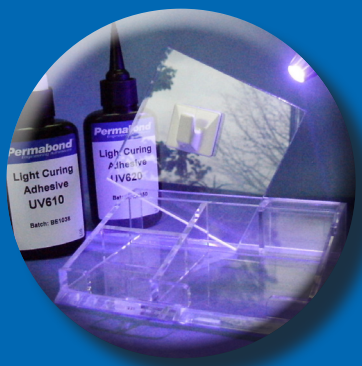
Permabond® Adhesive Guide

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 Copper Magnesium	Steel Nickel Iron Aluminium Zinc	Anodized aluminium Cadmium finishes Chrome finishes Passivated metals Stainless steel Titanium	Ceramics Glass Plastics Painted finishes 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

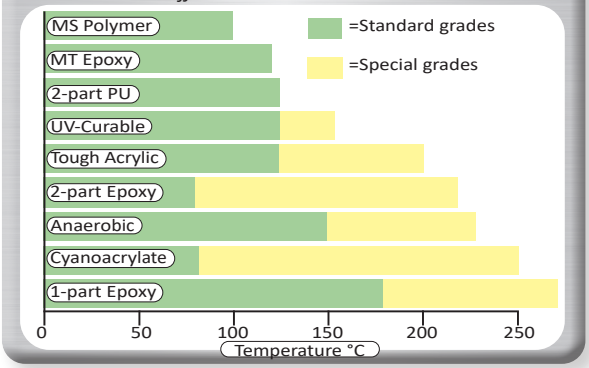
Gap fill and adhesive viscosity:

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.

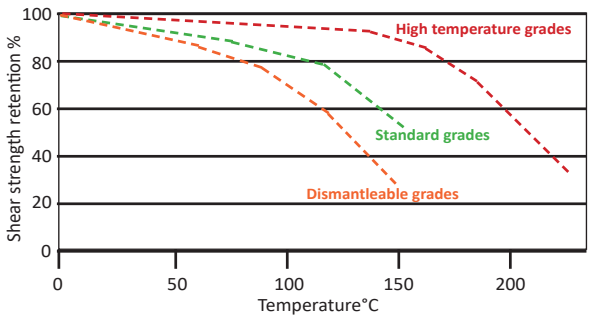
Service conditions:

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.

Typical temperature performance of different adhesive chemistries



Hot strength of Permabond anaerobic adhesives:

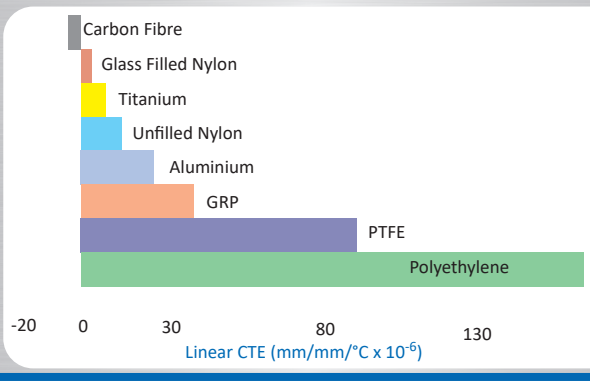


The temperature range the joint will be exposed to is an important factor in deciding which adhesive to use. Adhesive strength reduces as temperature increases, as demonstrated in the graphs to the left and above. Provided adhesives are kept within their recommended temperature range, full strength should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

Co-efficient of thermal expansion figures for various materials

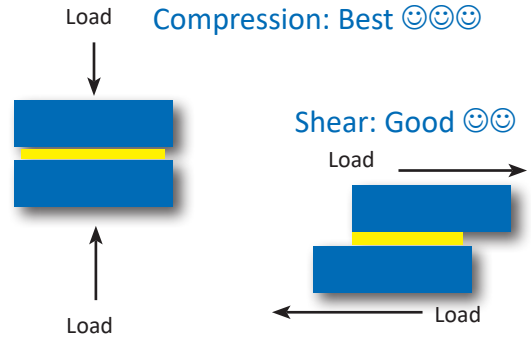


Joint Design

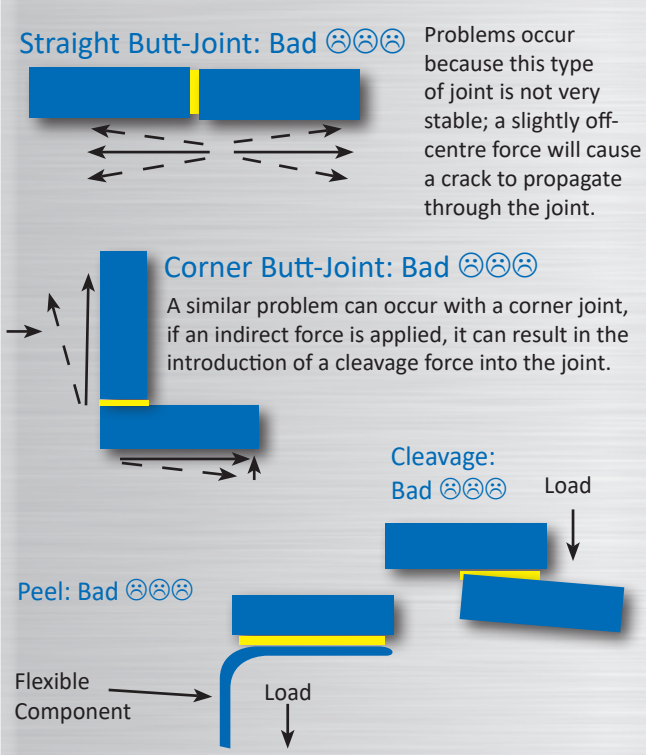
There are three basic joint types; co-axial, lap and butt joints. Anaerobic adhesives are usually most suitable for co-axial type joints (where one part slots into another) or for threaded parts. Whether or not the joint needs to be dismantled will determine the strength of adhesive to use.

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.



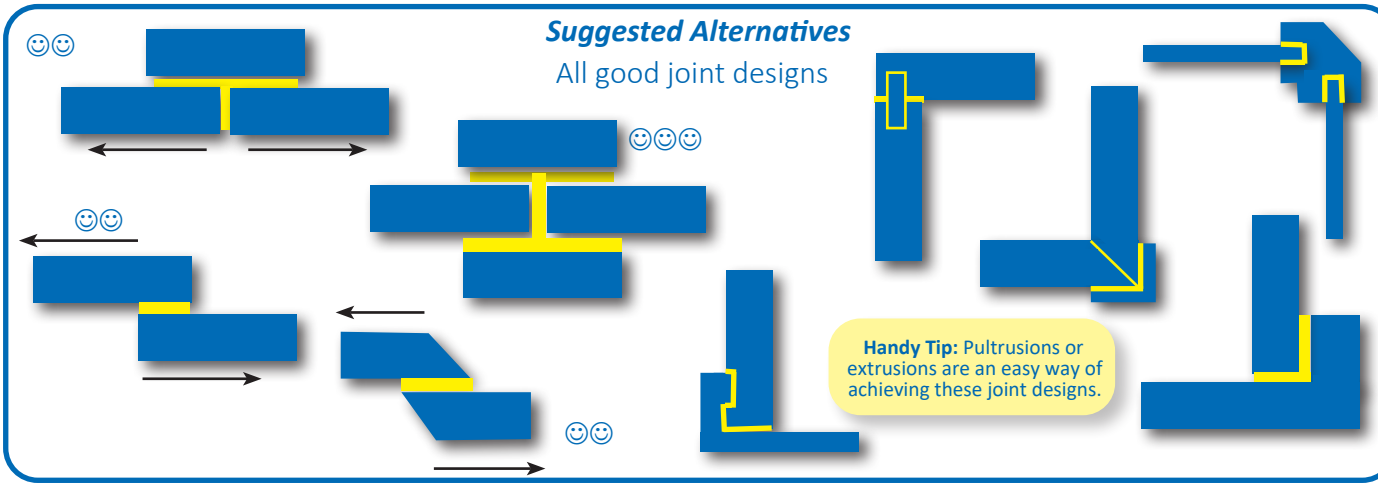
These are examples of bad adhesive joint design.



Handy Tip: If joint design cannot be modified, opt to use a toughened adhesive with high peel-strength.

Suggested Alternatives

All good joint designs

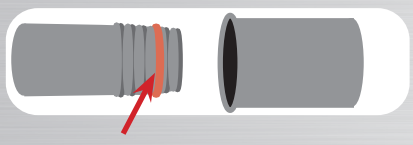


Handy Tip: Pultrusions or extrusions are an easy way of achieving these joint designs.

Correct assembly technique for pipe joints

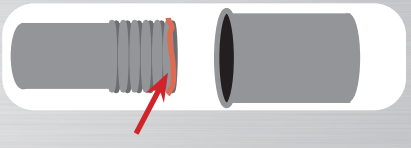
EXCESS ADHESIVE SHOULD BE SEEN IN BOTH CASES AFTER TIGHTENING

Taper to parallel pipe joints



Apply adhesive several threads back from the leading edge of the male component to ensure maximum contact.

Parallel to parallel pipe joints



Apply adhesive to the leading edge of the male component.

Coverage

Usage Estimator

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

Container Size	Number of Drops
3g	45
20g	300
28g (1 oz)	420
30g	450
300g	4500
454g (1lb)	6810
500g	7500
2kg	30,000

Container Size	Number of Drops
10ml	150
50ml	750
75ml	1125
250ml	3750
300ml	4500
500ml	7500
750ml	11,250
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. Alternatively, etch with phosphoric acid.	Good 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. 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 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. 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. 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	TA46XX range	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*

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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	TA46XX range	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 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 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 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.

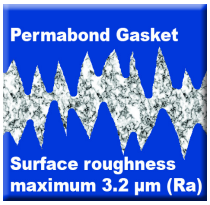
Handy Tip: Pipe joints sealed with low-strength pipesealants can be dismantled using normal tools. Heating parts with a hot air gun or blow torch will help weaken adhesive and make parts easier to undo. Before re-using, clean pipe joints with a wire brush & chemically clean / degrease.

Gasketing

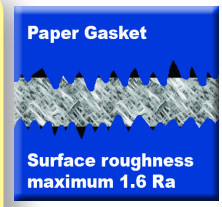
Permabond gasketing anaerobic adhesives are designed to replace traditional cork, wood, rubber, paper & silicone gaskets.

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 20rpm: 1,700	0.12	5	12	16	8	-55 to +150	Standard
	HH131	High temperature.	Red	2rpm: 23,000 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 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 20rpm: 8,000	0.5	15	21	30	50	-55 to +150	Standard
	A140	Sealing gas fittings.	Green	2rpm: 37,500 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 20rpm: 2,500	0.2	15	30	28	30	-55 to +100	Standard
	F202	Toughened.	Brown	2rpm: 135,000 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 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 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 20rpm: 10,000	0.3	15-20	20	35	50	-55 to +230	Standard
Threadsealing	A129	Medium strength.	Orange	2rpm: 65,000 20rpm: 20,000	0.5	15	12	12	7	-55 to +150	Standard
	A131	Low strength.	White	2rpm: 40,000 20rpm: 6,000	0.5	45	6	10	7	-55 to +150	Standard
	A1044	High strength.	White	2rpm: 70,000 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 20rpm: 25,000	0.5	15	10	20	11	-55 to +150	Standard
	MH072	CoSHH friendly.	Yellow	2rpm: 65,000 20rpm: 25,000	0.5	30	N/A	18	8	-55 to +150	Niche
Gasketing	A136	General purpose, Toughened.	Red	2rpm: 75,000 20rpm: 18,000	0.5	<30	12	10	8	-55 to +150	Standard
	LH197	Flexible.	Green	2rpm: 50,000 20rpm: 20,500	0.3	20	5	10	5	-55 to +150	Standard
	MH196	High temperature.	Red	2rpm: 500,000 P 20rpm: 100,000	0.5	15	10	20	23	-55 to +200	Standard
	MH199	High temperature.	Red	2rpm: 225,000 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 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 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 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 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 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 Initiator: Brown Mixed: Amber	20rpm: 20,000 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 Initiator: Brown Mixed: Amber	20rpm: 30,000 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 Initiator: Green Mixed: Green	20rpm: 25,000 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 Initiator: Brown Mixed: Dark orange	20rpm: 40,000 2.5rpm: 130,000	0.5	5-10 mins 20-30 secs +I41	60-120 mins 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 Initiator: Green 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 Initiator: Green 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 Part B: Green 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 Initiator: Green Mixed: Green	20rpm: 20,000 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 Initiator: Brown 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 Part B: Cream 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 Part B: Green 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 Part B: Clear 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 Part B: Clear 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 Part B: Yellow 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 Part B: Cream 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 Part B: Green 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 Initiator: Green Mixed: Turquoise	20rpm: 20,000 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 Initiator: Yellow/green Mixed: Turquoise	20rpm: 9,000 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 Part B: Translucent Mixed: Off-white	Mixed: 125,000	1.0	5-10 mins	2-4 hrs	PP: 5-8 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 Part B: Translucent Mixed: Off-white	Mixed: 210,000	1.0	12-15 mins	6-8 hrs	PP: 5-8 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 Part B: Translucent Mixed: Off-white	Mixed: 18,000	0.05	10 - 16 mins	6-8 hrs	PP: 5 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 Part B: Translucent Mixed: Off-white	Mixed: 125,000	1.0	20-25 mins	24- 72 hrs	PP: 3-5 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 150°C: 60 mins 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 150°C: 60 mins 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 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 150°C: 45 mins 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 2rpm: 150,000-300,000	2.0	90°C: 75 mins 100°C: 40 mins 120°C: 25 mins 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 2rpm: 45,000-75,000	0.5	135°C: 35 mins 150°C: 20 mins 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 150°C: 60 mins 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 150°C: 60 mins 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 120°C: 60 mins 150°C: 45 mins 180°C: 20 mins 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 2rpm: 350,000-450,000	3.0	90°C: 180 mins 100°C: 90 mins 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 150°C: 20 mins 160°C: 15 mins	Steel:30-35 FRP glass/ epoxy: 14-16 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 2rpm: 350,000-700,000	5.0	130°C: 90 mins 150°C: 70 mins 160°C: 15 mins	Steel: 27-41 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 2rpm: 50,000-100,000	0.5	90°C: 60 mins 100°C: 45 mins 120°C: 30 mins 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 20rpm: 40,000-100,000	5.0	130°C: 60 mins 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.

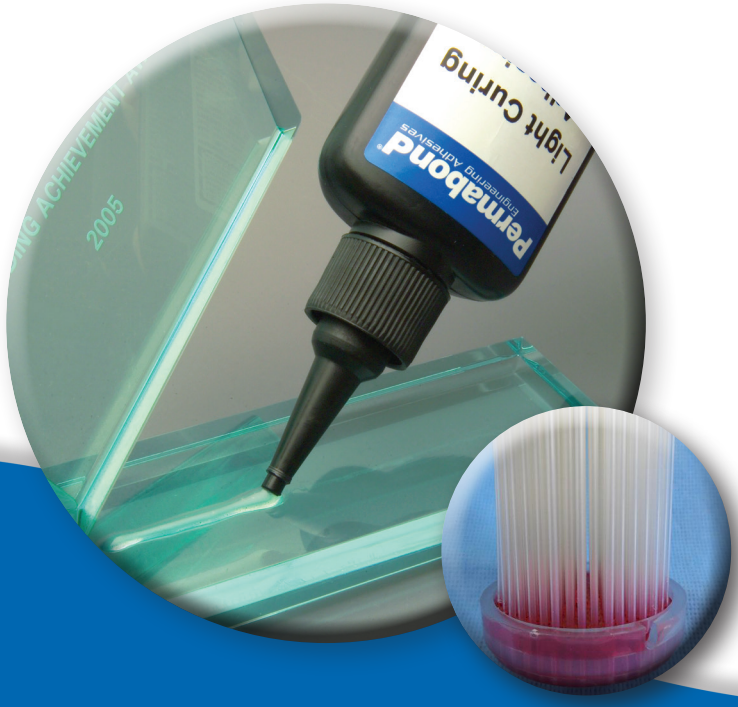
They are excellent for bonding glass to glass or glass to metal and form very high strength bonds for load bearing joints, such as those found in glass furniture and display cases.

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 (MT3836 only).
- Thermally conductive (MT3836).

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
MT3836	Thermally conductive epoxy hybrid	Light Grey	Paste	5.0	5-30 mins	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*, MT3836 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

*MT3826 is now discontinued & replaced by MT3836

Conversion Tables

Weight

1 kilogram (kg)	= 1000 grams (g) = 2.2 pounds (lbs)
1 pound (lb)	= 16 ounces (oz) = 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) = 1000 millimetres (mm) = 3.28 feet = 39.37 inches
1 inch	= 2.54 centimetres (cm) = 25.4 millimetres (mm) = 1000 mil (thou)
1 centimetre (cm)	= 0.39 inches = 10 millimetres (mm)
1 millimetre (mm)	= 1,000 microns (µm)
1 mil (thou)	= 40 microns

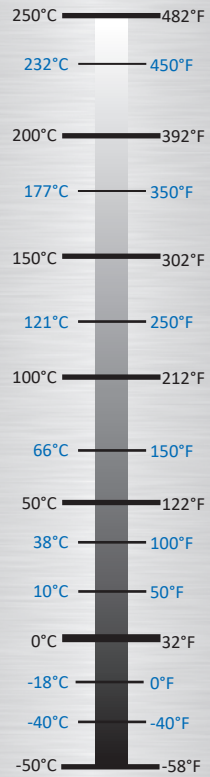
Volume

1 US gallon	= 8 US pints = 3.79 litres = 4 US quarts = 0.83 UK gallons
1 Imperial gallon	= 8 UK pints = 4.55 litres = 4 UK quarts = 1.2 US gallons
1 litre	= 1000 millilitres (ml) = 0.22 UK gallons = 0.26 US gallons = 1.76 UK pints = 2.11 US pints = 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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