How to Choose a Static Mixer to Mix a 2-Component Adhesive

IntelliSpense
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How to Choose a Static Mixer to Mix a 2-Component Adhesive

Choosing a static mixer requires more than reading a sales catalog and selecting a part number. Adhesive manufacturers and end users both should investigate many variables when evaluating mixer characteristics for specific applications. This is a guide to help make the right decision when choosing a static mixer to properly mix a 2-component adhesive.

A **static mixer**, which sometimes is also called a **motionless mixer**, is a simple device with no moving parts, and consists of a series of internal baffles or elements within a plastic tube. This seemingly elementary product is used to effectively mix 2 flowable liquids in what can be a very complicated process. As components are forced through the mixer, they are repeatedly divided and recombined, thus creating a complete and uniform mixture.

Static mixers are frequently chosen when users encounter too many difficulties with conventional adhesive handling methods, such as when components are scooped into a cup, hand mixed and transferred to a dispensing container.

Utilizing a static mixer provides many benefits, including **consistency of mix** and **eliminating the introduction of air into the mixing**, which is an essential step, since air represents a source of voids in cured bond lines and the possibility of a bonding failure. Process control in hand mixing is difficult to maintain, which can create serious bonding problems, as well as problems with waste, cost, and safety.

This overview will **not** evaluate or compare a static mixer vs. hand mixing; rather, it focuses on an adhesive manufacturer or end user's choice of a particular static mixer for mixing and dispensing 2-component adhesives.

Applications

In general, applications using a static mixer can be divided into **two categories**:
(1) **for use with a cartridge and a hand held dispenser**, or
(2) **for use with Meter Mix and Dispense [MMD] equipment.**

Flow rate is a key factor – but certainly not the only factor - to consider when choosing between hand held and automated MMD systems.

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Applications (continued)

In either of these 2-component adhesive mixing operations, **the components are kept separate** in a pre-proportioned (1:1, 2:1, 4:1, 10:1) molded plastic cartridge or in larger plastic or machined steel cylinders before they are introduced into a static mixer.

The user must first calculate the amount of pressure necessary to keep the two liquids flowing at the appropriate rate for a specific application. For example, **with high viscosity components**, it may require a significant force to move the liquids at a proper flow rate. Understanding the *maximum* flow rate that a hand held cartridge system can generate provides a data point for making a cartridge vs. MMD equipment decision.

MMD systems are automated and can dispense higher volumes of liquid than is possible with hand held cartridge systems.

Volume is one reason for using a Meter/Mix/Dispenser, **but volume alone is not the primary deciding factor.** In many cases, MMD systems are an upgrade from hand held systems, particularly when precise, controlled, adhesive shots are needed. **This is often the case with assembly line and robotic applications.**

Airplane manufacturers often use hand held cartridge systems because their **bonding requirements are often spread out over large factory areas** and inside the airplane, during fabrication, a worker must work in a large area that has many tight spots into which they need to apply a material. Plant maintenance operations are also more likely to use hand held systems for similar reasons.

Complex manufacturing or maintenance operations often use many different adhesives in a wide range of applications. **Changing adhesives with MMD systems can be time consuming and require cleaning and purging of difficult materials**, and many operators feel that changing adhesives in a hand held system is no more difficult than changing a cassette in a VCR.

Simplicity of use and limited downtime are two excellent reasons that hand held systems are chosen. Even in a less complex operation, like repairing cracks around swimming pools, an end user will find a hand held cartridge system to be better because of the size of each area needing repair. MMD systems are typically used inside buildings and plants; **hand held systems are used both inside and outside.**

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Applications (continued)

Hand held cartridge systems are manufactured in a limited number of volumetric ratio systems - **1:1, 3:2, 2:1, 4:1, and 10:1** - whereas MMD systems are always customized, which yields a nearly unlimited set of volumetric ratios and many are not compatible with discrete ratios offered in cartridge systems. **A ratio such as 100:36 or 100:28, for instance, might require the use of MMD equipment.**

Another advantage to MMD systems is that some are capable of **variable ratios**, a boon to the operation that requires the **flexibility** of one machine to do the job of **two or more applications.**

Choosing a System

When making the choice between hand held or MMD system, each specific application presents a decision to be made for adhesive manufacturers and end users; and to this end, a hand held cartridge system is often an excellent choice to ***simulate*** an application before moving to the more expensive MMD solution.

An adhesive manufacturer or end user can **experiment with hand held cartridge systems** to test variables that affect static mixer performance for specific applications, such as temperature, humidity, length or diameter of the mixer, and curing time and work life of the adhesives.

Reliability

Reliability in adhesive operations is critical for achieving consistent result, **whether you are hand mixing or using a static mixer**, usually, the static mixer is a positive change for an end user. Although a static mixer generally gives consistent results, there are some important variables that can affect its performance:

- **Temperature and humidity can have a significant impact on chemical and physical reactions and processes;** therefore, static mixers should be tested under various climatic conditions.
- The need to achieve a consistent mix underscores **the importance of experimenting with both manual and pneumatic dispensers**, since the type of dispensing gun and how it is used can influence mixing outcomes.
- Each person operating a manual gun may have a different dispensing style and hand strength.

Reliability (continued)

Although hand held systems are by far the most prevalent, **a pneumatic gun may be needed to provide constant pressure on the cartridge and mixer** to minimize problems caused by constant flexing of the plastic tubes that hold the sections of the static mixer.

Flexing can be limited to some degree by using plastic cartridges with thick walls, but this introduces another variable in the decision process; **a user can take an integrated approach and select dispensing tools and static mixers made specifically for the cartridge being dispensed, avoiding situations where the dispensers are too powerful.** The dispenser's mechanical advantage may be offset by flexing and subsequent mixing problems.

In cases where this "flexing" is unavoidable, **sheaths are available for most models of static mixers to hold them rigid.** It is best that the end user do some consulting for the best integrated dispensing solution for his application before finding out that the small things stop his production cold.

Physical Aspects

Important physical aspects of a static mixer, such **as number of elements or special attachments**, should be identified, analyzed and tested before specifying them into an application. **Each of these dimensions can affect the success of the application**; end users should be sure to test prospective static mixers to determine which features are acceptable **both applying the material and best consistency of mix.**

The following questions can help test the physical aspects of static mixers:

- Is the static mixer's outlet the appropriate size to deliver the correct amount of material (**what inside diameter and number of mixing elements create the right flow rate?)**
- Is the static mixer the right length for the application?
- Is the adhesive being dispensed in locations that are difficult to reach? For instance**: If you are using an adhesive to glue a metal fastener inside a hole in concrete, the application may require that the adhesive bottom out at the base of the hole to avoid trapped air.** A custom mixer with an extension might be required.
- Does the application require specialized attachments, such as a luer lock adapter, **ribbon spreader tip**, bent, and/or customized flexible tubing?

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Physical Aspects (continued)

- How much "content volume" waste can be afforded? **Make sure the amount left in the mixer does not exceed an acceptable amount in your bill of materials for production.** If you are leaving behind 50 cents worth of an adhesive on a part that must be 10 cents, you have a problem.
- In an MMD application, **will the pressure drop** during the mixing operation require the use of a shroud?
- Are the pressures high enough to require stronger elements, such as substituting polyacetal for polypropylene elements, which means a higher cost? **If there is too great a pressure drop, a static mixer may not keep its shape and the components could pass along the mixer walls instead of being properly mixed.** Likewise, if the elements were to break, the system could pass along broken plastic fragments.
- Would a shroud help with equipment positioning? A mixer is, after all, only plastic. Should you require absolute positioning (**in a robotic application, for example**) or in an application that involves heating, a shroud, though adding somewhat to your costs, may save a great deal of time and rework.

Conclusion - Testing and Experimenting

Adhesive manufacturers often run tests and experiments that might chart work life, gel and curing times for various adhesives. This data, with disclaimers outlining chemical properties and operating limits based on specific applications of the adhesives and the conditions under which they are dispensed, **might allow you to take the specifications and test various dispensing systems under different operating conditions**, such as varying temperature or humidity, or with different lengths or special attachments.

Another consideration; how the curing rates of adhesives interact with various static mixers. If there are pauses in the dispensing phase, over time **any curing that occurs in the tube could alter the effective diameter of the mixer**, which can negatively impact the chemical and physical properties of the adhesive. Useful experiments **must consider the consequences of hardening of the materials in the tube.**

If the application requires frequent replacement of the mixer due to hardening, **you may have to weigh the benefits of a low cost static mixer versus a more expensive mixer configuration that would eliminate the need for frequent replacements.** Such a choice may mean a higher materials cost, but ultimately a lower operating cost.

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Conclusion - Testing and Experimenting (continued)

Testing and experimenting is a reliable path to choosing the right static mixer for a 2-component adhesive. **It is the shared responsibility of the adhesive manufacturer and the customer to identify the static mixer that consistently mixes the adhesive in such a way that when cured, the adhesive meets peel strength, shear strength, tensile strength, and other specifications reliably.**

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Testing and experimentation are a process to help choose the right static mixer and will help determine the success of your application.

As you see from all of the above, technical and financial implications must be included in this decision making process. **The static mixer is a central part of the dispensing system.** Choosing a method of dispense without doing the homework necessary to come up with the proper configuration could spell disaster.

Our approach to dispensing is spelled out in our name, **Integrated Dispensing Solutions**. We strongly recommend that you discuss with your formulator the static mixer combinations that have been successful in laboratory testing and field experience and to **get it right the first time by looking at the application in its entirety and understanding the interplay between all of the components.**

For more information, contact us:

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Meter Mix Equipment Premixed/Frozen Questionnaire

Because meter/mix/dispense equipment is completely material driven, we need to know as much as possible about your material and application. Everything is important. All of the information we can gather will help us to help you. And why gamble that the question you don't answer is critical to the success of the project?

Many epoxies, especially those that have a work life of 45 minutes or more, can be premixed and flash frozen. Are you using small enough batches that it might be easier, faster or more economical to have the epoxy ready for use?

IDS will obtain the epoxy or other material you choose, mix it and degas (if necessary) in in a centrifuge (if necessary) and match the container (syringe, cartridge or other) to your specific dispensing applicator. We will flash freeze it and send it to you in a specially made box packed in dry ice; you can then store it in one of the IDS Brand Super Cold **-40 freezers** and will keep for many months. Simply remove the container form the freezer, thaw and dispense. **Tell us about your application.** We will try to process this information as soon as possible. Please print it out and fax it to IDS at **(818) 597-4301.**

Company	
Address	
City	
State	
ZIP	
Country	
Tel	
Fax	
Email	
Quote required by (date)	

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1a.	Material (name and number)		
1b.	Name of material manufacturer		
2.	Ratio by weight:	Ratio by volume:	Accuracy:
3.	Filler (additive)	Resin	Catalyst
3.1.	Filler material		
3.2.	Amount		
3.3.	Abrasive - yes/no		
3.4.	Filler settles - fast/slow		
4a.	Air content		
4b.	Is degasification required		
5.	Resin viscosity	@ temp	
6.	Catalyst viscosity	@ temp	
7.	Is either material moisture sensitive?		
8.	Is either material corrosive?		
9.	Specific gravity	of resin:	of catalyst:
10.	Pot-life	mass:	temp:
11.	Shot size	gram:	cc: other:
12.	Accuracy of shot size		
13.	Shot rate	PCS./hr:	PCS./week:
14.	Size of reservoirs required:	Resin:	catalyst: purge:
15.	Heat required		
16.	Description of process (additional if necessary):		

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