MQL and Turning Operations

Implementing MQL (Minimum Quantity Lubrication) in a turning operation can provide numerous benefits when done properly. When relying on minute amounts of lubricant to reduce friction, proper nozzle placement is critical for ensuring lubricant is applied to the correct spot in the cutting application. In a turning operation, where the cutting tool can be embedded in the work piece, this can be challenging.

External Nozzles

Where the nozzle head needs to be directed is dependent on the type of tool being used. When using a cut off tool, we recommend spraying from underneath the cutting tool up into the cut. Spraying on the top side of the tool does not work because the entire cutting edge is covered by the chip being formed (Figure D1, D2).

Figure D2

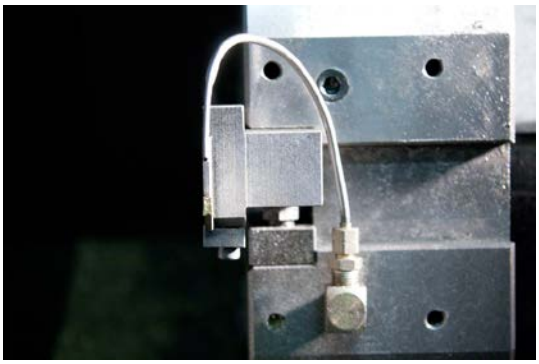
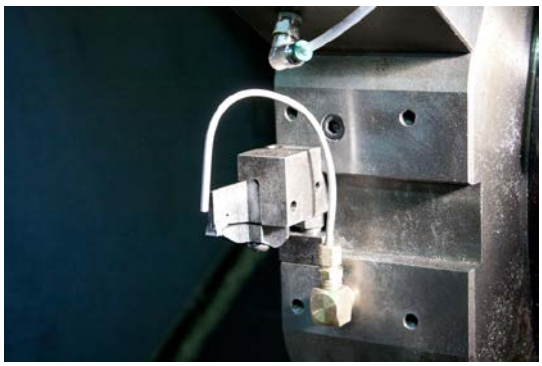


Figure D2



When turning the end of the material or outside diameters, where the cutting tool is not entirely covered by the material, it is better to spray on the top side of the tool. The spray should be directed so that it hits the cutting edge and some lube lands on the material being machined. As the cutting edge moves through lubricant film on the material it will help lubricate the cutting edge. (Figure E1,E2,E3)

Figure E1

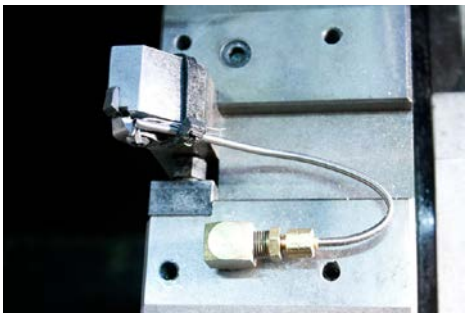


Figure E2

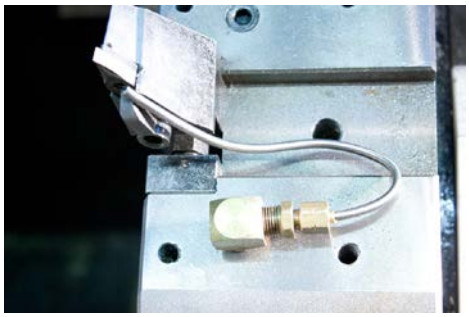
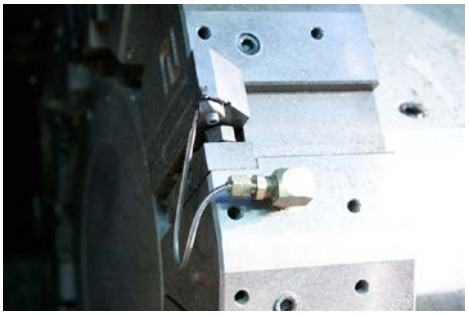


Figure E3



For drill bits and taps, aim the nozzle to spray down the length of the drill (Figure F1, F2)

Figure F1

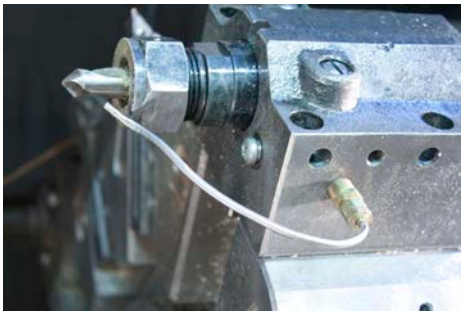
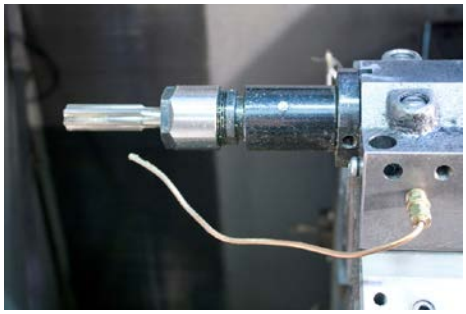


Figure F2



For coolant fed drills or boring tools, use small diameter tubing (1/8”OD or 5/32”OD) to connect to the tools. (Figure G1, G2)

Figure G1

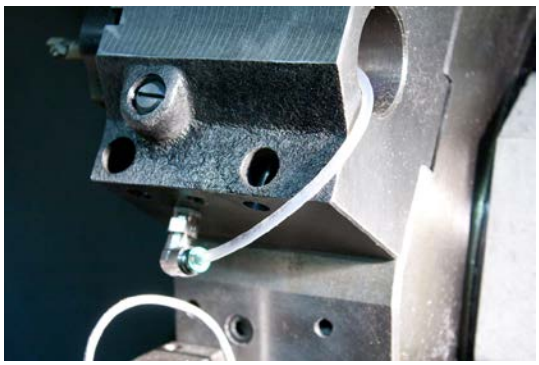
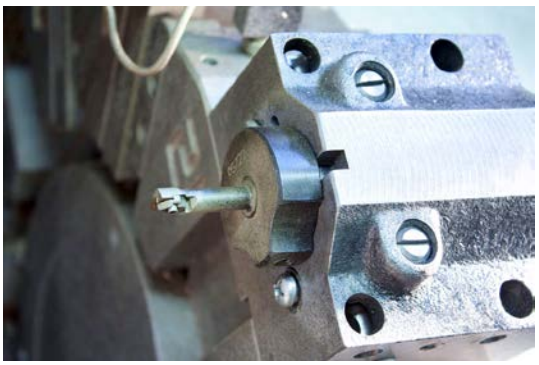


Figure G2



If the external nozzle is not getting the lubricant into the cutting interface, it often ends up applied to the cut chips, resulting in smoking chips and premature tool wear. Positioning the external the nozzles as described above reduces smoking and improves stool life.

Existing Coolant Ports

Utilizing the existing coolant ports on a turning machine designed with through-the-turret coolant is another way to apply MQL fluids to the target area of the cutting tool. In this case the turret’s interior passageways need to be relatively small and have a consistent diameter throughout the entire length. Since this varies widely on different machines and models a good diagram of the passageways will need to be obtained from the manufacturer. And just as with an external nozzle, the MQL fluids need to be applied to the cutting tool/work piece inter face so the fluid outlets may need to be on the underside and directed toward the cut.

To help make this clear, let's look at a specific example. To support MQL on our own Mazak QTN-200 turning center we modified the existing coolant inlets on the casting that supports the tool turret as shown below (Figure H1, H2)

Figure H1

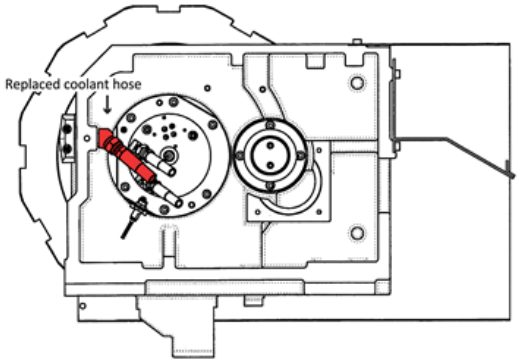
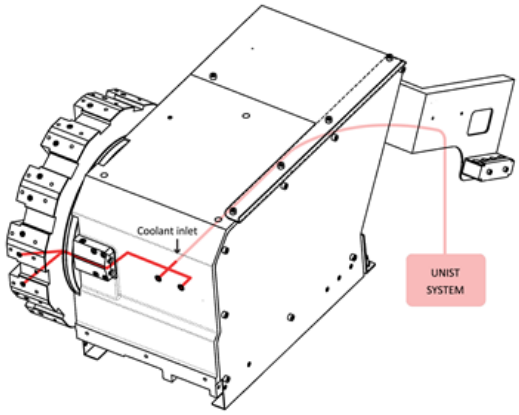
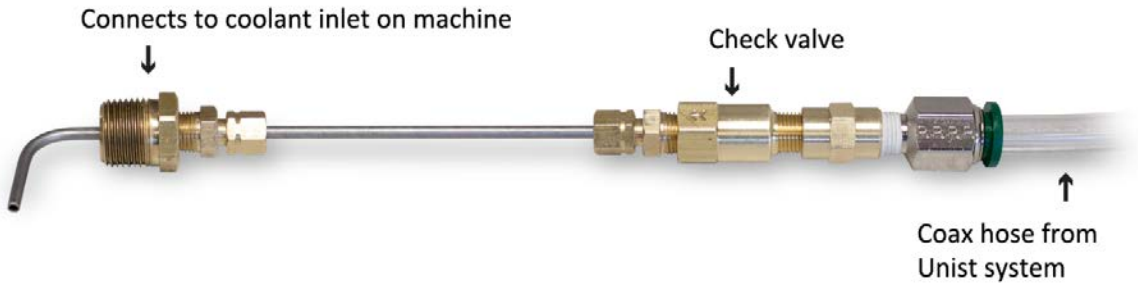


Figure H2



When we installed the MQL system we used a special nozzle assembly (Figure I1) designed to optimize the flow of the lubricant through the passageway.

Figure I1



Because the passageway has a 90 degree turn immediately after the inlet, we bent the end of the nozzle 90° to direct the spray down the length of the passageway towards the turret. This bend allows the atomized lubricant to flow down the length of the channel instead of wetting the inside the channel. Although we exclusively use MQL here at Unist, to demonstrate how it can be done we installed a check valve in the nozzle that would allow the use of coolant that by preventing the coolant from entering the MQL hose.

At each tool position on the turret there are two coolant outlet ports available. We used the lower of the two ports and plugged the higher port. For tools needing external spray we installed either a small nozzle made from 1/8”OD stainless tubing and mounted directly onto the coolant outlet ports (Figures J1 – J5).

Figure J1

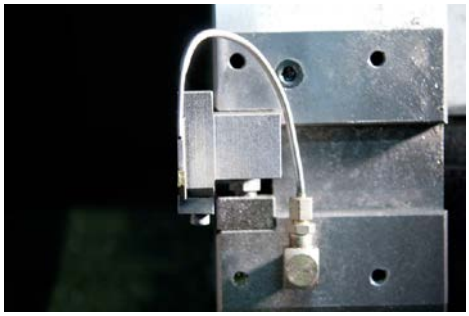


Figure J2

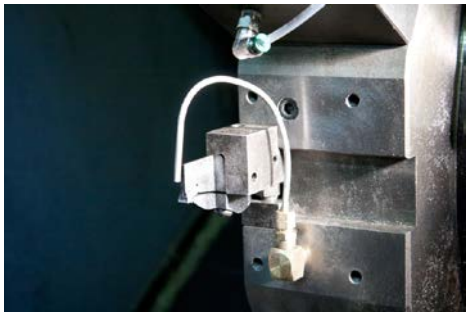


Figure J3

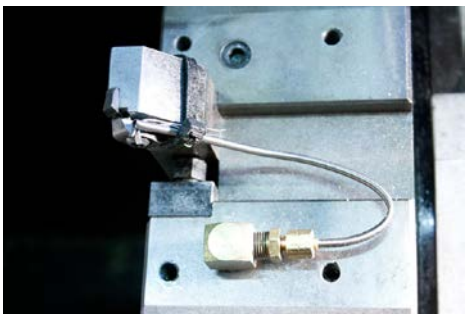


Figure J4

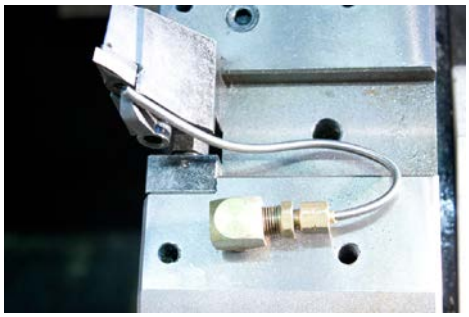
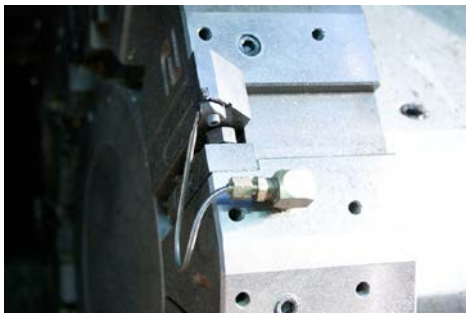


Figure J5



Unist can assist with this nozzle design and fabrication, but to ensure proper operation detailed information about the tool and part will likely be needed.

Figure K1

To connect to a coolant fed tool we use a section of small diameter tubing (Figure K1).

The MQL unit is controlled by the same M-Codes that would have controlled the flood coolant. We disconnected the cable that controlled the coolant pump and attached it to a solenoid valve on our lubricator system.

Like all MQL applications, the proper steps need to be taken to ensure that the end results are successful. Paying attention to and addressing all critical factors will ensure help the success of the Unist MAL system in your turning operation.