

# THE INS AND OUTS OF COOLING WATER MANIFOLDS

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Cooling water manifolds don't get much attention in the press compared to some of the more sophisticated auxiliaries and accessories used in plastics processing. But, it is a generally accepted rule of thumb that the mold cooling phase accounts for approximately 75-80% of a molding cycle.

Manifolds serve a necessary and useful purpose; they are key components of mold water cooling circuits. Their primary function is to route cooling water from the tower or chiller to the water passages in the mold, then collect the warmer water leaving the mold, at turbulent flow rates, and return it to the external cooling water loop.

Manifolds provide an efficient alternative to do-it-yourself plumbing. We've all seen examples of in-house plumbing art that resembles a Christmas tree decorated with an array of nipples, tees, various hose connection fittings and a spaghetti-like tangle of cooling water hoses around a molding machine. These “cobbled up” contraptions have real disadvantages:

- The tortuous path they create can encourage corrosion buildup from dirty water, which causes substantial pressure drop and reduced water flow
- Actual costs of construction are seldom, if ever, known.
- They are prone to leak, creating water puddle hazards.
- They are not color-coded or labeled, so identification of supply and return lines is difficult.

In contrast, manufactured manifolds are engineered products that provide a convenient means to neatly arrange multiple water hoses. More importantly, they are designed to supply the mold water passages with adequate cooling water at turbulent flow rates while keeping the backpressure effect in the return manifold leg of the cooling loop to a minimum.

Molder benefits from the proper use of engineered manifolds are:

- Adequate mold cooling
- Reduced and more consistent cycle times
- More consistent molded parts
- Reduced mold setup time
- Easily identifiable water lines to aid proper hookup

Enhanced shop safety is a collateral benefit because water hoses can be neatly arranged off the shop floor. Housekeeping is improved so there is less chance for an operator to trip while working close to the molding machine.

## The Basic Structure

Manifolds come in various shapes, sizes, materials and colors. Depending upon molder preference and application requirements, manifolds can be mounted on the machine frame, a temperature control unit cabinet, the tool or located on the floor alongside the press.

Cooling water manifolds can be a single unit, welded or threaded construction, but all have three primary parts: inlet, body and ports (see Figure 1). The body can be thought of as a length

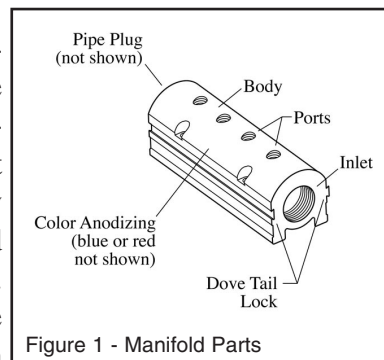


Figure 1 - Manifold Parts

of pipe or tubing, with one end plugged. The other end is the inlet. Cooling water enters the blue “supply” manifold through the inlet for distribution through the ports to the mold water passages. These ports typically run in-line along the top of the manifold.

Water flow is the opposite for the red “return” manifold. Warm water from the mold cooling passages enters the ports and is discharged through the inlet to

the return loop. The number of ports depends on the number of cooling water passages in the mold. Water passages can vary from a few to a dozen or more. The average is usually about eight.

Common materials of manifold construction are aluminum, carbon steel, and stainless steel.

- Anodized aluminum manifolds (see Figure 2) are lightweight and easily customized. Their smooth bores mean lower pressure drop. The true cost of ownership is low.
- Carbon steel manifolds are usually painted for improved appearance. Despite the fact that corrosion buildup can be a problem, there are many in service.
- Stainless steel manifolds (see Figure 3) are typically fabricated from 304 square tubing. Half couplings for supply, return and distribution ports are welded to the tube. SS manifolds are often specified for highly corrosive cooling water applications.

Common supply and return connection sizes are 3/4, 1, 1-1/4, 1-1/2 and 2-inch NPT(F)[National Pipe Thread (Female)]. Port sizes are typically 3/8, 1/2, 3/4 or 1-inch NPT(F). Though less common, NPT(M) is used on some applications, primarily for plumbing accommodation. Optional quick-connect fittings and hose barbs are also popular, particularly when custom molding operations require frequent tool changes and setups.

Most aluminum manifolds are color anodized after machining to provide corrosion resistance from the cooling water and to identify supply and return lines at a glance. Typical color choices are red, blue, black or clear. Red and blue anodizing are the most popular because blue denotes cooler supply water and red the warmer water returning from the mold. Color

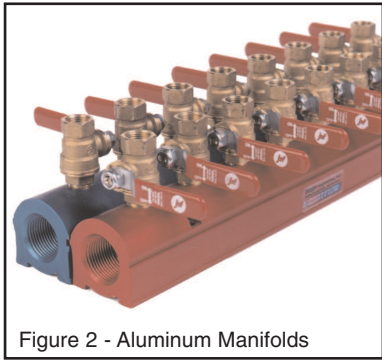


Figure 2 - Aluminum Manifolds

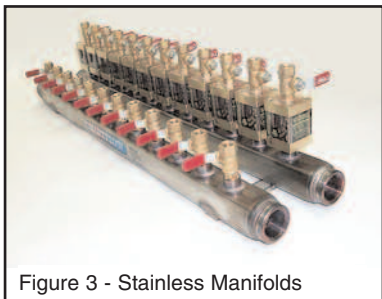


Figure 3 - Stainless Manifolds

coding reduces the chances of incorrect water hose hookup after a tool change and set-up. Some manifold manufacturers use labels instead of color coding to depict supply and return water lines.

In addition, different manifold manufacturers use different design features to differentiate their product and add value. Some of these differences include:

- The incorporation of a sliding dovetail lock so multiple manifolds can be locked in parallel. This feature facilitates mounting and the connection of multiple water hoses.
- The option of additional fittings and flowmeters for a semi-custom flow meter and shutoff installation (see Figure 3).

### Specifying a Manifold

Okay, so now that you know the benefits, basic configuration and options available, how do you decide what kind of manifold you need? Unfortunately, it's not an exact science.

In operation, pressure drops and flow rates at the various ports depend on a number of factors, including the number and location of ports that are open or closed, supply pressure, inlet and port sizes, port spacing and manifold length.

Another point to consider is that a manifold can be divided into thirds along its length. The ports that are in the third closest to the plugged end have the greatest pressure and flow, the ports in the third closest to the inlet have the second greatest and the ports in the middle third have the lowest pressure and flow. This is an important point to remember if your tool has critical water requirements.

Rule of thumb when specifying a manifold is that the combined areas of the ports should not be greater than the area of the inlet. For example, a 1-inch manifold has an inlet area of .785 square inches. Using the equal area rule, this manifold would have optimal performance with up to seven 3/8-inch ports or up to four 1/2-inch ports. A 3/4-inch manifold could be configured with up to nine 1/4-inch ports, up to four 3/8-inch ports or only two 1/2-inch ports.

This rule of thumb, however is seldom observed. It is common to see relatively small manifolds with several fairly large ports. But it is a good practice to select the manifold with the largest

practical inlet for most applications. The determinant should be performance, not plumbing accommodation to the cooling water drop line size.

Think of a manifold like a header (see Figure 4). It is generally undesirable to have the “supply” manifold constitute an upstream restriction and cause an avoidable pressure drop in the cooling water flow loop before it enters the tool to do its intended work. Likewise, the water leaving the tool should not encounter avoidable backpressure because the return manifold is undersized.

Some molders prefer to specify that manifolds be installed directly on the mold when new tooling is ordered. This arrangement reduces port hose length or eliminates port hoses altogether. When considered during tool design, the port openings in the manifold base and the water passage openings in the tool can be aligned and sealed with o-rings. The measurable benefits to the molder are less heat gain in the cooling water port hoses and reduced tool change and setup times.

Cooling water flow can be metered with simple devices, such as hand operated 1/4-turn ball valves and vane-type mechanical flowmeters. More sophisticated devices, such as pulsed solenoid valves or proportional valves, which are actuated by a micro-processor-based controller, can also be used.

## In Conclusion

Molders are on a continuous quest for shorter and more consistent cycle times, along with the increased overall efficiency that the manufacturers of new molding machines claim. They understand the importance of proper cooling water flow to and from the mold. They know that regardless of the brand name or age of the injection press, when cooling water is delivered at the proper flow rates through supply manifolds to the tool and return manifolds from the tool, it is likely that good molded parts will be produced.

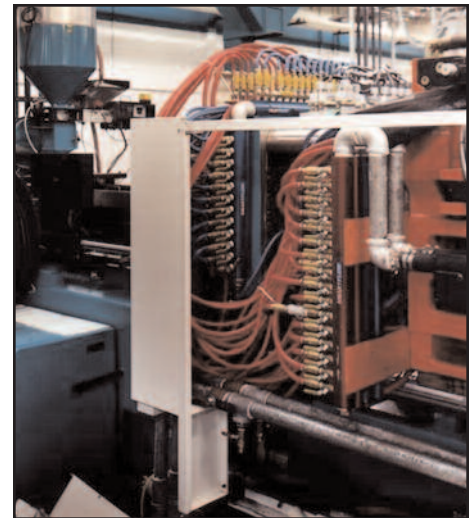


Figure 4 - 2-inch Manifolds installed for maximum water flow

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