WHITE PAPER

Get a Grip! An introduction to hose barbs

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Hose barbs on fittings come in many shapes and sizes.

It is easy to take the humble hose barb for granted. After spending careful hours evaluating chemical compatibility and calculating peak pressure and flow rate, a decision is made on just the right tubing or hose for your system. Yet sometimes the next decision on how to connect them receives less scrutiny. A very common method is using a coupling or fitting with a hose barb termination. But it isn't quite that easy. A secure and reliable connection is really determined by how well the fitting and tubing work together. Selecting the proper hose barb is just as important as the choice of tubing.

Fittings with hose barbs offer a simple, dependable and inexpensive means for terminating tubing or hoses. Hose barb fittings may have one barb or several barbs (see figures below). Barbs may be spaced evenly or with extra space behind, between or in front of each barb. The fitting itself may be constructed of various plastic or metal materials and have barbs in different configurations. All of these sub-tle differences are meant to improve the seal and grip for the various grades of tubing available on the market.

In any system, connections can be the weakest link. Failure of a $20 part has been cited as the reason for shut-down of a multi-million dollar operation; or just the inability to deliver a carbonated drink mixture to a dispenser. Without a proper match between tubing and fittings, connections can be pulled off from vibration or tension, blown off from a pressure spike, or leak just enough to cause problems. Finding the proper tubing connection is essential for a safe and secure system.

Figure 1: Fittings with hose barbs offer a simple, dependable and inexpensive means for terminating tubing or hoses.

THE HOSE BARB GRIPS AND SEALS

A hose barb is defined as one or more continuous ridges or bumps on a fitting that are used to grip the inside diameter of a tube and seal the connection. As a tube is installed on the fitting, it expands over the barb. Grip and seal occur as the tube tries to relax to its original inside diameter behind the barb. For most applications, one hose barb on a fitting provides 100% of the sealing and most of the holding force for a tubing termination. Certain applications or tubing quality require a tie or clamp to

provide additional holding power. While compression and screw-on fittings have their place, the barbed fitting remains the dominant system for connecting flexible tubing.

Hose barbs on fittings come in many shapes and sizes. Slope and depth of the barb, sharpness of the gripping edge, number of barbs, and spacing of barbs are all factors that contribute to the gripping and sealing ability of hose barbs. The internal diameter of the tube, flexibility of the tube material, and the intended application all factor into the decision on which fitting to choose for the job.

A key component of determining tubing terminations is the accuracy of the inside diameter of tubing. Given the inherent variability in tubing and hose material, it is important to carefully select a fitting or coupling that meets the inside diameter specification of the tubing being used.

The rubber hose and plastic tubing available today all exhibit different levels of flexibility, a factor that plays a large part in how well a connection performs. In general, the softer the tubing, the more likely that a hose barb type fitting is appropriate for the application. While it is the inside diameter of the tube that largely determines selection of the proper fitting, there are other factors to consider:

- *Pull-off resistance:* When a tube is pulled, it tends to contract and grab more tightly. A particular fitting will therefore exhibit different tensile strength characteristics for different sizes and grades of tubing. If the barb is too sharp and the tubing is very soft, enough pulling and vibration could cut the material and cause leaks and failure. On the other hand, a shallow or rounded barb mated with very stiff tubing may allow a tube to disengage with minimal pulling force.
- *Blow-off resistance:* Spikes in pneumatic or hydraulic pressure tend to make tubes expand, potentially loosening the grip of the barb. For high pressure applications, the shape and arrangement of barbs and the relative flexibility of the tubing determines how the connection will perform under expansion of the tubing material.
- *Ease of installation:* Shape and placement of barb(s) on fittings combined with tubing flexibility determine the force required to connect the fitting to the tubing. Easing the burden of the installation technician is one issue to consider. More important, if it is too difficult to push tubing onto the fitting, the tubing may not grip properly and open the possibility for leaks and failure.

Clearly, selection of tubing, hoses and couplings or fittings is best made in tandem. Securing samples of each for evaluation is a great place to start.

THE RIGHT NUMBER OF BARBS

Because for many things in life more is often better, it is also tempting to conclude that more barbs on a fitting provide better holding and sealing power. After all, hose barbs are designed to grip the inside of a tube; it seems logical that more barbs will provide more gripping power. In reality, this is not always true.

The right number of barbs for a fitting really depends upon the application and type of tubing used. For example, fittings for many medical applications such as IV sets and chest drains that use very flexible tubing have only one barb. While this barb provides 100% of the sealing and most of the gripping, the fitting features a smooth area behind the barb. Instead of using a clamp to secure the connection, this smooth area allows tubing to be permanently bonded to the fitting.

In the absence of clamps or use of bonding materials, some fitting designs show that one barb provides better gripping power than multi-ple barbs. The reason is found not so much in the geometry of the barb but in the spacing of barbs and the behavior of the tubing. As the tubing is pushed onto the fitting over the barb, it expands over the barb and relaxes on the other side. This is where the gripping

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occurs where the tubing relaxes to its original shape just beyond the barb. Of course, the wild card is the tubing used in the application. Tubing with poor memory—that won't relax—will not grip as well on barbed fittings and will require a clamp.

This is not to say that multiple hose barbs on fittings are bad. For example, if barbs are spaced so that the tubing relaxes between each barb, then each additional barb can provide additional grip. Yet if barbs are spaced so that the tubing cannot relax, then only the end barb provides significant grip. In this case, multiple barbs on a fitting may make you feel good, but they don't necessarily translate into improved grip. However, multiple barbs provide more than one sealing surface which is important if one of the barbs gets damaged.

TO CLAMP OR NOT TO CLAMP

While the hose barb effectively grips the inside of the tube, clamps provide an extra measure of holding power from the outside. Use of clamps depends upon the tubing material, the pressure of the system and environmental conditions. Some will use a clamp no matter the situation; there is something to be said for peace of mind for a few extra cents per tubing termination. For highly inflexible tubing, clamps are often necessary. Tubing that has been repeatedly installed and removed over one or more barbs and is no longer elastic enough to relax behind a barb will require a clamp, too. Certainly, if pressures and temperatures are unknown, and always when vibration can be an issue, clamps are an important element for connecting tubing to fittings.

On the other hand, with higher quality materials such as braided tubing, or in a range of pressure systems, clamps may not be necessary. In these cases, the hose barb provides more than enough blow-off and pull-off resistance.

There is also a downside to clamps. If installed incorrectly, clamps can actually induce leaks and failures. If a tie-type clamp is cinched too tightly on low durometer, or soft, tubing the clamp can lift the tubing away from the fitting. Securing a clamp over the portion of tubing that is stretched over a barb can have the same effect—degrade the seal enough to cause leaks.

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Installed properly behind hose barbs, the clamp is highly effective for providing additional grip on tubing. Still, it is worth investigating the pull-off and blow-off resistance of barbed fittings before you commit to clamps. After testing in your own application you may find that you don't need to use a clamp and that the proper combination of tubing and hose barb alone will perform to your specifications.

WOULD YOU LIKE METAL OR PLASTIC?

For extremely high pressure applications, for handling certain chemi-cals and compounds, or where the environment can be rough, a metal fitting is often the best choice. Yet just because metal is an inherently stronger material doesn't mean that metal fittings provide gripping force that is superior to plastic fittings.

With plastic fittings, the gripping edge of the barb can be molded precisely with no radius—sharp enough to grab, but not so sharp as to cut the tube. This is not always the case with barbs on metal fittings. Different manufacturing techniques, such as application of a plating layer to the metal fitting, create a radius over the barb that dulls the gripping and sealing edge. In terms of gripping tubing and holding the pressure, plastic barbs will perform equally, if not better, than metal barbs. In addition, plastic fittings will almost always cost less.

Of course, not all plastic fittings are created equal. In making a plastic part, a mold opens and closes as each piece is produced. In this process, a parting line is created, a seam that produces a slight imperfection on the plastic part where the two halves of the mold meet. On the barb of a fitting, a mold parting line invites leaks and system failure. Parting lines are especially prevalent with a poorly molded part or where the manufacturer has skimped on tooling investment or maintenance.

Mold parting lines on barbs present a potential weakness for plastic fittings with hose barbs. To remedy the situation, it is possible to create parting-line-free hose barbs. Using advanced molding processes, the mold parting line extends from the body of the fitting no further than the base of the barb. This more expensive manufacturing process ensures a smooth, uniform surface on the barb that is necessary for a tight grip and seal.

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If the application is inflating balloons, a leak at the parting line may be tolerable. However, the tubing connection that supports the manufacture of a high-value chemical payload requires extremely high tolerance components such as fittings with parting-line-free hose barbs.

CONCLUSION

In the end, it is important to understand the humble hose barb. More barbs or metal barbs are not necessarily the formula for more secure, reliable systems for connecting tubing and hoses to fittings and couplings. Reliable connections for your system start with finding the proper combination of tubing and fittings.

Matched properly with tubing or hose, the gripping and sealing power of fittings with a hose barb termination offers a connection with pull-off and blow-off resistance for most applications. Hose barbs are an integral part of today's fitting and coupling solutions, providing a low cost and effective means for connecting many different types of tubes and hoses. To ensure a safe and secure system, determine how these critical elements work together to provide the best grip and seal for your application.

About CPC

CPC is the leading provider of quick disconnect couplings, fittings and connectors for use with tubing in low-pressure fluid-handling applications. Employed in a broad range of applications, CPC's 10,000+ innovative standard products allow flexible tubing to be quickly and safely connected and disconnected. CPC also engineers custom solutions to improve the overall functionality and design of equipment and processes for life sciences, bioprocessing, specialty industrial and chemical-handling applications.

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