

CIMCOOL[®]

Technical Report

Milacron Marketing Co. | Consumable Products Division | Cincinnati, Ohio 45209

MICROLUBRICATION : VERY LOW-VOLUME / LOW-PRESSURE DELIVERY OF METALWORKING FLUID

Conventional metalworking fluid delivery systems provide fluids to the work zone in volumes which "flood" the work area. Typically these fluids are filtered and then recirculated through the system. Microlubrication delivery systems provide extremely low volumes of fluid to the process. (Microlubrication is also known as MQL, minimum quantity lubrication or near-dry machining.) Typical flow rates are measured in ounces per hour. Microlubrication metering pumps operate at very low process pressure, relying on shop compressed air (commonly between 80-100 psi) to disperse the fluid.

Applications

Microlubrication delivery systems are for single use fluid applications. Fluid is not recirculated. The fluid applied to the operation can be neat or diluted, depending on the fluid type and the manufacturer's recommendations. Typical applications are for metal removal operations with light stock removal or parts requiring minimal areas to be machined. (Examples are sawing, reaming, tapping or light milling, some drilling and turning.) The process can reduce or eliminate fluid disposal costs and provides drier chips for recycling scrap.

Process Considerations

The use of microlubrication equipment for metalworking fluid applications requires specific modifications in the process. Multiple metering pumps are usually required for each installation.

Attention needs to be directed to the placement and use of special nozzles. The shop air supply must provide clean, dry air in sufficient quantity to maintain adequate fluid distribution. The machine should be enclosed to contain the fluid spray. The addition of a mist collection unit may be necessary to meet the required OSHA and other environmental regulations.

Metalworking Fluid Considerations

Microlubrication delivery systems are designed to apply minimal quantities of fluid to metalworking operations. During a typical machining process, the basic functions that metalworking fluids provide are lubrication, cooling, chip removal and corrosion control.

Lubrication

As in traditional machining operations, microlubrication systems provide fluid with lubrication properties that reduce rubbing friction between the tool and the workpiece in the cutting zone. This reduces the amount of heat generated in the operation. Metering pump adjustments for stroke distance, stroke rate and air pressure, are balanced to achieve the proper quantity of fluid for each nozzle in use. Settings can also be affected by fluid viscosity. (Consult the equipment manufacturer's recommendations for the settings required for your application.) The optimum number of nozzles and their correct placement are needed for effective lubrication.

Cooling

Temperature variations must be minimized within the workpiece in order to prevent dimensional changes in the finished part. Beyond friction control, thermal buildup is created from metal deformation during machining operations. The heat transfer capability of microlubrication systems is limited to the cooling capacity of air blown over

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the operation and evaporative cooling. This type of cooling action does not have the cooling capacity found with water-based flood application.

Chip Removal

Microlubrication systems rely on air pressure to disperse the fluid. The low kinetic energy of the spray cannot force chips out of the cut zone. In order to prevent chip re-cutting and damage to tooling, other physical means must be provided to evacuate chips from the operation. In addition, a process washer or cleaning operation may be required after machining to remove any lubricant residue or chips.

Corrosion Protection

In microlubrication delivery systems, the fluid is applied through nozzles aimed at the tooling. The workpiece may only receive an over-spray coating, protecting only a localized surface of the workpiece. Large or complex shaped parts may require post-process corrosion protection.

Equipment Installation

Microlubrication delivery systems are designed for point-of-use installation. Systems used for metal removal operations must be installed on each machine. Every cutting spindle may also require multiple spray nozzles. The fluid output for each nozzle is adjusted by a separate metering pump setting, for stroke distance, stroke rate and air pressure, in order to achieve the proper spray mixture. The air supply is critical for proper equipment operation. A sufficient volume of regulated and filtered air at >80 psi is needed.

Comparison of Microlubrication Process to Flood Delivery

Fluid:	Microlubrication	Flood
Volume	Ounces/hour	Gallons/Min.
Delivery	Single-use	Recirculated
Pump Type	Fine metering	Std. Coolant
Power Supply	Air and electric	Electric
Application	Light machining	Any severity
Chip Removal	Ineffective	Effective
Corrosion Protection	Point-of-contact	Overall Part

Metalworking Fluid Recommendations

The selection of the proper metalworking fluid for any operation must be based upon a review of all aspects of the process. Operations that use microlubrication systems are no exception. Whether using neat or diluted product, the fluid selected must provide the proper corrosion protection for the work materials that are being machined and be capable of performing the necessary operations. There are many CIMCOOL[®] metalworking fluids that are suitable for microlubrication delivery systems. Consult your regional CIMCOOL[®] Technical Service Engineer for specific recommendations, or call Milacron CIMCOOL[®] Technical Service at 513-458-8199.