Dispensing Solutions for Cyanoacrylate Adhesives

Nordson
EFD

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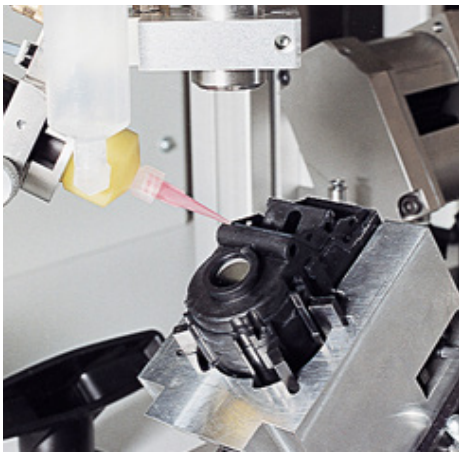
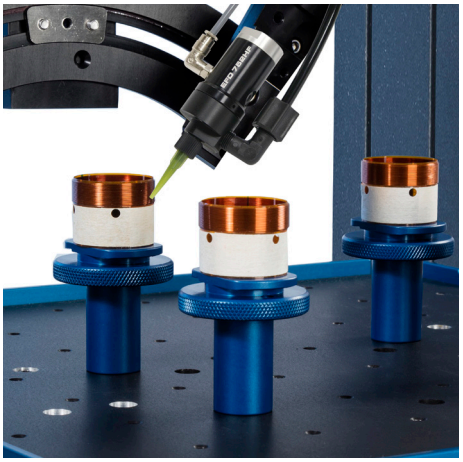
Introduction

Cyanoacrylate adhesives, also known as CAs or cyanos, are highly effective at bonding many types of materials together in assembly processes. Often referred to as super glues, they exhibit high bond strength and fast cure times that help manufacturers speed production processes for higher throughput yields.

This makes them an ideal choice for assembling products in a variety of industries, including automotive, electronics, life sciences, defense, and consumer goods. Though beneficial, these moisture-cure adhesives can be a challenge, especially when your assembly process requires precise, repeatable dispensing.

This paper outlines proper handling methods and dispensing solutions for successful CA dispensing. Find out how to minimize material waste by more than 60% while also minimizing operator exposure to the adhesive. Speed your production processes while producing higher quality parts with less downtime.





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How Cyanoacrylates Work

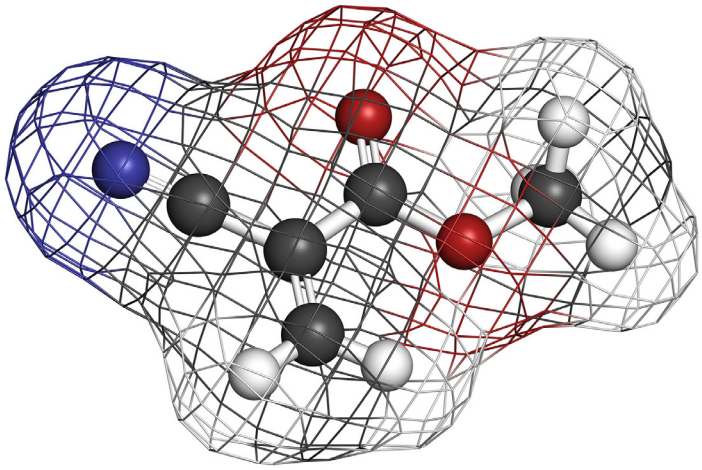
Unlike other types of adhesives that require heat, light, or catalysts to initiate curing, humidity in the air alone is sufficient to cure cyanoacrylates. For this reason, CAs are often called rapid-cure, quick-bonding, or instant adhesives.

When a CA is exposed to moisture, the molecules in the adhesive and the molecules in the surface to which it's applied start a chain reaction. This reaction creates a bond or adhesion, which can often occur in less than a minute and reach full strength within a few hours. Adding heat or light speeds the curing process even more.

Light-cure instant adhesives combine the advantages of UV technology with the rapid-curing features of cyanoacrylates. Exposure to UV or visible light often provides a tack-free surface in less than five seconds.

Types of cyanoacrylates include:

- Methyl 2-cyanoacrylate
- Ethyl 2-cyanoacrylate
- N-butyl cyanoacrylate
- 2-octyl cyanoacrylate



Methyl cyanoacrylate molecule, the main component of cyanoacrylate glues

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Advantages of CAs

Cyanoacrylates provide several manufacturing advantages, including:

- Strong bonding to many non-porous surfaces, such as plastics, metals, ceramics, and glass
- No special mixing or controlled-storage requirements other than keeping air out
- Only small amounts needed for a strong bond
- Rapid cure time initiated simply by exposure to ambient air — the lower the viscosity, the faster the cure time*

Though the advantages of using CAs far outnumber the disadvantages, it's important to understand the dispensing challenges given this material's superfast curing time and reactive qualities.

*UV-cure cyanos require heat and light for curing, and thicker CAs require UV light for faster curing.

CA Dispensing Challenges

The main challenge when dispensing cyanoacrylates is keeping unwanted moisture out. Any moisture that contacts the CA will start the bonding reaction prematurely. This can cause costly rework and rejects, in addition to slowing production.

Unfortunately, some of the advantages of CAs contribute to its dispensing challenges, including:

- **Correct placement** — Due to its fast-setting nature, a CA must be applied accurately the first time, since even small adjustments after curing are generally not possible.
- **Precise deposits** — The strongest bond is created with a minimal amount of cyanoacrylate. This presents a challenge for operators because it's not easy to apply thin deposits consistently. Since most cyanos are low viscosity, this can be particularly challenging because thin fluids are often prone to dripping.
- **Migration** — This occurs when CAs seep beyond the desired deposit location, creating chalky, white filaments that can impair part quality. Preventing migration is a major dispensing challenge and is especially tricky with low-viscosity cyanos.
- **Safety** — Since CAs can adhere to skin, skin contact should be avoided. This is a safety concern for operators. Dispensing systems must safely contain the fluid and reduce the amount of handling.
- **Cost** — Because many CAs are expensive, inconsistent dispensing can lead to costly material waste and part rejection. This is another reason to consider using precision dispensing solutions that can reduce fluid waste by more than 60%.

Precise placement of super glues is critical to preventing part rejects.

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Best Practices for Dispensing CAs

Less is more when dispensing cyanoacrylates. The less cyano applied, the better the bond strength. Here are a few more best practices for improving process control with CA dispensing.

1. Avoid using squeeze bottles in manual applications

Many CA applications begin with squeeze bottles that are used to manually apply the material to the part in an assembly process. Though these bottles often provide instructions for how to apply the material from the packaging, this method requires pressure that the assembler physically applies to the bottle to determine the amount of fluid dispensed.

Operator fatigue, shift changes, and variations in the perception of "just the right amount" can affect how much adhesive is applied to the part. This often means too little or too much material for an adequate bond. This not only affects bond strength, but wastes costly material.

In most cases, assemblers apply too much because it's human nature to think that if a little is good, more must be better. Once opened, the bottle exposes the CA to air, causing premature curing. Often partially-used bottles must be discarded.

Operator safety is also a concern. Exposure to the CA is greater when using a squeeze bottle. Also manual applications tend to increase the risk of migration, which occurs when the material weeps or oozes into other areas. For these reasons, it's best to avoid manual squeeze bottle methods when dispensing CAs.

"Converting the cyanoacrylate application from squeeze bottles to timed-pulse dispensing has cut rejects 99% and saves thousands in rework costs annually."

— DEVELOPMENTAL SERVICES

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Best Practices for Dispensing CAs

2. Eliminate moisture contamination

Introducing moisture will expedite CA curing. Here are helpful guidelines for avoiding moisture contamination:

- **Use nitrogen or clean, dry compressed air**
  Nitrogen gas is best because it is inert and will not introduce moisture to your cyanoacrylate. If you're dispensing with compressed air, install a coalescing filter assembly to prevent moisture contamination. Installing a five-micron filter regulator with a coalescing filter will ensure the air supplied to your precision dispensing equipment is regulated and moisture-free for the best possible dispensing results.

- **Select fluid-carrying parts that don't introduce moisture**
  Since cyanoacrylates are cured by moisture, great care must be taken to minimize air exposure prior to dispensing. The fluid-carrying or wetted parts (i.e. parts that come into direct contact with the fluid) in your dispensing equipment must not introduce moisture. Always specify polypropylene, polyethylene, PTFE*-lined, or PTFE-coated fluid-carrying parts. Using other wetted parts can lead to clogging and dispensing failure.

  – **Fluid feed tubing** – Choose polyethylene tubing. Avoid urethane. CAs will react with urethane tubing, causing it to soften.

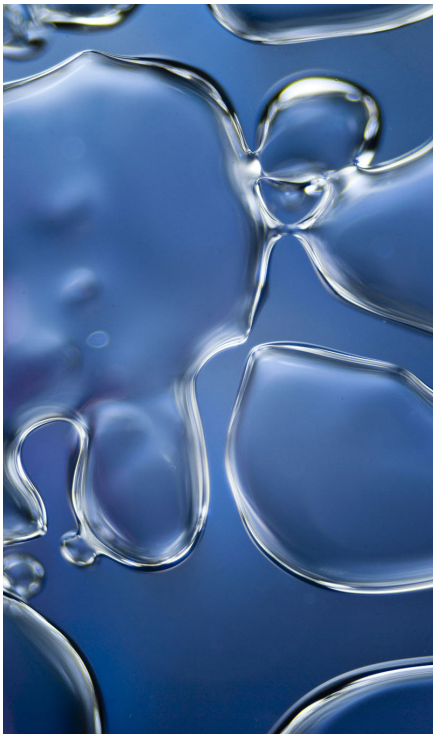
  – **Valve fittings and tip adapters** – Avoid nylon fittings and tip adapters, which can absorb moisture and cause curing. Instead, specify polypropylene fittings and tip adapters for CA applications.

  – **Dispensing components** – (See #5. "Choose dispensing components designed for CAs")

It's also important to avoid any metal fluid-carrying parts because metal will react with CAs. Passivated stainless steel is the exception.

Passivation is an acid bath etching process that strips free iron from the surface of stainless steel. Free iron deposits are the result of machining and drawing processes. Free iron on the surface of stainless steel can react with CAs, causing early clogging.

*Polytetrafluoroethylene



Moisture can cause CAs to cure prematurely, leading to costly material waste and production downtime.

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Best Practices for Dispensing CAs

3. Choose a fluid dispenser designed for CAs

For low- to medium-volume production, precision benchtop fluid dispensers provide the most controlled cyano dispensing process.

Nordson EFD's Ultimus™ II high-precision dispenser is designed for low-viscosity cyanoacrylates and other fluids. This unit features a 0-15 psi (0-1 bar) constant-bleed pressure regulator that provides accurate, repeatable CA deposits required by your application.

It allows fine adjustment of time, pressure, and vacuum dispensing parameters to apply the right amount material. A digital display of those parameters delivers better process control. And it features 16 memory settings for easily transition from one type of application to the next.

When using a benchtop fluid dispenser for CA dispensing, it's always a good idea to use a syringe barrel adapter assembly with a filter trap. This will prevent fluid from being sucked back into the dispenser if, for example, the vacuum is set too high or an operator inadvertently lays the syringe barrel on its side.

Note: Keep in mind that even if you're using the blue LV Barrier™ piston designed for watery CAs, we still recommend using the adapter assembly with a filter trap.

The Ultimus II provides the most control when dispensing watery CAs.

Use an adapter assembly with a filter trap to prevent suck back.

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Best Practices for Dispensing CAs

4. Choose a valve system ideal for CA dispensing

For high-volume production, a precision dispense valve system provides the most controlled CA dispensing process. The best valve system for cyanos is a closed loop system that won't introduce air or moisture from any source.

Tip selection is critical to the success of cyanoacrylate applications.

Valves

Diaphragm valves such as Nordson EFD's 752V valve are designed to prevent the introduction of air. Inside the valve, a diaphragm isolates the fluid chamber from the mechanical parts — protecting the internal components from air and adhesive contamination.

Additional features include:

- A UHMW (Ultra High Molecular Weight) polyethylene fluid body prevents CA from curing prematurely
- Very small dead volume, which reduces exposure of the adhesive to the ambient environment and reduces air entrapment
- Adjustable stroke control for better flow rate control of low-viscosity cyanos

Valve controllers

Valve controllers feature a programmable time function. This allows for exact, repeatable output and easy purge capabilities when changing to a new bottle of adhesive. Controllers also simplify valve set up and allow for fast, on-the-fly adjustments to the dispensing parameters.

Tanks

Nordson EFD's 615 Series 1-liter tank accommodates 1-pound bottles of CAs. This simplifies refilling and reduces handling. Top porting allows a user to feed fluid directly from a 1-pound bottle, so no pouring or cleaning of the reservoir is necessary. This creates a closed system that keeps air out of the process from start to finish.

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Best Practices for Dispensing CAs

5. Choose dispensing components designed for CAs

CAs are available in a range of viscosities, from thin fluids to thicker gels. For best results, use dispensing components that are well-matched to the viscosity of the CA being applied:

PTFE-lined tips prevent clogging and feature a crimp that controls the flow of thin CAs.

Dispense Tips

- PTFE-lined tips resist clogging because they don't react with the CA itself. They provide the best flow control for micro-deposits of low-viscosity CAs. For larger deposits, specify the flexible polypropylene tips.
- Flexible tips are best for medium- to low-viscosity CAs and applications that involve sensitive work surfaces, dispensing around component edges, or depositing CAs into deep recesses. The tip hub and cannula are made of inert polypropylene.
- Tapered tips (both rigid and standard) provide a smooth flow for thicker materials. These tips work best with gel cyanoacrylates. Avoid use with very thin, watery cyanos.
- In applications where a rigid shaft is required, general purpose tips made from passivated, burr-free 303 stainless steel provide excellent performance.

Syringe Barrels

- Clear, industrial-grade polypropylene syringe barrels are suitable for CA dispensing. Precision-molded barrels manufactured to precise tolerances with 0° taper internal bores provide controlled dispensing with minimal fluid waste.

Pistons

- For low-viscosity CAs, blue LV Barrier pistons are the ideal solution. The LV Barrier piston features a small hole in the piston wall. That hole allows enough air to pass through to actuate a deposit and vacuum suction to prevent dripping. It also keeps the fluid and fumes inside the barrel for operator safety.
- For gel-like CAs, white SmoothFlow™ pistons are the best fit. Double-wiper edges guarantee clean and smooth emptying of the syringe barrel, with minimal material waste.

An experienced dispensing application specialist can help you select the best dispensing component types and sizes for your CA, and often provide free samples and application testing.

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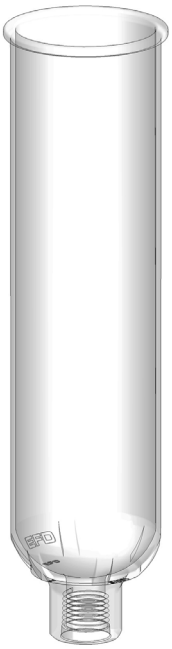
Cyanoacrylate Dispensing Components

For self-leveling or low-viscosity cyanoacrylates, specify the blue LV Barrier piston.

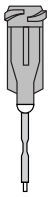
For gel cyanoacrylates, the low-friction polyethylene white SmoothFlow piston with double-wiper edges provides clean, smooth emptying of the barrel.
For use only with gel CAs.



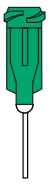
Precision-molded proprietary barrels with thick walls prevent cracking or rupturing, and provide excellent chemical compatibility especially for dispensing cyanoacrylates.

Engineered 0° taper internal bore provides complete wiping and controlled dispensing without fluid waste.

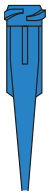
Unique 360° SafetyLok™ thread ensures a safe, positive tip attachment to the barrel. Threaded attachment prevents leakage commonly associated with luer lock attachments.



PTFE-lined tips offer the best control for low-viscosity cyanoacrylates. The PTFE lining prevents premature curing and clogging.



Flexible polypropylene tubing bends into recesses, prevents scratching, and spreads fluid easily.



Flash-free tapered tips mean accurate deposits and smooth flow, especially for gel cyanoacrylates.

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Best Practices for Dispensing CAs

6. Don't mix batches of CAs

After dispensing, always discard any remaining cyanoacrylate in a container along with the container, including squeeze bottles, syringe barrels, cartridges, 1-pound bottles, etc. Never mix batches. In other words, avoid pouring the remaining CA from a used container into a new container of fluid. Doing so can cause crystallization due to cross-contamination. This will impair your dispensing outcomes.

Always use new syringe barrels, cartridges, and any other containers. Even in closed systems, there may be some skimming along the inside walls of used CA syringe barrel packaging, which can affect bonding properties or cause tip clogging.

After changing to a new container, run a few cycles and measure or weigh the deposits to ensure they meet specifications.

7. Establish special operating procedures

Because of CAs fast curing time, special operating procedures should be followed during set up, short breaks, shift changes, overnight, and weekends.

Valve systems – Set up

Upon initial installation and before dispensing CA, flush the entire valve system with fresh 100% acetone, or another chemically compatible ketone, to remove any moisture that has accumulated inside the tank, feed tubing, and valve. Do not use Isopropyl Alcohol (IPA) or any other alcohol for this flushing process because all alcohols contain some percentage of water.

In many cases, you can place a bottle of acetone directly inside the tank. Set your supply pressure at the five-micron filter regulator. Make the other adjustments necessary to your tank pressure. Place a container under the valve nozzle to collect the acetone. Turn the valve controller on and hold the purge button to open the valve. Allow the acetone to flow through the valve until all acetone has been dispensed from the tank, fluid lines, and valve.

Some dispensing systems may have different setup procedures for CAs. Always consult your fluid application specialist.

Setup recommendations continued next page

Best Practices for Dispensing CAs

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Valve systems – Maintenance

For short periods of downtime (24 hours or less), leave the valve system idle without any special preparation. Leave the dispensing tip on the valve. The CA will cure at the end of the tip, forming a natural seal against moisture. Before start-up the next day, simply install a new tip and resume dispensing.

Some dispensing systems may have different maintenance procedures for CAs. Always consult your fluid application specialist.

Leaving the tip in place reduces the chance of introducing humid air inside the tip cap or tip adapter. If curing starts in the tip cap and migrates up into the tip adapter and outlet orifice, material may begin curing in the valve. The operator will be faced with additional maintenance instead of simply changing a tip.

For long periods of downtime (more than 24 hours) with systems dispensing from a tank, remove the CA from the reservoir and purge the system with acetone to clear the fluid lines, valves, and fittings of the CA and any moisture. Immediately cap the valve outlet with a tip cap to seal out moisture.

Fluid dispensers – Set up

Benchtop fluid dispensers generally involve dispensing CAs from a handheld syringe barrel with a dispensing tip installed. When dispensing a gel cyano, you'll likely purchase it pre-packaged in a syringe barrel with the piston already installed. This simplifies set up. You'll attach it to your fluid dispenser, secure a dispensing tip, and start dispensing.

When dispensing low-viscosity or self-leveling CAs, the process may require pouring the CA into a syringe barrel secured with a tip cap to prevent the fluid from escaping. A funnel is recommended to avoid skin contact. For best results, fill the barrel half full.

Insert the blue LV Barrier piston just below the top of the syringe barrel, with a gap between the piston and the fluid. During dispensing, the barrier will remain at the top of the barrel. Follow the instructions in your operating manual to complete the set up.

The blue piston should sit above the fluid to prevent it from bonding to the syringe.

Fluid dispensers – Maintenance

For short periods of downtime (half an hour or less), set the syringe barrel in the barrel stand. Put fresh 100% acetone into the catch bottle of the barrel stand to prevent the material from curing in the tip. For downtime exceeding half an hour, close the safety clip on the syringe barrel adapter assembly and install a tip cap.

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Best Systems for Dispensing CAs

Recommended dispensing systems for cyanoacrylates include benchtop dispensers, semi-automated dispense valves, and automated dispensing robots. These systems provide controlled, repeatable dispensing results. Some reduce material use by as much as 60% and virtually eliminate rejects.

- **A benchtop system with an air-powered fluid dispenser**
  In this system, an operator holds a syringe barrel and guides the dispense tip to the correct location, then presses the foot pedal or finger switch to release the fluid. This is a much more controlled dispensing method than squeeze bottles or hand-lever valves. The system is best for low- to medium-volume production and applications that require smaller, more precise deposits.
- **A benchtop system with a dispense valve, valve stand, and valve controller**
  In this system, an operator places the part or workpiece under the valve, which is fixed to a valve stand. The operator actuates the dispense valve, which is connected to the valve controller. This option is ideal for medium-volume production processes.

Benchtop dispensers are ideal for increasing the accuracy and repeatability of CA deposits in manual applications.

"We've nearly tripled the number of parts bonded per one pound bottle of cyanoacrylate. We're savings $8,400 a year in adhesive costs alone."

— HI-LEX CONTROLS

Best Systems continued next page

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Best Systems for Dispensing CAs

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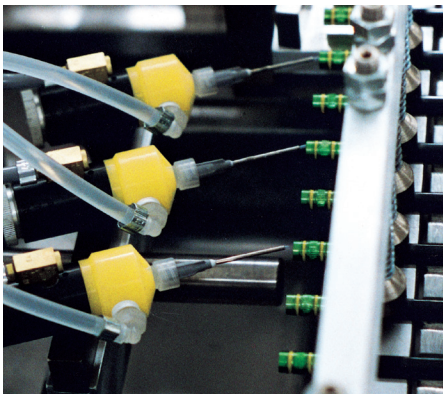
- **A semi-automated system with a tabletop dispensing robot, dispense valve, and valve controller**
  In this system, the operator places a batch of parts on a fixture plate and presses the run button. The dispense valve is mounted to the dispensing robot. The valve controller is the interface between the robot actuation signal and the valve. With this system, the valve dispenses a controlled amount of CA in a pre-programmed pattern onto the workpiece. A dispensing robot can dispense CAs in complex patterns. This is the best option for higher volume production or applications that require extremely precise, repeatable deposit placement.

For the most accurate placement of CAs, use an automated dispensing system.

- **A fully automated system with parts that advance on a production line**
  In this system, parts placed on a conveyor or rotary table are detected by sensors and automatically receive a deposit of CA from the dispensing valve. The valve may be mounted on the line and controlled by a valve controller or PLC. It may also be mounted on an automated dispensing robot, which is programmed and controlled via a personal computer.



EFD's 752V valves are designed for CA dispensing.

Summary

The importance of properly handling cyanoacrylates in a dispensing process cannot be over emphasized. If you would like to experience greater productivity and other benefits from more controlled CA dispensing, we invite you to learn more about EFD dispensing solutions.

Useful Resources

Application Videos

Visit our Video Gallery to access 150+ application, how-to, and product videos. See EFD dispensing solutions in action.

Watch Videos: *www.nordsonefd.com/VideoGallery*

Expert Recommendations

Knowledgeable Nordson EFD fluid application specialists have, on average, more than 10 years of experience helping customers find the right dispensing solutions.

Request Expert Advice: *www.nordsonefd.com/Advice*

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It's easy to search our digital catalog to find products by part number or keywords. Plus, get links to product specs, videos, and more. With our app, you can even access the catalog from your smartphone.

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CAD Models

When you partner with Nordson EFD, you benefit from a wide range of reliable, best-in-class precision fluid dispensing solutions.

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Request More Information

Nordson EFD's worldwide network of experienced product application specialists are available to discuss your dispensing project and recommend a system that meets your technical requirements and budget.

Call or email us for a consultation.

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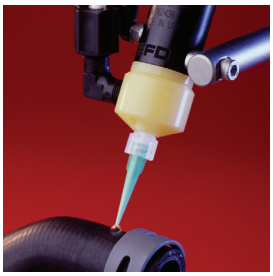

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