

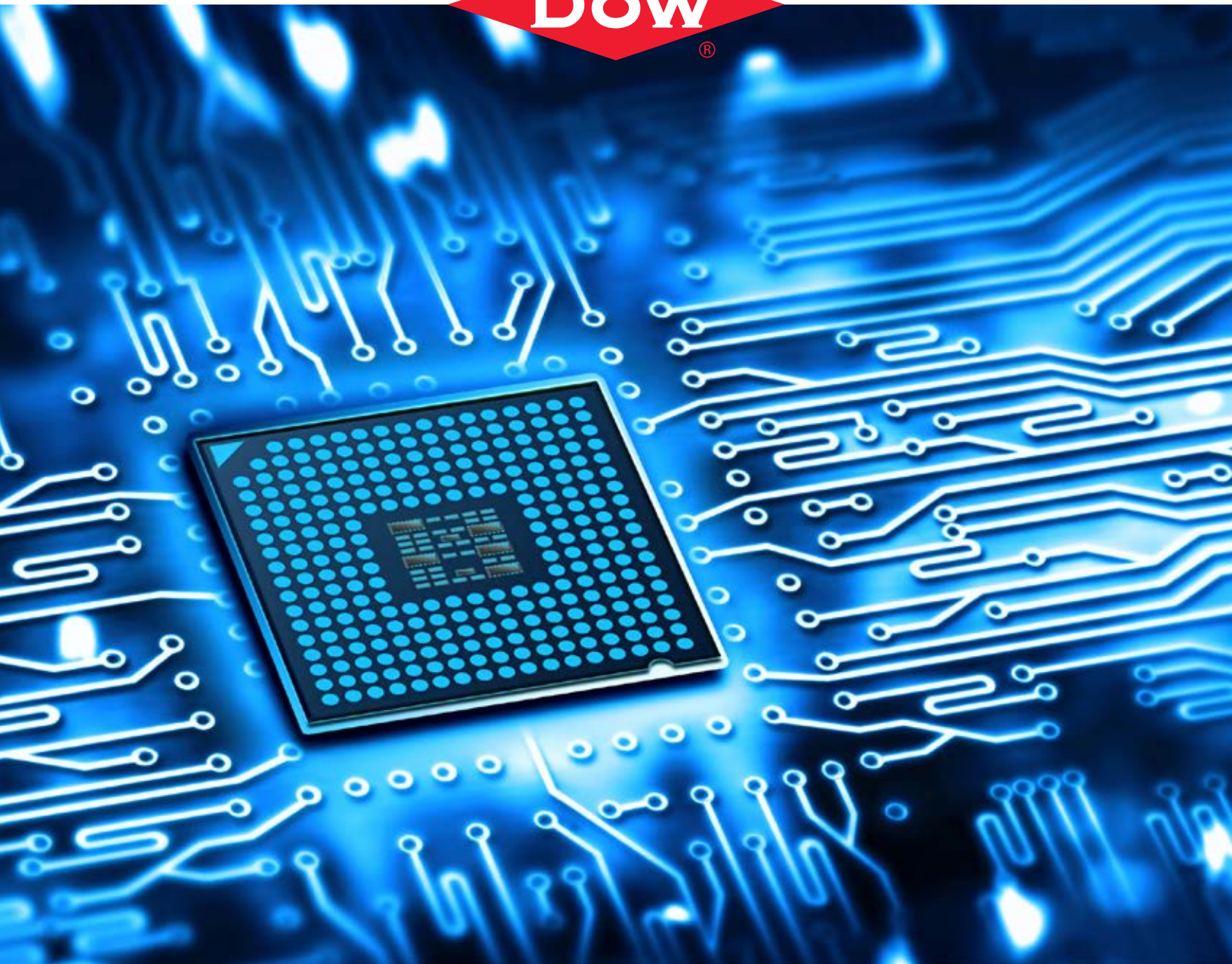
ELECTRONICS

Dow Industrial Solutions

# Enable electronics processing

**DOW**

®



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**“If we can’t do it better  
than others, why do it?”**

Herbert H. Dow  
(1866-1930)





# Dow Chemical

The Dow Chemical Company (Dow) combines science and technology knowledge to develop premier materials science solutions that are essential to human progress. Dow has one of the strongest and broadest toolkits in the industry, with robust technology, asset integration, scale and competitive capabilities that enable it to address complex global issues. Dow's market-driven, industry-leading portfolio of advanced materials, industrial intermediates, and plastics businesses deliver a broad range of differentiated technology-based products and solutions for customers in high-growth markets such as packaging, infrastructure, and consumer care.

# Dow Industrial Solutions highlights

## Integrated production sites and global logistics

Over 1,000 products made in 50 manufacturing facilities on 18 Dow sites around the globe





## Customized electronic-grade products and strong quality control

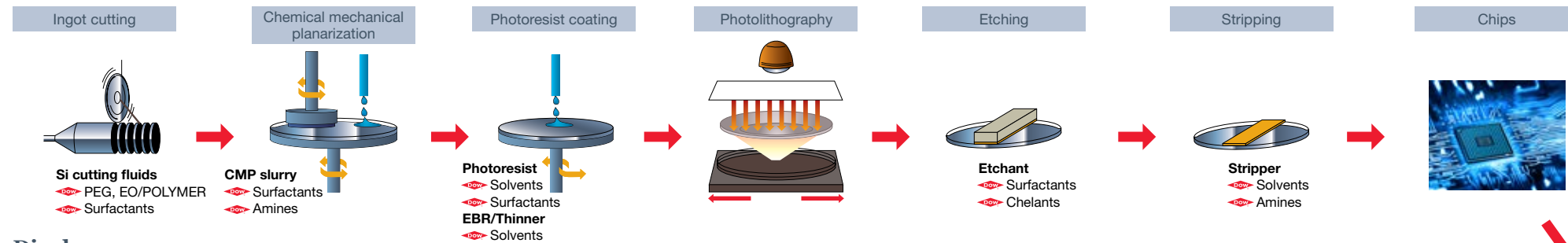
- Focused on electronic market and holistically serving our customers
- Various electronic grade materials to serve diverse needs
- Continuous improvement of processes at all levels of our operations
- Clean room with Inductively Coupled Plasma Mass Spectrometer (ICP-MS)
- Dedicated logistic processes to minimize contamination

### **Chemical know-how and technical support**

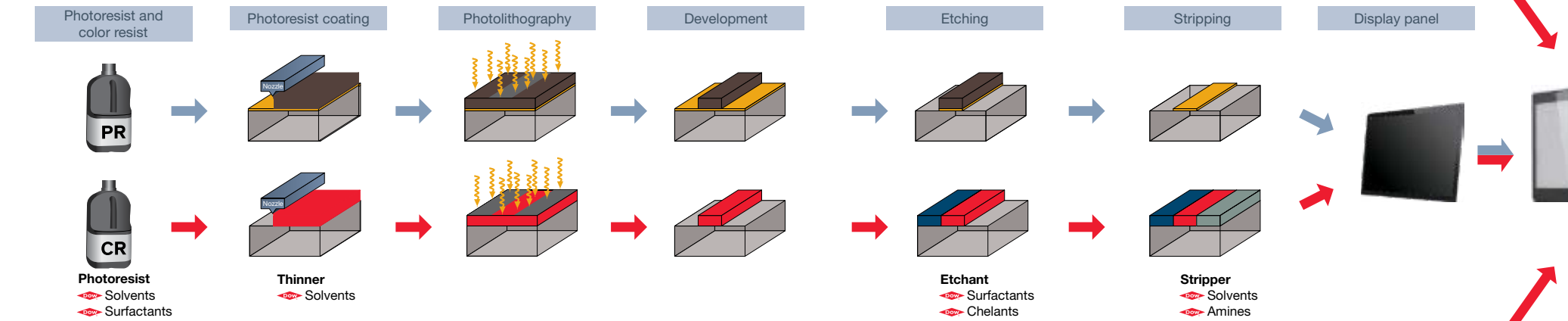
- Multiple pilot plants and research labs
- 80+ years of research and application expertise on our core molecules
- Leading analytical capabilities with reliable analytical services
- Real time technical support to optimize the use of Dow materials and make our customers more successful
- Innovative product joint development with strategic customers

# Chemistries to enable electronics processing

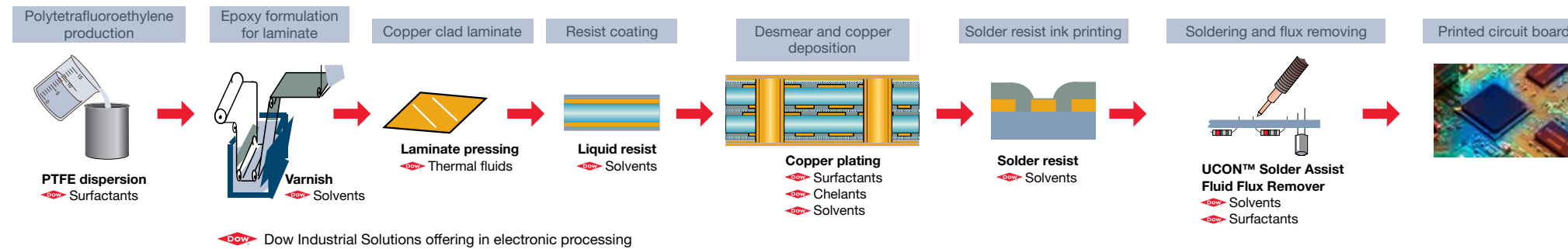
## Semiconductor



## Display



## Printed circuit board



## Dow Industrial Solutions products highlight

Dow Industrial Solutions combines the power of different product groups, including amines and chelants, oxygenated solvents and polyglycols, surfactants and fluids. We customize selected products to the standard which meet specific electronics application requirements

- Controlled low metal concentration
- High purity
- Consistent quality control

Our product offerings include, but not limited to, below highlighted products.



# Oxygenated solvents

Dow offers the world's largest portfolio of oxygenated solvents, including a wide selection of alcohols, esters, ketones and ethylene- and propylene-based glycol ethers. We provide excellent solvency, high dilution ratios, low surface tension and a broad range of evaporation rates, which help you formulate differentiated products for semiconductor, display and printed circuit board industries. We are capable to supply consistent quality-controlled solvents with low metal concentration and high purity.

	Oxygenated solvents	Chemical nomenclature	Structural formula	CAS number	Molecular weight, g/mol	Boiling point °C at 760mm Hg	Flash point °C	Evaporation rate nBuAc=1	Specific gravity at 25°C/25°C	Viscosity cP at 25°C	Vapor pressure (mm Hg @ 20°C)	Surface tension, dynes/cm at 20°C	Hansen Solubility parameters (joules/cm <sup>3</sup> ) <sup>1/2</sup>			Solubility wt% at 20°C		Features
													Dispersion	Polar	H Bonding	In water	Water in	
P-Series Glycol Ethers	DOWANOL™ PM Glycol Ether	Propylene Glycol Methyl Ether	CH <sub>3</sub> OCH <sub>2</sub> CHOHCH <sub>3</sub>	107-98-2	90.1	120	31 <sup>1</sup>	0.62	0.919	1.7	8.7	27.7	15.6	7.2	13.6	∞	∞	Standard solvent for display/semiconductor application. Fast evaporation rate. Water miscible.
	DOWANOL™ DPM Glycol Ether	Dipropylene Glycol Methyl Ether	CH <sub>3</sub> O[CH <sub>2</sub> CH(CH <sub>3</sub> )O] <sub>2</sub> H	34590-94-8	148.2	190	75 <sup>1</sup>	0.035	0.951	3.7	0.28	28.8	15.5	4.0	10.3	∞	∞	Moderate evaporation rate. Water miscible.
	DOWANOL™ PMA Glycol Ether	Propylene Glycol Methyl Ether Acetate	CH <sub>3</sub> OCH <sub>2</sub> CH(CH <sub>3</sub> )OOCCH <sub>3</sub>	108-65-6	132.2	146	42 <sup>2</sup>	0.33	0.966	1.1	2.8	28.9	15.6	5.6	9.8	16.0	3.0	Acetate of PM. Standard solvent for display/semiconductor application. Aproticity.
	DOWANOL™ DPMA Glycol Ether	Dipropylene Glycol Methyl Ether Acetate	CH <sub>3</sub> OCH <sub>2</sub> CH(CH <sub>3</sub> )O <sub>2</sub> OCCH <sub>3</sub>	88917-22-0	190.2	209	86 <sup>2</sup>	0.015	0.977	1.7	0.08	27.3	16.3	4.9	8.0	16.0	3.5	Acetate of DPM. Aproticity
	DOWANOL™ PnP Glycol Ether	Propylene Glycol n-Propyl Ether	C <sub>3</sub> H <sub>7</sub> OCH <sub>2</sub> CHOHCH <sub>3</sub>	1569-01-3	118.2	149	48 <sup>1</sup>	0.21	0.883	2.4	1.53	25.4	15.3	4.9	11.2	∞	∞	C3 alkyl group. Moderate evaporation rate. Water miscible.
	DOWANOL™ DPnP Glycol Ether	Dipropylene Glycol n-Propyl Ether	C <sub>3</sub> H <sub>7</sub> O[CH <sub>2</sub> CH(CH <sub>3</sub> )O] <sub>2</sub> H	29911-27-1	176.2	213	88 <sup>1</sup>	0.014	0.919	3.9	0.08	27.8	15.0	2.9	9.2	19.6	20.3	C3 alkyl group. Slow evaporation rate.
	DOWANOL™ PnB Glycol Ether	Propylene Glycol n-Butyl Ether	C <sub>4</sub> H <sub>9</sub> OCH <sub>2</sub> CHOHCH <sub>3</sub>	5131-66-8	132.2	171	63 <sup>1</sup>	0.093	0.878	2.8	0.85	27.5	15.2	4.2	10.5	5.5	15.5	C4 alkyl group. Moderate evaporation rate.
	DOWANOL™ PPh Glycol Ether	Propylene Glycol Phenyl Ether	C <sub>6</sub> H <sub>5</sub> OCH <sub>2</sub> CHOHCH <sub>3</sub>	770-35-4	152.2	243	119 <sup>1</sup>	0.002	1.062	25.2	0.01	38.1	17.4	5.3	11.5	1.0	6.0	Phenolic glycol ether. Slow evaporation rate. High hydrophobicity. High viscosity.
	DOWANOL™ PGDA Glycol Ether	Propylene Glycol Diacetate	CH <sub>3</sub> COOCH <sub>2</sub> CH(CH <sub>3</sub> )OOCCH <sub>3</sub>	623-84-7	160.0	161	86 <sup>2</sup>	0.039	1.056	2.6	0.23	32.5	15.8	3.5	8.8	7.4	4.1	Di-acetate. Aproticity.
E-Series Glycol Ethers	PROGLYDE™ DMM Glycol Diether	Dipropylene Glycol Dimethyl Ether	CH <sub>3</sub> O[CH <sub>2</sub> CH(CH <sub>3</sub> )O] <sub>2</sub> CH <sub>3</sub>	111109-77-4	162.2	175	65 <sup>1</sup>	0.13	0.902	1.0	0.55	26.3	14.9	2.1	3.8	35.0	4.5	Di-ether. Aproticity. Moderate water compatibility. Low polarity.
	CARBITOL™ Solvent	Diethylene Glycol Ethyl Ether	C <sub>2</sub> H <sub>5</sub> O[CH <sub>2</sub> CH <sub>2</sub> O] <sub>2</sub> H	111-90-0	134.2	202	96 <sup>2</sup>	0.013	0.989	3.6	0.09	31.8	16.1	9.2	12.2	∞	∞	Water miscible. Slow evaporation rate.
	Methyl CARBITOL™ Solvent	Diethylene Glycol Methyl Ether	CH <sub>3</sub> O[CH <sub>2</sub> CH <sub>2</sub> O] <sub>2</sub> H	111-77-3	120.1	194	92 <sup>2</sup>	0.019	1.020	3.5	0.23	32.5	16.2	7.8	12.6	∞	∞	Water miscible. Moderate evaporation rate.
	Butyl CARBITOL™ Solvent	Diethylene Glycol n-Butyl Ether	C <sub>4</sub> H <sub>9</sub> O[CH <sub>2</sub> CH <sub>2</sub> O] <sub>2</sub> H	112-34-5	162.2	230	99 <sup>2</sup>	0.004	0.951	4.9	0.028	30.0	16.0	7.0	10.6	∞	∞	C4 alkyl group. Water miscible. Slow evaporation rate.
	Hexyl CARBITOL™ Solvent	Diethylene Glycol Hexyl Ether	C <sub>6</sub> H <sub>13</sub> O[CH <sub>2</sub> CH <sub>2</sub> O] <sub>2</sub> H	112-59-4	190.3	259	135 <sup>2</sup>	0.0006	0.931	6.2	0.001	29.2	16.0	6.0	10.0	2.0	53.4	C6 alkyl group. Slow evaporation rate. Effective reduction of water surface tension.
	Butyl CARBITOL™ Acetate	Diethylene Glycol n-Butyl Ether Acetate	C <sub>4</sub> H <sub>9</sub> O[CH <sub>2</sub> CH <sub>2</sub> O] <sub>2</sub> OCCH <sub>3</sub>	124-17-4	204.3	245	102 <sup>2</sup>	0.0017	0.978	4.5	0.007	30	16.0	4.1	8.2	4.0	3.4	Acetate of Butyl CARBITOL™. Aproticity. Slow evaporation rate.
	Propyl CELLOSOLVE™ Solvent	Ethylene Glycol Propyl Ether	C <sub>3</sub> H <sub>7</sub> OCH <sub>2</sub> CH <sub>2</sub> OH	2807-30-9	104.2	151	51 <sup>2</sup>	0.22	0.91	2.7	1.77	26.3	16.1	8.0	13.1	∞	∞	Fast evaporation rate. Water miscible.
	Butyl CELLOSOLVE™ Solvent	Ethylene Glycol n-Butyl Ether	C <sub>4</sub> H <sub>9</sub> OCH <sub>2</sub> CH <sub>2</sub> OH	111-76-2	118.2	171	65 <sup>2</sup>	0.079	0.901	2.9	0.66	27.4	16.0	7.6	12.3	∞	∞	C4 alkyl group. Moderate evaporation rate. Water miscible.
	Butyl CELLOSOLVE™ Acetate	Ethylene Glycol n-Butyl Ether Acetate	C <sub>4</sub> H <sub>9</sub> OCH <sub>2</sub> CH <sub>2</sub> OOCCH <sub>3</sub>	112-07-2	160.2	192	71 <sup>2</sup>	0.04	0.941	1.6	0.38	29.6	16.0	4.5	8.8	1.6	1.8	Acetate of Butyl CELLOSOLVE™. Aproticity. Slow evaporation rate.
Esters	DOWANOL™ EPh Glycol Ether	Ethylene Glycol Phenyl Ether	C <sub>6</sub> H <sub>5</sub> OCH <sub>2</sub> CH <sub>2</sub> OH	122-99-6	138.2	244	121 <sup>1</sup>	0.001	1.109	21.5	0.004	42.0	17.8	5.7	14.3	2.5	9.0	Phenolic glycol ether. Slow evaporation rate. Very hydrophobic. High viscosity.
	UCAR™ Ester EEP	Ethyl 3-Ethoxypropionate	C <sub>2</sub> H <sub>5</sub> OC <sub>2</sub> H <sub>4</sub> C(O)OCH <sub>2</sub> CH <sub>3</sub>	763-69-9	146.2	170	60	0.12	0.951	1.3	0.9	28.1	16.2	3.3	8.8	5.2	2.2	Ester. Aproticity. Low surface tension.

These properties are typical of the product, but should not be confused with, or regarded as, sales specifications.  
 1 Setflash Method (Closed Cup); 2 Tag Closed Cup (TCC); ∞ Miscible

## Amines and chelants

Dow offers versatile family of ethanolamines, isopropanolamines and alkyl alkanolamines, which are diversified, polyfunctional molecules that combine the characteristics of amines and alcohols. They can provide alkalinity, corrosion inhibition, photoresist removal and cleaning function in various formulations. We are capable to provide selected products with strong photoresist removal capability and low corrosion to metal like copper. Our VERSENE™ Chelating Agents neutralize harmful metal ions found in water-based formulations and processes.

Amines	Chemical nomenclature	Structural formula	CAS number	Molecular weight, g/mol	Freezing point °C	Boiling point °C at 760mm Hg	Flash point °C	Specific gravity at 20°C/20°C	Viscosity cP at 20°C	Vapor pressure (mm Hg @ 20°C)	Solubility in water at 20°C	Features
MEA	Monoethanolamine	$\text{HOC}_2\text{H}_4\text{NH}_2$	141-43-5	61.1	10	171	96 <sup>1</sup>	1.01	24	0.50	∞	Strong alkalinity Primary amine
TEA	Triethanolamine	$(\text{HOC}_2\text{H}_4)_3\text{N}$	102-71-6	149.2	21	335	208 <sup>1</sup>	1.13	404(30°C)	<0.001	∞	Alkalinity Hygroscopic tertiary amine
MIPA	Monoisopropanolamine	$\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{NH}_2$	78-96-6	75.1	3	159	73 <sup>2</sup>	0.96	23(25°C)	0.53	∞	Strong alkalinity Primary amine
MDEA	N-methyldiethanolamine	$\text{CH}_3\text{N}(\text{CH}_2\text{CH}_2\text{OH})_2$	105-59-9	119.2	-21	247	138 <sup>1</sup>	1.04	101	<0.01	∞	Alkalinity Tertiary amine
NMEA	N-Methylethanolamine	$\text{CH}_3\text{NHCH}_2\text{CH}_2\text{OH}$	109-83-1	75.1	-5	160	73 <sup>2</sup>	0.94	13	0.48	∞	Strong alkalinity Secondary amine
AEEA	Aminoethylethanolamine	$(\text{HOC}_2\text{H}_4)_2\text{NH}(\text{C}_2\text{H}_4\text{NH}_2)$	111-41-1	104.2	-45	243	127 <sup>1</sup>	1.03	141	<0.01	∞	Alkalinity

1 Pensky-Martens Closed Cup

2 Setafash Method (Closed Cup)

Chelants	Chemical nomenclature	Appearance	Chelation value (mg as $\text{C}_2\text{CO}_3$ per g)	% Assay	Molecular weight	Specific gravity at 25°C/25°C	Bulk density $\text{kg/m}^3$	pH (1 wt% Aqueous solution)	Features
VERSENE™ 100 Chelating Agent	Tetrasodium ethylene diaminetetraacetate	Amber, light	102	39 wt% as $\text{Na}_4\text{EDTA}$	380.2	1.3	1270	11.0 – 11.8	Most cost effective chelant
VERSENE™ Diammonium EDTA Chelating Agent	Diammonium ethylene diaminetetraacetate	Light, straw-colored liquid	137	45 wt% as $(\text{NH}_4)_2\text{EDTA}$	328.2	1.2	1200	4.6 – 5.3	Neutral pH High EDTA solubility
VERSENE™ 220 Crystals Chelating Agent	Tetrasodium ethylene diaminetetraacetate tetrahydrate	White crystalline powder	219	99.0 wt% as $\text{Na}_4\text{EDTA} \cdot 4\text{H}_2\text{O}$	452.2	—	720	10.5 – 11.5	Dry and crystallized
VERSENEX™ 80 Chelating Agent	Pentasodium diethylene triaminepentaacetate	Light, straw-colored liquid	80	40.2 wt% as $\text{Na}_5\text{DTPA}$	503.1	1.3	1310	11.0 – 11.8	Extra strength with bleach stability
VERSENOL™ 120 Chelating Agent	Trisodium N-(hydroxyethyl)-ethylenediaminetriacetate	Light, straw-colored liquid	120	41 wt% as $\text{Na}_3\text{HEDTA}$	344.2	1.3	1290	11.0 – 11.8	Iron control



## Polyglycols, surfactants and fluids

Dow Polyglycols, Surfactants and Fluids include some of the most familiar anionic and nonionic surfactants, polyglycols, EO/PO copolymers and solder assistant fluids. Dow surfactants and polyglycols are known for excellent wetting, emulsification, dispersion, and foam control. Water-soluble UCON™ fluids are well-suited as base solder assist fluids. With Dow polyglycols, surfactants and fluids, you can also receive a wide range of available chemistries, extensive applications expertise, a global technical support network and stable product supply from world-class manufacturing facilities.

Nonionic surfactants	Chemical nomenclature	Actives	Form at 25°C	Cloud point (°C, 1 wt% aq)	HLB	Critical micelle concentration (ppm at 25°C)	Surface tension (dynes/cm at 1% actives, 25°C)	Foam height <sup>1</sup>	Pour point (°C)	Features
TERGITO™ 15-S-9	Secondary Alcohol Ethoxylate	100%	Liquid	60	13.3	52	30	124/43	9	Excellent detergency, rapid dissolution and good rinseability, low odor, excellent formulation and handling properties
TRITON™ HW-1000	Secondary Alcohol Ethoxylate	100%	Liquid	Insoluble	10.8	Insoluble	Insoluble	Insoluble	-18	Non-silicone-based, superior wetting and leveling agent, low foam, wets various substrates, narrow gel range
ECOSURF™ EH-9	2-Ethylhexanol Alkoxyate	100%	Liquid	61	12.5	1066	31	60/0	16	Exceptional wetting, low odor, excellent formulation properties, very low aquatic toxicity
TERGITO™ TMN-6 (90%)	Branched Secondary Alcohol Ethoxylate	90%	Liquid	36	13.1	800	27	130/22	-40	Excellent wetting, penetrating and dispersing agent, narrow gel range
TRITON™ RW-150	Alkyl Amine Ethoxylate	100%	Liquid	>100	>16	860 (pH=12) - (pH=2)	30 (pH=12) 54 (pH=2)	135/15 pH=12	11	Good detergency and wetting, pH reversible
TERGITOL™ XD	EO/PO Copolymer	100%	Solid	74	—	—	38	60/25	34	Excellent steric and freeze thaw stabilizer
TRITON™ CG-110	Alkyl Polyglucoside	60%	Liquid	>100	—	1748	27	105/100	-15	Mild, good detergent and wetter, soluble in highly alkaline solutions
DOWFAX™ DF-103	Polyether Polyol	100%	Liquid	22	—	Insoluble	Insoluble	1/0	<-20	Long-lasting defoaming efficacy, pH stability (pH 2-12)

Anionic surfactants	Chemical nomenclature	Actives	Diluent	Form at 25°C	Surface tension (dynes/cm at 1% actives, 25°C)		Foam height <sup>1</sup>		Features
					Neutral <sup>2</sup>	Alkaline <sup>3</sup>	Neutral <sup>2</sup>	Alkaline <sup>3</sup>	
DOWFAX™ 2A1	Alkyldiphenyloxide Disulfonate	45%	Water	Liquid	34	35	140/130	145/145	Excellent solubility and stability in acidic, alkaline, bleach and other oxidizing systems, rinses easily from surfaces
TRITON™ GR-5M	Dioctyl Sulfosuccinate	60%	Isopropanol/ water	Liquid	26	NR <sup>4</sup>	190/180	NR <sup>4</sup>	Excellent wetting, emulsifying and dispersing ability

Footnotes: (1) Ross-Miles foam height: mm at 0.1 wt% actives, 25°C, initial / 5 minute; (2) Actual pH = 7 (distilled water); (3) Actual pH = 12.5 (sodium hydroxide solution); (4) NR = Not recommended; can hydrolyze under some alkaline conditions

UCON™ Solder Assist Fluids	Viscosity (cP at 40°C)	Specific gravity at 20°C	Pour point (°C)	Flash point, closed cup/ open cup (°C / °C)	Surface tension (dynes/cm at 1% actives, 25°C)	Water solubility at 25°C	Cloud point (°C, 1 wt% aq)	Features
SAF-10	280	1.088	-15	177 / 318	38.7	∞*	85	Excellent thermal and oxidative stability make them ideal for formulations used in printed circuit board manufacturing and assembly. Inhibited fluids provide high temperature stability, high flash and fire points, and low foaming tendencies
SAF-24	123	1.139	-5	268 / 218	45.5	∞*	>99	
SAF-25	90	1.151	-34	182 / 279	37.8	∞*	>99	
SAF-26	90	1.152	-34	279 / 310	38.1	∞*	>99	

\* Product contains small amounts of water insoluble additives, which are present to improve thermal stability.

For more information about Dow products, please contact Dow Customer Information Group (CIG):

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