LUBRICANTS **Technical Bulletin**

CITGO METALWORKING FLUID RECOMMENDATIONS

Proper selection of a cutting oil or soluble oil is dependent upon these factors:

1. Machinability of metal
2. Severity of operation
3. Feed speed
4. Tool composition.

Typical operating ranges and dilution levels for various cutting oils and soluble oils can be graphed or plotted based on metal groupings and operation severity even though the feed speed and tool composition are unknown. However, operating ranges for fluids derived in this manner are only typical and should be used primarily as guidelines in fluid selection. The ensuing pages present such typical operating ranges for CITGO metalworking fluids.

The operating ranges for CITGO NC 100 and 400 series cutting oils show up as the shaded areas in their respective graphs. In the case of CITGO NC 200 series soluble oils and CITCOOL® Concentrates, the operating ranges give suggested water dilution ratios for each product in a given application.

To use either graph system, it is necessary to know the actual operation and the hardness of the metal being worked. When these two points are established, then the selection of either an NC 100 series or NC 400 series CITGO fluid is simply a matter of matching a shaded area with the two reference points. In the case of a CITGO NC 200 series soluble oil and CITCOOL® Concentrates, the reference points are matched up to get a water dilution ratio.

CITGO Performance Range

CITGO Cutting Oil NC 120

Metal Machinability Groups

CITGO Cutting Oil NC 130

Metal Machinability Groups

Maching Operation	1 Non-Ferous Soft Metals	2 Nickel Alloys, Nitralloy Steels, Cast Irons & Alloy Steels (up to 200 Brinell)	3 Stainless Steels, 'Monel' Metals, Cast Irons & Alloy Steels (200 to 300 Brinell)	4 Titanium Alloys, High Tensile Nickel Alloys, Austenitic Stainless Steels, Tool Steels & High Tensile Alloy Steels (300 to 400 Brinell)	1 Non-Ferous Soft Metals	2 Nickel Alloys, Nitralloy Steels, Cast Irons & Alloy Steels (up to 200 Brinell)	3 Stainless Steels, 'Monel' Metals, Cast Irons & Alloy Steels (200 to 300 Brinell)	4 Titanium Alloys, High Tensile Nickel Alloys, Austenitic Stainless Steels, Tool Steels & High Tensile Alloy Steels (300 to 400 Brinell)
Turning								
Boring								
Drilling								
Reaming								
Automatic Operations*								
Milling								
Gear Hobbing								
Spline Hobbing								
Gear Shaping								
Gear Shaving								
Form Milling								
Thread Rolling (Rotary)								
Screw Cutting								
Tapping								
Form Grinding								
Thread Grinding								
Internal Broaching								
Surface Broaching								
Deep Hole Drilling								
Rifle Boring								
Trepan Boring								
Honing								

**Automatic Screw Machines and Turret Lathes.*

CITGO Performance Range

	CITGO Cutting Oil NC 140				CITGO Cutting Oil NC 150			
	Metal Machinability Groups				Metal Machinability Groups			
Maching Operation	**1** Non-Ferous Soft Metals	**2** Nickel Alloys, Nitralloy Steels, Cast Irons & Alloy Steels (up to 200 Brinell)	**3** Stainless Steels, 'Monel' Metals, Cast Irons & Alloy Steels (200 to 300 Brinell)	**4** Titanium Alloys, High Tensile Nickel Alloys, Austenitic Stainless Steels, Tool Steels & High Tensile Alloy Steels (300 to 400 Brinell)	**1** Non-Ferous Soft Metals	**2** Nickel Alloys, Nitralloy Steels, Cast Irons & Alloy Steels (up to 200 Brinell)	**3** Stainless Steels, 'Monel' Metals, Cast Irons & Alloy Steels (200 to 300 Brinell)	**4** Titanium Alloys, High Tensile Nickel Alloys, Austenitic Stainless Steels, Tool Steels & High Tensile Alloy Steels (300 to 400 Brinell)
Turning								
Boring								
Drilling								
Reaming								
Automatic Operations*								
Milling								
Gear Hobbing								
Spline Hobbing								
Gear Shaping								
Gear Shaving								
Form Milling								
Thread Rolling (Rotary)								
Screw Cutting								
Tapping								
Form Grinding								
Thread Grinding								
Internal Broaching								
Surface Broaching								
Deep Hole Drilling								
Rifle Boring								
Trepan Boring								
Honing								

**Automatic Screw Machines and Turret Lathes.*

Note: CITGO Cutting Oil 150 is similar to Cutting Oil NC 140. However, it is particularly suited to operations where surface finish is a concern.

CITGO Typical Dilutions[1]

	CITGO Cutting Oil NC 205 (Soluble)				CITGO Cutting Oil NC 215 (Soluble)			
	Metal Machinability Groups				Metal Machinability Groups			
Maching Operation	**1** Non-Ferous Soft Metals	**2** Nickel Alloys, Nitralloy Steels, Cast Irons & Alloy Steels (up to 200 Brinell)	**3** Stainless Steels, 'Monel' Metals, Cast Irons & Alloy Steels (200 to 300 Brinell)	**4** Titanium Alloys, High Tensile Nickel Alloys, Austenitic Stainless Steels, Tool Steels & High Tensile Alloy Steels (300 to 400 Brinell)	**1** Non-Ferous Soft Metals Note: (2)	**2** Nickel Alloys, Nitralloy Steels, Cast Irons & Alloy Steels (up to 200 Brinell)	**3** Stainless Steels, 'Monel' Metals, Cast Irons & Alloy Steels (200 to 300 Brinell)	**4** Titanium Alloys, High Tensile Nickel Alloys, Austenitic Stainless Steels, Tool Steels & High Tensile Alloy Steels (300 to 400 Brinell)
Turning, Milling, Drilling, Boring, Forming, Sawing	30:1	20:1	10:1			20:1	20:1	10:1
Tapping, Reaming, Broaching, Thread Rolling, Screw Cutting	20:1	10:1	10:1			20:1	10:1	10:1
Gear Shaping, Shaving and Hobbing, Form and Thread Milling	20:1	20:1	10:1			30:1	10:1	10:1
Internal and External Grinding, Form and Thread Grinding	60:1	40:1	30:1					

Notes:

1. Dilution ratios shown are approximate and may require higher or lower water concentrations depending on a number of factors including the type of metal cut, machine speed, the severity of the operation, metal hardness, etc.
2. Not recommended for aluminum, aluminum alloys or magnesium.

CITGO Performance Range

Maching Operation	CITGO Cutting Oil NC 400 — Metal Machinability Groups				CITGO Cutting Oil NC 420 — Metal Machinability Groups			
	1 Non-Ferous Soft Metals	**2** Nickel Alloys, Nitralloy Steels, Cast Irons & Alloy Steels (up to 200 Brinell)	**3** Stainless Steels, 'Monel' Metals, Cast Irons & Alloy Steels (200 to 300 Brinell)	**4** Titanium Alloys, High Tensile Nickel Alloys, Austenitic Stainless Steels, Tool Steels & High Tensile Alloy Steels (300 to 400 Brinell)	**1** Non-Ferous Soft Metals	**2** Nickel Alloys, Nitralloy Steels, Cast Irons & Alloy Steels (up to 200 Brinell)	**3** Stainless Steels, 'Monel' Metals, Cast Irons & Alloy Steels (200 to 300 Brinell)	**4** Titanium Alloys, High Tensile Nickel Alloys, Austenitic Stainless Steels, Tool Steels & High Tensile Alloy Steels (300 to 400 Brinell)
Turning	■				■			
Boring	■				■			
Drilling	■				■			
Reaming	■				■			
Automatic Operations*	■				■			
Milling					■			
Gear Hobbing								
Spline Hobbing								
Gear Shaping								
Gear Shaving					■			
Form Milling					■			
Thread Rolling (Rotary)					■			
Screw Cutting					■			
Tapping					■			
Form Grinding					■			
Thread Grinding					■			
Internal Broaching					■			
Surface Broaching					■			
Deep Hole Drilling	■							
Rifle Boring	■							
Trepan Boring	■							
Honing	■							

Automatic Screw Machines and Turret Lathes.

Note: Cutting Oil NC 420 is particularly suited to operations where staining due to oil spray is a concern.

CITGO Performance Range

CITGO Cutting Oil NC 425

Maching Operation	Metal Machinability Groups			
	1 Non-Ferous Soft Metals	**2** Nickel Alloys, Nitralloy Steels, Cast Irons & Alloy Steels	**3** Stainless Steels, 'Monel' Metals, Cast Irons & Alloy Steels	**4** Titanium Alloys, High Tensile Nickel Alloys, Austenitic Stainless Steels, Tool Steels & Tensile Alloy Steels
	High			
Turning	■	■		
Boring	■	■		
Drilling	■	■		
Reaming	■	■		
Automatic Operations*	■	■		
Milling	■			
Gear Hobbing	■			
Spline Hobbing	■			
Gear Shaping	■			
Gear Shaving	■			
Form Milling	■			
Thread Rolling (Rotary)	■			
Screw Cutting	■			
Tapping	■			
Form Grinding	■			
Thread Grinding	■			
Internal Broaching	■			
Surface Broaching	■			
Deep Hole Drilling	■			
Rifle Boring	■			
Trepan Boring	■			
Honing	■			

CITGO Typical Dilutions[1]

CITGO CITCOOL® Fluids 22 and 33

Maching Operation	Metal Machinability Groups			
	1 Non-Ferous Soft Metals	**2** Nickel Alloys, Nitralloy Steels, Cast Irons & Alloy Steels (up to 200 Brinell)	**3** Stainless Steels, 'Monel' Metals, Cast Irons & Alloy Steels (200 to 300 Brinell)	**4** Titanium Alloys, High Tensile Nickel Alloys, Austenitic Stainless Steels, Tool Steels & High Tensile Alloy Steels (300 to 400 Brinell)
Turning, Milling, Drilling, Boring, Forming, Sawing	20:1	20:1	10:1	10:1
Tapping, Reaming, Broaching, Thread Rolling, Screw Cutting	20:1	20:1	10:1	10:1
Gear Shaping, Shaving and Hobbing, Form and Thread Milling	20:1	20:1	10:1	10:1
Internal and External Grinding, Form and Thread Grinding	20:1	20:1	20:1	20:1
Stamping	10:1	10:1	5:1	5:1

Notes:

1. Dilution ratios shown are approximate and may require higher or lower water concentrations depending on a number of factors including the type of metal cut, machine speed, the severity of the operation, metal hardness, etc.
2. CITCOOL® 22 is suitable for maching aluminum, magnesium and their alloys (non-staining). CITCOOL® 33 is not recommended for machining aluminum alloys or magnesium (due to possible staining).