
Semi-Synthetic CNC Coolant: Technical Material Specification

1.0 Material Overview & Common Uses

Semi-synthetic CNC coolant is a hybrid metalworking fluid that combines the lubricity of soluble oils with the cooling and cleanliness of synthetic fluids. It consists of a stable emulsion of mineral oil (typically 5-30%) in water, along with emulsifiers, corrosion inhibitors, biocides, and anti-foaming agents. This formulation provides excellent heat dissipation, chip flushing, and rust protection while leaving a less oily residue than traditional soluble oils.

Common industrial applications include general machining, turning, milling, drilling, and grinding of ferrous and non-ferrous metals such as steel, stainless steel, aluminum, and cast iron. It is widely used in CNC machining centers, automatic lathes, and transfer lines where a balance of cooling and lubrication is required. Semi-synthetic coolants are preferred in operations with high coolant flow rates and central filtration systems due to their long sump life and resistance to bacterial growth.

2.0 Core Technical Properties & Sizing

- Appearance: Translucent to milky white emulsion (concentrate is typically amber to dark brown liquid).
- Concentrate density at 20°C: 0.95 – 1.05 g/mL (varies by formulation).
- pH at recommended dilution (5-10%): 8.5 – 9.5 (alkaline range for corrosion inhibition).
- Refractive index factor (RI factor): Typically 1.0 – 1.2 (used for concentration measurement with a refractometer).
- Recommended dilution ratio: 5% to 10% by volume (1:20 to 1:10 concentrate-to-water).
- Viscosity of concentrate at 40°C: 20 – 100 cSt (varies by brand and formulation).
- Flash point (concentrate): >150°C (typically not flammable at use dilution).
- Corrosion protection: Passes ASTM D-4627 (cast iron chip test) at 5% dilution.
- Standard packaging: 20 L pails, 55 gal drums, 205 L drums, 1000 L IBC totes.

3.0 Processing, Machinability & Application

Semi-synthetic coolants are ready-to-use after dilution with water. Mixing must be performed carefully to ensure a stable emulsion. Always add concentrate to water, never water to concentrate, to prevent inversion and separation. Use a mixing proportioner or pre-mix tank with agitation for consistent concentration.

- Water quality: Use deionized or softened water (hardness <200 ppm CaCO₃) to prevent emulsion instability and scale buildup.
- Mixing temperature: 10-30°C for both water and concentrate to ensure proper emulsification.
- Recommended concentration for general machining: 6-8% (check refractometer reading against RI factor).
- For aluminum or high-lubricity applications: Increase to 8-10% concentration.
- For grinding operations: Use 4-6% concentration with enhanced filtration.
- Coolant pressure: 30-60 psi for flood cooling; 100-300 psi for through-spindle or high-pressure systems.
- Filtration: Recommend 50-100 micron filtration for general machining; 10-30 micron for grinding or high-finish applications.
- Sump life: 6-12 months with proper maintenance (concentration control, pH monitoring, biocide dosing).

4.0 Common Defects & Quality Control

- Reject if concentrate shows visible separation, sediment, or gel formation at the bottom of the container.
- Reject if emulsion is unstable: oil layer floating on top or water layer at bottom after 24 hours of mixing.
- Reject if pH drops below 8.0 (indicates bacterial growth or depletion of corrosion inhibitors).
- Reject if pH exceeds 10.0 (risk of skin irritation and aluminum staining).
- Reject if concentration varies by more than $\pm 1\%$ from target (measured by refractometer).
- Reject if foul odor (rotten egg, sour) is present, indicating anaerobic bacterial contamination.
- Reject if excessive foaming occurs during normal flow rates (anti-foam additive depletion).
- Reject if emulsion leaves sticky or gummy residue on machined parts or machine surfaces.
- Reject if concentrate has passed its shelf life (typically 1-2 years from manufacture date).

5.0 Storage, Handling & WHMIS Guidelines

- Store concentrate in original sealed containers at 5-40°C, away from direct sunlight and freezing temperatures.
- Shelf life: 12-24 months from date of manufacture (check label for expiry).
- Follow FIFO (First In, First Out) inventory rotation to prevent aging of concentrate.
- WHMIS hazard classification: May be classified as Class D2B (toxic materials) or Class E (corrosive) depending on formulation. Always consult Safety Data Sheet (SDS).
- Mandatory PPE: Chemical-resistant gloves (nitrile or neoprene), safety glasses with side shields, and chemical-resistant apron during mixing or handling concentrate.
- Ventilation: Use local exhaust ventilation when mixing concentrate to avoid inhalation of mists or vapors.
- Spill containment: Use absorbent pads or vermiculite for small spills; contain large spills with dikes and dispose per local regulations.
- Disposal: Do not drain to sewers or waterways. Collect used coolant and dispose as industrial waste per provincial regulations (e.g., Ontario Regulation 347).
- First aid: In case of skin contact, wash with soap and water. For eye contact, flush with water for 15 minutes and seek medical attention. If ingested, do not induce vomiting; call poison control.

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