



ACUDYNE™ 180 Hair Fixative Resin

A firm hold, extremely low tack, fast drying polymer for hair sprays and other styling products.

Description

ACUDYNE™ 180 Hair Fixative Resin is an aqueous acrylic emulsion polymer that upon neutralization yields clear hair spray solutions and crystal-clear films on hair.

Feature	Benefit	Enabling Mechanism
<ul style="list-style-type: none"> Polymer Structure and Composition 	<ul style="list-style-type: none"> Virtually no tack on hair during application or re-tack in humid environment – even in alcohol-free gels Unmatched humidity resistance No build-up on hair Compatible in: <ul style="list-style-type: none"> - 55-80% VOC pump sprays - DME and Dymel HFC 152a aerosols, or DME/hydrocarbon aerosols where DME is dominant propellant alcohol-free or alcohol containing gels 	<ul style="list-style-type: none"> Hydroxyl groups on polymer enable formulation compatibility with water or aqueous alcoholic systems while also being humidity resistant in sprays, gels, and mousses
<ul style="list-style-type: none"> Excellent process control 	<ul style="list-style-type: none"> No resin build-up on hair, firmer hold without the wet feel, Faster dry times More formulation options because viscosity is not as much of a limitation 	<ul style="list-style-type: none"> Narrow polymer chainlength distribution means firmer hold and fine spray droplets
<ul style="list-style-type: none"> Supplied in Emulsion Form 	<ul style="list-style-type: none"> Quick and easy to formulate 	<ul style="list-style-type: none"> Low viscosity, dissolved by neutralization
<ul style="list-style-type: none"> Corrosion Technology 	<ul style="list-style-type: none"> Stable in tin-plate aerosol cans in the presence of corrosion inhibitors No plastic liners needed 	<ul style="list-style-type: none"> No corrosion causing salts
<ul style="list-style-type: none"> Economical 	<ul style="list-style-type: none"> Attractive formulation economics 	<ul style="list-style-type: none"> Leverage Dow process and manufacturing competence

Chemical Properties

Chemistry

ACUDYNE™ 180 Hair Fixative Resin is a linear, random tetra polymer of methacrylic acid, hydroxyethyl methacrylate, methyl methacrylate and butyl acrylate. It is manufactured as an emulsion in water, with tight molecular weight control. In this form, it is easy and fast to formulate into liquids or gels.

Film Properties

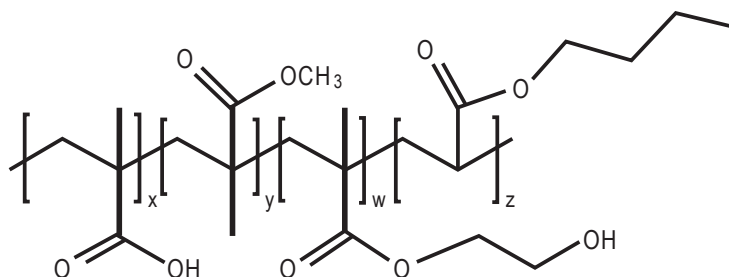
ACUDYNE 180 gives optimum film tensile strength and high humidity curl retention when about 50 to 70% of the polymer acid sites are neutralized with aminomethyl propanol. In this range, the films are very humidity resistant. At 92% relative humidity, the film absorbs only about 0.4% water after 24 hours.

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ACUDYNE™ 180 Hair Fixative Resin

Structure



Physical Properties

The following are typical properties of ACUDYNE™ 180 Hair Fixative Resin; they are not to be considered product specifications.

Trade name:	ACUDYNE™ 180
INCI name:	Acrylates/Hydroxyesters Acrylates Copolymer
Appearance:	Emulsion in water (neutralizes to clear solution)
Solids:	47.5 to 48.5%
pH:	3.3 - 4.3
Acid level, mmoles/gram active:	1.90 - 2.30
Tg:	~ 90°C
Molecular weight:	~ 90,000
Preservative:	0.75% Benzoic acid

Hair Spray Application Data

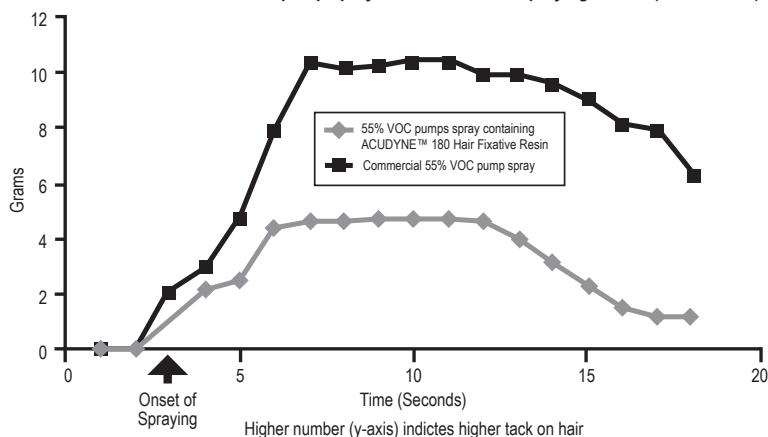
When partially neutralized in a 55% VOC water/ethanol mixture, ACUDYNE 180 gives uncompromising performance. It provides low tack on hair versus other resins, the best humidity resistance, and a firm hold tunable from medium to very stiff out of pump or aerosol hair sprays.

A. Extremely low tack and dry time on hair and no re-tack on hair

ACUDYNE 180 offers extremely low magnitude of tack during drying versus any other resin we have measured.

Curled hair swatches were sprayed 3 times with 55% VOC pump hair spray while in a miniature tensile tester. The force required to disengage the probe from the curled tress was measured over the time it took to dry.

A. Magnitude of Tack on hair comparing 55% VOC ACUDYNE™ 180 Hair Fixative Resin pump and commercial 55% VOC pump spray from the onset of spraying on hair (t=3 seconds)



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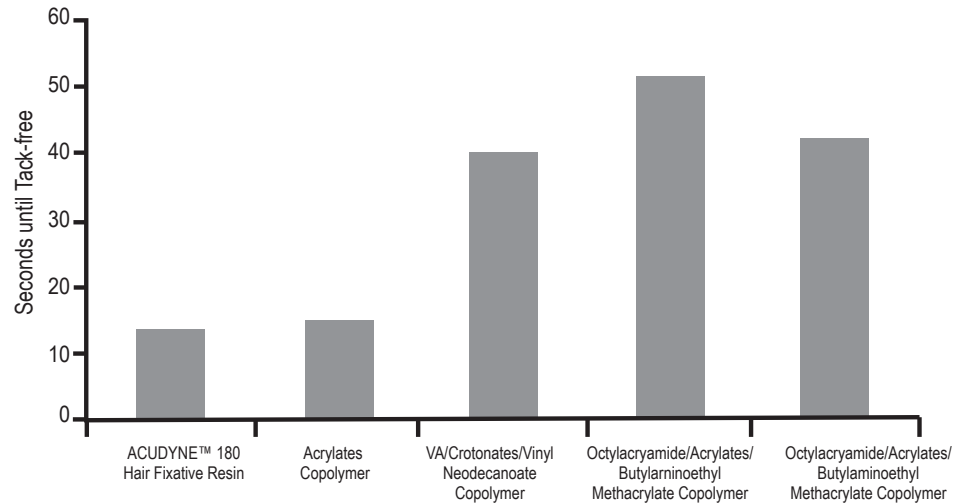
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B. Lowest Duration of Tack on Hair after spraying

ACUDYNE™ 180 Hair Fixative Resin provides the fastest drying time of any resins evaluated.

Tack was measured after applying 3 sprays to the hair tress and measuring the time it took for panelists to indicate the absence of tack on hair.

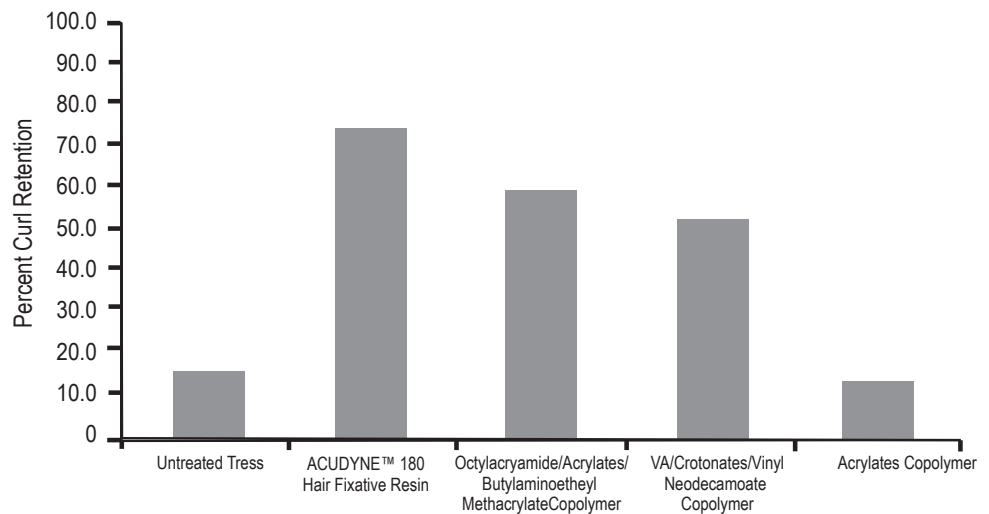
B. ACUDYNE™ 180 Hair Fixative Resin has the Lowest Duration of Tack on Hair after Spraying



C. Uncompromised Humidity resistance

ACUDYNE 180 has the best humidity resistance on hair versus a host of other resins.

C. Aerosol High Humidity Curl Retention after 4 hrs at 94% RH, 23°C



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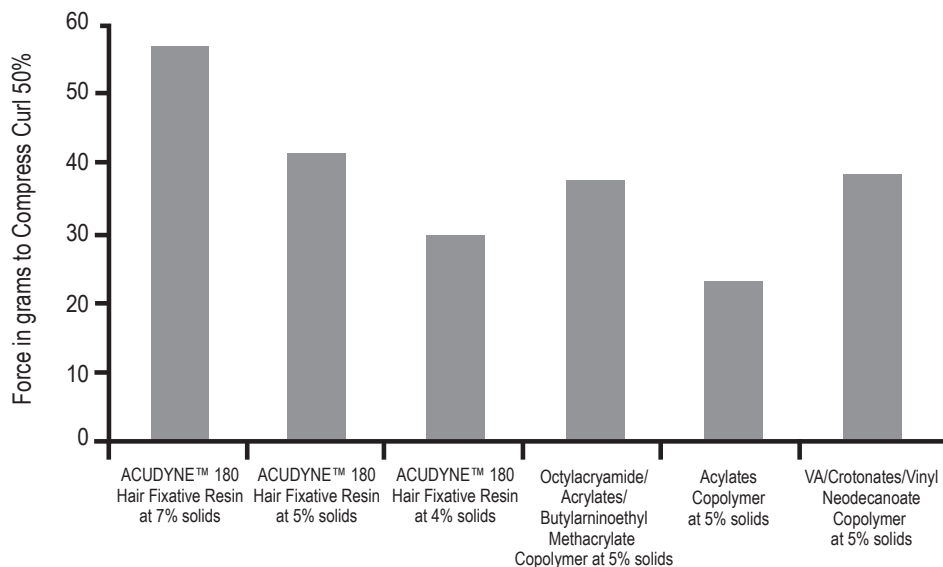
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D. Easy Tunability of Hold, from Firm to Very Firm Hold

ACUDYNE™ 180 Hair Fixative Resin gives a firm hold on hair without build-up or flaking and while retaining easy comb through and shampoo removability. Firmness of hold is tunable, depending on the concentration of resin in the formulation, choice of valve, and degree of neutralization. (See formulation guidelines.)

Method: Firmness is measured using a Diastron Miniature Tensile Tester. Tresses were compressed one time to 50% of the initial curl diameter.

D. Firmness Assessment of Pump Formulations



E. Overall Aesthetics on Hair in 55% VOC pump sprays: Curl Memory, Combing, Build-up

ACUDYNE 180 provides firm hold to hair while maintaining easy comb, curl memory, and low tack versus other resins. These properties, while difficult to measure instrumentally, are critical to the acceptability and appeal of any hair resin. To determine the performance of ACUDYNE 180 as compared to other commercial resins, a panel of trained panelists rated the polymer for a variety of aesthetic features.

ACUDYNE 180 was found to provide the best combination of properties in this evaluation as detailed in the table below.

	No Build-Up	Ease of Comb-through	Curl Memory	Tack Dry Time	Humidity Resistance	Hold and Feel
ACUDYNE™ 180 Hair Fixative Resin	★	●	●	★	★	★
VA Crotonates/vinyl neodecanoate	■	■	■	■	●	■
Octylacrylamide/acrylates/butyl aminomethacrylate Copolymer	●	●	●	■	★	★
Acrylates Copolymer	●	■	■	●	■	■

★ Superior ● Good ■ Fair

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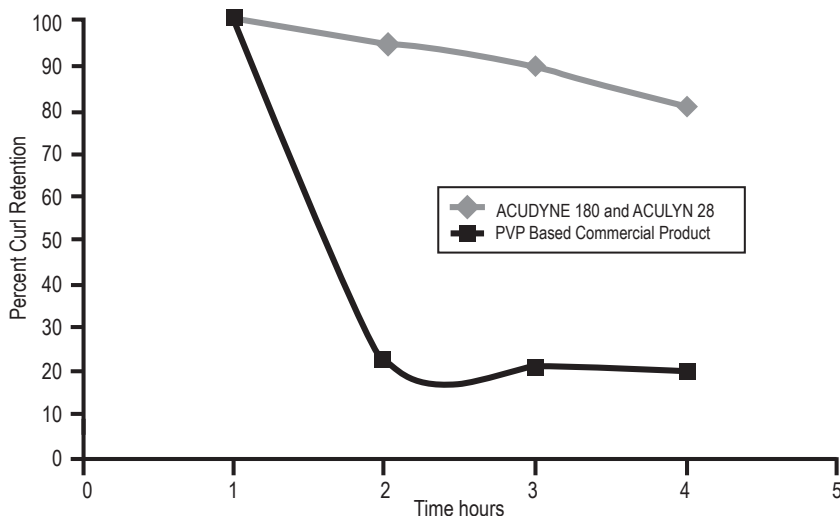
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Hair Gel Application Data

A. ACUDYNE™ 180 Hair Fixative Resin provides far superior humidity resistance versus PVP in alcohol-free gels.

As demonstrated in the graph, ACUDYNE 180 achieves excellent high humidity curl retention for 4 hours at 94% relative humidity.

A. Percent Curl Retention in Alcohol-Free Gels



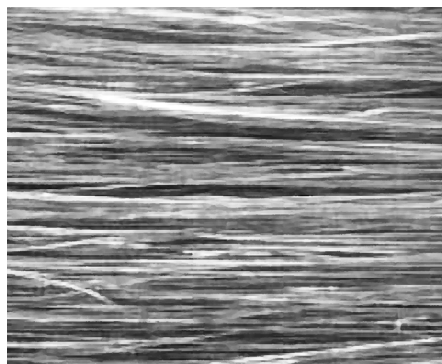
B. ACUDYNE™ 180 Hair Fixative Resin is non-flaking on hair versus PVP as shown in photomicrographs below.

Note flaking of resin on hair



Hair gel containing PVP

Note resin remains unflaked on hair



Hair gel containing ACUDYNE™ 180 Hair Fixative Resin

Neutralization

$$X = \frac{A * B * C *}{E * 1000}$$

X = grams of neutralizing agent

A = 2.1 mmoles acid/g solid

NOTE: Certificate of analysis may vary this value and adjust accordingly

B = grams of polymer solids

C = molecular weight of neutralizing agent

D = % neutralization desired

E = % solids of neutralization agent

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Neutralizing with Aminomethyl propanol.

Aminomethyl propanol (AMP-95®) has a molecular weight of 89 g/mole.
It is 95% solids as supplied.

How many grams of AMP-95 is required to neutralize 5 grams of ACUDYNE™ 180 Hair Fixative Resin solids to 60% neutralization?

$$X \text{ gr AMP-95} = \frac{2.1(\text{mmoles}) \times 5(\text{grams}) \times 89(\text{grams/mole}) \times 60}{95 \times 1000} = 0.59 \text{ grams AMP-95}$$

% Neutralization Chart using AMP-95 based on 2.1 mmoles acid/g solid

	50% Ntr	60% Ntr	70% Ntr	80% Ntr	90% Ntr	100% Ntr
1 gram polymer solids	0.10	0.12	0.14	0.16	0.18	0.20
3 grams polymer solids	0.30	0.35	0.41	0.47	0.53	0.59
5 grams polymer solids	0.49	0.59	0.69	0.79	0.89	0.98
7 grams polymer solids	0.69	0.83	0.96	1.10	1.24	1.38
9 grams polymer solids	0.89	1.06	1.24	1.42	1.59	1.77

Formulations and Procedures - Pump Sprays

ACUDYNE™ 180 Hair Fixative Resin can be formulated into pump sprays by this procedure:

1. Add the ethanol and water to the mixing kettle.
2. Add the neutralization agent and stir until uniform.
3. Add the ACUDYNE™ 180 polymer to the mixing solution at a rate such that the emulsion disperses as it contacts the stirring solution.
4. Add plasticizer and fragrance.

These solutions rapidly turn clear. Formulation viscosities are between 10 to 12 cPs for 55% VOC hair sprays and 7 to 10 cPs for 80% VOC hair sprays, depending on resin concentration.

55% VOC, Firm Hold Pump (ACK 3060)

Trade Name	% Wt.	CTFA / INCI Name	Supplier
Water	34.0	Water	
Ethanol	55.0	Alcohol Denatured	
ACUDYNE™ 180 Hair Fixative Resin (48.5%)	10.4	Acrylates/Hydroxyesters Acrylates Copolymer	Dow
AMP-95®	0.5	Aminomethyl Propanol	Dow
Dow Corning 193 fluid	0.10	Dimethicone Copolyol	Dow Corning

Valving: Seaquist Perfect Euromist Optima, (160 µL), 0.014" x 0.010" deep. 0.060" tubing i.d.

Product Characteristics

Parameter	Range	Method
Viscosity	11.0 -12.0 cPs	Brookfield LV viscometer, Spindle #1, 60 rpm
pH	7.3-7.8	pH meter
Appearance	Clear	Visual

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55% VOC, Extra Firm Hold Pump (ACK 3093C)

Trade Name	% Wt.	CTFA / INCI Name	Supplier
Water	29.43	Water	
Ethanol	55.0	Alcohol Denatured	
ACUDYNE™ 180 Hair Fixative Resin (48.5%)	14.5	Acrylates/Hydroxyesters Acrylates Copolymer	Dow
AMP-95®	0.77	Aminomethyl Propanol	Dow
Dow Corning 193 fluid	0.10	Dimethicone Copolyol	Dow Corning
Panthenol 50 USP	0.20	Panthenol	BASF

Valving: Seaquist Perfect Euromist Optima, (160 µL), 0.014" x 0.010" deep, 0.060" tubing i.d.

Product Characteristics

Parameter	Range	Method
Viscosity	11.0 -12.0 cPs	Brookfield LV viscometer, Spindle #1, 60 rpm
pH	7.3-7.8	pH meter
Appearance	Clear	Visual

Formulations and Procedures - Aerosol Sprays

Processing Instructions for Aerosol Hair Sprays:

1. Add the alcohol and water to the mixing kettle followed by aminomethyl propanol. Stir until the mixture is uniform.
2. Add the ACUDYNE™ 180 Hair Fixative Resin to the mixing solution at a rate such that the emulsion disperses as it contacts the stirring solution. Stir until clear.
3. Add the Panthenol and the Monacor BE to the mixing solution at a rate such that the emulsion disperses as it contacts the stirring solution.
4. Charge propellant to aerosol can.

55% VOC, Firm Hold, Aerosol Hair Spray with DME Propellant (ACK 3094B)

Trade Name	% Wt.	CTFA / INCI Name	Supplier
Water	29.43	Water	
Ethanol	20.0	Alcohol Denatured	
ACUDYNE™ 180 Hair Fixative Resin (48.5%)	14.5	Acrylates/Hydroxyesters Acrylates Copolymer	Dow
AMP-95®	0.77	Aminomethyl Propanol	Dow
D-Panthenol 50 USP	0.10	Panthenol	BASF
Monacor BE	0.20	MEA Borate	Uniqema
Dymel A	35.0	Dimethyl Ether	DuPont

Valving: Seaquist ST-74, 0.013" stem, 0.015" vapor tap with Actuator ST-150 Gentle Mist, 0.018" Gentle Mist

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Product Characteristics

Parameter	Range	Method
Viscosity of concentrate	11.0 -12.0 cPs	Brookfield LV viscometer, Spindle #1, 60 rpm
pH	7.3-7.8	pH meter
Appearance	Clear	Visual

This formulation passed 90 day corrosion testing at 45° C in tin-plate aerosol cans.

Formulations and Procedures - Alcohol-Free Gels

Processing Instructions for alcohol-free gel:

1. Blend ACULYN™ 28 Rheology Modifier/Stabilizer and ACULYN™ 22 Rheology Modifier/Stabilizer with about half of the water (46 mL).
2. In a separate container with stirring, add the remaining water, aminomethyl propanol, ACUDYNE™ 180 Hair Fixative Resin and propylene glycol and stir until uniform. Gradually add in NEOLONE™ 950.
3. Add the mixture to the ACULYN 28/22 emulsion with stirring at 400 to 450 rpm with an overhead stirrer. Stir until clear.

Sculpting Alcohol-free Hair Gel (ACK-3062)

Trade Name	% Wt.	CTFA / INCI Name	Supplier
Water	93.59	Water	
ACUDYNE™ 180 Hair Fixative Resin (48.5%)	2.06	Acrylates/Hydroxyesters Acrylates Copolymer	Dow
AMP-95®	0.24	Aminomethyl Propanol	Dow
Propylene Glycol	1.0	Propylene Glycol	BASF
NEOLON™ 950	0.11	Methylisothiazolinone	Dow
ACULYN 28	3.0	Acrylates/Beheneth-25 Methacrylate Copolymer	Dow

Valving: Seaquist Perfect Euromist Optima, (160 mL), 0.014" x 0.010" deep, 0.060" tubing i.d.

Product Characteristics

Parameter	Range	Method
Viscosity	18,000-22,000 cPs	Brookfield LV viscometer, Spindle #6, 20 rpm
pH	6.0-7.0	pH meter
Appearance	Clear	Visual

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Smooth Flow Alcohol-free Gel (ACK-3116)

Trade Name	% Wt.	CTFA / INCI Name	Supplier
Water	92.94	Water	
ACUDYNE™ 180 Hair Fixative Resin (48.5%)	2.06	Acrylates/Hydroxyesters Acrylates Copolymer	Dow
ACULYN™ 28 (20%) Rheology Modifier/Stabilizer	3.0	Acrylates Beheneth-25 Methacrylate Copolymer	Dow
ACULYN™ 22 (30%)	0.65	Acrylates Steareth-20 Methacrylate Copolymer	Dow
AMP-95®	0.24	Aminomethyl Propanol	Dow
Propylene Glycol	1.0	Propylene Glycol	BASF
NEOLONE™ 950 (9.5%)	0.11	Methylisothiazolinone	Dow

Product Characteristics

Parameter	Range	Method
Viscosity	30.00-45,000 cPs	Brookfield LV viscometer, Spindle #6, 20 rpm
pH	7.0-7.5	pH meter
Appearance	Clear	Visual

Toxicity

For product safety information, refer to Safety Data Sheet (SDS).

ACUDYNE 180 is cleared under the major chemical inventories such as MITI, EINECS, TSCA, AICS and Canada. Dow is waiting approval of the proposed INCI name by the CTFA.

Handling Precautions

Before using this product, consult the Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS) for details on product hazards, recommended handling precautions and product storage.

Storage

Store products in tightly closed original containers at temperatures recommended on the product label.

Disposal Considerations

Dispose in accordance with all local, state (provincial) and federal regulations. Empty containers may contain hazardous residues. This material and its container must be disposed in a safe and legal manner.

It is the user's responsibility to verify that treatment and disposal procedures comply with local, state (provincial) and federal regulations. Contact your Dow Technical Representative for more information.

Dow is a member of the American Chemistry Council (ACC) and is committed to the ACC's Responsible Care® Program.

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Product Stewardship

Dow has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our product stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with Dow products – from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

Customer Notice

Dow strongly encourages its customers to review both their manufacturing processes and their applications of Dow products from the standpoint of human health and environmental quality to ensure that Dow products are not used in ways for which they are not intended or tested. Dow personnel are available to answer your questions and to provide reasonable technical support. Dow product literature, including Safety Data Sheets (SDS), should be consulted prior to use of Dow products. Current Safety Data Sheets are available from Dow.

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