



# Metalworking Fluids Solutions Portfolio



# Table of Contents

In many facets of industry, metalworking formulators are solving everyday challenges by leveraging the manufacturing and support expertise of Dow. This guide includes data on Dow's comprehensive portfolio of high quality metalworking fluids available in North America to help formulators select the right product for the challenge at hand. It is organized by function within a metalworking formulation and is further divided by product name to make it easy to find a product ready to meet specific needs.

For additional assistance on finding the right metalworking fluids solution or for additional technical support, please contact a Dow representative.

1. Emulsifiers .....	5
1.1 Nonionic Surfactants .....	5
1.2 Anionic Surfactants .....	9
1.3 Low Foam Surfactants .....	10
2. Base Stocks .....	13
2.1 Water Soluble Base Stocks .....	13
2.2 Water Insoluble Base Stocks .....	15
2.3 Semi-formulated Solutions .....	15
3. Thickeners .....	19
4. Performance Enhancers .....	23
5. Solvents and Coupling Agents .....	27
5.1 The Role of Glycol Ethers in Metalworking Fluid Formulations .....	27
5.2 Alcohols .....	30
6. Amines .....	33
6.1 Ethanolamines .....	33
6.2 Isopropanolamines .....	34
7. Stabilizers/Chelants .....	37

# 1 | Emulsifiers





# 1 | Emulsifiers

With many diverse products across several surfactant chemistries, it's not surprising that Dow surfactants can also be used to formulate effective metalworking fluids. In this application, Dow surfactants serve as:

- Emulsifiers
- Wetting agents
- Corrosion inhibitors
- Hard water stabilizers
- Detergents
- Lubricants

## 1.1 Nonionic Surfactants

### ECOSURF™ Nonionic Surfactants

Dow's innovative line of ECOSURF™ Surfactants is suited for use in a wide range of metalworking fluid applications. The following tables provide an overview of the physical and performance properties to help select the right product for a given application.

The ECOSURF™ EH series of nonionic surfactants is a new generation of high-performance, readily biodegradable specialty surfactants that provide performance equal to alkylphenol ethoxylate (APE) surfactants, and better than primary alcohol ethoxylate (PAE) surfactants in many applications, including hard surface cleaning, textile processing and any

application in which excellent wetting performance is required. ECOSURF™ EH Surfactants have an excellent environmental profile:

- Readily biodegradable: > 60 percent biodegradation within 28 days per Organization for Economic Cooperation and Development (OECD) 301F
- Aquatic toxicity EC50 > 10 mg/L
- Meets the criteria for the U.S. Environmental Protection Agency (EPA) Design for the Environment Surfactant Screen

The ECOSURF™ SA series is a new generation of patent pending, biodegradable, seed oil-based nonionic surfactants. ECOSURF™ SA Surfactants offer outstanding performance across a wide range of parameters including wetting and detergency, as well as excellent formulation and handling properties. These surfactants feature no aqueous gel ranges, rapid dissolution even in cold water, fast foam collapse rates and compatibility with a wide range of solvents.

ECOSURF™ LF Surfactants are non-APE based, low foaming readily biodegradable nonionic surfactants.

**Table 1.** Typical Properties of ECOSURF™ Surfactants Used as Emulsifiers<sup>1</sup>

Product	Cloud Point (°C) <sup>2</sup>	HLB <sup>3</sup>	CMC (PPM) <sup>4</sup> / Surface Tension (Dynes/cm) <sup>5</sup>	Pour Point (°C)	Biodegradable <sup>6</sup>	
ECOSURF™ EH Specialty Ethoxylates	ECOSURF™ EH-3	Dispersible	7.9	480/30	-21	Yes
	ECOSURF™ EH-6	40	10.8	914/30	5	Yes
	ECOSURF™ EH-9	61	12.5	1,066/31	16	Yes
	ECOSURF™ EH-9 (90%)	61	12.5	1,066/31	-5	Yes
	ECOSURF™ EH-14 (90%)	86	14	4,018/32	6	Yes
ECOSURF™ SA Seed Oil Surfactants	ECOSURF™ SA-4	Dispersible	7.5	Dispersible	-8	Yes
	ECOSURF™ SA-7	37	9.7	17/29	3	Yes
	ECOSURF™ SA-9	57	11.1	22/29	4	Yes
	ECOSURF™ SA-15	>100	135	153/34	27	Yes
ECOSURF™ LF Low Foam Surfactants	ECOSURF™ LF-20	20	10	22/30	-22	Yes
	ECOSURF™ LF-30	30	11	26/30	-5	Yes
	ECOSURF™ LF-45	45	12	28/32	6	Yes

<sup>1</sup>Typical properties, not to be construed as specifications.

<sup>2</sup>1 wt% actives aqueous solution

<sup>3</sup>Hydrophilic-lipophilic balance (HLB) range: <10 w/o emulsifier, >10 o/w emulsifier, 10-15 good wetting, 12-15 detergents

<sup>4</sup>Critical micelle concentration (CMC): ppm at 25°C

<sup>5</sup>Dynes/cm at 1% actives, 25°C

<sup>6</sup>Meets definition of OECD 301F

## TERGITOL™ Nonionic Surfactants

TERGITOL™ 15-S Secondary Alcohol Ethoxylates (SAE) are versatile, high-performance nonionic surfactants that provide an unbeatable combination of performance and cost when used in place of primary alcohol ethoxylates (PAEs), nonylphenol ethoxylates (NPEs), octylphenol ethoxylates (OPEs) and other general-purpose surfactants in a wide range of applications.

TERGITOL™ L series surfactants, including TERGITOL™ L Ethylene Oxide/Propylene Oxide (EO/PO) Copolymers, are high-performance, nonionic materials for defoaming, wetting and emulsifying. These readily biodegradable solutions deliver low foam, excellent solvency, chemical stability and reliable formulation performance in a number of applications.

**Table 2.** Typical Properties of TERGITOL™ Nonionic Surfactants Used as Emulsifiers<sup>1</sup>

Product	Cloud Point (°C) <sup>2</sup>	HLB <sup>3</sup>	CMC (PPM) <sup>4</sup> / Surface Tension (Dynes/cm) <sup>5</sup>	Pour Point (°C)	Form <sup>6</sup>	Biodegradable <sup>7</sup>	
TERGITOL™ 15-S SAE Surfactants	TERGITOL™ 15-S-3	Insoluble	8.0	Insoluble	-46	L Pale yellow	Yes
	TERGITOL™ 15-S-5	Dispersible	10.5	Dispersible	-25	L Pale yellow	Yes
	TERGITOL™ 15-S-7	37	12.1	38/30	1	L Pale yellow	Yes
	TERGITOL™ 15-S-9	60	13.3	52/30	9	L Pale yellow	Yes
	TERGITOL™ 15-S-12	89	14.5	104/33	22	S White semi-solid	Yes
	TERGITOL™ 15-S-12 (90%)	89	14.5	107/34	-8	L Pale yellow	Yes
	TERGITOL™ 15-S-15	>100	15.4	162/36	29	S White	Yes
	TERGITOL™ 15-S-20	>100	16.3	315/38	35	S White	Yes
	TERGITOL™ 15-S-20 (80%)	>100	16.3	315/38	6	L Colorless to pale yellow	Yes
	TERGITOL™ 15-S-30	>100	17.4	558/43	39	S White	Yes
	TERGITOL™ 15-S-40	>100	18.0	783/44	43	S White	Yes
	TERGITOL™ 15-S-40 (70%)	>100	18.0	1,314/45	5	L Pale yellow	Yes
TERGITOL™ L EO/PO Copolymers	TERGITOL™ L-61	24	3	-/40	-32	L	Yes
	TERGITOL™ L-62	32	7	-/41	-2	L	Yes
	TERGITOL™ L-64	62	15	-/44	7	L	Yes
	TERGITOL™ L-81	20	2	-/36	-20	L	Yes
	TERGITOL™ L-101	18	1	-/33	-24	L	Yes

<sup>1</sup>Typical properties, not to be construed as specifications.

<sup>2</sup>1 wt% actives aqueous solution

<sup>3</sup>Hydrophilic-lipophilic balance (HLB) range: <10 w/o emulsifier, >10 o/w emulsifier, 10-15 good wetting, 12-15 detergents

<sup>4</sup>Critical micelle concentration (CMC): ppm at 25°C

<sup>5</sup>Dynes/cm at 1% actives, 25°C

<sup>6</sup>Form at 25°C: L = Liquid, S = Solid

<sup>7</sup>Meets definition of OECD 301F

### TERGITOL™ and TRITON™ Specialty Surfactants

TERGITOL™ X Ethylene Oxide/Propylene Oxide (EO/PO) Copolymers are versatile nonionic specialty surfactants that provide excellent stabilizer and dispersant performance for aqueous systems. They are used in conjunction with other surfactants to provide stability and freeze-thaw resistance to emulsions, dispersions and emulsion polymer systems.

TERGITOL™ TMN Branched Secondary Alcohol Ethoxylates (SAE) are highly effective, nonionic wetting agents having low aqueous dynamic and equilibrium surface profiles.

TRITON™ Specialty Alkoxylates are used as emulsifiers, wetting agents or detergents in a number of applications.

**Table 3.** Typical Properties of TERGITOL™ and TRITON™ Specialty Surfactants Used as Emulsifiers <sup>1</sup>

Product		Cloud Point (°C) <sup>2</sup>	HLB <sup>3</sup>	CMC (PPM) <sup>4</sup> / Surface Tension (Dynes/cm) <sup>5</sup>	Pour Point (°C)	Form <sup>6</sup>
TERGITOL™ X EO/ PO Copolymer	TERGITOL™ XD	74	-	-/38	34	S
	TERGITOL™ XDLW	74	-	-/32	15	L
	TERGITOL™ XH	95	-	-/41	40	S
	TERGITOL™ XJ	49	-	-/36	27	S
TERGITOL™ TMN Branched SAE Surfactant	TERGITOL™ TMN-3	Insoluble	8.1	Insoluble	-49	L
	TERGITOL™ TMN-6 (90%)	36	13.1	800/27	<-40	L
	TERGITOL™ TMN-100X (90%)	65	14.0	830/27	-6	L
	TERGITOL™ TMN-10 (90%)	76	14.4	1,313/30	-19	L
TRITON™ Specialty Alkoxylates	TRITON™ CA	Dispersible	10-12	-/32	-20	L
	TRITON™ N-57	Dispersible	10.0	-/31	-28	L
	TRITON™ X-207	Dispersible	10.7	-/32	-14	L
	TRITON™ HW 1000	Insoluble	10.8	Insoluble	-18	L

<sup>1</sup>Typical properties, not to be construed as specifications.

<sup>2</sup>1 wt% actives aqueous solution

<sup>3</sup>Hydrophilic-lipophilic balance (HLB) range: <10 w/o emulsifier, >10 o/w emulsifier, 10-15 good wetting, 12-15 detergents

<sup>4</sup>Critical micelle concentration (CMC): ppm at 25°C

<sup>5</sup>Dynes/cm at 1% actives, 25°C

<sup>6</sup>Form at 25°C: L = Liquid, S = Solid

### TERGITOL™ Castor Oil Ethoxylates

TERGITOL™ Castor Oil Ethoxylates are a new generation of emulsifiers and dispersants that offer excellent lubricity and low aquatic toxicity.

### TRITON™ RW Amine Ethoxylates

TRITON™ RW series surfactants offer unique reversible surfactancy, allowing for easier separation of emulsified oils from aqueous waste streams. They are especially well-suited for industrial laundry applications and deliver exceptional metal cleaning performance.

**Table 4.** Typical Properties of TERGITOL™ Castor Oil Ethoxylates Used as Emulsifiers<sup>1</sup>

Product	Cloud Point (°C) <sup>2</sup>	HLB <sup>3</sup>	CMC (PPM) <sup>4</sup> / Surface Tension (Dynes/cm) <sup>5</sup>	Pour Point (°C)	Biodegradable <sup>6</sup>
TERGITOL™ ECO-20	Dispersible	10	56/40	-30	Yes
TERGITOL™ ECO-36	80	13	50/40	12	Yes
TERGITOL™ ECO-40	80	13	50/40	15	Yes

<sup>1</sup>Typical properties, not to be construed as specifications.

<sup>2</sup>1 wt% actives aqueous solution

<sup>3</sup>Hydrophilic-lipophilic balance (HLB) range: <10 w/o emulsifier, >10 o/w emulsifier, 10-15 good wetting, 12-15 detergents

<sup>4</sup>Critical micelle concentration (CMC): ppm at 25°C

<sup>5</sup>Dynes/cm at 1% actives, 25°C

<sup>6</sup>Meets definition of OECD 301F

**Table 5.** Typical Properties of TRITON™ RW Amine Ethoxylates Used as Emulsifiers<sup>1</sup>

Product	Cloud Point (°C) <sup>2</sup>	HLB <sup>3</sup>	CMC (PPM) <sup>4</sup> / Surface Tension (Dynes/cm) <sup>5</sup>	Pour Point (°C)	Form <sup>6</sup>
TRITON™ RW-20	Insoluble	6-8	Insoluble	<-6	L
TRITON™ RW-50	-	12-14	260/29 pH = 12 -/51 pH = 2	<-6	L
TRITON™ RW-150	-	>16	860/30 pH = 12 -/54 pH = 2	11	L

<sup>1</sup>Typical properties, not to be construed as specifications.

<sup>2</sup>1 wt% actives aqueous solution

<sup>3</sup>Hydrophilic-lipophilic balance (HLB) range: <10 w/o emulsifier, >10 o/w emulsifier, 10-15 good wetting, 12-15 detergents

<sup>4</sup>Critical micelle concentration (CMC): ppm at 25°C

<sup>5</sup>Dynes/cm at 1% actives, 25°C

<sup>6</sup>Form at 25°C: L = Liquid, S = Solid



## 1.2 Anionic Surfactants

### DOWFAX™ Alkyldiphenyloxide Disulfonate Salts

DOWFAX™ surfactants are an excellent choice for formulations containing acids, bleach or caustic. They offer excellent solubility and stability in concentrated electrolyte, and are remarkably resistant to oxidative and thermal degradation.

### TRITON™ Anionic Surfactants

The TRITON™ GR series of surfactants features excellent wetting and rewetting properties as well as excellent emulsifying and dispersing ability. These versatile surfactants are available in a range of solvent compatibilities for use in many applications.

**Table 6.** Typical Properties of DOWFAX™ and TRITON™ Anionic Surfactants Used as Emulsifiers <sup>1</sup>

Product	Actives	Diluent	Form <sup>2</sup>	Surface Tension (Dynes/cm) <sup>3</sup>		
				Neutral <sup>4</sup>	Alkaline <sup>5</sup>	
DOWFAX™ Alkyldiphenyloxide Disulfonate Salts	DOWFAX™ 2A1	45	Water	L Amber	34	35
	DOWFAX™ 3B2	45	Water	L Yellow/light brown	37	38
	DOWFAX™ 8390	35	Water	L Light brown	44	46
	DOWFAX™ C6L	45	Water	L Light brown	34	34
	DOWFAX™ C10L	45	Water	L Yellow/brown	35	37
	DOWFAX™ 30599	45	Water	L Yellow/brown	33	34
TRITON™ GR Dioctyl Sulfosuccinates	TRITON™ GR-5M	60	IPA/water	L Colorless	26	NR <sup>6</sup>
	TRITON™ GR-7M	64	Petroleum distillate <sup>7</sup>	L Amber	Insoluble	Insoluble
TRITON™ Phosphate Esters	TRITON™ H-55	50	Water	L Amber	45	53
	TRITON™ H-66	50	Water	L Yellow	45	41
	TRITON™ QS-44	80	Water	L Amber	38	39
	TRITON™ XQS-20	70	Water	L Amber	46	46
TRITON™ Sulfates	TRITON™ QS-15	100	None	L Amber	33	36
	TRITON™ XN-45S	60	Ethanol/water	L Amber	33	32

<sup>1</sup>Typical properties, not to be construed as specifications.

<sup>2</sup>1 wt% actives aqueous solution

<sup>3</sup>Dynes/cm at 1 wt% actives, 25°C

<sup>4</sup>Actual pH = 7 (distilled water)

<sup>5</sup>Actual pH = 12.5 (sodium hydroxide solution)

<sup>6</sup>Not recommended; can hydrolyze under some alkaline conditions

<sup>7</sup>Blend of ethanol, naphtha, propylene glycol and naphthalene

## 1.3 Low Foam Surfactants

### TRITON™ and TERGITOL™ Low Foam Surfactants

Low foam surfactants from Dow include specialty products used in applications where low- to no-foam performance is required. These solutions provide excellent detergency and wetting properties as well as caustic and acid stability.

**Table 7.** Typical Properties of TERGITOL™ Castor Oil Ethoxylates Used as Emulsifiers<sup>1</sup>

Product	Active Ingredient (wt%)	Cloud Point (1% Aq, °C [°F])	HLB <sup>2</sup> (Calculated)	Surface Tension (Dynes/cm) <sup>3</sup>	CMC (PPM) <sup>4</sup>	Viscosity <sup>5</sup>	Pour Point (°C) <sup>6</sup>
TRITON™ CF-10/ CF-10 (90%)	100	28 (82)	12.6	36	75	250	15/-1
TRITON™ CF-21	100	40 (104)	12.9	32	130	250	-27
TRITON™ CF-32	95	25 (77)	11	37	-	550	2
TRITON™ CF-76	100	31 (88)	12.6	33	25	295	7
TRITON™ CF-87	90	32 (90)	12.7	34	80	240	0
TRITON™ DF-12 <sup>7</sup>	100	17 (63)	10.6	34	290	60	16
TRITON™ DF-16 <sup>7</sup>	100	36 (97)	11.6	30	530	35	-6
TRITON™ DF-20 <sup>7</sup>	100	-	-	30	180	630	-25
TERGITOL™ MinFoam 2X	100	21	12.1	31	24	56	< -40
TERGITOL™ MinFoam 1X	100	40	12.6	30	34	61	-34

<sup>1</sup>Typical properties, not to be construed as specifications.

<sup>2</sup>Hydrophilic-lipophilic balance (HLB)

<sup>3</sup>Dynes/cm at 1% actives, 25°C

<sup>4</sup>Critical micelle concentration (CMC): ppm at 25°C

<sup>5</sup>25°C (77°F), cP

<sup>6</sup>ASTM D97, °C (°F)

<sup>7</sup>Biodegradable; meets definition of OECD 301F

2 | Base Stocks





## 2 | Base Stocks

The base stocks offered by Dow are produced by polymerizing ethylene oxide (EO) and/or propylene oxide (PO). The ratio and order of the oxide addition, together with the choice of initiator and the molecular weight, determine the chemical and physical properties of the final polyalkylene glycol (PAG). The Dow product line includes a diverse range of PAGs, including base fluids or additives for homopolymers and random copolymers designed from mono-, di- or multi-functional initiators. These PAGs are excellent synthetic lubricants.

The performance of these products can be improved by incorporating anti-wear and extreme pressure additives. Rust inhibitors can be used to provide residual corrosion protection, while oxidation inhibitors can also be used to provide oxidation stability.

### 2.1 Water Soluble Base Stocks

Water soluble UCON™ Fluids and Lubricants and SYNALOX™ Lubricant Base Stocks are random copolymers of EO and PO.

#### UCON™ Fluids and Lubricants

Water soluble UCON™ Fluids and Lubricants are available for use as components in metalworking fluids, or they can be used as base stocks. Water soluble base stocks are preferred in water soluble synthetic cutting fluids for grinding or tube drawing for ferrous and non-ferrous applications. With several water soluble base stocks in Dow's product line, choosing the right fluid can be a challenge. The following tables are intended to help simplify the selection process.

**Table 8.** Typical Properties of UCON™ Fluids and Lubricants Used as Water Soluble Base Stocks<sup>1</sup>

Product	Viscosity (cSt)		Cloud Point (1% Aq, °C)	Average Molecular Weight (g/mol)
	40°C (104°F)	100°C (212°F)		
Test Method	ASTM D445/446	ASTM D2024		
UCON™ 50-HB-55, inhibited	8.3	2.4	-	270
UCON™ 50-HB-100	19	4.6	-	520
UCON™ 50-170	33	7.5	71	750
UCON™ 50-260	53	11.1	65	970
UCON™ 50-400	81	16.3	-	1,230
UCON™ 50-660	130	25.6	58	1,590
UCON™ 50-450	60	19.6	-	980
UCON™ 75-1400	290	41.5	-	2,470
UCON™ 75-9500	1,800	250	-	6,950
UCON™ 75-90,000	17,000	2,545	-	12,000

<sup>1</sup>Typical properties, not to be construed as specifications.

### SYNALOX™ Water Soluble Lubricant Base Stocks

This family of PAGs is soluble in cold water but exhibits inverse solubility at high temperatures (cloud point). Waterbased solutions provide low surface tension, good wetting and good penetration characteristics, while also exhibiting low foaming properties. Dow offers an extensive range of SYNALOX™ Water Soluble Lubricant Base Stocks in viscosities ranging from ISOVG 22 to 1,000.

### CARBOWAX™ PEGs

These polyethylene glycols (PEGs) are liquid, water soluble polymers. These materials are useful in tube drawing and other applications.

**Table 9.** Typical Properties of SYNALOX™ Water Soluble Lubricant Base Stocks Used as Water Soluble Base Stocks<sup>1</sup>

Product	Viscosity (cSt)		Cloud Point (1% Aq, °C)	Pour Point (°C)	Molecular Weight (g/mol)	Regional Availability
	40°C (104°F)	100°C (212°F)				
Test Method	ASTM D445/446	ASTM D2024				
SYNALOX™ 40-D50	68	13	> 100	-40	900	U.S.
SYNALOX™ 40-D100	150	26	> 100	-39	1,700	U.S.
SYNALOX™ 40-D150	220	39	8	-38	1,900	Canada, U.S.
SYNALOX™ 40-D220	320	58	85	-36	2,500	U.S.
SYNALOX™ 40-D300	460	78	80	-35	3,400	Mexico, U.S.
SYNALOX™ 40-D700	1,050	178	70	-31	5,300	Mexico, U.S.
SYNALOX™ 50-30B	50	11	63	-45	1,000	U.S.
SYNALOX™ 55-70B	100	20	56	-32	1,600	U.S.
SYNALOX™ 50-100B	140	27	56	-30	1,900	U.S.

<sup>1</sup>Typical properties, not to be construed as specifications.

**Table 10.** Typical Properties of CARBOWAX™ PEGs Used as Water Soluble Base Stocks<sup>1</sup>

Product	Form	Molecular Weight (g/mol)	Density		Melting or Freezing Range (°C)	Solubility in Water at 20°C, % by weight	Viscosity at 100°C (cSt)
			20°C	60°C			
CARBOWAX™ PEG 200	Liquid	190 - 210	1.1238	1.0921	Sets to glass below -65	Complete	4.3
CARBOWAX™ PEG 300	Liquid	285 - 315	1.1249	1.0927	-15 to -8	Complete	5.8
CARBOWAX™ PEG 400	Liquid	380 - 420	1.1255	1.0931	4 to 8	Complete	7.3

<sup>1</sup>Typical properties, not to be construed as specifications.

## 2.2 Water Insoluble Base Stocks

Water insoluble base stocks are homopolymers of propylene oxide (PO). They are available for use as fluids and lubricants without modification, or they can be used as base stocks for lubricant formulation. Water insoluble base stocks are a good choice when the lubricant may be exposed to natural oils, organic solvents, plasticizers, resins or gums.

## 2.3 Semi-formulated Solutions

A selection of unique polymers and semi-formulated metalworking fluids are also available for use as components for formulating water soluble cutting and grinding fluids as well as in forming operations, such as drawing, stamping and rolling. They can be used alone or in combination with extreme-pressure additives. UCON™ metalworking fluids feature inverse solubility (i.e., they become less soluble in water as the temperature of the solution increases). When in contact with a hot tool or workpiece, the fluid comes out of the solution and coats the metal surfaces with a polymer film, helping to improve tool life.

**Table 11.** Typical Properties of UCON™ Fluids and Lubricants and SYNALOX™ Lubricant Base Stocks Used as Water Insoluble Base Stocks<sup>1</sup>

Product	Viscosity (cSt)		Pour Point (°C)	Cloud Point (1% Aq, °C)	Molecular Weight (g/mol)
	40°C (104°F)	100°C (212°F)			
Test Method	ASTM D445/446		ASTM D97	ASTM D2024	ASTM D97
UCON™ LB-65	11	2.7	-57	25	340
UCON™ LB-135	28	5.7	-48	-	640
UCON™ LB-165	34	6.7	-46	-	740
UCON™ LB-250	50	9.9	-51	-	1,100
UCON™ LB-285	61	10.8	-40	15	1,020
UCON™ LB-385	80	14	-37	-	1,200
UCON™ LB-525	100	18.4	-34	-	1,420
UCON™ LB-625	120	21.4	-32	10	1,550
UCON™ LB-1145	230	36.9	-29	-	2,080
UCON™ LB-1715	370	51.9	-23	8	2,490
SYNALOX™ 100-20B	30	6	-44	18	700
SYNALOX™ 100-50B	72	14	-35	10	1,300

<sup>1</sup>Typical properties, not to be construed as specifications.

**Table 12.** Typical Properties of UCON™ Fluids and Lubricants Unique Polymers and Solutions<sup>1</sup>

Product	Viscosity (cSt)	Specific Gravity (20/20°C)	Product Composition
Test Method	ASTM D445/446		
UCON™ EPML-577	28.-38.9 <sup>2</sup>	1086	Acid grafted polymer
UCON™ EPML-483	2,000-3,500 <sup>3</sup>	1083	Acid grafted polymer
UCON™ EPML-X	4,000-3,800 <sup>3</sup>	1116	Semi-formulated fluid containing acid grafted polymer
UCON™ MWL-2	155-190 <sup>4</sup>	1028 <sup>5</sup>	Base fluid

<sup>1</sup>Typical properties, not to be construed as specifications.

<sup>2</sup>25°C

<sup>3</sup>37.8°C

<sup>4</sup>40°C

<sup>5</sup>25°C/25°C





### 3 | Thickeners





## 3 | Thickeners

UCON™ 75-H Series Fluids and Lubricants are diol-initiated base stocks containing 75 weight percent oxyethylene and 25 percent oxypropylene groups along with two terminal hydroxyl groups. They are water soluble at temperatures below 75°C and are available in a variety of molecular weights and viscosities. UCON™ 75-H series products enable exceptional lubricity and cleanliness in many lubricant applications, including textile fiber lubricants, water glycol hydraulic fluids, quenchant and metalworking fluids.



**Table 13.** Typical Properties of UCON™ 75-H Series Fluids and Lubricants Used as Thickeners<sup>1</sup>

Product	Water Content (wt%)	Viscosity (cSt)	
		40°C	50°C
Test Method		ASTM D445/446	
UCON™ 75-90,000	0.30 max	17,000	12,300
UCON™ 75-90,000 AQ	28-32	2,410	1,630
UCON™ 75-90,000 AQ 40%	39-41	1,140	750
UCON™ 75-380,000 AQ	28-32	8,800	6,000
UCON™ 75-280,000 AQ 40%	39-41	2,600	1,800
UCON™ 75-280,000 AQ 44%	43-45	1,700	1,300
UCON™ 75-380,000 AQ 20%	18.5-21.5	22,000	15,000
UCON™ 75-380,000 AQ 40%	39-41	4,000	2,500

<sup>1</sup>Typical properties, not to be construed as specifications.



4 | Performance Enhancers





## 4 | Performance Enhancers

Dow's oil soluble polyalkylene glycols (PAGs) are copolymers of butylene oxide (BO) and propylene oxide (PO), and homopolymers of BO. They can be used as a base oil in neat oils or as lubricity additives in semi-synthetic or soluble oils. Formulators have also experienced success using them as antifoams.



**Table 14.** Typical Properties of UCON™ Fluids and Lubricants Used as Performance Enhancers<sup>1</sup>

Product	Viscosity (cSt)		Viscosity Index (VI)	Pour Point (°C)	Flash Point (°C)
	40°C	50°C			
Test Method: ASTM D445/446					
UCON™ OSP-18 <sup>2</sup>	18	4	123	-41	204
UCON™ OSP-32 <sup>2</sup>	32	6.5	146	-57	216
UCON™ OSP-46	46	8.5	164	-57	216
UCON™ OSP-68	68	12	171	-53	218
UCON™ OSP-680	680	77	196	-30	243

<sup>1</sup>Typical properties, not to be construed as specifications.





## 5 | Solvents and Coupling Agents





## 5 | Solvents and Coupling Agents

As a solvent provider for more than 100 years, Dow continues develop differentiated solutions that help metalworking fluid formulators stay ahead of changing environmental regulations, maintain low cost to serve and compete in a fast-changing business environment. The Company offers a large portfolio of solvents, including a wide selection of alcohols, esters, ketones and ethylene and propylene-based glycol ethers.

### 5.1 The Role of Glycol Ethers in Metalworking Fluid Formulations

Due to the hydrophilic-lipophilic nature inherent in their chemical structure, glycol ethers are able to facilitate the formulation of clear, homogeneous fluids by coupling water-oil mixtures in relatively low concentrations. Glycol ethers are also good degreasers with the ability to provide cleaning power. They reduce the surface tension of aqueous solutions, improving wetting and disrupting foam formation, and are stable across a wide pH range.

Several glycol ethers from Dow have been evaluated as components for soluble oil and semi-synthetic metalworking fluid formulations. These materials have been found useful in the development of homogeneous, stable fluids that suppress foaming and do not have a negative effect on pH or corrosion inhibition. In addition, most glycol ethers are biodegradable, which makes them well suited for water-based formulations that may ultimately be processed through a waste water treatment facility.



**Table 15. Typical Properties of P-Series Glycol Ethers from Dow Used as Solvents and Coupling Agents<sup>1</sup>**

Product	Chemical Nomenclature	Molecular Weight (g/mol)	Boiling Point (°C) <sup>2</sup>	Flash Point (°C)	Evaporation Rate <sup>3</sup>	Specific Gravity <sup>4</sup>	Viscosity (cP) <sup>5</sup>	Vapor Pressure (mm Hg) <sup>6</sup>	Surface Tension (Dynes/cm) <sup>7</sup>	Hansen Solubility Parameters (Joules/cm <sup>3</sup> ) <sup>1/2</sup>			Solubility (wt%) <sup>8</sup>		
										Dispersion	Polar	H Bonding	Solvent in Water	Water in Solvent	
P-Series	DOWANOL™ PM Glycol Ether	Propylene Glycol Methyl Ether	90.1	120	31 <sup>9</sup>	0.62	0.919	1.7	8.7	27.7	15.6	7.2	13.6	Miscible	Miscible
	DOWANOL™ PnP Glycol Ether	Propylene Glycol n-Propyl Ether	118.2	149	48 <sup>9</sup>	0.21	0.883	2.4	1.5	25.4	15.3	4.9	4435	Miscible	Miscible
	DOWANOL™ PMA Glycol Ether	Propylene Glycol Methyl Ether Acetate	132.2	146	42 <sup>10</sup>	0.33	0.966	1.1	2.8	28.9	15.6	5.6	9.8	16	3
	DOWANOL™ PnB Glycol Ether	Propylene Glycol n-Butyl Ether	132.2	171	63 <sup>9</sup>	0.093	0.878	2.8	0.85	27.5	15.2	4.2	10.5	5.5	15.5
	DOWANOL™ DPM Glycol Ether	Dipropylene Glycol Methyl Ether	148.2	190	75 <sup>9</sup>	0.035	0.951	3.7	0.28	28.8	15.5	4	10.3	Miscible	Miscible
	DOWANOL™ PPh Glycol Ether	Propylene Glycol Phenyl Ether	152.2	243	120 <sup>9</sup>	0.002	1.062	25.2	0.01	38.1	17.4	5.3	11.5	1	6
	DOWANOL™ PGDA Glycol Ether	Propylene Glycol Diacetate	160	191	86 <sup>10</sup>	0.039	1.056	2.6	0.23	32.5	15.8	3.5	8.8	7.4	4.1
	PROGLYDE™ DMM Glycol Ether	Dipropylene Glycol Dimethyl Ether	162.2	175	65 <sup>9</sup>	0.13	0.902	1	0.55	26.3	14.9	2.1	3.8	35	4.5
	DOWANOL™ DPnP Glycol Ether	Dipropylene Glycol n-Propyl Ether	176.2	213	88 <sup>9</sup>	0.014	0.919	3.9	0.08	27.8	15	2.9	9.2	19.6	20.3
	DOWANOL™ DPMA Glycol Ether	Dipropylene Glycol Methyl Ether Acetate	190.2	209	86 <sup>10</sup>	0.015	0.977	1.7	0.03	27.3	16.3	4.9	8	16	3.5
	DOWANOL™ DPnB Glycol Ether	Dipropylene Glycol n-Butyl Ether	190.3	230	100 <sup>9</sup>	0.006	0.91	4.9	0.04	28.4	14.8	2.5	8.7	4.5	12
	DOWANOL™ TPM Glycol Ether	Tripropylene Glycol Methyl Ether	206.3	243	121 <sup>10</sup>	0.003	0.965	5.5	0.01	30	15.1	2.5	8.7	Miscible	Miscible
	DOWANOL™ TPnB Glycol Ether	Tripropylene Glycol n-Butyl Ether	248.4	274	126 <sup>9</sup>	0.0004	0.93	7	0.002	29.7	14.8	1.7	7.9	4.5	8

<sup>1</sup>Typical properties, not to be construed as specifications.

<sup>2</sup>°C at 760 mm Hg

<sup>3</sup>nBuAc = 1

<sup>4</sup>20/20°C

<sup>5</sup>cP at 20°C

<sup>6</sup>mm Hg at 20°C

<sup>7</sup>Dynes/cm at 20°C

<sup>8</sup>wt% at 20°C

<sup>9</sup>Setaflash Method (closed cup)

<sup>10</sup>Tag Closed Cup (TCC)

**Table 16.** Typical Properties of E-Series Glycol Ethers from Dow Used as Solvents and Coupling Agents<sup>1</sup>

Product	Chemical Nomenclature	Molecular Weight (g/mol)	Boiling Point (°C) <sup>2</sup>	Flash Point (°C)	Evaporation Rate <sup>3</sup>	Specific Gravity <sup>4</sup>	Viscosity (cP) <sup>5</sup>	Vapor Pressure (mm Hg) <sup>6</sup>	Surface Tension (Dynes/cm) <sup>7</sup>	Hansen Solubility Parameters (Joules/cm <sup>3</sup> ) <sup>1/2</sup>			Solubility (wt%) <sup>8</sup>		
										Dispersion	Polar	H Bonding	Solvent in Water	Water in Solvent	
E-Series	Propyl CELLOSOLVE™ Solvent	Ethylene Glycol Propyl Ether	104.2	151.3	51 <sup>9</sup>	0.2	0.91	2.7	1.77	26.3	16.1	8	13.1	Miscible	Miscible
	Butyl CELLOSOLVE™ Solvent	Ethylene Glycol n-Butyl Ether	118.2	170.7	65 <sup>10</sup>	0.079	0.901	2.9	0.66	27.4	16	7.6	12.3	Miscible	Miscible
	Methyl CARBITOL™ Solvent	Diethylene Glycol Methyl Ether	120.1	194.1	92 <sup>10</sup>	0.019	1.02	3.5	0.23	32.5	16.2	7.8	12.6	Miscible	Miscible
	CARBITOL™ Solvent	Diethylene Glycol Ethyl Ether	134.2	202	102 <sup>10</sup>	0.01	0.989	3.6	0.09	21.8	16.1	9.2	12.2	Miscible	Miscible
	DOWANOL™ EPh Glycol Ether	Ethylene Glycol Phenyl Ether	138.2	244	121 <sup>9</sup>	0.001	1.109	21.5	0.004	42	17.8	5.7	14.3	2.5	9
	Hexyl CELLOSOLVE™ Solvent	Ethylene Glycol Hexyl Ether	146.2	208	91 <sup>10</sup>	< 0.01	0.866	4.5	0.04	27.7	16	6.9	10.9	0.88	17.7
	Butyl CELLOSOLVE™ Acetate	Ethylene Glycol n-Butyl Ether Acetate	160.21	192	71 <sup>10</sup>	0.04	0.941	1.6	0.38	27.4	16	4.5	8.8	1.6	1.8
	Butyl CARBITOL™ Solvent	Diethylene Glycol n-Butyl Ether	162.2	230.4	99 <sup>10</sup>	0.004	0.951	4.9	0.028	30	16	7	10.6	Miscible	Miscible
	Hexyl CARBITOL™ Solvent	Diethylene Glycol Hexyl Ether	190.3	259.1	135 <sup>10</sup>	< 0.01	0.931	6.2	0.001	29.2	16	6	10	2	53.4
	Butyl CARBITOL™ Acetate	Diethylene Glycol n-Butyl Ether Acetate	204.3	245.3	102 <sup>10</sup>	< 0.01	0.978	4.5	< 0.01	30	16	4.1	8.2	4	3.4

<sup>1</sup>Typical properties, not to be construed as specifications.

<sup>2</sup>°C at 760 mm Hg

<sup>3</sup>nBuAc = 1

<sup>4</sup>20/20°C

<sup>5</sup>cP at 20°C

<sup>6</sup>mm Hg at 20°C

<sup>7</sup>Dynes/cm at 20°C

<sup>8</sup>wt% at 20°C

<sup>9</sup>Setaflash Method (closed cup)

<sup>10</sup>Tag Closed Cup (TCC)

## 5.2 Alcohols

The Dow portfolio includes alcohols ranging from two to twelve carbon atoms. A single hydroxyl group characterizes them, and performance is largely controlled by the related hydrocarbon structure. These alcohols help provide the proper balance of desired properties in a formulation.

**Table 17.** Typical Properties of Alcohols from Dow Used as Solvents and Coupling Agents<sup>1</sup>

Product	Molecular Weight (g/mol)	Boiling Point (°C) <sup>2</sup>	Flash Point (°C)	Evaporation Rate <sup>3</sup>	Specific Gravity <sup>4</sup>	Viscosity (cP) <sup>5</sup>	Vapor Pressure (mm Hg) <sup>6</sup>	Surface Tension (Dynes/cm) <sup>7</sup>	Hansen Solubility Parameters (Joules/cm <sup>3</sup> ) <sup>1/2</sup>			Solubility (wt%) <sup>8</sup>	
									Dispersion	Polar	H Bonding	Solvent in Water	Water in Solvent
n-Propanol	60.1	97	23	0.87	0.816	2.2	15.2	23.28	16	6.8	17.4	Miscible	Miscible
Isopropanol	60.1	82	12	1.11	0.787	2.4	33.1	21.4	15.8	6.1	16.4	Miscible	Miscible
n-Butanol	74.1	118	35	0.44	0.81	3	4.9	24.8	16	5.7	15.8	7.7	20.1
Isobutanol	74.1	108	28	0.63	0.802	4	8.1	23	15.1	5.7	15.9	8.5	15
n-Pentanol	88.2	138	48	0.3	0.816	4	1.4	25.7	15.9	4.5	13.9	2	9.5
Primary Amyl Alcohol Mixed Isomers	88.2	133	45	0.3	0.815	4.3	2.2	23.7	15.9	4.7	14	1.7	9.2
2-Methyl Butanol	88.2	127	45	0.5	0.818	5	3.8	25.7	16	5.1	14.3	2.2	8.3
2-Ethylhexanol	130.2	185	72	0.02	0.833	10.3	0.1	26.9	15.9	3.3	11.8	0.07	2.6
Methyl Isobutyl Carbinol	102.2	132	41	0.27	0.807	5.2	3.7	23	15.4	3.3	12.3	1.7	6.2
Diisobutyl Carbinol	144.3	178	65	0.02	0.811	15.4	0.1	26	14.9	3.1	10.8	0.06	1

<sup>1</sup>Typical properties, not to be construed as specifications.

<sup>2</sup>°C at 760 mm Hg

<sup>3</sup>nBuAc = 1

<sup>4</sup>20/20°C

<sup>5</sup>cP at 20°C

<sup>6</sup>mm Hg at 20°C

<sup>7</sup>Dynes/cm at 20°C

<sup>8</sup>wt% at 20°C

## 6 | Amines







# 6 | Performance Enhancers

## 6.1 Ethanol

The versatile family of ethanolamines from Dow, including monoethanolamine (MEA), diethanolamine (DEA), N-Methyldiethanolamine (MDEA) and triethanolamine (TEA), offers a broad spectrum of application opportunities. Triethanolamine is available as TEA 99%, TEA Commercial (which contains nominally 15 percent diethanolamine) and TEA 85 LFG (which contains nominally 15 percent water). Because ethanolamines combine the properties of amines and alcohols, they exhibit the unique capability of undergoing reactions common to both groups. As amines, they are mildly alkaline and react with acids to form salts or soaps. As alcohols, they are hygroscopic and can be esterified.

### Ethanolamines for Metalworking Fluids

Acidic additives and/or acidic decomposition products are the prime contributors to corrosion of metal surfaces, particularly in the presence of moisture. Ethanolamines are often used as neutralizers of acidic components and pH buffers in lubricants and are a time-tested means of preventing corrosion.

In water soluble cutting and grinding fluids, ethanolamines are used to provide the alkalinity needed to protect against rusting (ferrous metals do not oxidize under alkaline conditions). Ethanolamines are also used as intermediates in the preparation of water soluble lubricants, emulsifiers, proprietary corrosion inhibitors and biocides.



**Table 18.** Typical Properties of Ethanolamines from Dow Used in Metalworking Fluids<sup>1</sup>

Product	Chemical Nomenclature	Amine Number (mg KOH/g)	Absolute Viscosity (cP) <sup>2</sup>	Solubility in Water <sup>3</sup>	Vapor Pressure (mm Hg) <sup>4</sup>	Freezing Point (°C)	Boiling Point (°C) <sup>5</sup>
MEA	Monoethanolamine	918	24.1	Complete	< 1	10	171
DEA <sup>6</sup>	Diethanolamine	534	-	Complete	< 0.01	28	268 or 259
TEA	Triethanolamine	376	921	Complete	< 0.001	21	335
TEA COM <sup>6</sup>	Triethanolamine, Commercial	400	-	Complete	< 0.01	15.8	310.3
MDEA	N-Methyldiethanolamine	471	101	Complete	0.004	-21	243.3

<sup>1</sup>Typical properties, not to be construed as specifications.

<sup>2</sup>cP at 20°C

<sup>3</sup>wt% at 20°C

<sup>4</sup>mm Hg at 20°C

<sup>5</sup>°C at 760 mm Hg

<sup>6</sup>These products contain secondary amines in a concentration above 0.5% (w/w). In some countries, the application of these products is prohibited due to the secondary amine content. Follow local regulations when using these products.

## 6.2 Isopropanolamines

Isopropanolamines are basic chemicals that are used in many applications to achieve basicity, buffering and alkalinity objectives. Because they are good solubilizers of oil and fat, they are frequently used to neutralize fatty acids and sulfonic acid-based surfactants.

### Isopropanolamines for Metalworking Fluids

Dow offers various grades of MIPA (monoisopropanolamine), DIPA (diisopropanolamine) and TIPA (triisopropanolamine) for use in an array of metalworking fluid applications. Isopropanolamines and compounds made with isopropanolamines can be used to provide corrosion protection, improved lubricity, foam suppression, reduced friction and/or pH control in metal cutting applications.

**Table 19.** Typical Properties of Isopropanolamines from Dow Used in Metalworking Fluids<sup>1</sup>

Product	Chemical Nomenclature	Amine Number (mg KOH/g)	Absolute Viscosity (cP) <sup>2</sup>	Solubility in Water <sup>3</sup>	Vapor Pressure (mm Hg) <sup>4</sup>	Freezing Point (°C)	Boiling Point (°C) <sup>5</sup>
MIPA	Monoisopropanolamine	747	23	Completely miscible	0.53 <sup>5</sup>	3	159
DIPA <sup>6</sup>	Diisopropanolamine	421	870 <sup>7</sup>	1,200	0.035 <sup>8</sup>	44	249
TIPA	Triisopropanolamine	293	-	> 500	0.004 <sup>9</sup>	44	306

<sup>1</sup>Typical properties, not to be construed as specifications.

<sup>2</sup>cP at 25°C

<sup>3</sup>g/100 g, 25°C

<sup>4</sup>at 760 mm Hg

<sup>5</sup>20°C

<sup>6</sup>These products contain secondary amines in a concentration above 0.5% (w/w). In some countries, the application of these products is prohibited due to the secondary amine content. Follow local regulations when using these products.

<sup>7</sup>30°C

<sup>8</sup>50°C

<sup>9</sup>60°C

## 7 | Stabilizers/Chelants





## 7 | Stabilizers/Chelants

Chelating agents from Dow can effectively control metal ions in a broad range of applications. They are available in four chemistries to enable differing degrees of purity, as well as options of physical and salt form. These materials provide flexibility to address a wide variety of specific conditions, are suitable for both wet and dry applications and can be used to target particular problem metals or specific pH requirements.

VERSENE™ Chelating Agents are employed extensively in metalworking, from the preparation and cleaning of metal surfaces to final finishing and plating operations. They can be used to prepare metal surfaces for plating; clean oxides from iron, copper and brass and to prevent streaking after pickling. These versatile products are also used in plating baths to provide effective control of contaminating metal ions, in electrolyte formulations for conventional and immersion metal plating and in electroless plating of circuit boards. In addition, VERSENE™ 100 Chelating Agent has been shown to enhance the antimicrobial activity of preservatives in metalworking fluids.



**Table 20.** Typical Properties of Chelating Agents from Dow Used as Stabilizers<sup>1</sup>

Product	Active Ingredient	Calcium (CaCO <sub>3</sub> ) Chelation Value per Gram of Product	Metal Chelation Capacity: Parts Chelant per Part Metal (W/W)					Appearance	pH <sup>2</sup>	Freezing Point (°C)	Viscosity (cSt) <sup>3</sup>	Water Solubility
			CA	MG	FE	AL	MN					
VERSENE™ 80	Pentasodium diethylenetriaminepentaacetate	80	31.2	51.5	22.4	46.4	22.8	Light, strawcolored liquid	-28	33	33	Completely miscible
VERSENE™ 100	Tetrasodium ethylenediaminetetraacetate	25	25	41.2	17.9	36.1	18.2	Amber, light	-25	20	20	Completely miscible
VERSENE™ 120	Trisodium N-(hydroxyethyl)-ethylenediaminetriacetate	20.8	20.8	34.3	14.9	30.9	15.2	Light, strawcolored liquid	-25	27	27	Completely miscible

<sup>1</sup>Typical properties, not to be construed as specifications.

<sup>2</sup>1 wt% solution

<sup>3</sup>cSt at 20°C (68°F)

## About Dow

Dow (NYSE: DOW) is one of the world's leading materials science companies, serving customers in high-growth markets such as packaging, infrastructure, mobility and consumer applications. Our global breadth, asset integration and scale, focused innovation, leading business positions and commitment to sustainability enable us to achieve profitable growth and help deliver a sustainable future. We operate manufacturing sites in 31 countries and employ approximately 35,900 people. Dow delivered sales of approximately \$45 billion in 2023. References to Dow or the Company mean Dow Inc. and its subsidiaries. Learn more about us and our ambition to be the most innovative, customer-centric, inclusive and sustainable materials science company in the world by visiting [www.dow.com](http://www.dow.com).

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