CIMCOOL®
Technical Report
Milacron Marketing Co. | Consumable Products Division | Cincinnati, Ohio 45209

METALWORKING FLUIDS

MACHINE TOOL DESIGN CONSIDERATIONS

Metalworking fluids are designed to make modern machine tools perform more productively, accurately, and efficiently. A review of these guidelines will enable you to design machine tools for optimum compatibility and to make maximum use of the properties of these fluids.

WAY DESIGN

Metalworking fluids contain little or no oil and therefore cannot supplant the function of a *way* lubricant.

DO - Use positive lubrication.
DO - Protect *way* surfaces from forceful metalworking fluid flow which can displace *way* lubricant.
DO - Recommend and specify "water resistant" *way* lubricants.
DO - Use high quality wiper materials compatible with metalworking fluids (see Materials of Construction - Elastomers).

HYDRAULIC SYSTEM

Hydraulic oil is a contaminant that must be kept out of the metalworking fluid. Hydraulic oils, and particularly some of the additives formulated into them, can cause serious damage to the machine tool and metalworking fluid when mixed with water.

DO - Use high quality components to prevent external leakage.
DO - Design hydraulic systems so that external leakage will not flow into metalworking fluid.

MATERIALS OF CONSTRUCTION

Metals - Metalworking fluids contain highly effective corrosion inhibitors to prevent corrosion of ferrous and nonferrous metals. Nonferrous inhibitors are expensive. Your machine tool will last longer and your customer will be able to use more economical fluids if you avoid the use of aluminum, copper, brass, zinc, or other nonferrous alloys. Bimetallic corrosion can cause premature failure of components at the contact point between dissimilar metals.

DO - Use steel tubing rather than copper.
DO - Use steels, cast iron wherever possible.
AVOID - Nonferrous metals whenever possible.
AVOID - Aluminum gauges.
AVOID - Aluminum fixtures and bimetallic contact areas.
AVOID - Coolant pumps with brass or aluminum impellers.

Plastics and Elastomers - Metalworking fluids are moderately alkaline and may attack some plastics, which are not tolerant to higher pH. The most common pH range for a metalworking fluid is 8.8 to 9.2 (The pH of CIMCLEAN® 30 machine tool cleaner is approximately 11). Molded plastics such as polycarbonate are especially susceptible to stress corrosion cracking under these conditions. Elastomer components such as seals, hoses and wipers, which are tolerant to high pH, should be selected.

DO - Use high quality seals such as Nitrile (Oil Resistant Buna N), fluoroelastomers (e.g., VITON®, AFLAS®, KALREZ®) or TEFLON® for static seal applications.
DO - Use Polyurethane or HYTREL® for dynamic applications.
DO - Use seals to keep water out of critical components.
DO - Have new seal materials tested for compatibility with metalworking fluids, oils, and water.
DO - Use Permetex ULTRA BLUE® or ULTRA COPPER® for caulking materials.

AVOID - Neoprene, Silicone, Ethylene Propylene (EPR, EPDM), and Butyl rubber in areas where metalworking fluid contact is likely.
AVOID - Molded polycarbonates such as MERLON® and LEXAN®, which can undergo alkaline stress corrosion cracking.
AVOID - Using white or clear silicone for caulking materials.

SHIELDING

OSHA requires certain guards on machine tools. Selective shielding can be used to reduce contact between the metalworking fluid, the operator, and/or certain machine tool components.

DO - Use shields to keep metalworking fluid within the metal removal area and reduce metalworking fluid mists.
DO - Shield oiled components (e.g., *ways*) from direct contact with metalworking fluid.
DO - Protect operator from exposure to mist, splash, and chips.

NOZZLES

Metalworking fluid, regardless of effectiveness, cannot function if it doesn't get to the point of the chip/tool (chip/grinding wheel) interface. Proper application of the fluid can result in better finishes, more efficient cutting, and, in general, better overall machine performance. Because the air current circulating around a grinding wheel often prevents metalworking fluid penetration to the "cut zone", proper application in grinding can be extremely important to machine performance.

DO - Design nozzles to put the fluid where it belongs.
DO - Provide adequate pressure (see Sump Design) to penetrate the air blanket around the grinding wheel.
DO - Provide suitable, well placed nozzles to flush swarf to the sump (or trench).
DO - Make nozzle tips easy to clean, should they become plugged.
DO - Provide a separate flush hose to wash down the machine.
DO - Provide an air deflector to break the circulating air current.
DO - Insure metalworking fluid pressure is adequate to get to the "cut zone" (30 – 50 PSIG is standard, 90 PSIG or higher for high productivity.

SUMP DESIGN

The machine sump is critical to the long term efficiency and productivity of the machine tool. If the sump recirculates dirt and tramp oil, part quality may suffer. If the sump design encourages the growth of odor-producing bacteria, then frequent clean-outs may be necessary.

1) The sump should be readily accessible, ideally external for easy access.
2) Machine sumps should have sturdy, lightweight covers with handles or hand holds.
3) The purpose of the reservoir is to clean the coolant for reuse. For chip settling, large shallow sumps are needed.
4) Incorporate weirs and baffles into the reservoir to trap floating oil and swarf.
5) Provide sufficient (but not excessive) Pump Capacity.
   General purpose: 1 GPM per spindle HP
   High production: 2 GPM per spindle HP
6) Avoid turbulence in sump.
7) Use ungalvanized steel, cast iron or plastic for sumps, pipes, pumps and fittings. Avoid brass, copper and aluminum.
8) Size metalworking fluid supply lines to allow 10-ft./sec. velocity to prevent line plugging. Sump designs can be more complex to incorporate additional separation devices such as cyclones or paper filters.
9) For settling systems, "Retention Time" of 8 minutes is minimum, 10 minutes is ideal. The longer the "Retention Time" the better.
   Retention Time (Minutes) = Sump Capacity (Gallons) / Fluid Flow Rate (GPM)

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