PERMABOND®

General Purpose Cyanoacrylates

Ref #: 010104GPCA

TYPICAL APPLICATIONS

Wiper Blades
Rubber Bumpers
Rubber Feet
Strain Gauges
Speaker Cones
Gears to Shaft
Video Game Cartridges
Pushbuttons
Acrylic Windows
Nameplates
O-Rings
Display Panels
Honing Stones
Gear Shift Indicators
Jumper Wires
Spacers
Filter Caps
Heat Sinks
Hardware to PCBs
Ferrite Cores
Gaskets
Tennis Racket Assembly
Transistors
Fiberglass Molds
Slotted Screwheads

*See www.Permabond.com for Medical Device Cyanoacrylate Adhesives

FEATURES & BENEFITS

- Fast setting and fixturing of parts
- Rapid development of high strength
- Ease of use—no mixing, no heat-cure
- They bond most materials
- 100% reactive, no solvents

GENERAL DESCRIPTION

Cyanoacrylate adhesives are single component adhesives that polymerize rapidly when pressed into a thin film between parts. The moisture adsorbed on the surface initiates the curing of the adhesive. Strong bonds are developed extremely fast and on a great variety of materials. These properties make PERMABOND cyanoacrylates the ideal adhesives for high speed production lines. Uses can be found in a wide range of application areas such as bonding, potting, sealing and fixturing.

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TYPICAL PRODUCT FEATURES

ETHYL GRADES

PERMABOND 101 is a low viscosity product useful in wicking or penetrating applications or bonding closely fitting parts. It is fast setting and suitable for use on plastics, rubbers and metals.

PERMABOND 102 is a medium viscosity, general purpose product for metals, plastics and rubber.

PERMABOND 105 is specifically designed for bonding natural rubber, latex rubber and hard to bond plastics (Delrin®, plasticized vinyl). The viscosity allows some wicking action. Setting speed is extremely fast.

PERMABOND 200 is used in wire tacking and other applications where it is important that the adhesive stay in place. However, the viscosity of 1,500 cP still allows ease of dispensing. This product is intermediate in gap-filling capability.

PERMABOND 240 has a very high viscosity for maximum gap filling (10 mil or up to 20 mil with QFS accelerator).

METHYL GRADES

PERMABOND 910 provides high strength on metals. It can resist temperatures up to 88°C (190°F) long term, and as high as 150°C (300°F) for a few hours. It will also bond plastics and rubbers. Fast setting and medium viscosity features make 910 suitable in many industrial applications.

PERMABOND 910FS is a low viscosity version of 910 that allows wicking into pre-assembled parts. It is the fastest setting methyl cyanoacrylate.

SUBSTRATES

PERMABOND adhesives will bond most common engineering materials. Methyl cyanoacrylates (910, 910FS) give highest strength on metals, but will also bond plastic and rubber. Ethyl cyanoacrylates (101, 102, 105, 200 and 240) will give stronger bonds on most plastics and rubbers than methyl grades and will also bond metals. PERMABOND 105 bonds difficult-to-bond rubbers and plastics better than other grades but it does not perform as well on metals. The table below indicates some typical lap shear strengths at 25°C data. (Tested per ASTM D-1002.)

METALS	**METHYL**	**ETHYL**
aluminum-aluminum, psI	1980	1130
brass-brass, psi	2980	2550
stainless steel-stainless steel, psi	3050	2620
steel-steel, psi	3200	2720
RUBBERS		
butyl rubber-butyl rubber, psi	290*	290*
natural latex-natural latex, psi	450*	450*
Neoprene®-Neoprene®, psi	560*	560*
Nitrile rubber-nitrile rubber, psi	550*	550*
SBR-SBR, psi	460*	460*
PLASTICS		
ABS-ABS, psi	1300*	1300*
Delrin®-Delrin®, psi	640	1060
nylon-nylon, psi	780	850
phenolic-phenolic, psi	1400*	1400*
acrylic to acrylic, psi	2120	2140
polystyrene-polystyrene, psi	600*	600*

*Denotes failure of the material before the adhesive fails.

PHYSICAL PROPERTIES OF THE UNCURED ADHESIVE

	101	102	105	200	240	910	910FS
Base Compound	Ethyl Cyanoacrylate					Methyl Cyanoacrylate	
Appearance	Coloress, Transparent Liquid					Colorless, Transparent Liquid to Slightly Cloudy	
Viscosity cP @ 25°C (77°F)	1-3	65 –125	30-50	1300-1700	1700-2400	75-125	2.5
Specific Gravity	1.05	1.05	1.05	1.05	1.05	1.09	1.09
Flash Point, °C (°F)	83 (181)					82 (180)	
Shelf Life stored at 2°C-7°C, (35°F-45°F), months	12					12	
Military Classification, Type	II	II	II	II	II	I	I
(per Mil-A-46050C)* Class	1	2	1	3	3	2	1

*A-A-3097 supersedes Mil-A-46050C

PHYSICAL PROPERTIES OF THE CURED ADHESIVE

	101	102	105	200	240	910	910FS
Appearance	Colorless, Transparent, Solid					Colorless, Transparent, Solid	
Hardness (Shore A)	85	85	85	85	85	90	90
Dielectric Strength (volts/mil), approx.	250	250	250	250	250	250	250
Operating Temperature, °C (°F)	-60 (-80°) to 82 (180°)					-60 (-80) to 88 (190)	
Soluble In	Nitroethane, Methyl Ethyl Ketone, Acetone					Nitroethane	

PERFORMANCE PROPERTIES OF THE CURED ADHESIVE

Set Time, seconds	101	102	105	200	240	910	910FS
Steel							
Buna N Rubber	5	10	5	15	20	10	5
Phenolic	5	10	5	15	15	10	5
	5	10	5	15	15	10	5
Lap Shear Strength on							
Steel at 25°C, psi							
(24 hours)	1800	2200	1800	2200	2200	3000	2500
Aluminum at 25°C, psi							
(24 hours)	2200	1200	1000	1200	1200	1200	1200
Impact Strength (ASTM D-950), ft-lb/in^2	3-7	5-8	3-7	3-7	3-7	5-8	3-7

Good bond strength will not be obtained on polyethylene, polypropylene, Teflon® and silicone rubber, although fixturing may occur. Bond strengths can be improved by etching the surface of these materials.

The bonding of glass presents specific problems. Although the initial strength on glass is excellent, a degeneration of the bond results because of the alkalinity of the glass. Cyanoacrylates can be used for temporary fixturing of glass but are not recommended for long term bonds.

At times it appears that certain plastics are attacked, crazed or cracked by the cyanoacrylate adhesives. This is always caused by the liquid adhesive. The cured adhesive is inert. Rapid cure is an effective way to avoid this phenomenon. Use of the fastest adhesive and immediate assembly after application or use of QFS 16 are recommended.

Some of the plastics that can be affected in this manner are:

Acrylic
ABS
Cellulose Acetate Butyrate
Polycarbonate
Polystyrene (foam)

SURFACE PREPARATION

Although PERMABOND adhesives are quite tolerant of slight surface contamination such as oil, mold release agent, dust and dirt, gross contamination should be avoided. Generally those conditions will lead to slower cure and lower strength.

The following method and treatment is recommended to improve bonding to contaminated surfaces.

The surface should be free of gross contamination such as dirt, dust, grease or oil. An alcohol wipe is suitable for cleaning most surfaces. Acetone is recommended for epoxies, polyesters, phenolics, melamine, urea formaldehyde, nylon and polyurethane. Optimum strength is obtained by abrading the surface followed by a solvent wipe to remove any loose particles.

SPEED OF CURE

A typical cure curve for PERMABOND 910 is shown below. The speed of cure is influenced by the thickness of the bond, the activity of the surface and the designed speed of the product.

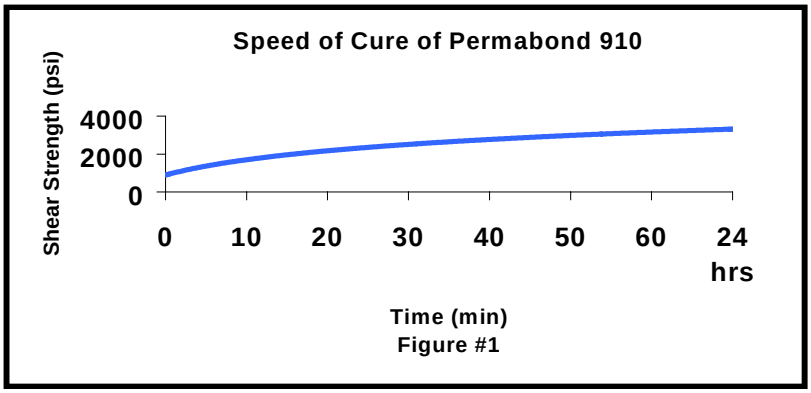

Figure #1

Cure will be slower with a higher viscosity product (e.g. 240 is slower than 910), a thicker bondline or when the materials have a somewhat acidic surface. Use of a QFS accelerator can overcome these conditions, and reduce the set time. Faster curing products such as the 260 or 790 series are also suitable for obtaining shorter set times.

THERMAL RESISTANCE

Cured PERMABOND cyanoacrylates are thermoplastic materials that soften at approximately 177°C (350°F), but they can safely be used at temperatures between –60°C (-80°F) and 82°C (180°F). Beyond this temperature, strength loss is relatively rapid. While the product may perform in certain situations, a general recommendation is not made for use above 82°C (180°F). All grades can resist short exposures up to 150°C (300°F).

HOT STRENGTH

This is shown in Figure 2. Bonded assemblies are cured at room temperature for 24 hours. Then assemblies are heated for 2 hours and tested hot.

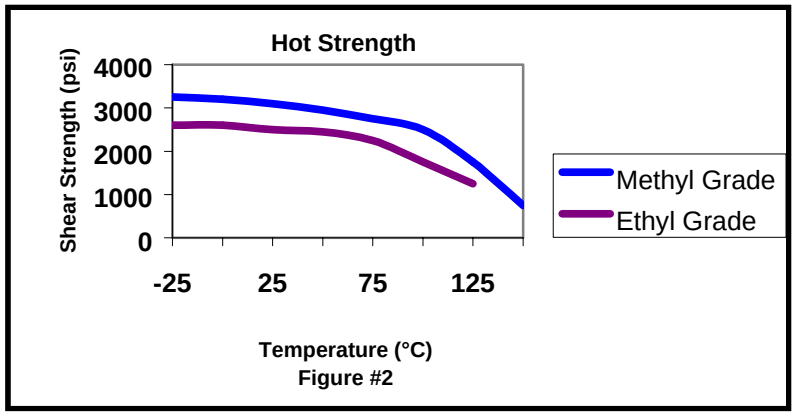

Figure #2

DURABILITY

Assemblies joined with PERMABOND cyanoacrylates exhibit good long-term durability, particularly when the substrates are somewhat flexible, such as rubbers and most plastics. Bonded lap shear specimens have been aged outdoors for many years with good retention of strength. This is shown in the graph and table below:

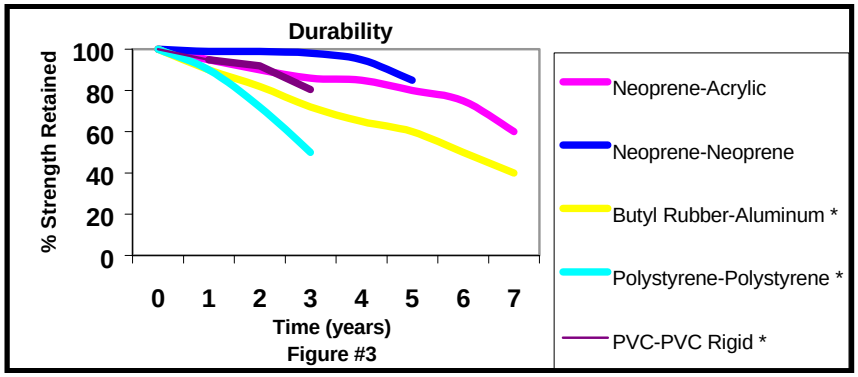

Figure #3

*Denotes substrate failure

Strength retention of cyanoacrylate bonds after outdoor weathering (1-Neoprene to Neoprene, 2-Neoprene to acrylic, 3-butyl rubber to aluminum, 4-polystyrene to polystyrene, 5-rigid PVC to rigid PVC.)

The performance of these same assemblies under CONTROLLED CLIMATIC CONDITIONS is indicated in Table 2.

Table 2. Percentage Strength Retention When Stored at 23°C (73°F) And 50% RH for:

Materials Bonded	1	1 ½	2	3	4	5	7	Years
Neoprene to Neoprene	100		80				60	
Neoprene to acrylic	93		87			93		
Butyl rubber to aluminum	65*	92*			55*		55*	
Polystyrene to polystyrene		80*		83*				
Rigid PVC to rigid PVC		93*		100*				

*Denotes substrate failure

CHEMICAL RESISTANCE

Cured PERMABOND adhesives have good resistance to many common solvents. (See table 3.) However, the cured resistance is reduced as the polarity of the solvent increases. Non-polar solvents such as gasoline, motor oil, and dioctyl phthalate (DOP) have only a minimal effect but polar solvents cause severe bond deterioration. Alcohols will only deteriorate bonds over several months, but acetone is a good solvent for cyanoacrylate. Boiling water will destroy the bonds in less than 24 hours and this process is accelerated when the solution is alkaline. Amines tend to dissolve the bond rapidly. Most solvent washes will not affect the adhesive bonds due to the short exposure time.

Table 3. Solvent Resistance

Solvent at 24°C (75°F)	Percent Strength Retention of Cured Methyl Cyanoacrylate after 1 month Immersion
None (control)	100
Gasoline	100
Isopropyl alcohol	100
10-W-30 Oil	100
Toluene	82
VM&P Naphtha	80
Acetone	1

GAP FILLING

Cyanoacrylate adhesive have limited gap-filling capability. Low viscosity grades can fill gaps to approximately 2 mil, medium viscosity up to 10 mil and high viscosity up to 15-20 mil. However the speed of cure will be slower and the ultimate strength lower as the gap increases. (See Figure 4.)

For example, when the gap is 15 mil, it requires an hour for sufficient handling strength; but with a gap of 1 mil, it only takes 10 seconds. Cure speed can be increased by the use of QFS Accelerator.

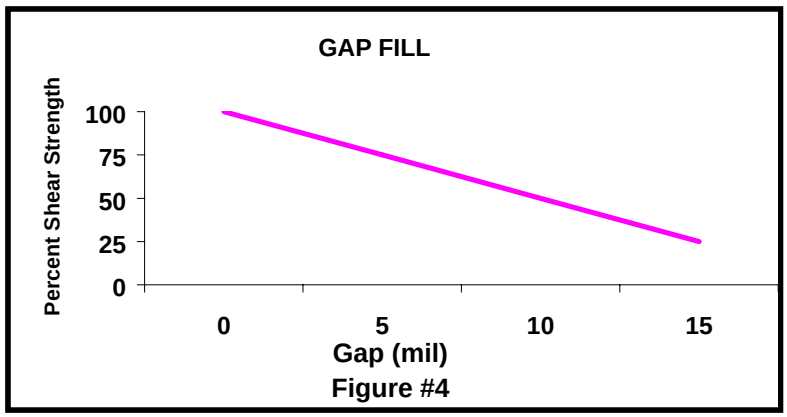

Figure #4

BEHAVIOR UNDER VACUUM (Outgassing)

When PERMABOND cyanoacrylate adhesives are fully cured, they will not yield volatile matter under vacuum of 10^{-7} mm Hg at room temperature. If cure is not complete, trace quantities of uncured monomer and moisture may be initially eliminated. After that, no more outgassing will result. When heated to 125°C (250°F) at 10^{-7} mm Hg, all cyanoacrylates appear to outgas about 5% of their weight.

RADIATION RESISTANCE

Cyanoacrylate adhesive bonds are subject to degeneration by UV radiation if used on transparent substrates.

For medical instruments, cyanoacrylate bonds can be sterilized either by radiation sterilization (up to 3.5 megarads) or by the ethylene oxide process. **See www.Permabond.com for Medical Device Cyanoacrylate Adhesives*

MILITARY SPECIFICATIONS

All PERMABOND cyanoacrylate adhesives are manufactured according to the guidelines of MIL-A-46050C. Their type and Class are indicated in Physical Properties of the Uncured Adhesive.

APPLICATION & DISPENSING

As single component products, cyanoacrylates are easy to dispense. The adhesives can be applied directly from the bottle or by means of dispensing equipment. Positive displacement or pressure vessels with pinch valve systems are available through your PERMABOND Sales Engineer.

STORAGE & HANDLING

Cyanoacrylate adhesives are subject to an aging process and have a limited shelf life. The shelf life is one year when stored in a refrigerator. It could be less when stored at ambient environment depending on conditions of temperature and humidity.

A note of caution: Before opening, the containers must be warmed to room temperature; otherwise water might condense into the bottle and cause hardening of the adhesive.

Cyanoacrylates can form strong bonds to skin rapidly. To break the bond, peel and flex the skin carefully. With appropriate caution, solvents like acetone or nail polish remover can also be used. To avoid skin bonding, wear polyethylene gloves. Do not use rubber or cloth gloves.

Cyanoacrylate vapors are lachrymatory and can irritate eyes and mucous membranes in poorly ventilated areas. Use of goggles or safety glasses is recommended.

VAPOR CONTROL RECOMMENDATIONS

1. Use adequate ventilation. Remove adhesive vapors with suitable exhaust ducting. Since cyanoacrylate vapors are heavier than air, place exhaust intake below work area. Activated charcoal filters using an acidic charcoal have been found effective in removing vapors from effluent air.

2. Avoid use of excess adhesive. Excess adhesive outside of the bond area will increase the level of vapors. Automatic dispensing equipment will prevent excess adhesive.

3. Assemble parts as quickly as possible. Long open times will increase level of vapors.

CLEAN UP OF SPILLED LIQUID

When large quantities of cyanoacrylate adhesives are accidentally spilled, the area should be flooded with water that will cause the liquid cyanoacrylate to cure. The cured material can then be scraped easily from the surface. NOTE: The liquid adhesive should not be wiped up with rags or tissue. The fabric will cause polymerization and large quantities of adhesive will generate heat on cure, causing smoke and strong irritating vapors. ALWAYS FLOOD WITH EXCESS WATER TO CLEAN UP SPILL CONDITIONS.

FOR INDUSTRIAL USE ONLY. KEEP OUT OF REACH OF CHILDREN.