

# Permabond®

*Engineering Adhesives*



*"Our Science . . .  
Your Success"*

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## *Permabond is an ISO 9001:2000 certified global manufacturer of adhesives and sealants.*

Our technical and manufacturing staff are dedicated to formulating high quality, engineering grade adhesives.

Our entire team is focused on providing answers to the manufacturing challenges faced in today's industry. We look forward to understanding how we can assist you with increases in quality, efficiency, and cost effectiveness.

**Contact Permabond for all of your bonding and sealing needs!**



**800-714-0170**



***www.permabond.com***

**We welcome your call!**



*This brochure contains information on our most popular products. If you don't see exactly what you need or would like assistance in selecting the best product for your application please contact us.*

**Application Assistance - 800•640•7599**

# Just some of the industries that trust Permabond

## Aerospace



## Defense



## Electronics



## Military Specifications & Standards

### MIL-S-22473E<sup>1</sup> • ASTM D5363<sup>2</sup>

Permabond Grade	Grade	ASTM D5363 Assigned #	Group	Class	Grade
HH120	AVV	AN 0124	01	2	4
HL126	AA	AN 0111	01	1	1
MM115	CVV	AN 0143	01	4	3
LM012	HVV	AN 0163	01	6	3
ASC10	N & T	N/A	N/A	N/A	N & T

### MIL-A-46050C<sup>1</sup>

Permabond Grade	Type/Class
101	Type II, Class 1
102	Type II, Class 2
105	Type II, Class 1
108	Type II, Class 3
170	Type I, Class 3
268	Type II, Class 3
790	Type II, Class 1
791	Type II, Class 1
792	Type II, Class 2
795	Type II, Class 3
798	Type II, Class 3
799	Type II, Class 4
910	Type I, Class 2
910FS	Type I, Class 1
919	Type V, Class 1
920	Type V, Class 2
922	Type V, Class 3
QFS16	All Types

### MIL-S-46163A<sup>1</sup> • ASTM D5363<sup>2</sup>

Permabond Grade	Type/Grade	ASTM D5363 Assigned #	Group	Class	Grade
HH120	I / L	AN 0211	02	1	1
HL126	III / R	AN 0261	02	6	1
HM118	II / O	AN 0331	03	3	1
HM128	I / K	AN 0221	02	2	1
LM113	II / M	AN 0311	03	1	1
MM115	II / N	AN 0321	03	2	1
ASC10	F	N/A	N/A	N/A	N & T

### MIL-R-46082B<sup>1</sup> • ASTM D5363<sup>2</sup>

Permabond Grade	Type	ASTM D5363 Assigned #	Group	Class	Grade
HL138	I	AN 0411	04	1	1
HM160	II	AN 0412	04	1	2
HM161	III	AN 0421	04	2	1

<sup>1</sup>MIL-SPECS are for existing designs ONLY

<sup>2</sup>ASTM D5363 is for NEW designs

### CID A-A-3097

Permabond Grade	Type/Class
108	Type II, Class 3
791	Type II, Class 1
792	Type II, Class 2
795	Type II, Class 3
910	Type I, Class 2
910FS	Type I, Class 1
QFS16	All Types

## Transportation



## Automotive



## Motor





Permabond has a large number of company specific and industry specifications. Following is a brief listing of common specifications. Contact Permabond if the one you require is not listed here.



## Medical - Biocompatibility

### USP CLASS VI

Permabond Grade	USP CLASS VI
4C10	PASS
4C20	PASS
4C30	PASS
4C40	PASS

### CYTOTOXICITY

Permabond Grade	CYTOTOXICITY
4C10	PASS
4C20	PASS
4C30	PASS
4C40	PASS
4UV80	PASS
1001	PASS
820	PASS

## Oxygen Gas (BAM Certified)

Permabond Grade	BAM Certification
MH052	Approved for use with gaseous oxygen up to 10 bar (145 psi) and 60°C (140°F).

## Potable Water

### NSF / ANSI 61 Certified

	Permabond Grade
	HH040 PURE
	LH050 PURE
	MM115 PURE

## Fire Protection

	Permabond Grade
	LH056
<p>FGG/BM/CZ™ System Compatible indicates that this product has been tested, and is monitored on an ongoing basis to assure its chemical compatibility with FlowGuard Gold®, BlazeMaster® and Corzan® pipe and fittings. FGG/BM/CZ™, FlowGuard Gold®, BlazeMaster®, and Corzan® are licensed trademarks of The Lubrizol Corporation.</p>	

## Underwriters Laboratory (UL Listed)

	Permabond Grade
	LH050
	LH150



Following is a brief overview of the benefits and limitations by adhesive chemistry type to assist you in selecting the best adhesive for your application.

## Highlights & Limitations by Chemistry

	Anaerobics	Cyanoacrylates	2-Part Acrylics	No-Mix Acrylics	1 Part Epoxies	2 Part Epoxies	UV Light Cured
Highlights	Lock, retain & seal, prevent loosening & corrosion	Rapid cure, bond a wide range of substrates	High strength, with good impact resistance	Flexible, fast fixture, with good impact resistance	Strong - no mix	Strong - room temperature cure	Rapid cure & good adhesion to plastics, glass & metals
Limitations	Metals only	Poor polar solvent resistance	Mix required	2 step application	Heat required	Mix required	Cure equipment required

## Solvent Resistance by Chemistry

	Polar Solvents	Non-Polar Solvents
UV	Good	Good
Tough Acrylic	Good	Very Good
Epoxy	Very Good	Very Good
Cyanoacrylate	Poor	Good
Anaerobic	Excellent	Excellent

## Chemical Compatibility of Anaerobics

Liquids									Gases		
Acetic acid	B	Chromic acid	C	Glycerine	A	Oil (hydraulic)	A	Shellac	A	Air	A
Acetone	A	Citric acid	C	Gypsum	A	Oil (linseed)	A	Sodium Hydroxide	C	Carbon dioxide	A
Alcohols	A	Copper sulphate	A	Hexane	A	Oil (lubricating)	A	Starch	A	Carbon monoxide	A
Ammonia sol.	C	Creosote	A	Hydrochloric acid	C	Oil (mineral)	A	Sugar	A	Chlorine	X
Animal fat	A	Cyanide sol.	B	Ink	A	Ozone (wet)	X	Sulphuric acid	C	Freon	C
Battery acid	B	Detergents	A	Insecticide*	A	Paraffin	A	Sulphurus acid	C	Helium	A
Bleach	A	Dielectric fluid*	A	Isocyanate resin	A	Perfume	A	Toluene	A	Methane	A
Bromine	X	Dye stuffs	A	Jet fuel	A	Petrol	A	Trichloroethane	A	Natural gas	A
Carbolic acid	B	Ethyl acetate	A	Kerosene	A	Petroleum jelly	A	Turpentine	A	Pure oxygen	**
Carbonic acid	B	Ferric chloride	B	Lactic acid	A	Photo Developer	A	Water (fresh/sea)	A	Ozone	X
Cement	A	Fertilizer*	A	Nitric acid	X	Phosphoric acid	C	Water (heavy)	A	Propane	A
China Clay	A	Formaldehyde	C	Oil (fuel)	A	Sewage	A	Xylene	A	Steam	X

\*\* MH052 - Approved for use with gaseous oxygen up to 10 bar (145 psi) and 60°C (140°F).

Few industrial chemicals have a damaging effect on Permabond's anaerobic adhesives. However strong concentrations or if hot may.

\*Test first as some brands/types are more aggressive than others.

**A:** Most Permabond products are suitable

**C:** Only use high-strength Permabond products

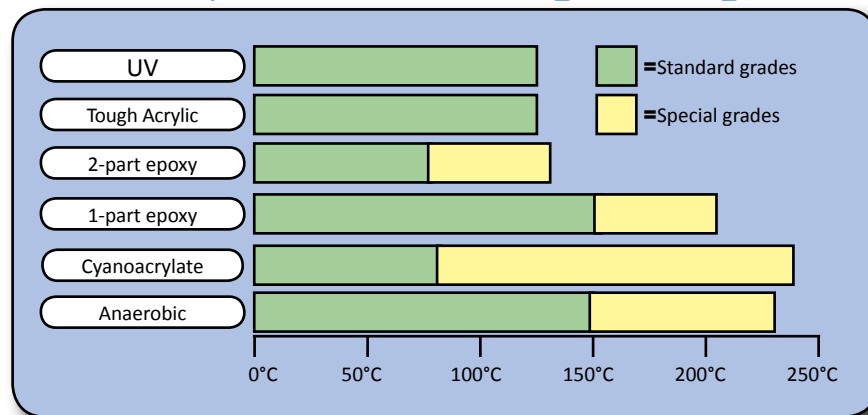
**B:** For concentrations up to 10% most adhesives can be used

**X:** Not suitable for Permabond anaerobic adhesives.

### Adhesion by Chemistry

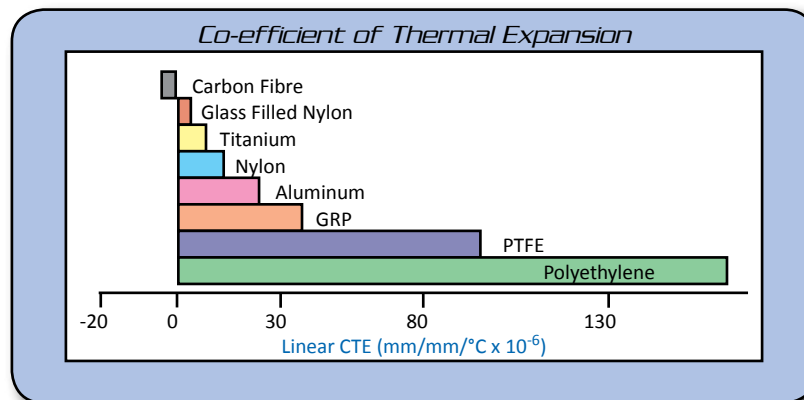
Substrate	Anaerobics	Cyanoacrylates	2-Part Acrylics	No-Mix Acrylics	1 Part Epoxies	2 Part Epoxies	UV Light Cured
Metals	Excellent	Very Good	Excellent	Excellent	Excellent	Excellent	Good
Plastics	Not applicable	Excellent	Very Good	Good	Not applicable	Good	Very Good
Glass	Not applicable	Poor	Good	Excellent	Excellent	Excellent	Excellent
Rubber	Not applicable	Very Good	Poor	Poor	Fair	Poor	Poor
Wood	Not applicable	Good	Good	Good	Very Good	Very Good	Poor

### Temperature Resistance by Chemistry



Products can withstand higher temperatures for brief periods providing joint is not unduly stressed.

### Co-efficient of Thermal Expansion



### Strength & Flexibility by Chemistry

	Anaerobics	Cyanoacrylates	2-Part Acrylics	No-Mix Acrylics	1 Part Epoxies	2 Part Epoxies	UV Light Cured
Shear Strength	High	High	High	High	Very high	High	High
Peel Strength	Medium	Low	Medium	Medium	Medium	Medium	Medium
Tensile Strength	High	High	High	High	High	High	High
Elongation (Flexibility)	Low	Low	Medium	Medium	Low	Medium	Medium
Hardness	Rigid	Rigid	Semi-Rigid	Semi-rigid	Rigid	Semi-Rigid	Semi-Rigid

**TIP:** When bonding dissimilar materials together, particularly in an environment subject to temperature change, slightly flexible, toughened adhesives can be better than rigid methods of fixture such as mechanical fastenings. The differential thermal expansion and contraction between materials can induce stress in the substrates and into the joint. Flexible adhesives spread that stress across a larger area and can absorb some of the stress.

# Anaerobic Adhesives & Sealants

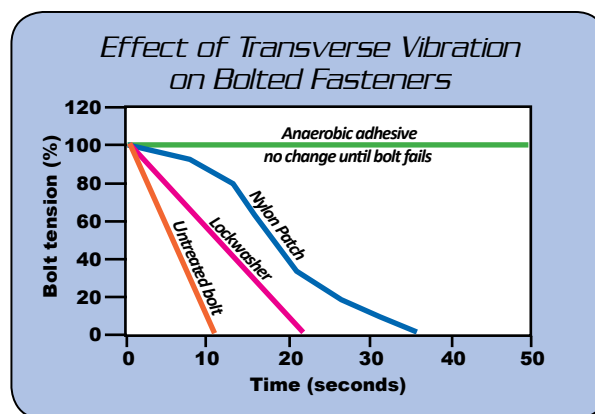
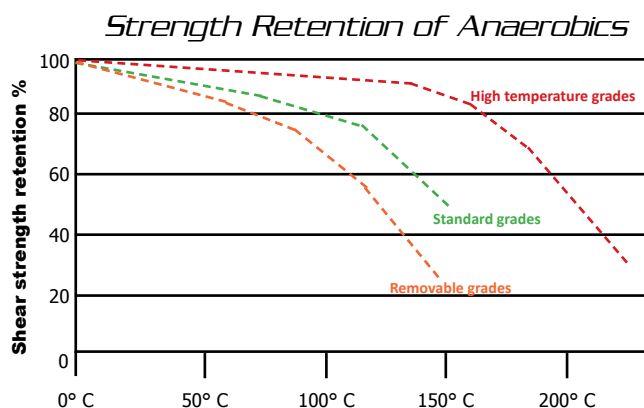
## Threadlocking

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

### Benefits

- Prevents nuts rusting onto bolts
- Low strength for parts which may require future disassembly
- Medium & high strength to prevent theft and vandalism
- More cost-effective than using mechanical fastenings
- Lubricates for easier assembly
- Machining tolerances can be increased
- Seals against leaks
- Stops nuts and bolts working loose due to vibration

Product	Description	Color	Viscosity cP
LM113	Removable, low strength, for small diameter fasteners	Purple	1,200
MM115	Removable, general purpose	Blue	1,300
MM115 Pure	Removable, general purpose, NSF/ANSI 61 Certified	Colorless	1,300
HM118	Removable, high strength	Red	1,800
HH120	Permanent, maximum strength, for large diameter bolts	Red	7,000
HL126	Wicking grade for post assembly, also used for weld sealing	Green	12
HM128	Permanent, general purpose	Red	500
HM129	Permanent, high strength, for up to 1" diameter fasteners	Red	500
HH131	Permanent, high temperature resistant, high strength, up to 1½" diameter fasteners	Red	10,000



Product	Max. Gap Fill		Shear Strength, Steel		Torque, M10 Steel nuts & bolts				Fixture Time, Steel mins	Temperature Range			
	in	mm	psi	N/mm²	Breakaway		Prevail			Min.		Max.	
					in•lb	N•m	in•lb	N•m		°F	°C	°F	°C
LM113	0.006	0.152	750	5	80	9	40	5	15	-65	-54	300	150
MM115	0.006	0.152	1,500	10	140	16	60	7	10	-65	-54	300	150
MM115 Pure	0.006	0.152	1,500	10	140	16	60	7	10	-65	-54	300	150
HM118	0.008	0.203	2,500	17	200	23	280	32	10	-65	-54	300	150
HH120	0.010	0.254	2,500	17	275	31	300	34	10	-65	-54	300	150
HL126	0.005	0.127	1,500	10	125	14	300	34	8	-65	-54	300	150
HM128	0.006	0.152	2,500	17	275	31	350	40	5	-65	-54	300	150
HM129	0.006	0.152	2,500	17	280	32	500	56	10	-65	-54	300	150
HH131	0.012	0.305	2,500	17	240	27	480	54	15	-65	-54	445	230





## Thread Sealing

Permabond thread sealing anaerobic adhesives are designed to replace traditional thread sealing materials such as hemp, PTFE tape, and pipe dope.

### Benefits

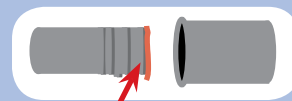
- No loose particles to clog valves
- Will not shred, creep, or relax over time
- Easy to apply, allows accurate positioning of pipes and fittings
- Lubricates for easier assembly
- Typically seals to the burst pressure of the pipe when fully cured
- Grades suitable for water, gas, air, and hydraulic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

Product	Description	Color	Viscosity cP
LM012	No fillers, hydraulic sealing	Brown	2,000
LH050	General purpose thread sealant, UL Listed	White	250,000
LH050 Pure	General purpose, NSF/ANSI 61 Certified	White	250,000
LH051	Automatic dispensing	White	250,000
LH056	Fire protection grade	White	250,000
MH052	Medium strength for coarse threads, BAM approved for oxygen	Yellow	50,000
LH150	Stainless steel pipe sealant	White	260,000

**TIP:** Pipe joints sealed with low-strength thread sealants 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 reapplying sealant, clean pipe joints with a wire brush.

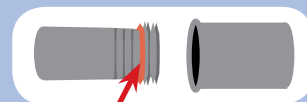
### Correct assembly technique

- Parallel to parallel pipe joints  
Apply adhesive to the leading edge of the male component.



IN BOTH CASES EXCESS ADHESIVE SHOULD BE SEEN AFTER TIGHTENING

- Taper to parallel pipe joints  
Apply adhesive several threads back from the leading edge of the male component to ensure maximum contact.



Product	Max. Gap Fill		Shear Strength, Steel		Torque, M10 Steel nuts & bolts				Fixture Time, Steel, mins	Temperature Range			
	in	mm	psi	N/mm²	Breakaway		Prevail			Min.		Max.	
					in•lb	N•m	in•lb	N•m		°F	°C	°F	°C
LM012	0.008	0.203	750	5	25	3	15	2	30	-65	-54	350	177
LH050	0.020	0.508	1,000	7	35	4	25	3	120	-65	-54	350	177
LH050 Pure	0.020	0.508	1,000	7	35	4	25	3	120	-65	-54	350	177
LH051	0.020	0.508	1,000	7	35	4	25	3	120	-65	-54	350	177
LH056	0.020	0.508	1000	7	35	4	25	3	120	-65	-54	350	177
MH052	0.020	0.508	1,400	10	180	20	100	11	15	-65	-54	300	150
LH150	0.020	0.508	1,000	7	35	4	25	3	120	-65	-54	350	177

# Anaerobic Adhesives & Sealants

## Form-in-Place Gasketing

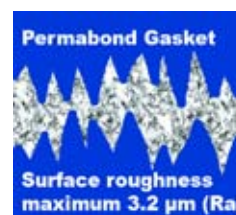
Permabond gasketing anaerobic adhesives are designed to replace traditional cork, wood, rubber, paper and silicone gaskets.

### 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
- Surfaces need not be so smooth so there can be less machining
- Non-shimming
- 100% metal to metal contact for better stress distribution

Product	Description	Color	Viscosity cP
HH190	General purpose flange sealant	Purple	600,000
MH196	Fast curing, high temperature resistant	Red	150,000
LH197	Flexible, easy to remove	Green	37,000
MH199	Highly thixotropic, high temperature resistant	Red	185,000

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



Product	Max. Gap Fill		Shear Strength, Steel		Fixture Time, Steel, mins	Temperature Range			
	in	mm	psi	N/mm²		Min.		Max.	
						°F	°C	°F	°C
HH190	0.025	0.635	900	6	15	-65	-54	250	120
MH196	0.020	0.508	1,500	10	15	-65	-54	390	200
LH197	0.012	0.305	750	5	20	-65	-54	300	150
MH199	0.020	0.508	1,100	8	20	-65	-54	390	200

### 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

**TIP:** Use Permabond ASC10 to activate non-metal or less active metals to speed cure.

### Other products...

Permabond CA Solvent to remove oil, grease & dirt before adhesive application.

Permabond ASC10 Anaerobic Surface Conditioner to speed-up anaerobic adhesive cure and for use on inactive surfaces.



## Retaining Compounds

Retaining compounds are for the permanent bonding of co-axial joints.

*Typical retaining compound applications include:*

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

### Benefits

- Augments/replaces slip fits
- Prevents corrosion
- Mounts bearings
- Restores correct fit
- Reduces machining time due to relaxed tolerances
- Rapid, quick and easy assembly of parts
- 100% surface-to-surface contact
- Allows for greater load carrying capacity

Product	Description	Color	Viscosity cP
HH040	General purpose, maximum gap fill	Green	5,000
HH040 Pure	General purpose, NSF/ANSI 61 Certified	Colorless	5,000
HL138	General purpose, press fit	Green	150
HM160	General purpose, slip fit	Green	600
HM161	Gap fill, slip fit	Green	2,000
HM162	Fast curing, high temperature resistant	Green	800
HM165	Maximum gap fill, high temperature resistant	Green	10,000
HH167	Maximum gap fill, metal repair	Silver	500,000

**TIP:** See pages 3 & 4 for specifications and approvals.

Product	Max. Gap Fill		Shear Strength, Steel		Torque, M10 Steel nuts & bolts				Fixture Time, Steel mins	Temperature Range			
	in	mm	psi	N/mm²	Breakaway		Prevail			Min.		Max.	
					in•lb	N•m	in•lb	N•m		°F	°C	°F	°C
HH040	0.010	0.254	2,000	14	200	23	300	34	15	-65	-54	300	150
HH040 Pure	0.010	0.254	2,000	14	200	23	300	34	15	-65	-54	300	150
HL138	0.005	0.127	2,300	16	180	20	320	36	10	-65	-54	300	150
HM160	0.008	0.203	3,000	21	250	28	400	45	10	-65	-54	350	177
HM161	0.010	0.254	3,500	24	275	31	400	45	10	-65	-54	350	177
HM162	0.008	0.203	4,300	30	280	32	550	62	5	-65	-54	390	200
HM165	0.012	0.305	3,800	26	250	28	480	54	15	-65	-54	445	230
HH167	0.012	0.305	4,700	32	280	32	400	45	15	-65	-54	300	150





## Instant Adhesives

Cyanoacrylate adhesives are single component adhesives that cure by reacting to small traces of moisture on the surface of the substrates being bonded. Cyanoacrylate adhesives cure very quickly at room temperature, eliminating the need for costly ovens or curing equipment. Cyanoacrylate adhesives can lower costs by reducing the number of inventoried products necessary for manufacturing.

### Typical cyanoacrylate applications include:

- Electronics wire tacking
- Bonding headsets
- Hose clips onto hoses
- Bonding automotive interior trim
- Tacking parts during assembly process
- Joining silicone O-rings
- Disposable medical device bonding
- Bonding musical instrument components
- Bonding mobile phone casings, antennae, & keypads
- Sealing batteries
- Glazing applications
- Sealing transformer laminates

**TIP:** When bonding with cyanoacrylates, use only enough adhesive to cover the bond area. Excess adhesive will not increase bond strength and can reduce cure speed.

**General Purpose** The following set of general purpose ethyl cyanoacrylate adhesives bond a wide variety of substrates quickly. Strengths listed here are for grit blasted steel but these adhesives are known for their ability to bond a wide variety of plastics and other substrates.

Grade	Description	Viscosity cP	Max. Gap Fill		Shear Strength*		Set Time, Steel sec	Temperature Range			
			in.	mm	psi	N/mm <sup>2</sup>		Min.		Max.	
								°F	°C	°F	°C
101	Wicking type, plastic bonding	2	0.002	0.051	3,000	21	5	-65	-54	180	82
102	Plastic bonding	80	0.006	0.152	3,100	21	10	-65	-54	180	82
105	Elastomer bonding	40	0.004	0.102	2,900	20	10	-65	-54	180	82
108	Intermediate gap fill, plastic bonding	500	0.008	0.203	3,000	21	10	-65	-54	180	82
240	Plastic bonding, maximum gap fill and flow control	2,000	0.017	0.432	3,300	23	15	-65	-54	180	82
268	Fast curing maximum gap fill	1,800	0.017	0.432	3,000	21	10	-65	-54	180	82
2010	Thixotropic gel, maximum gap fill	23,000	0.020	0.508	3,100	21	10	-65	-54	180	82

\* Grit blasted steel



The excellent performance and versatility of PermaBond's cyanoacrylate adhesives have eliminated many product design and production limitations, making the efficiency of cyanoacrylate adhesives a reality for more challenging applications.

PermaBond manufactures a full spectrum of cyanoacrylates in a variety of viscosities, cure speeds, gap-filling capabilities, and adhesion to substrates. Cyanoacrylates are ideal for bonding materials such as plastics, metals, rubbers, composites, and phenolic. Our chemists have perfected PermaBond cyanoacrylates to perform superbly with hard to bond materials including silicone, polypropylene, polyethylene, and PTFE. PermaBond's high performance cyanoacrylates include Toughened, Surface Insensitive (rapid cure), Non-blooming (low odor), High Temperature Resistant, and Metal Bonding grades. Accelerators, Primers, and Solvents are also available to increase cure speed, adhesion, and clean up.

**TIP:** See pages 3 & 4 for specifications and approvals.





***Toughened for Impact Resistance*** Cyanoacrylates form bonds with strong shear and tensile properties. For increased impact resistance, PermaBond offers its impact resistant 730 series in both clear and black. Consider this series when the assembly is subject to vibration, impact, peel, or flexing stresses. In addition to the impact resistance, these ethyl cyanoacrylates have higher temperature resistance. The service temperature range is -65°F (-54°C) to 250°F (120°C); brief periods of higher temperatures can be withstood providing the joint is not unduly stressed.

Grade	Description	Color	Viscosity cP	Max. Gap Fill		Shear Strength*		Set Time, Steel sec	Temperature Range			
				in.	mm	psi	N/mm²		Min.		Max.	
									°F	°C	°F	°C
731	Excellent peel, impact & shear strength	Clear	150	0.006	0.152	4,000	27	30	-65	-54	250	120
735	Excellent peel, impact & shear strength	Black	250	0.006	0.152	4,000	27	30	-65	-54	250	120
737	Impact resistant, gap fill	Black	3,000	0.020	0.508	3,100	21	15	-65	-54	250	120

\* Grit blasted steel

***Surface Insensitive*** PermaBond overcomes the challenges posed when bonding acidic surfaces such as wood, leather, paper, or cork with their range of surface insensitive products. These ethyl cyanoacrylates also perform well on very dry or porous materials, thereby extending the range of application possibilities. The full product line includes wicking grades for post assembly application, gap filling to 0.508 mm and a true non-sag, no-drip gel for vertical applications.

Grade	Description	Viscosity cP	Max. Gap Fill		Shear Strength*		Set Time, Steel sec	Temperature Range			
			in.	mm	psi	N/mm²		Min.		Max.	
								°F	°C	°F	°C
790	Extremely fast curing, wicking type	2	0.002	0.051	2,900	20	3	-65	-54	180	82
791	Extremely fast curing, close fitting parts	40	0.004	0.102	2,900	20	3	-65	-54	180	82
792	Extremely fast curing, close fitting parts	80	0.006	0.152	2,900	20	3	-65	-54	180	82
795	Extremely fast curing, general purpose	500	0.007	0.178	2,900	20	4	-65	-54	180	82
799	Extremely fast curing, maximum gap fill	5,000	0.020	0.508	3,000	21	8	-65	-54	180	82
2011	Thixotropic gel, non-sag, maximum gap fill	Gel	0.020	0.508	3,200	22	10	-65	-54	180	82

\* Grit blasted steel

***Non-blooming, Low Odor*** Odors and residue (blooming or frosting) are caused by molecules released into the air during the cure process of traditional cyanoacrylates. PermaBond's proprietary formulations contain low vapor pressure monomers which result in a less volatile product. There is little to no odor during application and virtually no residue when cured. This leads to improved aesthetics and worker comfort.

Grade	Description	Viscosity cP	Max. Gap Fill		Shear Strength*		Set Time, Steel sec	Temperature Range			
			in.	mm	psi	N/mm²		Min.		Max.	
								°F	°C	°F	°C
940	Low odor & low bloom, wicking type	7	0.002	0.051	2,600	18	10	-65	-54	180	82
941	Low odor & low bloom, close fitting parts	30	0.003	0.076	2,600	18	10	-65	-54	180	82
943	Low odor & non-blooming, general purpose	100	0.006	0.152	2,600	18	10	-65	-54	180	82
947	Low odor & low bloom, gap fill	1,200	0.010	0.254	2,600	18	25	-65	-54	180	82

\* Grit blasted steel



**High Temperature Resistant** The 800 series offers the highest temperature resistance available without using a secondary heat cure process. PermaBond 919 & 920 are formulated to offer increased temperature resistance with the use of a secondary heat cure process.

Grade	Description	Viscosity cP	Max. Gap Fill		Shear Strength*		Set Time, Steel sec	Temperature Range			
			in.	mm	psi	N/mm²		Min.		Max.	
								°F	°C	°F	°C
801	Resists to 130°C, wicking type	35	0.003	0.076	3,000	21	10	-65	-54	270	130
802	Resists to 160°C	100	0.006	0.152	3,000	21	10	-65	-54	320	160
820	Resists to 200°C	100	0.006	0.152	3,000	21	10	-65	-54	390	200
919	Resists to 250°C, wicking type	4	0.002	0.051	3,000	21	10	-65	-54	482**	250**
920	Resists to 250°C	80	0.006	0.152	3,000	21	10	-65	-54	482**	250**
922	Resists to 250°C max. gap fill	1,600	0.017	0.432	3,000	21	10	-65	-54	482**	250**

\* Grit blasted steel

\*\* With Secondary Heat Cure

PRODUCT	TEMP RESIST
820	200°C
920	250°C*
typical ethyl	82°C
typical methyl	90°C

\* with secondary heat cure

In order to withstand high temperature environments, PermaBond 919, 920, & 922 were designed with a secondary curing mechanism that is activated at temperatures higher than 150°C (302°F). The procedure to activate this mechanism is:

- 1) Parts are bonded and clamped at room temperature for four hours.
- 2) The clamped parts are then heated at 150°C (302°F) for two hours.
- 3) After the two hours, the bond will be thermally resistant up to 250°C (482°F).

**Metal Bonding** The original instant adhesive, 910, continues to be the only pure methyl cyanoacrylate. It is relied on to create the strongest bonds between metal substrates. PermaBond 910FS is a faster setting product and PermaBond 170 is a higher viscosity product with more gap filling capability.

Grade	Description	Viscosity cP	Max. Gap Fill		Shear Strength*		Set Time, Steel sec	Temperature Range			
			in.	mm	psi	N/mm²		Min.		Max.	
								°F	°C	°F	°C
170	Maximum gap fill	1,500	0.015	0.381	3,500	24	15	-65	-54	195	90
910	General purpose, the original!	80	0.006	0.152	3,700	26	10	-65	-54	195	90
910FS	Metal bonding, wicking type	3	0.002	0.051	3,700	26	5	-65	-54	195	90

\* Grit blasted steel

At PermaBond an “ounce” is still an ounce.



**Primers & Accelerators** Cyanoacrylate adhesives are very effective at bonding many substrates including PP, PE, PTFE with the use of PermaBond POP (Polyolefin Primer). QFS10, QFS16 and CSA NF increase the speed of cure of cyanoacrylates and cure any exposed cyanoacrylate adhesive very quickly, reducing blooming.

Grade	Chemistry	Description
POP	Solvent	Polyolefin primer
QFS16	Solvent	Cyanoacrylate accelerator
CSA-NF	Solvent	Non-flammable cyanoacrylate accelerator
CA Solvent	Solvent	Cleaner and adhesive remover

#### Package Options...

Most products are available in one ounce and one pound bottles. For other sizes or packaging options contact PermaBond.

**Medical Device Grades** Cyanoacrylates bond a wide variety of plastics commonly used in the medical device industry.

Product	Cured Appearance	Chemistry Type	Viscosity cP/mPa	Impact Strength ft•lb/in <sup>2</sup> (kJ/m <sup>2</sup> )	Cytotoxicity	USP Class VI	Fixture time in secs.	Shear Strength psi (N/mm <sup>2</sup> )					Typical Application
								Steel	Aluminum	Styrene	PVC	Polycarbonate	
4C10	Clear and colorless	Ethyl	40	4 (8)	Pass	Pass	10	3,050 (21)	1,000 (7)	The strength of the bond exceeds the strength of the plastic.			Tube set bonding
4C20	Clear and colorless	Ethyl	500	4 (8)	Pass	Pass	10	3,050 (21)	1,000 (7)				Bonding tips to swabs
4C30	Clear and colorless	Ethyl	1,500	4 (8)	Pass	Pass	10	3,050 (21)	1,000 (7)				Gap filling for custom tube sets
4C40	Clear and colorless	Ethyl	2,000	4 (8)	Pass	Pass	10	3,050 (21)	1,000 (7)				Rubber bumper bonding
820	Clear and colorless	Modified ethyl	100	5 (11)	Pass	Not Tested	10	2,600 (18)	1,000 (7)				High temp. resistant applications
1001	Clear & slightly violet	Butyl	5	5 (11)	Pass	Not Tested	< 60	700 (5)	N/A	N/A			Various

## Epoxy Adhesives

**Epoxies - One Component** 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. Their excellent resistance to impact and temperatures from -40°F up to 355°F (-40°C to 180°C) make them a popular structural bonding choice.

Product	Description	Color	Viscosity cP	Max. Gap Fill		Shear Strength*		Peel Strength*	
				in.	mm	psi	N/mm <sup>2</sup>	PIW	N/25mm <sup>2</sup>
ES550	High strength, no sag	Grey	1,500,000	0.12	3.00	4,000 - 6,000	27 - 41	20 - 30	89 - 135
ES558	High strength, free flowing	Grey	200,000	0.02	0.51	4,000 - 6,000	27 - 41	20 - 30	89 - 135
ES562	High strength, free flowing	White	20,000	0.01	0.25	3,000 - 5,000	20 - 35	8 - 14	35 - 62
ES569	High strength, no sag	Black	375,000	0.20	5.00	4,000 - 6,000	27 - 41	10 - 20	45 - 89
ES578	Thermally conductive, electrically insulative	Black	700,000	0.20	5.00	4,000 - 6,000	27 - 41	10 - 20	45 - 89
4ES70	Needle bonding grade	Cream	10,000 - 30,000	0.01	0.25	3,000 - 5,000	20 - 35	8 - 14	35 - 62

\* Grit blasted steel

### Single Part Epoxy Benefits

- High peel strength increases joint design versatility
- Excellent chemical and environmental durability
- Significantly reduces assembly production costs
- Will bond most materials
- A good alternative to welding or brazing
- Low temperature curing grade available for bonding heat vulnerable parts

**Epoxies - Two Component** Two part epoxies cure at room temperature. Heat is not required but can be used to accelerate cure. All are easily dispensed with a static mixing nozzle; no measuring or hand mixing is needed. Permabond's ET540 is a 2:1 mix ratio and resists temperatures from -40°F up to 240°F (-40°C to 120°C). All others are 1:1 and resist temperatures from -40°F to 175°F (-40°C to 80°C).

Product	Description	Color	Viscosity cP, Mixed	Max. Gap Fill		Shear Strength*		Peel Strength*		Handling Strength mins.
				in.	mm	psi	N/mm <sup>2</sup>	PIW	N/25mm <sup>2</sup>	
ET500	Fast, non-yellowing	Clear	12,000	0.08	2.00	1,750 - 2,000	12-14	10	45	4 - 6
ET505	Tough, multi purpose	Amber	20,000	0.08	2.00	2,600 - 3,000	18 - 21	13	60	180
ET510	Flexible, high peel & impact resistance	Amber	25,000	0.08	2.00	1,200 - 1,750	8 - 12	17	80	15 - 25
ET514	Toughened, high strength	Gray	65,000	0.20	5.00	2,600 - 3,500	18 - 24	17	80	60 - 90
ET515	Clear, flexible, excellent peel & impact resistance	Lt. Amber	20,000	0.08	2.00	1,200 - 1,750	8 - 12	13	60	15 - 25
ET536	Toughened, thixotropic	Gray	200,000	0.20	5.00	2,100 - 3,500	15 - 24	17	80	60 - 90
ET538	Structural, excellent adhesion to many plastic & composites	Gray	300,000	0.20	5.00	2,600 - 2,900	18 - 20	17	80	180 - 240
ET540	Toughened, thixotropic, high temp. Resistance	Amber	300,000	0.20	5.00	2,000 - 2,600	14 - 18	17	80	60 - 180

\* Grit blasted steel

### Two Part Epoxy Benefits

- High peel strength increases joint design versatility
- Most are 1:1 mix ratio for easy mixing
- Rapid cure increases production rates
- Excellent chemical and environmental durability
- No curing equipment required
- Will bond virtually anything; no gap restrictions



## Structural Acrylic Adhesives

**Structural Acrylic Adhesives - No-Mix Surface Activated** Permabond no-mix, surface activated, structural acrylics are solvent free and non-flammable. They fixture quickly and cure at room temperature providing an efficient solution to the continuous demands for increased line speeds.

Permabond structural acrylics are suitable for bonding a wide variety of substrates, greatly expanding the range of design possibilities. Materials such as metals, glass, magnets and composites are easily bonded with Permabond structural acrylics.

Product	Description	Color	Viscosity cP	Fixture Time	Shear Strength*		Peel Strength*		Temperature Range	
					psi	N/mm <sup>2</sup>	PIW	N/25mm <sup>2</sup>	°F	°C
<b>TA430 &amp; Initiator 41</b>	No mix, metals, plastics, ceramics & wood	Amber	30,000	50 - 90 secs.	2,200 - 3,600	15 - 25	10 -14	45 - 65	-65 to 250	-54 to 120
<b>TA435 &amp; Initiator 41</b>	No mix, metals, ferrites & thermoplastics, high impact	Amber	90,000	50 - 90 secs.	2,200 - 3,600	15 - 25	18 - 22	85 - 100	-65 to 250	-54 to 120
<b>TA436 &amp; Initiator 43</b>	No mix, metals & ferrites, high impact & high temperature	Amber	17,000	1 - 3 mins.	2,200 - 3,600	15 - 25	10 -14	45 - 65	-65 to 300	-54 to 150
<b>TA437 &amp; Initiator 41</b>	No mix, metals & ferrites, high temperature	Orange	120,000	30 - 45 secs.	2,000 - 3,000	14 - 20	18 - 22	85 - 100	-65 to 390	-54 to 200
<b>TA437</b>	Single component, metals & ferrites, high temperature	Orange	120,000	3 - 5 mins.	2,000 - 3,000	14 - 20	18 - 22	85 - 100	-65 to 390	-54 to 200
<b>TA439 &amp; Initiator 41</b>	No mix, metals, ferrites & ceramics	Clear	1,000	10 - 20 secs.	1,500 - 1,700	10 - 12	10 -14	45 - 65	-65 to 250	-54 to 120
<b>TA459 &amp; Initiator 43</b>	No mix, metals, ferrites, ceramics & some thermoplastics, non-corrosive to sensitive copper parts or other electrically conductive surfaces	Blue	20,000	15 - 30 secs.	2,900 - 3,600	20 - 25	N/A	N/A	-65 to 300	-54 to 150

\*Grit Blasted Steel

**Structural Acrylic Adhesives - Two Component** Permabond TA440 is a two component solvent free, non-flammable material. It is not dispensed through a static mixer but is designed to mix itself upon assembly. Simply dispense a bead of component A, then dispense a bead of component B on top of it. As the components are assembled, adequate mixing occurs to initiate cure. TA440 forms very strong durable bonds to metals and ferrites.

Permabond TA4810 and TA4820 are methyl methacrylate adhesives. Both form high strength, durable bonds to many plastics, metals and unprimed metals. TA4810 sets up quickly and TA4820 allows more working time for complex assemblies.

Product	Description	Color	Viscosity cP	Fixture Time	Shear Strength*		Peel Strength*		Temperature Range	
					psi	N/mm <sup>2</sup>	PIW	N/25mm <sup>2</sup>	°F	°C
<b>TA440 A+B</b>	Bead on bead for metal, glass, wood & rigid plastic	Part A: Amber Part B: Green	10,000	< 30 secs.	2,200 - 3,600	15 - 25	10 - 14	45 - 65	-65 to 250	-54 to 120
<b>TA4810</b>	A 2-part 1:1 toughened methacrylate adhesive designed for bonding thermoplastics, thermosets, metals and composites	Part A: Off-White Part B: Amber	95,000	10 - 15 mins.	3,500 - 4,500	24 - 31	14 - 22	65 - 100	-40 to 248	-40 to 120
<b>TA4820</b>	A 2-part 1:1 toughened methacrylate adhesive designed for bonding thermoplastics, thermosets, metals and composites	Part A: Off-White Part B: Amber	95,000	30 - 35 mins.	3,500 - 4,500	24 - 31	14 - 22	65 - 100	-40 to 248	-40 to 120

\*Grit Blasted Steel

**TIP:** Static mix tips come in a variety of types. For additional tips or to ensure you use the correct tip contact Permabond.

## UV Light Curable Adhesives

**UV Light Curable Adhesives** Flexible and non-yellowing, Permabond UV Light Curable Adhesives are single part, solvent-free adhesives with temperature ranges of -65 to 250°F (-54 to 120°C). They are suitable for a wide range of applications and cure on demand. Permabond UV7141 offers a dual anaerobic/UV light cure and resists temperatures from -65 to 300°F (-54 to 150°C).

*Typical UV light curable applications include:*

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

Product	Description	Cure Type	Appearance (cured)	Visc. cP	Tensile Strength		Shear Strength		Shore D Hardness	Elongation
					psi	N/mm <sup>2</sup>	psi	N/mm <sup>2</sup>		
UV610	High strength, glass to metal	UV	Cloudy	900	2,500	17	1,900 - 2,300 <sup>1</sup>	13 - 16 <sup>1</sup>	70	95%
UV620	General purpose, optically clear, glass bonder	UV	Clear	2,500	2,300	16	1,300 - 1,500 <sup>1</sup>	9 - 10 <sup>1</sup>	62	75%
UV625	Large gaps, vertical application, glass bonder	UV	Clear	Gel	2,400	16.5	1,400 - 1,600 <sup>1</sup>	10 - 11 <sup>1</sup>	65	40%
UV670	Metal to glass, flexible	UV	Clear	2,500	1,700	12	1,100 - 1,300 <sup>1</sup>	8 - 9 <sup>1</sup>	58	85%
UV7141	Ceramic coated glass, glass to metal	UV- Anaerobic	Clear	1,500	3,000	20	2,000 - 2,500 <sup>1</sup>	14 - 17 <sup>1</sup>	N/A	N/A
UV630	Low viscosity, high strength, plastic bonder	UV-Visible	Clear	250	2,000	14	Substrate failure <sup>2</sup>		60	110%
UV640	Medium viscosity, plastic bonder	UV-Visible	Clear	3,500	1,900	13	Substrate failure <sup>2</sup>		60	110%
UV645	High viscosity, plastic bonder	UV-Visible	Clear	10,000	2,000	14	Substrate failure <sup>2</sup>		65	110%
UV649	Thixotropic gel, plastic bonder	UV-Visible	Clear	Gel	2,200	15	Substrate failure <sup>2</sup>		65	110%
4UV80	Needle bonding adhesive- tested for cytotoxicity (other viscosities available)	UV-Visible	Clear	150	1,740	12	Substrate failure <sup>2</sup>		70	N/A
4UV82	Excellent bond strength to common medical device plastics	UV-Visible	Clear	250	2,000	14	Substrate failure <sup>2</sup>		60	170%

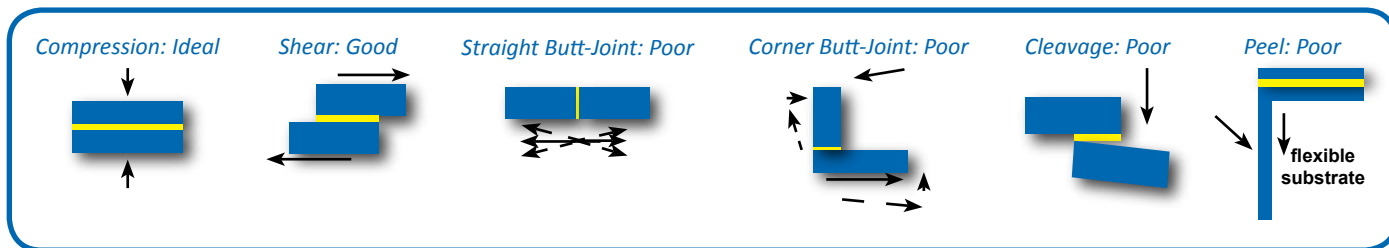
<sup>1</sup> Steel to glass

<sup>2</sup> Polycarbonate to polycarbonate. The polycarbonate failed but the bond remained intact.

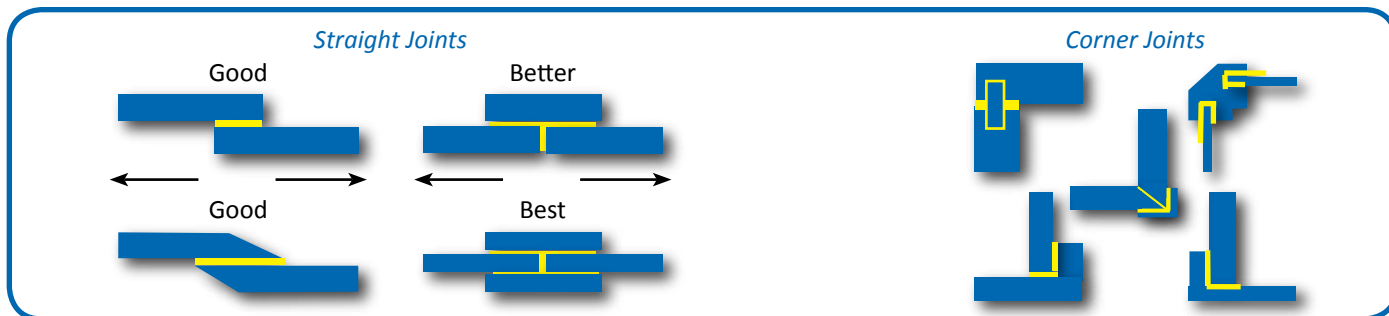
# Design Considerations

Designing components and assembly processes with adhesive use in mind improves quality and efficiency. Joint design, surface preparation and cure methods are reviewed in the following sections.

## Joint Designs Rated



## Suggested Improvements for Poor Joints



**TIP:** If joint design cannot be modified, opt to use a toughened adhesive with high peel strength.

## Surface Preparation

Most materials can be bonded without surface pre-treatment unless surfaces are grossly contaminated. To achieve maximum performance and repeatable results, it is advisable to ensure the bondable surface is consistent. Surface preparation can ensure the cleanliness and consistent surface energy. Higher surface energy increases wetting of the adhesive to optimize adhesion.

### Low Surface Energy



### Surface Treatment

- Solvent wiping
- Mechanical abrasion
- Chemical pretreatments
- Flame
- Chromic acid
- Iodine
- Corona or Plasma treatments
- Primers

### High Surface Energy



## Accelerators, Primers, Activators....

### CYANOACRYLATE ACCELERATORS

**Permabond CSA-NF, QFS10 and QFS16:** accelerators for use with Permabond cyanoacrylates to speed cure rate, particularly on porous or acidic surfaces. These products also cure adhesive that is outside of a joint and reduce blooming.

### PERMABOND POLYOLEFIN PRIMER

**Permabond (POP):** designed to increase adhesion when bonding surfaces such as polypropylene, polyethylene, silicone and PTFE with cyanoacrylate adhesives.

### ANAEROBIC ACTIVATOR

**Permabond ASC10:** surface activator for anaerobic adhesives, suitable for use on non-metallic surfaces or on less active metals to accelerate cure speed.



## Gap Fill and Adhesive Viscosity

Adhesive viscosity and gap fill capability are closely related - generally the higher the adhesive viscosity, the larger the gap filling capability. To help “get a feel” for viscosity measurements, the list below shows everyday substances and their approximate viscosity. It is important to note the maximum gap fill for each product. Exceeding the maximum gap fill can weaken bond strength.

Substance	Viscosity mPa.s = cP	Substance	Viscosity mPa.s = cP
Water	1	Maple syrup	5,000
Milk	3	Honey	10,000
SAE 10 Motor oil	85-140	Chocolate 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

## Service Conditions

Chemical exposure can affect adhesives. It is important to consider not only the type of chemical the adhesive will be exposed to, but the concentration and the 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. Provided adhesives are kept within their recommended temperature range, full strength should be regained upon returning to room temperature. Products can withstand higher temperatures for brief periods providing the joint is not unduly stressed.

**TIP:** Check a discreet area of plastic for compatibility with adhesives / cleaners as some plastics are prone to stress cracking.

## Process Considerations

### Cure Method Considerations by Chemistry



#### Anaerobic Adhesives & Sealants

Anaerobic adhesives cure in the absence of oxygen and the presence of metal. The cure speed is affected by the degree of ‘activity’ of the metal (see chart below) as well as the gap the adhesive must cure through and the temperature.

Super Active (Very fast cure)	Active (Fast cure)	Inactive (Slow cure)	Passive (Activator required)
Brass Copper Magnesium	Steel Nickel Iron Aluminum Zinc	Anodized aluminum Cadmium finishes Chrome finishes Passivated metals Stainless steel Titanium	Ceramics Glass Plastics Painted finishes Lacquered finishes



#### Cyanoacrylate Adhesives

Cyanoacrylate adhesives cure when traces of moisture on the substrates deactivate the stabilizer in the adhesive allowing it to cure. The cure speed is affected by the amount of moisture on the surface. Acidic surfaces and porous surfaces will yield reduced cure speeds and may require a surface insensitive cyanoacrylate and/or accelerator (see chart below). Cure is also affected by the gap the adhesive must cure through and the temperature.

Very fast cure	Acidic (use surface insensitive e.g. 790)	Porous (use accelerator)	Porous and Acidic (use surface insensitive ex. 790 & accelerator e.g. CSA NF)
Most Plastics Metals	Leather Plated metals	Ceramic Fabrics	Wood Paper





### UV Curable Adhesives

UV curable adhesives cure when UV light activates the process. Many products also have visible light cure capabilities. Unless otherwise noted, the cure of the adhesive will cease when the light is removed. Permabond UV7141 has a secondary anaerobic cure mechanism: UV light can be used to cure the exposed area, and the adhesive that is between two pieces of metal will continue curing anaerobically. Cure speed is affected by the wavelength and intensity of light at the bond site. Distance, attenuation, and light absorption by the substrate and through the gap of the adhesive all play a role in cure rate. Permabond adhesives have been designed to cure quickly with low intensity lamps.



### Epoxy Adhesives

Permabond one component adhesives cure with heat as indicated on the Technical Data Sheet. Note whether the adhesive will flow during the cure process to ensure the adhesive placement is in the desired area. Permabond two component adhesives do not require heat but the cure speed of the mixed adhesive will be accelerated with heat. To ensure consistent cure speed and adhesion and to eliminate weighing or measuring adhesive use the specified static mix tip.

### Structural Acrylic Adhesives

Permabond manufactures a variety of types of structural acrylic adhesives.

**Permabond No Mix** (also known as Surface Activated Adhesives) are comprised of an adhesive and an initiator. The initiator is applied to one surface and the adhesive to the other. Cure begins once the components are assembled and the adhesive and initiator come into contact. Permabond TA437 is a No Mix that will also cure without the initiator, making it a single component that does not require heat to cure.

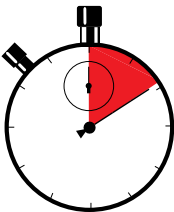
**Permabond Bead on Bead** - This two component adhesive is not meant to be mixed prior to bonding. A bead of one component is dispensed on top of a bead of the other component. When the parts are assembled enough mixing occurs to cure the adhesive.

**Permabond 2 component** adhesives do not require measuring, weighing or hand mixing when dispensed through the static mix nozzle.



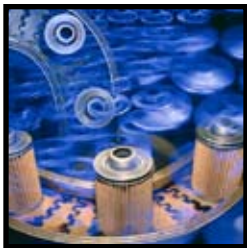
## Process and Cure Speed Estimates

The stages of cure include fixture, handling strength, and full cure. Various cure stages are considered for processing requirements. For more detail on cure schedules review the technical data sheet or call 800-640-7599.



- Anaerobics - fixture time from two minutes up to 1 hour depending on substrates
- Cyanoacrylates - cure to handling strength in 1 - 30 seconds
- Structural acrylics - quick curing grades reach handling strength in 1-4 minutes
- Two-part epoxies - handling strength from 5 minutes to several hours depending on grade
- Single-part heat-cure epoxies - cure time dependent on temperature / heating method
- UV-curables - cure in 1-2 seconds on exposure to high-intensity UV-light

## Production Line Considerations



### 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 offers 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

Conveyors, robotics, and X-Y machines can greatly increase assembly rates for high-speed production lines. Adhesives can easily be incorporated into highly automated systems with minimal cost.

### Clamping / jigging & cure speed

It is important that bonded parts are not disturbed during the curing process, at least until they have reached handling strength. Movement of the parts during the curing process could cause misalignment or lower bond strength. To keep clamping time to a minimum, choose one of Permabond's rapid curing adhesives to speed up production.

## Adhesive Usage Estimates

The number of free flow drops is listed below. All of the data was determined using an 18 gauge needle to create an 1/8" (3.17mm) drop.

Actual Size ●

Container Size	Number of Drops	Container Size	Number of Drops
3 g	258	10 ml	150
20 g	1,720	50 ml	600
28 g (1 oz)	2,400	75 ml	1,125
30 g	2,580	250 ml	3,750
300 g	25,800	300 ml	4,500
454 g (1 lb)	39,044	500 ml	7,500
500 g	43,000	750 ml	11,250
2 Kg	172,000	1 Liter	15,000

### Calculation for volume of a bead of adhesive:

$$\text{Volume (ml)} = \frac{\pi D^2}{4} \times L$$

L = Length of bead in cm  
D = Diameter of bead in cm

## 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 meter (m) = 100 centimeters (cm)  
= 1000 millimeters (mm)  
= 3.28 feet  
= 39.37 inches  
= 3.28 feet  
= 39.37 inches

1 inch = 2.54 centimeters (cm)  
= 25.4 millimeters (mm)  
= 1000 mils

1 centimeter (cm) = 0.39 inches  
= 10 millimeters (mm)

1 millimeter (mm) = 1,000 microns (μm)

1 mil (thou) = 40 microns

### Volume

1 US gallon = 8 US pints  
= 3.79 liters  
= 4 US quarts  
= 0.83 UK gallons

1 Imperial gallon = 8 UK pints  
= 4.55 liters  
= 4 UK quarts  
= 1.2 US gallons

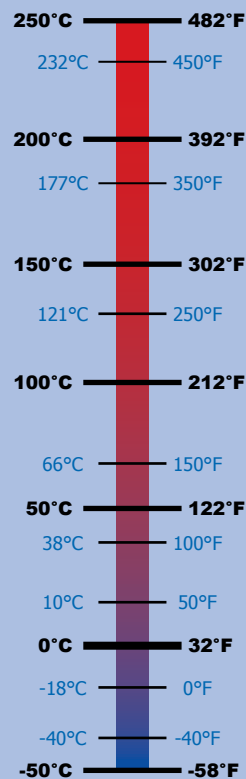
1 liter = 1000 milliliters (ml)  
= 0.22 UK gallons  
= 0.26 US gallons  
= 1.76 UK pints  
= 2.11 US pints  
= 33.81 fluid ounces

1 US pint = 473 milliliters (ml)  
1 UK pint = 568 milliliters (ml)  
1 milliliter (ml) = 1 cubic centimeter (cc)  
1 cubic inch = 16.39 cubic centimeters  
1 microliter = 0.001 milliliters

### Pressure

1 MPa = 145 psi  
1 psi = 0.0069 MPa  
1 MPa = 1 N/mm<sup>2</sup>  
1 bar = 14.50 psi  
1 psi = 0.069 bar

### Temperature



There is a wealth of information available to assist you in selecting the best adhesive solution for your very specific requirements. For a prompt response, contact us by phone 800-640-7599 or visit our website at [www.permabond.com](http://www.permabond.com) and e-mail a Technical Support Request directly to our technical team.

## This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



Permabond Adhesives and Sealants are sold worldwide through authorized distributors. Call us for a distributor in your area.

**The Americas: 1•800•714•0170 ♦ 1•732•868•1372**

***Europe: +44•1962•711•661***

***Asia: +86•21•5773•4913***

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Not responsible for typographical errors.