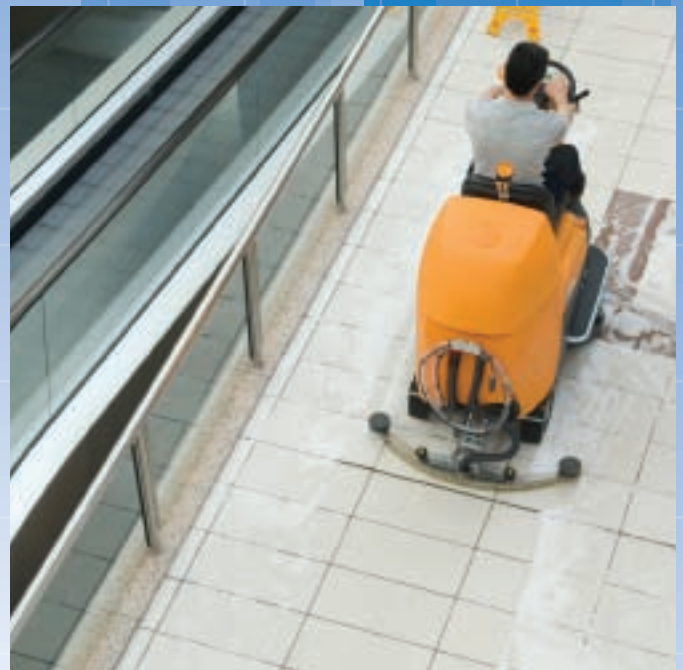


BIO-SOFT®

N-Series

Product Guide

Stepan 

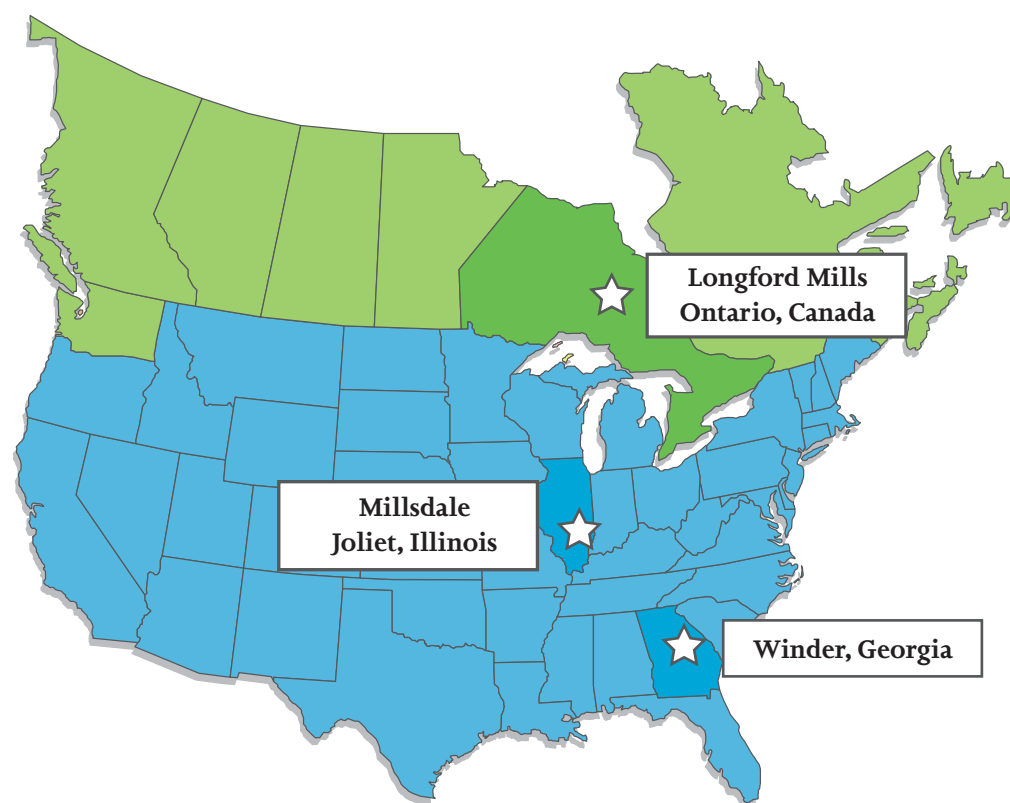


Thank you for considering Stepan Company as Your Complete Surfactant Source.™

Stepan's linear alcohol ethoxylates (LAEs) are sold under the BIO-SOFT® registered trademark and are classified as nonionic surfactants. Stepan offers a number of LAEs with differing alcohol chain lengths and degrees of ethoxylation allowing for use in a wide range of finished products. The BIO-SOFT N-Series provides excellent wetting, emulsification and detergency with moderate foam production. They are biodegradable, mild to the skin and easily colored and fragranced. Stepan's LAEs range from clear liquids to semi-solids with relatively low melting points.

Stepan has a number of other alkoxyated products sold under the following trademarks: MAKON®, TOXIMUL®, NINEX®, and STEPANTEX®. Stepan also offers a line of STEOL® sulfated LAE anionics for use in laundry and cleaning, personal care and other applications. In addition, Stepan is capable of blending various products with different properties in order to meet your specific needs.

Stepan's alkoxylation network includes locations in Illinois, Georgia and Ontario.



Human Safety

Alcohol ethoxylates are used in many consumer and industrial products today. Although the materials have low acute oral and dermal toxicity, precautions should be used when handling the products at full concentration. The BIO-SOFT LAEs are moderately irritating to skin and severely irritating to eyes at full strength. However, at dilutions of 1-10%, they are generally classified as mild to moderate skin irritants.

Biodegradation

As a class, linear alcohol ethoxylates undergo rapid primary (97% in 5-7 days) and ultimate (84% in 28 days) biodegradation under laboratory conditions and are considered readily biodegradable. Although biodegradation of LAEs has been assumed to be slower under anaerobic as compared to aerobic conditions, a number of studies have confirmed biodegradation by anaerobic bacteria (>80%).

Stepan Products and CleanGredients™

Stepan Company has a number of alkoxyates listed on www.cleangredients.org. As referenced by the Greenblue Institute, CleanGredients™ is an on-line database of institutional and industrial (I&I) cleaning ingredients designed to: (1) help formulators identify ingredients that have potential environmental and human health and safety benefits, and (2) provide opportunity for manufacturers and producers of cleaning ingredients to showcase their ingredients with potential environmental and human health and safety benefits. For approved ingredient listings, go to www.cleaningredients.org.

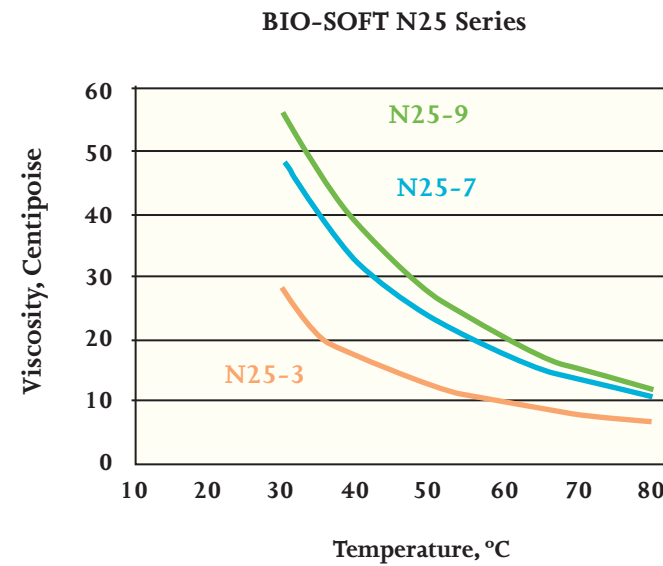
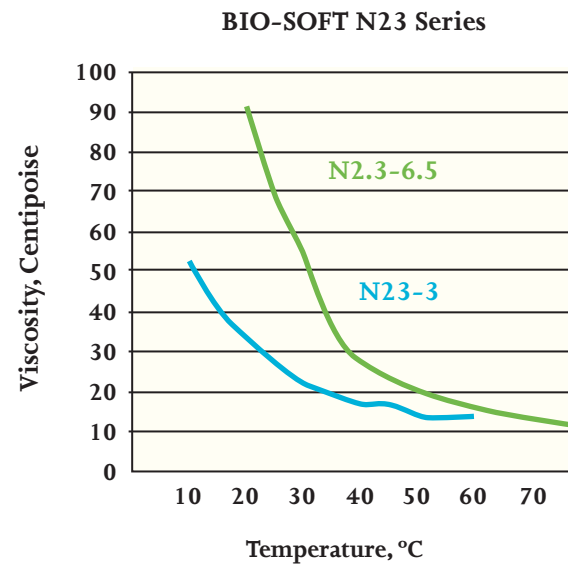
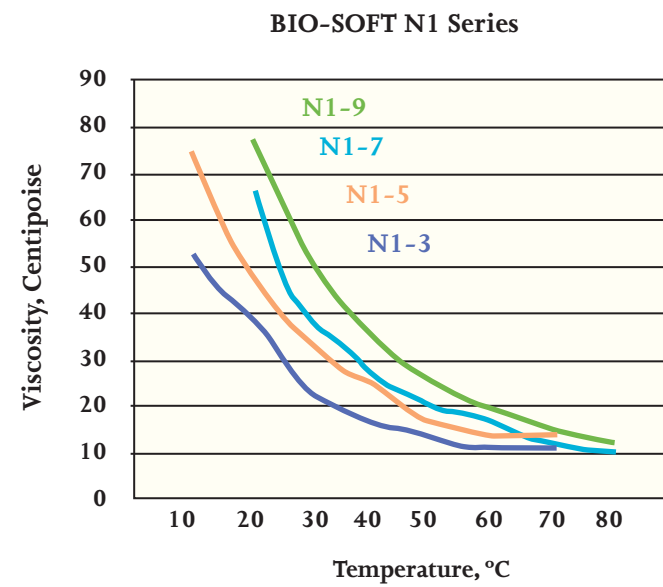
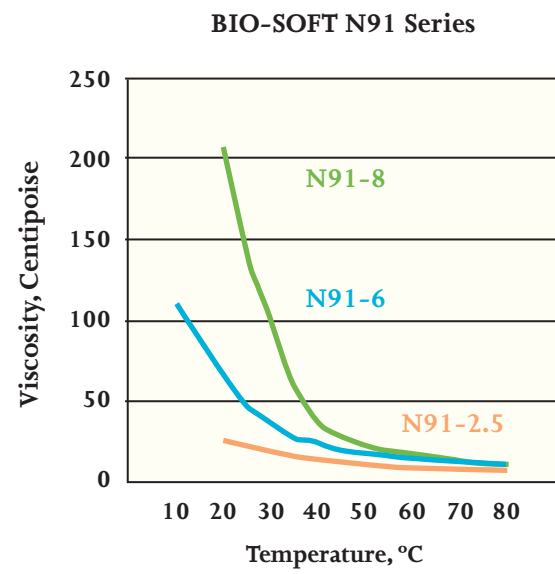
Regulatory Clearances

The BIO-SOFT LAEs are approved for use as Indirect Food Additives under U.S. FDA 21 CFR Parts 175.105, 176.170, 176.180 and 176.210. They are also approved for use as agricultural inert ingredients under U.S. EPA 40 CFR 180.910 and 180.930. BIO-SOFT LAEs are listed for use globally.

Product	United States (TSCA) Canada (DSL) Australia (AICS)	Korea (ECL)	Europe (EINECS)	China (IECSC) Philippines (PICCS)	New Zealand (NZloc)	Japan (ENCS)
N91-2.5	68439-46-3	KE-13383	---	68439-46-3	---	7-97
N91-6	68439-46-3	KE-13383	Polymer exempt	68439-46-3	---	7-97
N91-8	68439-46-3	KE-13383	Polymer exempt	68439-46-3	---	7-97
N1-3	34398-01-1	KE-28888	Polymer exempt	34398-01-1	34398-01-1	7-97
N1-5	34398-01-1	KE-28888	Polymer exempt	34398-01-1	34398-01-1	7-97
N1-7	34398-01-1	KE-28888	Polymer exempt	34398-01-1	34398-01-1	7-97
N1-9	34398-01-1	KE-28888	Polymer exempt	34398-01-1	34398-01-1	7-97
N23-3	66455-14-9	KE-13386	Polymer exempt	66455-14-9	66455-14-9	7-97
N23-6.5	66455-14-9	KE-13386	Polymer exempt	66455-14-9	66455-14-9	7-97
N25-3	68131-39-5	KE-13386	Polymer exempt	68131-39-5	68131-39-5	7-97
N25-7	68131-39-5	KE-13388	Polymer exempt	68131-39-5	68131-39-5	7-97
N25-9	68131-39-5	KE-13388	Polymer exempt	68131-39-5	68131-39-5	7-97

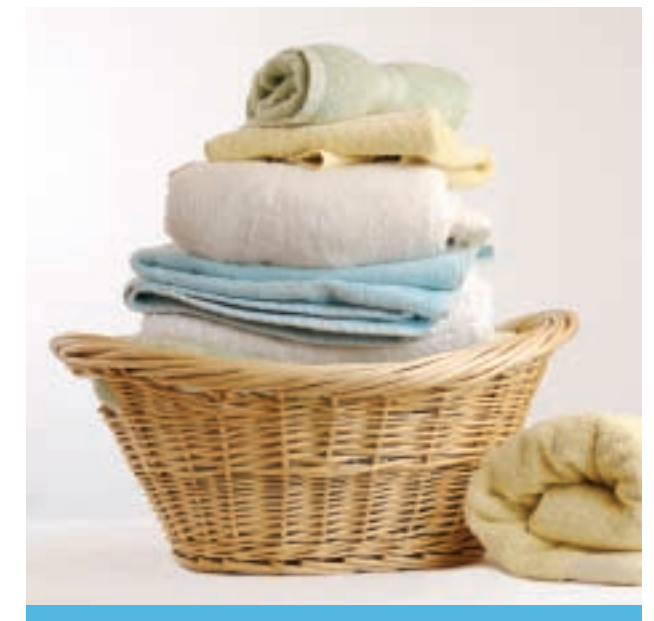
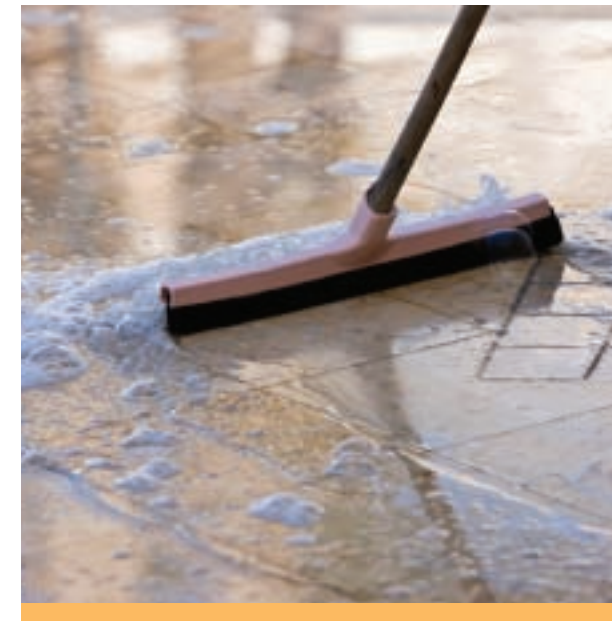
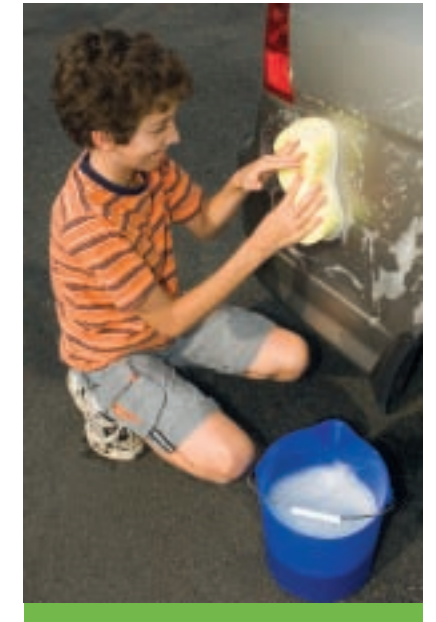
*--- indicates that the product is not cleared for use in that country.

A viscosity profile determines its ease of pumping through production equipment. To facilitate handling, some LAEs may require heating in order to reduce the viscosity. Typical viscosity versus temperature curves for the BIO-SOFT LAEs are below.



BIO-SOFT N-Series Product Guide

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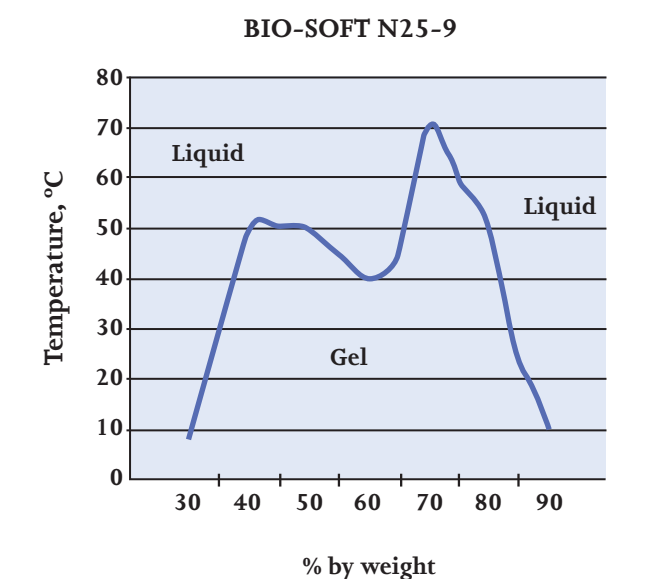
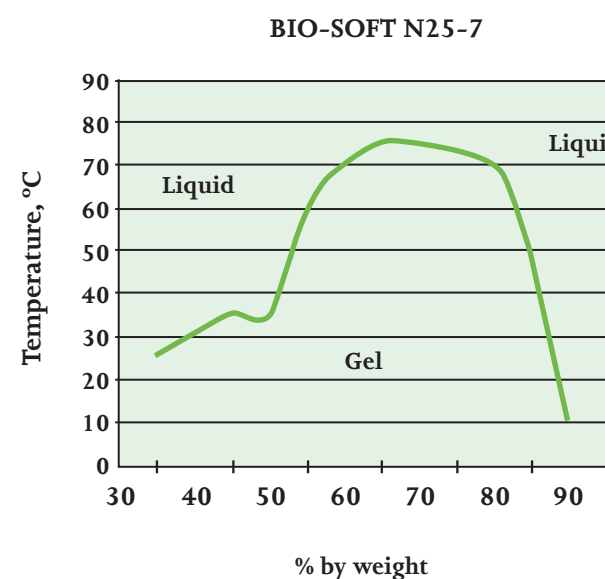
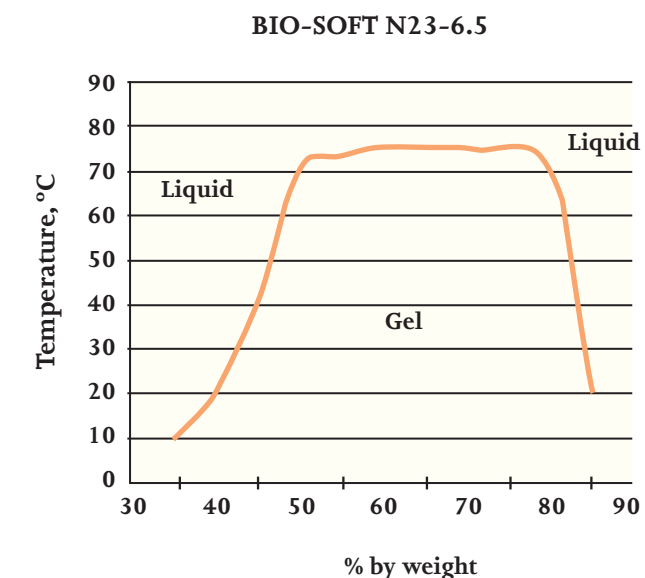
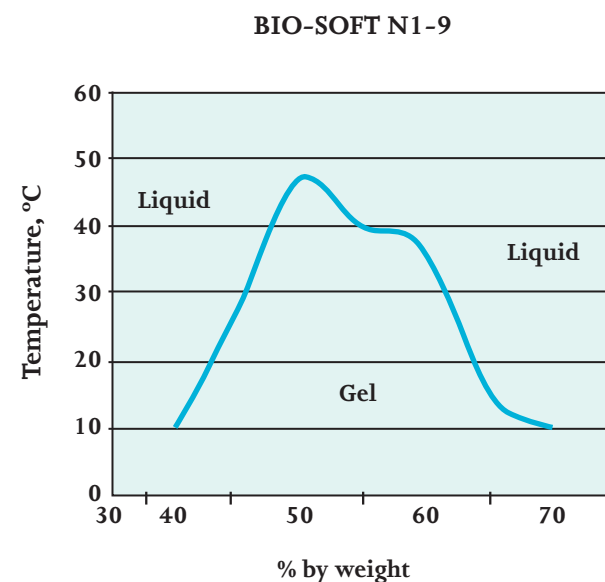
The BIO-SOFT LAEs are named according to the alcohol chain length and the average number of moles of ethoxylation. For instance, BIO-SOFT N23-3 has a carbon chain length of 12-13 and 3 moles of ethylene oxide.



R = Alkyl portion of the molecule
n = Average moles of ethylene oxide

The Personal Care Products Council (PCPC) has adopted names for personal care product ingredient labeling (INCI names). Listed next to the INCI name is the corresponding CAS number, which is the numerical identifier of a given chemical substance and allows worldwide indexing.

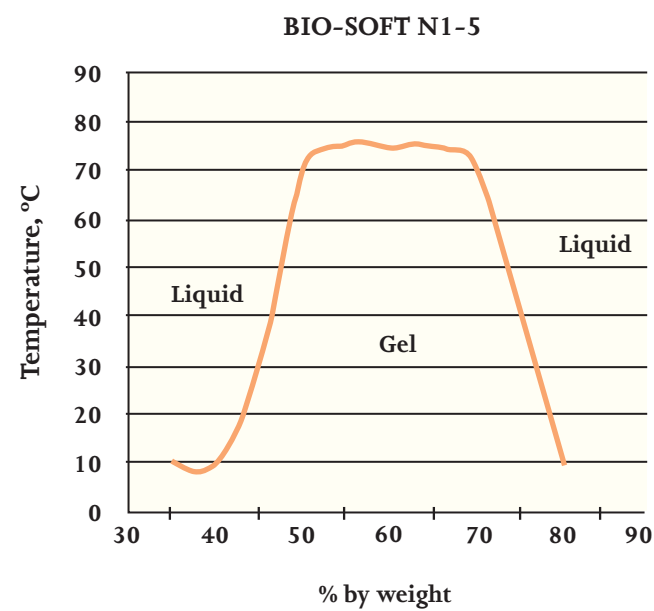
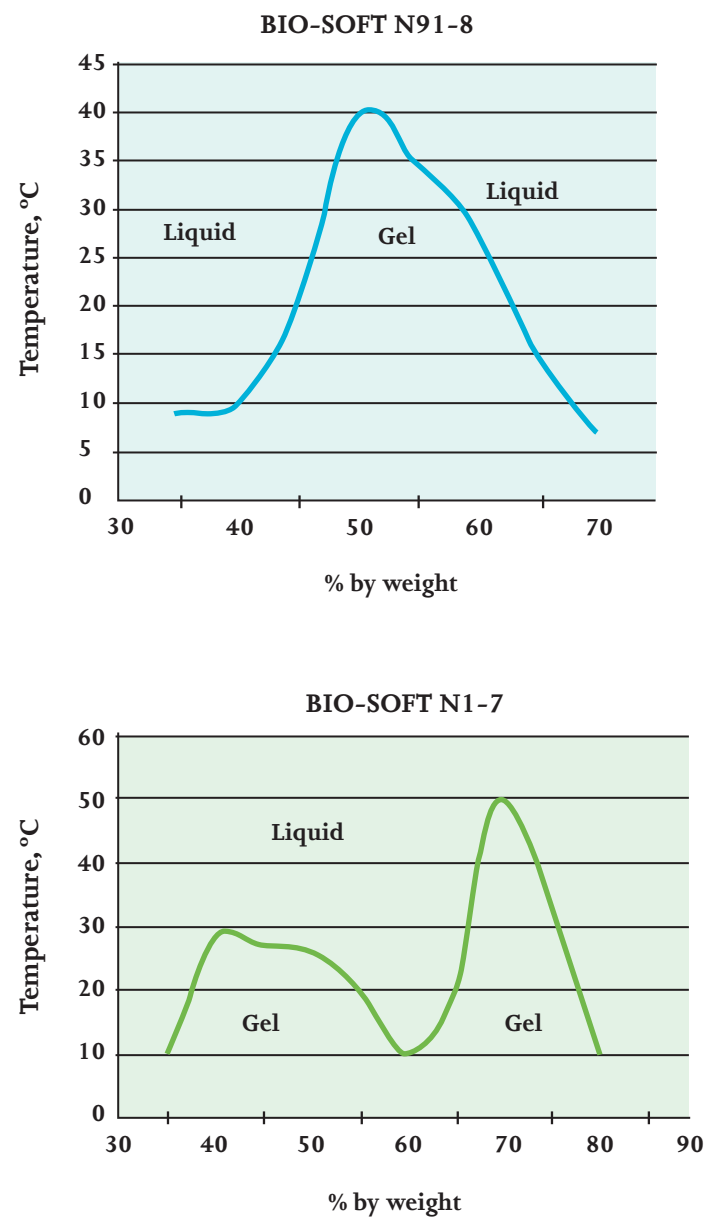
Product	Alcohol Chain Length	Average Moles of Ethoxylation	INCI Name	CAS Number
BIO-SOFT N91-2.5	C ₉ , C ₁₀ , C ₁₁	2.5	C ₉₋₁₁ Pareth-3	68439-46-3
BIO-SOFT N91-6	C ₉ , C ₁₀ , C ₁₁	6	C ₉₋₁₁ Pareth-6	68439-46-3
BIO-SOFT N91-8	C ₉ , C ₁₀ , C ₁₁	8	C ₉₋₁₁ Pareth-8	68439-46-3
BIO-SOFT N1-3	C ₁₁	3	Undeceth-3	34398-01-1
BIO-SOFT N1-5	C ₁₁	5	Undeceth-5	34398-01-1
BIO-SOFT N1-7	C ₁₁	7	Undeceth-7	34398-01-1
BIO-SOFT N1-9	C ₁₁	9	Undeceth-9	34398-01-1
BIO-SOFT N23-3	C ₁₂ , C ₁₃	3	C ₁₂₋₁₃ Pareth-3	66455-14-9
BIO-SOFT N23-6.5	C ₁₂ , C ₁₃	6.5	C ₁₂₋₁₃ Pareth-7	66455-14-9
BIO-SOFT N25-3	C ₁₂ , C ₁₃ , C ₁₄ , C ₁₅	3	C ₁₂₋₁₅ Pareth-3	68131-39-5
BIO-SOFT N25-7	C ₁₂ , C ₁₃ , C ₁₄ , C ₁₅	7	C ₁₂₋₁₅ Pareth-7	68131-39-5
BIO-SOFT N25-9	C ₁₂ , C ₁₃ , C ₁₄ , C ₁₅	9	C ₁₂₋₁₅ Pareth-9	68131-39-5



Gel Characteristics

When making concentrated solutions of alcohol ethoxylates in water, gels can often result. The gel characteristics of each BIO-SOFT LAE are shown in the following gel curves.

In order to avoid gel formation, the formulator should add the alcohol ethoxylate to, or dilute neat ethoxylate with, water that has been sufficiently heated to maintain the temperature of the mixture above the peak temperature shown on the gel curve for that particular LAE.



Typical Physical and Chemical Properties

In choosing a nonionic surfactant, a formulator may consider various properties including pour point, cloud point and HLB (hydrophile/lipophile balance).

- **Pour point** - assesses handling ease and whether heated storage is required
- **Cloud point** - helps estimate the maximum temperature range for application use
- **HLB** - expresses the emulsifying efficiency of a surfactant associated with the polarity of the molecule

All BIO-SOFT LAEs are near colorless, 100% active, non-flammable and have a viscosity of less than 40 cps at 38°C.



BIO-SOFT	Avg Moles EO	Molecular Weight	EO Content % Wt.	Hydroxyl Number, mg KOH/g	HLB	Specific Gravity @ 25°C	Density lbs/gal @ 25°C	Cloud Point, °C (0.1% Aq.)	Pour Point, °C
N91-2.5	2.5	281	40.6	200	8.5	0.940	7.82	2*	-13
N91-6	6	425	62.7	129	12.4	0.991	8.25	55	6
N91-8	8	524	69.5	107	13.9	1.020	8.49	79	15
N1-3	3	305	43.3	184	8.7	0.936	7.79	8.5*	-7
N1-5	5	392	56.0	143	11.2	0.968	8.05	34	6
N-17	7	479	64.0	117	12.9	0.993	8.26	58	13
N1-9	9	569	69.6	100	13.9	1.013	8.43	74	18
N23-3	3	322	40.6	173	8.1	0.926	7.70	0.6*	4
N23-6.5	6.5	484	59.0	120	11.9	0.985	8.19	43	14
N25-3	3	330	40.6	170	8.0	0.920	7.65	-1*	8
N25-7	7	524	61.8	107	12.2	0.965	8.03	51	19
N25-9	9	597	65.9	94	13.3	0.982	8.17	73	24

* Partially insoluble

Typical HLB and Functional Properties

HLB expresses the emulsifying efficiency of a surfactant associated with the polarity of the molecule.

- HLB > 10 tends to be water-soluble and is best for oil-in-water-emulsions.
- HLB < 10 tends to be oil-soluble and is best for water-in-oil-emulsions.

Dispersion in Water	Typical HLB Range
No dispersion	1-4
Poor dispersion	3-6
Milky dispersion after vigorous agitation	6-8
Stable milky dispersion	8-10
Translucent to clear dispersion	10-12
Clear solution	13+

Water solubility relates directly to the ethylene oxide (EO) chain length. As the EO content increases, water solubility also increases.

- LAEs > 50% by weight EO are typically water-soluble.
- LAEs < 50% by weight EO are typically oil-soluble.

HLB Range	Range of EO Content % by Weight	Applications
4-6	20-30	Water-in-Oil Emulsifier
7-15	35-75	Wetting Agent
8-18	40-90	Oil-in-Water Emulsion
10-15	50-75	Detergent
10-18	50-90	Solubilizer

The BIO-SOFT N1 series provides exceptional cleaning, especially on oily soils, in both household and industrial applications while the BIO-SOFT N25 series is recommended for general purpose applications. The BIO-SOFT N23 series is useful in a wide range of Industrial and Institutional products.

Product	HLB	Wetting Agent	Oil/Water Emulsifier	Detergent	Solubilizer	Water/Oil Emulsifier
BIO-SOFT N91-2.5	8.5					*
BIO-SOFT N91-6	12.4	*	*	*	*	
BIO-SOFT N91-8	13.9	*	*	*	*	
BIO-SOFT N1-3	8.7					*
BIO-SOFT N1-5	11.2	*	*	*	*	
BIO-SOFT N1-7	12.9	*	*	*	*	
BIO-SOFT N1-9	13.9	*	*	*	*	
BIO-SOFT N23-3	8.1					*
BIO-SOFT N23-6.5	11.9	*	*	*	*	
BIO-SOFT N25-3	8.0					*
BIO-SOFT N25-7	12.2	*	*	*	*	
BIO-SOFT N25-9	13.3	*	*	*	*	

Handling Characteristics

Solution Properties

One of the many characteristics that set each of the alcohol ethoxylates apart is their solubility in water. Typically, most nonionic surfactants form a gel with the addition of water at room temperature. When making up solutions containing BIO-SOFT LAEs, the higher the HLB, and typically the higher the moles of ethylene oxide, the more soluble the alcohol ethoxylate is in water.

Alcohol ethoxylates containing between one and five moles of ethylene oxide and having an HLB value less than ten are typically water insoluble.

The following table shows the viscosity of the water-soluble BIO-SOFT LAEs as a function of concentration. Alcohol ethoxylate can form gels at room temperature at concentrations of 30-80% by weight.

Viscosities of Aqueous BIO-SOFT LAEs (at 25°C)

Product	Concentration, % by Weight									
	10	20	30	40	50	60	70	80	90	
BIO-SOFT N91-6	5	12	62	170	166	120	95	70	53	
BIO-SOFT N91-8	4	8	24	126	Gel	Gel	Gel	89	71	
BIO-SOFT N1-5	39	64	93	Gel	Gel	Gel	Gel	Gel	58	
BIO-SOFT N1-7	5	15	103	Gel	Gel	Gel	Gel	100	72	
BIO-SOFT N1-9	5	8	30	262	Gel	Gel	195	115	84	
BIO-SOFT N23-6.5	58	340	468	568	Gel	Gel	Gel	Gel	77	
BIO-SOFT N25-7	8	75	1332	Gel	Gel	Gel	Gel	Gel	109	
BIO-SOFT N25-9	5	10	Gel	Gel	Gel	Gel	Gel	Gel	124	



The following are starting formulations. Scale up and product/packaging stability testing is advised. For additional formulations, visit us at www.stepan.com under *products, formulations*.

PRIVATE LABEL 2X LIQUID LAUNDRY	
Ingredients	% by Weight
Water	40.5
STEPANATE®SXS	7.5
BIO-SOFT®D40	19.0
Sodium Carbonate	2.0
STEOOL®CS-330	23.8
BIO-SOFT®N25-7	6.7
Sodium Chloride	0.5

DILUTABLE ALL PURPOSE FLOOR CLEANER	
Ingredients	% by Weight
Water	89.5
ENVIOMET™C140 (Innospec) EDDS	2.5
STEPANATE®SXS	2.0
BIO-SOFT®D40	3.5
BIO-SOFT®N1-7	2.5

BATHROOM TUB & TILE CLEANER	
Ingredients	% by Weight
Water	90.0
BIO-SOFT®N91-6	1.0
DOWANOL® PnP (Dow)	2.0
Butyl CARBITOL	2.0
Citric Acid	5.0

Surface Tension

Aqueous solutions of nonionic surfactants significantly reduce the surface tension of water. In dilute aqueous solutions, the surface tension* decreases as the EO content increases. At a certain concentration, a surfactant will reach its critical micelle concentration (CMC). The CMC refers to the surfactant concentration at which micelles begin to form. As micelles form, the air-water surface tension and soil-water interfacial tension attain their minimum levels. For optimum cleaning, the surfactant concentration must be above the CMC as micelles are necessary to solubilize soils.

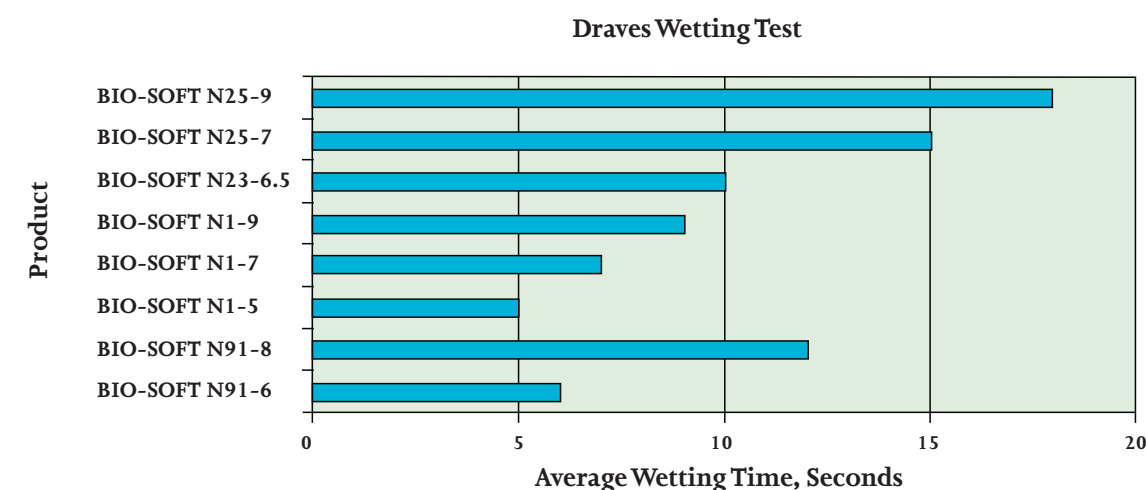
Product	Surfactant Concentration Dynes/cm at 24°C in distilled water				CMC, % Weight
	0.0001	0.001	0.01	0.1	
BIO-SOFT N91-6	62	53	33	29	0.0250
BIO-SOFT N91-8	63	54	37	30	0.0270
BIO-SOFT N1-5	57	43	26	25	0.0120
BIO-SOFT N1-7	60	50	30	28	0.0100
BIO-SOFT N1-9	60	50	34	31	0.0150
BIO-SOFT N23-6.5	53	33	28	28	0.0017
BIO-SOFT N25-7	51	32	30	30	0.0009
BIO-SOFT N25-9	54	35	31	30	0.0018

*The Wilhelmy Plate Method was conducted on a Kruss K-12 Tensiometer.

Draves Wetting

The Draves Wetting Test** distinguishes surfactants and surfactant systems based on their ability to penetrate and wet cotton. The table below reports the time it takes for a cotton skein to be fully saturated. The smaller the value, the faster the wetting power of the nonionic.

- The BIO-SOFT N91 and N1 series are fast wetting agents due to their shorter hydrophobic chains.
- Increasing the EO content increases water solubility and decreases attraction to the hydrophobe cotton substrate, resulting in slower wetting.

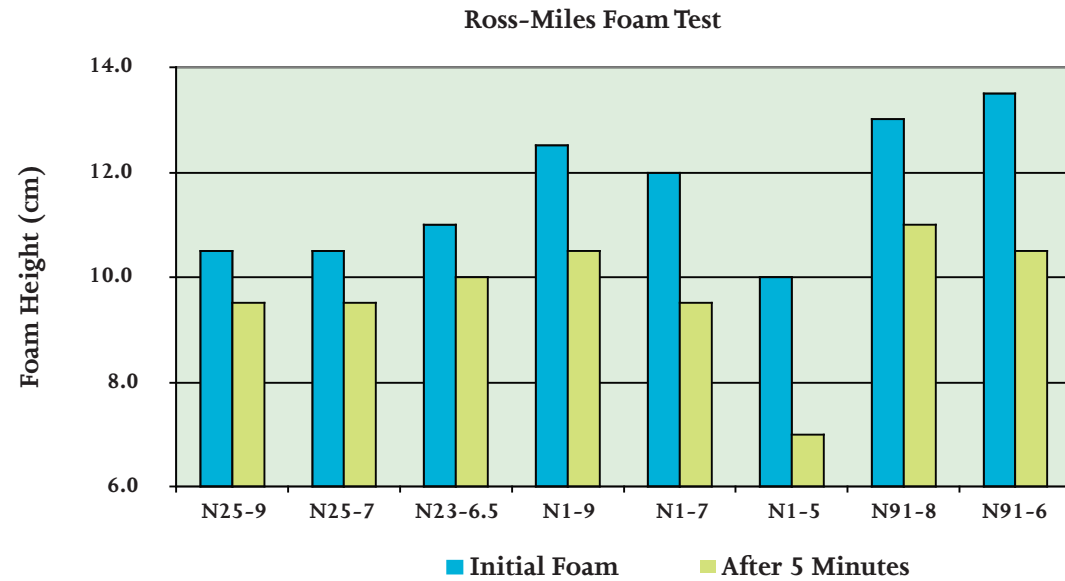


**Test was run as stated in ASTM D 2281 using a 5 gram cotton skein and a 3 gram hook in a 0.1% active dilution in deionized water.

Ross-Miles Foam

The Ross-Miles Foam Test* determines the instant flash foam and foam stability properties of a surfactant solution.

- All BIO-SOFT N-Series products produce moderate ‘visual’ foam.
- The foam produced is stable and does not break quickly.
- LAE foam is easily rinsed, making them very suitable for use in household cleaning products.



*Test was run using ASTM Method D1173 at 0.1% active in 150 ppm hard water.

Dissolution Properties

In general, nonionics tend to gel when added to water. In order to facilitate dissolution, first charge water and any solubilizing agent, such as sodium xylene sulfonate (SXS) or solvent, and then with good agitation, slowly add the nonionic. The table below ranks the dissolution rate** for the BIO-SOFT LAEs. Nonylphenol ethoxylate 10 EO is included for comparison.

- BIO-SOFT N91-6 and N1-5 dissolve significantly faster than NPE-10.
- BIO-SOFT N25-7 and N25-9 are solid and require heat to dissolve.

Product	Time to Dissolve, seconds
BIO-SOFT N91-6	7
BIO-SOFT N1-5	15
BIO-SOFT N23-6.5	77
NPE-10	96
BIO-SOFT N91-8	120
BIO-SOFT N1-7	150
BIO-SOFT N1-9	190

**Dissolution Test: At 25°C, charge 100ml DI water into a 250-ml beaker. Mix with a stir bar @ 400 rpm. Add 6 drops of nonionic at just above the water surface; 1 drop/sec. Record the time for complete dissolution.

		BIO-SOFT Products											
		N91-2.5	N91-6	N91-8	N1-3	N1-5	N1-7	N1-9	N23-3	N23-6.5	N25-3	N25-7	N25-9
Household Products	All Purpose Cleaner		•	•		•	•	•		•		•	•
	Dilutable Cleaner		•	•	•	•	•	•		•		•	•
	Spray Cleaner		•	•	•	•	•	•		•		•	•
	Disinfectant Cleaner		•	•	•	•	•	•		•		•	•
	Hand Dishwashing Liquid		•	•				•					
	Laundry Pre-spotter	•			•	•			•	•	•	•	
	Laundry Liquid		•			•	•			•		•	•
	Laundry Powder (Blend)					•			•	•		•	•
	Fragrance Solubilizer							•					
Industrial & Institutional Cleaners	Hard Surface Cleaner	•	•	•	•	•	•	•	•	•			•
	Floor/Wall/Tile	•	•	•	•	•	•	•		•		•	•
	Car/Truck/Ship/Airplane	•	•	•	•	•	•	•		•			
	High Foam Car Wash		•	•		•	•	•					
	Laundry Liquid		•			•	•			•		•	•
	Laundry Powder		•	•		•	•	•		•		•	•
	Metal Soak Cleaner	•	•	•	•	•	•	•		•		•	•
	Rug Cleaner									•		•	•
	Solvent Cleaner	•	•	•	•	•	•	•	•	•	•		
	Metal Rolling Oil				•					•		•	
Industrial Process & Formulations	Mining Dedust		•				•						
	Oil Field Chemical	•	•	•	•	•	•	•	•	•	•		
	Latex Paint		•	•		•	•	•		•			•
	Pesticide Adjuvant		•	•		•	•	•		•			•
	Textile Application		•	•		•	•	•	•	•		•	•
	Leather Processing	•	•	•	•	•	•	•	•		•		



To answer any further technical questions contact Stepan Technical Service Departments at the telephone numbers listed below or techserv@stepan.com.

For pricing and order placement, contact the Stepan Account Services Departments at the telephone numbers listed below or order.placement@stepan.com.

UNITED STATES

Northfield, Illinois (Corporate Headquarters)

Account Services

Phone: ++1-800-457-7673

Email: order.placement@stepan.com

Technical Service

Phone: ++1-800-745-7837 (US & Canada)

Email: techserv@stepan.com

CANADA

Burlington, Ontario L7N 3N1

Sales and Account Services

Phone: ++1-905-814-7231

Email: techserv@stepan.com

EUROPE

38343 Voreppe, Cedex, France

Account Services

Phone: ++33-47-650-5100

Email: custserv@stepaneurope.com

Technical Service

Phone: ++33-476-505-160

Email: tech.service@stepaneurope.com

MEXICO

Mexico City, Mexico

Sales, Account Services and Technical Service

Phone: ++52-555-533-1697

Email: techserv@stepan.com

COLOMBIA

Bogota, D.C. Colombia

Sales, Account Services and Technical Service

Phone: ++57-1-636-2808

Email: techserv@stepan.com

BRAZIL

CEP 64012-001 Sao Paulo - SP

Sales, Account Services and Technical Service

Phone: ++55-11-5089-2200

Email: techserv@stepan.com

PHILIPPINES

Muntinlupa City 1780

Sales, Account Services and Technical Service

Phone: ++63-2-842-9751

Email: techserv@stepan.com

CHINA

Shanghai 200032 China

Sales, Account Services and Technical Service

Phone: ++86-21-6422-7225

Email: techserv@stepan.com

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