I&J Fisnar Inc. Dispensing Dynamics - Part 2 - Fluids

Cyanoacrylate Dispensing

Bond Conditions

Cyanoacrylate is an “instant” adhesive with three (3) principal chemical components, namely: methyl, ethyl, and butyl. Cyanoacrylate is generally a clear liquid with a viscosity from 3 cps to 2000 cps. The higher viscosity cyanoacrylates are described as “gap-filling”. There is also a cyanoacrylate, called Black-Max, with a rubber component to provide elasticity. Bonding strength is 15 Kg per cm^2.

Polymerization

The polymerization of cyanoacrylate is a reaction which occurs when the adhesive comes into contact with humidity.

Polymerization reaction starts at the surface of the adhesive toward the center of the deposit. In order to have good adhesion (bond) between two substrates, the thickness of the cyanoacrylate must be thin.

Example: If a large glob of glue is dispensed on a flat service, it will stay in liquid form because only a very thin layer of adhesive contacts the surface and will polymerize.

Blooming

Blooming may occur when a large amount of cyanoacrylate remains in liquid form. Some of the liquid material may vaporize and react with humidity. The result is a polymerization, which appears as a white dusty marking on the surface near the adhesive.

To solve (or reduce) blooming:

- Ventilate to eliminate vapor
- Use an “activator” to polymerize at a faster rate

An “activator” is generally a liquid which is volatile and can be applied before or after the assembly of the two parts being joined. When using an “activator”, the total polymerization process occurs in seconds and not over a longer period if relying on humidity alone to propagate the polymerization. The negative effect when using an activator is that it slightly reduces the strength and adhesion of the “bond”.

Other conditions that can affect the bond strength and rate of polymerization are:

- Too great a clearance between the two pieces requiring an excessive amount of material: Solution - use “gap-filling” material or “activator”

- An acidic surface which may affect humidity

- An irregular surface, which provides limited surface contact between the two parts being joined - Solution - use a higher viscosity or gel-type cyanoacrylate

- Room air is too dry - Solution - control the level of humidity or use an “activator”

The materials to be bonded can influence polymerization. Since Teflon is a material that “repels” humidity on its surface, it cannot be glued with cyanoacrylate. This is a reason for using Teflon-lined tips when dispensing cyanoacrylates.

Polyethylene and polypropylene are also materials which cannot be easily glued with cyanoacrylates (only with a special primer).

Bond Characteristics

Cyanoacrylates generally become hard and brittle after curing. For this reason cyanoacrylates should not be used to bond materials in cases where:

- The two materials have a different coefficient-of-expansion due to temperature changes.

- The assembly will be exposed to water.

- The assembly will be exposed to vibration.

Storage and Packaging of Cyanoacrylates

Cyanoacrylates are generally shipped in 20 gram, 50 gram or 500 gram high-density polyethylene bottles. Gel cyanoacrylate is generally packed in tubes because of its viscosity. Placing the bottles into a refrigerated environment will eliminate moisture and extend the life of the fluid.

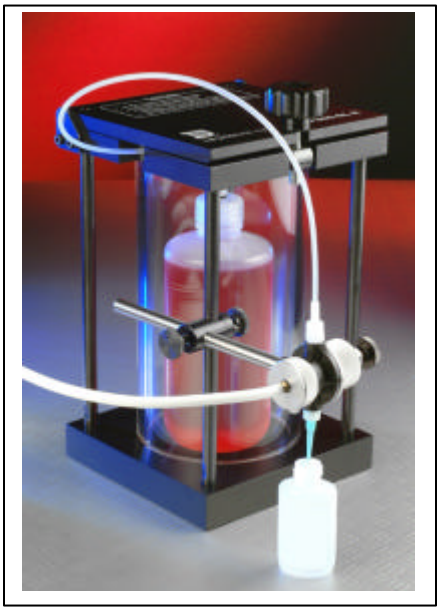
Cyanoacrylate Dispensing Solutions

Selecting a Pneumatic Valve for a Dispensing Purpose

- Use barrels or cartridges

- Dispense directly from a bottle using a PP300-GL-A (Glass) fluid reservoir or a peristaltic pump
- Use a 700PTPCW pinch pen for manual control
- Use a 710PTNM pinch tube valve for timed control

The choice is made depending upon the material packaging and how it is to be dispensed. Since cyanoacrylate reacts with moisture and "metal-ions," it is important to use dry compressed air (or nitrogen) and non-metallic wetted parts.

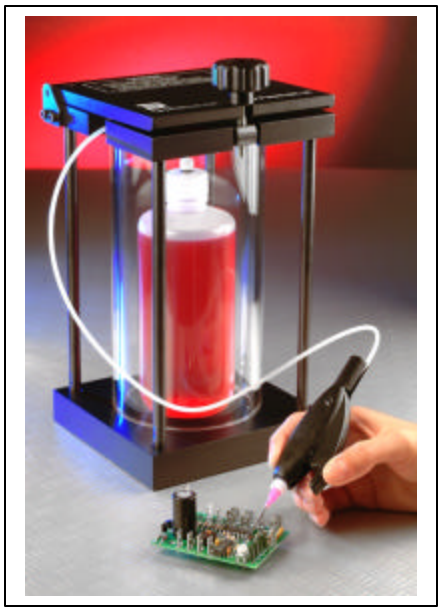


Example 1:

A PP300-GL-A fluid reservoir is a good solution, as the plastic bottle package containing the cyanoacrylate can be placed directly into the pressure reservoir, (30 PSI low cps fluid). *Note that the acrylic version model PP300-A is not suitable for cyanoacrylates.* As an alternative, a less costly I&J2601 fluid reservoir can also be used in the same manner. An advantage of using the PP300-GL-A is that the level of fluid can be monitored through the glass chamber.

System- PP300-GL-A, 710PTNM valve, DSPE501A controller and tip *(Displayed)*

- PPD-130, PPD119 or PPD120 peristaltic pump



Example 2:

A pinch-tube pen 700PTPCW is a practical low-cost option for low-viscosity manual dispensing of cyanoacrylates and has a natural mechanical no-drip function with nothing to adjust. It's particularly useful for applying beads of CA.

System: - PP300-GL-A or I&J2601-107 with 710PTNM & 560017A Teflon tip *(PP300-GL-A Displayed)*

When using wet compressed air, "blooming" may occur on the inside of the PP300-GL-A glass. Blooming is the reaction of the cyanoacrylate vapor with the water content in the air, resulting in crystallization of the cyanoacrylate on the inside wall of the glass chamber.

The “blooming” residue can be easily cleaned with a solvent or with Loctite: DECAPLOCK 55.

When using an I&J Fisnar Inc. DSPE501A and or JBE1113 liquid dispenser with a dispensing syringe to dispense cyanoacrylate, dripping may be prevented by using their suck-back features. However, caution must be exercised to avoid increasing the vacuum so that the material is drawn into the controller solenoid, voiding the warranty and incurring an expensive repair.

When dispensing cyanoacrylates, a polyethylene piston is recommended as a barrier to the fluid in a syringe, but the barrier will prevent suck-back control.
If suck-back is desired, then a filter-trap 560034 and safety clip 580123A should be installed as a protective combination in-line to the syringe to avoid any contamination to the dispenser. If a valve with a reservoir is used, the filter-trap should be put in-line between the valve and reservoir.

Anaerobic Resin Dispensing

Anaerobic resins are acrylic-base formulations that can be formulated to alter the adhesive strength of a final assembly, providing greater or lower bond strengths between a torque of 300 KG-CM and 50 KG-CM.

The most common dispensing application for anaerobic resin is in the assembly of screws as an alternative to a lock-washer. Another application would be for assembling cylinder parts and seals.

Polymerization of Anaerobic Resins

Two conditions are necessary for polymerization:

- Absence of air
- Presence and quantity of metal-ions

After polymerization is complete, the resin forms a hard plastic. Different metals have varying levels of metal-ions and, consequently, this affects curing time. Stainless steel and aluminum are poor in ions and so the curing time is long. Copper and brass contain an abundance of free metal-ions and therefore provide a fast polymerization.

NOTE: Less metal-ions increase the curing time, but this feature will also increase the adhesion strength.

An activator solvent containing metal-ions can be used to reduce curing time.

Temperature also influences curing time; for example, at room temperature (25°C) the total curing time is 24 hours. At 80°C it’s only 20 minutes. Increasing the temperature also increases the adhesion. Maximum temperature after polymerization is 150°C.

Because the curing time is long, the fluid has sufficient time to permeate surfaces and threads, including any irregular surfaces, thus providing an excellent sealing material.

Mechanical Characteristics of Anaerobic Resins

Anaerobic fluids are suitable for the following:

- Screw locking
- Assembly of 2 cylindrical parts, e.g., bearings
- Sealing two parts of an assembly forming a liquid gasket

Screws and bearing assemblies may require disassembly for maintenance or for other reasons, hence 3 different strength formulations are available: High (300 KG-CM), Medium (200 KG-CM) and Low (60 KG-CM).

Viscosity

As we mentioned previously, since viscosity is sensitive to temperature, volumetric control is often required to dispense precise quantities of anaerobic fluids. Viscosity increases between 15°C to 25°C, but up to 25°C the change of viscosity is too low to affect the shot size. Controlling the temperature to 30°C is a solution to maintain viscosity consistency.

Storage and Packaging

Low-viscosity anaerobic fluids are supplied in 50 and 250 gram bottles, and tubes or cartridges for high viscosity. Bottles are made from low-density polyethylene which permits air to pass through to the resin. Generally, anaerobic fluids are shipped in bottles which are not completely filled; this allows movement of the entire contents, some of which might otherwise cure. Larger 1kg bottles are available for high production requirements. Anaerobic fluids have a shelf life at room temperature of between 2 and 3 months of purchase; however, if refrigerated, the shelf life is extended to 1 year. Prior to use, refrigerated material must be brought to ambient temperature to provide a normal working viscosity.

Dispensing Systems for Anaerobic Fluids

- Teflon-lined or flexible tips should be used to dispense anaerobic resins if the room temperature is not too high and dispensing is continuous.
- For low-viscosity materials, polyethylene pistons are useful to prevent any dripping effect when using a syringe.

- If a piston is not used in a syringe it is important to use an in-line fluid filter-trap to protect the dispenser.

- 250 gram bottles can be placed directly inside an I&J2601-107 reservoir or a glass chamber reservoir PP300-GL-A. Regulated air pressure will feed the fluid to a pinch tube pen or valve such as model 700PTPCW or model 710PTNM valve.

- When a timed control of shot size is required, a model DSPE501A or JBE1113 time/pressure dispenser will control shot size by pressure and time. This system can be used with a syringe or a reservoir feeding a 710PTNM pinch tube valve, a DV509 and VD510 diaphragm valve or a model MV-0180-P valve. Metal reservoirs cannot be used or any valve having a metal wetted chamber.

Dispensing High Viscosity Anaerobic Fluid

- When using a 710PTNM pinch-tube valve to dispense from a cartridge, the valve must be situated as close to the exit of the cartridge and with as little material feed hose as possible, thereby reducing the resistance of flow to the valve.

- If the fluid is supplied in a cartridge, it can be transferred to a syringe/barrel by a barrel loader 560022 (12 oz cartridges) or 560548 (1/10th gallon cartridges); the syringe can then be used with a dispenser. Alternatively, it can be dispensed directly from the cartridge using a cartridge retainer.

- There are several options to dispense from a 300ml cartridge with a cartridge model retainer 580091A

    - Use the nozzle shipped with the cartridge

    - Use a 560546 adaptor with a 10cc 0-Ring plus a 1/4 Nozzle

    - Use a 560546 adaptor + 560519 Tip Adapter + Tapered Tip

- If the cartridge has a 1/4NPT male thread, use 561129 Nozzle Adapter plus 560064 Luer-Lock Adapter when using a tip.

  Caution should be exercised when using 580091A with a timed dispenser for the following reasons:

  When the dispensing cycle is initiated, a solenoid opens within the dispenser and pressurized air enters the cartridge. There is always a slight delay for the fluid to dispense from the cartridge, since the air line and the cartridge must reach operating pressure. As the cartridge empties, the time delay to get the material to dispense gets slightly longer, resulting in a slightly smaller shot

size. To compensate for these phenomena, the operator could increase the pressure or increase the time to maintain a correct shot size.

UV Cure Dispensing

UV Cure Resin Properties

UV cure fluids are a diversified range of products. They are not a family of products but a system of cure. They perform three principal functions: Bonding, Coating, and Sealing.

UV light can be used to secure an assembly and a further process run to complete polymerization, such as an anaerobic or a heat treatment process.

For many UV cure resins, polymerization can only be achieved by exposure to UV light. A significant advantage of using these products is that they provide time for assembling components and for making adjustments. Polymerization occurs rapidly from exposure to an intensified UV source.

UV resins have excellent adhesive characteristics in production environments, but they are costly in comparison to other alterative adhesives and require the purchase of curing equipment.

Polymerization

Three levels of UV are: UVA 500nm, UVB, 300-400nm, UVC 200nm (This frequency is for sterilization).The necessary wave length to cure UV resin is 365 nanometers (nm), and it is generally obtained with a high density mercury bulb. The power of a UV ray is calculated in milliwatts per cm^2. For adequate polymerization, a minimum strength of 50 milliwatts is required.

Since natural sunlight radiates UV rays, the resin has to be protected from daylight. As an example, at the Equator the sun radiates 15 milliwatts per cm^2 of 365nm UV ray. A standard domestic lamp will also emit a high infrared temperature at a maximum of 700°C.

Occasionally a UV cure resin cannot be properly cured as it is not possible for the light source to penetrate the resin. In these cases another polymerization initiator can be associated in the process.

Examples:

1. – UV cure resin + anaerobic: An axle and gear assembly may require UV + Heat

2. – UV cure resin + infrared: Bonding CMS may require UV + Humidity

3. – UV cure resin + solvent: In a possible coating and sealing application, the solvent is present to reduce the viscosity so as to have a self-leveling effect.

Notes:

There are silicones which polymerize with UV; in these instances the silicone should be treated with the same dispensing requirements as silicon.

Some plastics which are used for outdoor products are clear but include some anti-UV, for example, polycarbonate.

Some UV cure resins are also anaerobic and are sensitive to metal contact, not sufficient to polymerize but enough to gel.

Storage and Packaging

Packaging is generally in the form of 50 gram, 250 gram, 1kg bottles. High viscosities are packaged in cartridges. A lower temperature is better for storage, but viscosity increases measurably with lower temperatures. Storage life is between 6 months and 1 year at room temperature.

Mechanical Character

The range of elasticity and elongation of UV resin is extensive. The ratio can extend from 0% to 1800%, and hardness from shore A to shore D. This wide ratio makes UV resins suitable for bonding different materials which have different dilation ratios, such as aluminum with glass, etc.
The maximum temperature acceptable after polymerization is around 1004 C.

Dispensing Solutions

Similar methods used to dispense anaerobic materials are used to dispense UV resins. However, a few changes are required:

- Amber or black barrels must be used with UV resins
- Valves and reservoirs must use stainless steel wetted chambers

Silicone Dispensing

Purpose and Types

Silicone is generally a high-viscosity material which is also known as RTV (Room Temperature Vulcanization).

Silicones are also available in two-part formulations, but in this chapter we will concern ourselves with single part silicone fluids:

There are three major uses of silicone:
- Bonding
- Sealing
- Coating

Cautions:
1) Silicone is an anti-adhesion material; paint and other coatings will not adhere to silicone.

2) Some silicones can be corrosive to electronic circuit boards, formulations are available that are suitable for use in electronic circuits.

3) Many silicones will attack copper.

Vulcanization

For silicones, curing is not as a result of polymerization but due to vulcanization, which is a chemical reaction with humidity as is the case with cyanoacrylate.
As the humidity reacts with the silicone the fixing acids are released and the material rubberizes.

Care should be taken during the storage of silicone to protect it from humidity. The principle component of silicone is acetic acid. A few grades of silicone use dioxyme as a replacement for acetic acid, eliminating the odor caused by the acid.

When silicone is dispensed, the acetic acid will evaporate, which will expose the silicone to environmental humidity causing a vulcanization reaction, thus curing the fluid. The curing time is generally 12 hours but can vary due to the type of product and the thickness of the silicone applied.

Mechanical Characteristics

Adhesion of silicone is about 50 Kg / cm^2, and the resistance to pressure when used for sealing is approximately 100 KG / cm^2. Silicone has excellent resistance to elevated temperatures of up to 250 degrees C.

The elasticity of silicone also provides a high resistance to vibration during elevated temperatures and is also resistant to oil and water.

Packaging

Silicone is supplied in many forms of packaging options, including tubes, cartridges and plastic pails.

Dispensing Solutions

As vulcanization can only commence with contact with air, permitting the acid to evaporate, the most important criterion in dispensing is to ensure an air-tight seal throughout the system.

Should dispensing be paused for extended durations between cycles, the dispensing needle or nozzle should either be parked in silicone oil to prevent the fluid vulcanizing or a small amount of silicone oil should be placed on the tip.

Equipment Options

1. Dispensing from a 580091A cartridge retainer

There are several options to dispense from a 300ml cartridge using a 580091A

- Use the nozzle shipped with the cartridge
- Use a 560546 adaptor, with a 10cc 0-ring plus a 1/4 nozzle
- Use a 560546 adaptor with a 560519 tip adapter + tapered tip

If the cartridge has a 1/4NPT male thread, use 561129 nozzle adapter plus a 560064 Luer-Lock adapter when using a tip.

Caution should be exercised when using the 580091A with a timed dispense. When a dispensing cycle is initiated, a solenoid opens within the dispenser and pressurized air enters the cartridge. There is a slight delay for the fluid to dispense from the cartridge, since the air line and the cartridge must reach operating pressure. As the cartridge empties, the time delay for the material to dispense gets slightly longer each cycle, resulting in a reduced shot size. To compensate for these phenomena, the operator should increase the pressure or increase the time to maintain a correct shot size.

2. For tubes the following options are recommended:

- Tube dispenser TD101 + tube adapter + tip adapter 560545
- ATD series Autotube + cartridge + tube adapter + tip adapter 560545
- Caulking gun 580112C

Preparation
3. To use a syringe, transfer the silicone supplied in a cartridge by a 560022 barrelloader (12 oz cartridges) or 560548 (1/10th gallon cartridges). The syringe can now be used with a dispenser.

4. To dispense from a 1 gallon or 5 gallon pail, use an Autocan system. The Autocan will pump the material to a valve by use of a follower plate within the pail. Valves are covered in Chapter 4.

Note that when the piston of an Autocan pump changes direction, it will supply an extra pulse of pressure, causing a pulse of fluid. This is a problem in automatic dispensing and is resolved by the addition of a flow-regulator in-line to the valve.

A material manifold can also be installed to distribute silicone fluid to a number of valves, but the flow rate and pressure will require careful calculation.

Grease Dispensing

Although there are many types of grease, we can separate them into two categories:

- Grease without filler
- Grease with filler

Packaging and Dispensing

Packaging and the methods of dispensing are similar to silicone (see Chapter 3.4) with the exception that vulcanization is not a consideration. Grease is normally dispensed via an extruder pump.

A few formulations of grease will separate during storage, causing a liquid to appear on the top of the can. The grease must be agitated prior to use, but if the dispensing application requires a high degree of shot consistency, care has to be exercised so as not to introduce air.

Generally, because the size of the shot is not usually critical in dispensing grease, an air bubble may not be an issue.

A number of grease products include filler, and due to the high viscosity the filler may not be evenly distributed. This issue may cause problems when using a valve by degrading or destroying its seals.

In order not to continuously block the dispensing tips, the tip size should be 4 times greater than the size of the filler particulate.

Similarly, as for silicone, when using an Autocan pump, a flow regulator is required in-line to the valve.

The most common nozzle when using grease products is ¼”.

Many grease products are expensive and the use of a dispense controller will save on material costs.

Varnish and Solvent Dispensing

These two fluids, varnish and solvent, are together in this chapter as the preparations, cautions and dispensing requirements are the same for each.

Solvent and Its Uses in Industry

Solvents have two functions:

- Reduce a viscose fluid to a less-viscose fluid as in the case of varnish and paint.

- Bond two parts of a plastic assembly by the solvent liquefying the surface areas contacted by the solvent and combining the materials so that when the solvent evaporates the parts of the assembly are bonded.

- Finally, in those instances where it is not possible to dispense between the parts of the assembly the parts are dipped into the solvent.

Varnish and Its Uses in Industry

A varnish is generally used for the following:

- Locking a plastic screw
- Protecting or coating a surface
- Marking products for quality control
- Sealing a hole
- Fixing a wire

Storage and Packaging

These products are normally packed in metal cans.
Some varnish products are in tubes, but because they are lower-viscosity fluids, an Autotube gun system cannot be used. The fluid will require decanting by hand or a

request made to the supplier to supply in an alternative container for insertion into a reservoir.

A few paints or varnishes contain oil and, after a long period of storage, the solvent and oil separate. In these cases the fluid should be agitated, but care has to be taken not to introduce air.

It is best to use a PP300-GL-A glass reservoir to store these fluids, as the plastic version is sensitive to solvents.

Dispensing Cautions

- All fittings and connections in the dispensing apparatus must be well sealed as solvent evaporates easily.

- Plastic components for use with solvents and varnishes are polyethylene and polypropylene which are resistant to these chemicals.

- O-rings and seals in valves will require regular replacement. When using solvents a Viton adapter O-ring is more resistant than one made from Buna.

- When using a syringe, a PE piston must be used as the solvent will evaporate through the hose and into the dispenser – also, use a liquid filter-trap and a safety clip.

- When a reservoir is used, the air inside will absorb the solvent to the extent of saturation; once saturated the atmosphere in the reservoir will remain stable. This is the same principle why a half-full can of varnish will remain liquid when the seal is closed. The reservoir must always remain under pressure and not be depressurized at night or after use. If this procedure is not carried out, fresh air will again become saturated with additional solvent and the fluid viscosity will begin to change, and dispensing will become inconsistent.

- To avoid the tendency of varnish and paints to block the tip, use the maximum size tip possible when using a valve, providing there is no dripping. If permitted dip a tip in solvent between each application.

Other Fluids

There are many fluids that can be dispensed for various applications. The above represent the most popular fluid materials that will be found in several industries. Other popular products are solder pastes, masks and underfill epoxies – all used in the electronics industry. It is best to cover these products within the subject of valves, since in the majority of cases a valve will be used to dispense these fluids in production environments.

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