Technical Information

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08_130213e-02/Page 1 of 9
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Lutensol® TO types

Lutensol® TO 2
Lutensol® TO 3
Lutensol® TO 5
Lutensol® TO 6
Lutensol® TO 65
Lutensol® TO 7
Lutensol® TO 79
Lutensol® TO 8
Lutensol® TO 89
Lutensol® TO 10
Lutensol® TO 109
Lutensol® TO 12
Lutensol® TO 129
Lutensol® TO 15
Lutensol® TO 20
Lutensol® TO 389

Nonionic surfactants for use in detergents and cleaners and for the chemical and allied industries

BASF
We create chemistry

Chemical nature

The Lutensol® TO types are nonionic surfactants. They are based on a saturated iso-C_{13}-alcohol.

They conform to the following structural formula.

$$RO(CH_2CH_2O)_xH$$

R = iso-$C_{13}H_{27}$
x = 2, 3, 5, 6, 6,5, 7, 8, 10, 12, 15, 20

The numeric code in the product name indicates the degree of ethoxylation.

Lutensol® TO 79 consists of approx. 90% Lutensol® TO 7 and approx. 10% water.
Lutensol® TO 89 consists of approx. 90% Lutensol® TO 8 and approx. 10% water.
Lutensol® TO 109 consists of approx. 85% Lutensol® TO 10 and approx. 15% water.
Lutensol® TO 129 consists of approx. 85% Lutensol® TO 12 and approx. 15% water.

The Lutensol® TO types are manufactured by causing the iso-C_{13} oxo alcohol to react with ethylene oxide in stoichiometric proportions. The ethoxylation temperature is kept as low as possible. This, combined with the high purity of the feedstocks, ensures that high-performance products with low toxicity are obtained.

PRD-Nos.*

30178622	Lutensol® TO 2
30044003	Lutensol® TO 3
30044057	Lutensol® TO 5
30044177	Lutensol® TO 6
30090427	Lutensol® TO 65
30044060	Lutensol® TO 7
30091779	Lutensol® TO 79
30044015	Lutensol® TO 8
30044017	Lutensol® TO 89
30044009	Lutensol® TO 10
30044022	Lutensol® TO 109
30044036	Lutensol® TO 12
30044020	Lutensol® TO 129
30044000	Lutensol® TO 15
30044001	Lutensol® TO 20
30044067	Lutensol® TO 5
30044067	Lutensol® TO 389

* BASF's commercial product numbers.

Storage

a) The Lutensol® TO types should be stored indoors in a dry place. Storerooms must not be overheated.

b) They are hygroscopic and readily soluble in water, with the result that they absorb moisture very quickly. Drums must be resealed each time they are opened.

c) The storage temperature should not be allowed to fall substantially below 20 °C. The setting points of these products also need to be taken into account.

d) Lutensol® TO 2, TO 3, TO 5, TO 6, TO 65, TO 7, TO 79 and TO 8, are cloudy liquids at room temperature, and they tend to form a sediment. This cloudiness can be dissipated by heating them to approx. 50 °C.

e) Liquid that has solidified or that shows signs of sedimentation should be heated to 50 – 70 °C and homogenized before it is processed.

f) Drums that have solidified or that have begun to precipitate should be reconstituted by gentle heating, preferably in a heating cabinet. The temperature must not be allowed to exceed 70 °C. This also applies if drums are heated by external electrical elements.
Internal electrical elements should not be used because of the localized anomalies in temperature that they cause.

g) The Lutensol® TO types must be blanketed with nitrogen if they are stored in heated tanks (at 50 – 70 °C) to prevent them from coming into contact with air. Constant, gentle stirring helps to prevent them being discoloured as a result of prolonged contact with electrical elements or external heating coils.

Materials

The following materials can be used for tanks and drums:

a) AISI 321 stainless steel (X6CrNiTi1810)
b) AISI 316 Ti stainless steel (X6CrNiMoTi17122)

Shelf life

The Lutensol® TO types have a shelf life of at least two years in their original packaging, provided they are stored properly and drums are kept tightly sealed.

Properties

Lutensol® TO 2, TO 3, TO 5, TO 6, TO 65, TO 7 and TO 8 are cloudy liquids at 23 °C which tend to form a sediment. They are clear at 50 °C.

Lutensol® TO 79, TO 89, TO 109, TO 129 and TO 389 are clear liquids at 23 °C.

Lutensol® TO 10, TO 12, TO 15 and TO 20 are soft, slightly yellowish pastes.

Lutensol®		**TO 2**	**TO 3**	**TO 5**	**TO 6**	**TO 65**	**TO 7**
Physical form (23 °C)		Liquid	Liquid	Liquid	Liquid	Liquid	Liquid
Degree of ethoxylation		approx. 2	approx. 3	approx. 5	approx. 6	approx. 6.5	approx. 7
Concentration	%	approx. 100	approx. 100	approx. 100	approx. 100	approx. 100	approx. 100
Cloud point (EN 1890)*							
Method A	°C	–	–	–	–	–	–
Method B	°C	–	–	–	–	–	–
Method C	°C	–	–	–	–	–	–
Method D	°C	approx. 37	approx. 50	approx. 66	approx. 70	approx. 71	approx. 72
Method E	°C	–	approx. 40	approx. 62	approx. 67	approx. 68	approx. 70
Molar mass (calculated from hydroxyl number)	g/mol	approx. 295	approx. 340	approx. 430	approx. 470	approx. 485	approx. 500
pH (5% in water)**		approx. 7	approx. 7	approx. 7	approx. 7	approx. 7	approx. 7
Density (DIN 51757, 23 °C)	g/cm^3	approx. 0.90	approx. 0.93	approx. 0.96	approx. 0.97	approx. 0.98	approx. 0.98
Dropping point (DIN 51801)	°C	<5	<5	approx. 14	approx. 18	approx. 18	approx. 18
Congealing point (ISO 2207)	°C	<5	<5	<5	<5	<5	approx. 5
Melting point	°C						
Viscosity (EN 12092, 23 °C, Brookfield, 60 rpm)	mPa·s	approx. 30	approx. 50	approx. 80	approx. 80	approx. 100	approx. 100
Hydroxyl number (DIN 53240)	mgKOH/g	approx. 190	approx. 165	approx. 130	approx. 120	approx. 115	approx. 110
Hydrophilic-lipophilic balance		approx. 7	approx. 9	approx. 10.5	approx. 11	approx. 11.5	approx. 12
Flash point (DIN 51376)	°C	>100	>100	>100	>100	>100	>100
Wetting power (EN 1772, in distilled water with 2 g/l soda ash at 23 °C)							
0.5 g/l	s	>300	>300	approx. 80	approx. 60	approx. 60	approx. 60
1.0 g/l	s	>300	>300	approx. 50	approx. 25	approx. 20	approx. 20
2.0 g/l	s	approx. 150	approx. 230	approx. 20	approx. 10	approx. 10	approx. 10
Foam formation (EN 12728, 40 °C, 2 g/l in water with 1.8 mmol Ca^{2+}-Ions/l, after 30 sec)	cm^3	approx. 10	approx. 10	approx. 50	approx. 70	approx. 90	approx. 120
Surface tension*** (EN 14370, 1 g/l in distilled water at 23 °C)	mN/m	approx. 27	approx. 27	approx. 27	approx. 27	approx. 27	approx. 27

* *Cloud point according to EN 1890:*
Method A : 1 g of surfactant + 100 g of distilled water
Method B : 1 g of surfactant + 100 g of NaCl solution (c = 50 g/l)
Method C : 1 g of surfactant + 100 g of NaCl solution (c = 100 g/l)
Method D : 5 g of surfactant + 45 g of diethylene glycol monobutyl ether solution (c = 250 g/l)
Method E : 5 g of surfactant + 25 g of diethylene glycol monobutyl ether solution (c = 250 g/l)

** *The pH of the Lutensol® TO types can decrease during storage, but this does not have any effect on their performance.*

*** *Applying Harkins-Jordan correction.*

Lutensol®		**TO 79**	**TO 8**	**TO 89**	**TO 10**	**TO 109**
Physical form (23 °C)		Liquid	Liquid	Liquid	Liquid	Liquid
Degree of ethoxylation		approx. 7	approx. 8	approx. 8	approx. 10	approx. 10
Concentration	%	approx. 90	approx. 100	approx. 90	approx. 100	approx. 85
Cloud point (EN 1890)*						
Method A	°C	–	approx. 60	approx. 60	approx. 70	approx. 70
Method B	°C	–	approx. 46	approx. 46	approx. 54	approx. 54
Method C	°C	–	approx. 35	approx. 35	approx. 43	approx. 43
Method D	°C	approx. 72	approx. 80	approx. 80	approx. 81	approx. 81
Method E	°C	approx. 70	approx. 80	approx. 80	approx. 82	approx. 82
Molar mass (calculated from hydroxyl number)	g/mol	approx. 500	approx. 600	approx. 600	approx. 630	approx. 630
pH (5% in water)**		approx. 7	approx. 7	approx. 7	approx. 7	approx. 7
Density (DIN 51757, 23 °C)	g/cm^3	approx. 0.99	approx. 1.01	approx. 1.02	approx. 0.97 (60 °C)	approx. 1.02
Dropping point (DIN 51801)	°C	<5	approx. 22	<5	approx. 25	approx. 5
Congealing point (ISO 2207)	°C	<5	approx. 10	<5	approx. 14	<5
Melting point	°C				approx. 21	
Viscosity (EN 12092, 23 °C, Brookfield, 60 rpm)	mPa·s	approx. 110	approx. 150	approx. 120	approx. 30 (60 °C)	approx. 150
Hydroxyl number (DIN 53240)	mgKOH/g	approx. 110	approx. 95	approx. 95	approx. 90	approx. 90
Hydrophilic-lipophilic balance		approx. 12	approx. 13	approx. 13	approx. 13.5	approx. 13.5
Flash point (DIN 51376)	°C	>100	>100	>100	>100	>100
Wetting power (EN 1772, in distilled water with 2 g/l soda ash at 23 °C)						
0.5 g/l	s	approx. 60	approx. 70	approx. 90	approx. 80	approx. 80
1.0 g/l	s	approx. 20	approx. 25	approx. 30	approx. 30	approx. 35
2.0 g/l	s	approx. 5	approx. 10	approx. 10	approx. 10	approx. 10
Foam formation (EN 12728, 40 °C, 2 g/l in water with 1.8 mmol Ca^{2+}-Ions/l, after 30 sec)	cm^3	approx. 50	approx. 550	approx. 550	approx. 600	approx. 600
Surface tension*** (EN 14370, 1 g/l in distilled water at 23 °C)	mN/m	approx. 27	approx. 28	approx. 28	approx. 28	approx. 29

* *Cloud point according to EN 1890:*
Method A : 1 g of surfactant + 100 g of distilled water
Method B : 1 g of surfactant + 100 g of NaCl solution (c = 50 g/l)
Method C : 1 g of surfactant + 100 g of NaCl solution (c = 100 g/l)
Method D : 5 g of surfactant + 45 g of diethylene glycol monobutyl ether solution (c = 250 g/l)
Method E : 5 g of surfactant + 25 g of diethylene glycol monobutyl ether solution (c = 250 g/l)

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*** *Applying Harkins-Jordan correction.*

Lutensol®		TO 12	TO 129	TO 15	TO 20	TO 389
Physical form (23 °C)		Paste	Liquid	Paste	Paste	Liquid
Degree of ethoxylation		approx. 12	approx. 12	approx. 15	approx. 20	approx. 7
Concentration	%	approx. 100	approx. 85	approx. 100	approx. 100	approx. 90
Cloud point (EN 1890)*						
Method A	°C	approx. 93	approx. 93	>100	>100	–
Method B	°C	approx. 75	approx. 75	approx. 80	approx. 86	–
Method C	°C	approx. 62	approx. 62	approx. 66	approx. 73	–
Method D	°C	approx. 87	approx. 87	approx. 88	approx. 90	approx. 72
Method E	°C	approx. 88	approx. 88	approx. 89	approx. 92	approx. 70
Molar mass (calculated from hydroxyl number)	g/mol	approx. 750	approx. 750	approx. 850	approx. 1000	approx. 500
pH (5% in water)**		approx. 7	approx. 7	approx. 7	approx. 7	approx. 7
Density (DIN 51757, 23 °C)	g/cm^3	approx. 0.99 (60 °C)	approx. 1.04	approx. 1.00 (60 °C)	approx. 1.02 (60 °C)	approx. 0.99
Dropping point (DIN 51801)	°C	approx. 30	approx. 8	approx. 33	approx. 38	approx. 5
Congealing point (ISO 2207)	°C	approx. 20	<5	approx. 22	approx. 26	<5
Melting point	°C	approx. 29		approx. 31	approx. 36	
Viscosity (EN 12092, 23 °C, Brookfield, 60 rpm)	mPa·s	approx. 40 (60 °C)	approx. 200	approx. 50 (60 °C)	approx. 60 (60 °C)	approx. 100
Hydroxyl number (DIN 53240)	mgKOH/g	approx. 75	approx. 75	approx. 65	approx. 55	approx. 110
Hydrophilic-lipophilic balance		approx. 14.5	approx. 14.5	approx. 15.5	approx. 16.5	approx. 12
Flash point (DIN 51376)	°C	>100	>100	>100	>100	>100
Wetting power (EN 1772, in distilled water with 2 g/l soda ash at 23 °C)						
0.5 g/l	s	approx. 120	approx. 120	approx. 160	>300	approx. 70
1.0 g/l	s	approx. 50	approx. 55	approx. 90	>300	approx. 30
2.0 g/l	s	approx. 20	approx. 20	approx. 40	approx. 200	approx. 10
Foam formation (EN 12728, 40 °C, 2 g/l in water with 1.8 mmol Ca^{2+}-Ions/l, after 30 sec)	cm^3	approx. 600	approx. 600	approx. 600	approx. 600	approx. 90
Surface tension*** (EN 14370, 1 g/l in distilled water at 23 °C)	mN/m	approx. 31	approx. 31	approx. 32	approx. 36	approx. 27

* *Cloud point according to EN 1890:*
Method A : 1 g of surfactant + 100 g of distilled water
Method B : 1 g of surfactant + 100 g of NaCl solution (c = 50 g/l)
Method C : 1 g of surfactant + 100 g of NaCl solution (c = 100 g/l)
Method D : 5 g of surfactant + 45 g of diethylene glycol monobutyl ether solution (c = 250 g/l)
Method E : 5 g of surfactant + 25 g of diethylene glycol monobutyl ether solution (c = 250 g/l)

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*** *Applying Harkins-Jordan correction.*

The above information is correct at the time of going to press. It does not necessarily form part of the product specification.

A detailed product specification is available from your local BASF representative.

Solubility

Details on the solubility of the Lutensol® TO types in various solvents are given in the table below.

Solubility of the Lutensol® TO types (10% solutions at 23 °C)

	Distilled water	Potable water (approx. 2.7 mmol Ca^{2+}-ions/l)	Caustic soda (5%)	Hydro-chloric acid (5%)	Salt solution (5%)	Mineral oils	Alcohols	Aromatic hydro-carbons
Lutensol® TO 2	–	–	–	–	–	+	+	+
Lutensol® TO 3	–	–	–	–	–	+	+	+
Lutensol® TO 5	–	–	–	–	–	+	+	+
Lutensol® TO 6	–	–	–	–	–	+	+	+
Lutensol® TO 65	–	–	–	–	–	+	+	+
Lutensol® TO 7	–	–	–	–	–	+	+	+
Lutensol® TO 79	–	–	–	–	–	+	+	+
Lutensol® TO 8	+	+	–	+	+	(+)	+	–
Lutensol® TO 89	+	+	+	+	+	+	+	–
Lutensol® TO 10	+	+	+	+	+	–	+	–
Lutensol® TO 109	+	+	+	+	+	(+)	+	–
Lutensol® TO 12	+	+	+	+	+	–	+	–
Lutensol® TO 129	+	+	+	+	+	(+)	+	–
Lutensol® TO 15	+	+	+	+	+	–	+	–
Lutensol® TO 20	+	+	+	+	+	–	+	–
Lutensol® TO 389	–	–	–	–	–	(+)	+	+

\+ = *Clear solution*
(+) = *Sparingly soluble*
– = *Insoluble*

Viscosity

The relationship between viscosity and temperature is always an important point to consider as far as storage and shipping are concerned. This is shown in the following diagram (mPa·s, Brookfield LVT).

Viscosity at °C	0	10	20	23	30	40	50	60
Lutensol® TO 2	150	80	40	30	20	<20	<20	<20
Lutensol® TO 3	350	130	60	50	30	<20	<20	<20
Lutensol® TO 5	>100000	2500	80	70	40	25	<20	<20
Lutensol® TO 6	>100000	8000	100	75	50	30	<20	<20
Lutensol® TO 65	16500	1700	600	100	70	30	25	20
Lutensol® TO 7	solid	25000	140	90	70	30	20	<20
Lutensol® TO 79	550	250	130	110	75	50	30	20
Lutensol® TO 8	solid	solid	>100000	300	75	50	40	20
Lutensol® TO 89	1200	250	160	120	70	40	25	20
Lutensol® TO 10	solid	>100000	>100000	50000	110	45	30	20
Lutensol® TO 109	1000	400	200	170	110	70	40	30
Lutensol® TO 12	$>10^5$	$>10^5$	$>10^5$	20000	800	200	80	40
Lutensol® TO 129	1200	650	280	200	150	80	50	35
Lutensol® TO 15	$>10^5$	$>10^5$	$>10^5$	30000	1500	250	100	50
Lutensol® TO 20	$>10^5$	$>10^5$	$>10^5$	$>10^5$	2000	300	120	60
Lutensol® TO 389	700	350	130	100	70	35	30	20

We would recommend preparing stock solutions with a concentration of 10 – 25% if the Lutensol® TO types are to be used in the form of very dilute solutions or if they are to be mixed with other solutions. This makes it very much easier to dilute them later on.

The rate at which the Lutensol® TO types dissolve can be increased by adding alcohols, glycols and other solubilizers.

The Lutensol® TO types can form fairly stiff gels at certain concentrations when water is added. The figures below were measured with a Brookfield viscometer at 23 °C and 60 rpm.

The viscosity of selected Lutensol® TO types as a function of concentration (in mPa·s)

Water content (%)	Lutensol®					
	TO 2	**TO 3**	**TO 5**	**TO 6**	**TO 65**	**TO 7**
10	50	70	80	110	120	120
20	100	80	140	4000	150	$>10^5$
30	130	160	30000	33000	35000	$>10^5$
40	120	200	30000	6000	40000	$>10^5$
50	100	200	$>10^5$	2000	28000	15000
60	70	200	$>10^5$	1000	8000	170
70	20	200	30000	300	2500	180
80	10	30	1000	200	700	270
90	10	20	280	70	150	80

Water content (%)	Lutensol®				
	TO 79	**TO 8**	**TO 89**	**TO 10**	**TO 109**
10	$>10^5$	170	$>10^5$	160	$>10^5$
20	$>10^5$	$>10^5$	$>10^5$	250	$>10^5$
30	$>10^5$	$>10^5$	27000	$>10^5$	$>10^5$
40	15000	27000	70000	850	$>10^5$
50	170	70000	$>10^5$	$>10^5$	500
60	180	$>10^5$	350	$>10^5$	250
70	270	350	30	150	100
80	80	30	20	20	30
90	50	20	10	10	20

Water content (%)	Lutensol®				
	TO 12	**TO 129**	**TO 15**	**TO 20**	**TO 389**
10	220	450	160	200	120
20	310	5000	200	250	10000
30	630	$>10^5$	600	1200	12000
40	$>10^5$	10000	$>10^5$	$>10^5$	10000
50	$>10^5$	300	$>10^5$	$>10^5$	1000
60	3860	100	600	$>10^5$	500
70	100	50	100	400	200
80	30	20	40	50	150
90	10	10	20	20	20

Safety

We know of no ill effects that could have resulted from using the Lutensol® TO types for the purpose for which they are intended and from processing them in accordance with current practice.

According to the experience we have gained over many years and other information at our disposal, the Lutensol® TO types do not exert any harmful effects on health, provided that they are used properly, due attention is given to the precautions necessary for handling chemicals, and the information and advice given in our safety data sheets are observed.

Labelling

Please refer to the latest safety data sheets for detailed, up-to-date information on classification, labelling and product safety.

Note

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