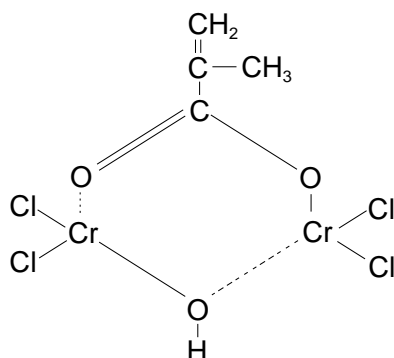




Volan®

bonding agents

Coupling Agents and Adhesion Promoters for Composites



Cr (III) Methacrylate Surface Active Agent

Product Overview

Volan® bonding agents are formulated solutions containing unique surface-complexing monomers of chromium (III) methacrylate. During application, the active molecules attach to inorganic or polar substrate surfaces and orient themselves with polymerizable groups outward, to permit combination with a wide variety of thermosetting resins:

- Polyester
- Epoxy
- Phenolic
- Vinyl
- Acrylic
- Polyvinyl Acetate

The ability of Volan® to attach securely to inorganic or polar surfaces allows it to develop tenacious bonds to substrates such as:

- Glass
- Metals
- Polymers
- Silica
- Boron
- Natural fibers

Chemical and Physical Properties

Two types of Volan® are supplied commercially: Volan® and Volan® L, the latter with reduced chloride content to eliminate or minimize the washing required in finishing a substrate such as glass fabric.

Physical properties and typical analyses are shown in **Tables 1** and **2**.

Table 1

Physical Properties	Volan®	Volan® L
Appearance	Dark Green	Dark Green
Odor	Alcoholic	Alcoholic
Boiling Point, °C (°F)	79 (174)	77 (171)
Flash Point (Tag Open Cup), °C (°F)	6 (43)	7 (45)
Specific Gravity at 20°C (68°F) (approx.)	1.02	0.95
pH of 1% H ₂ O Solution	3.1	3.1
Stability	Negligible deterioration with time	Negligible deterioration with time

Table 2

Typical Analyses	Volan®	Volan® L
Chrome Complex, % (active ingredient)	19–21	17–18
% Chromium	6.0	6.0
% Chloride	8.2	3.2
% Methacrylic acid	5.1	5.1
Solvent Carrier, %	79–81	82–83
% Isopropanol	40	56
% Acetone	10	10
% Water	30	16

Note: **Tables 1** and **2** give typical properties based on historical production performance. DuPont does not make any expressed or implied warranty that this product will continue to have these typical properties.

Warning

Volan® and Volan® L cause eye burns and skin, nose, and throat irritation. They are also flammable liquids. See "Personal Safety and First Aid" on page 3.

Volan® and Volan® L are completely miscible with water and their performance is not affected by normal water hardness. However, hard or otherwise contaminated water is always suspect if the treating solutions are not clear or if neutralization by the recommended procedures results in precipitation of the complex.

Volan® bonding agent begins to polymerize if it is diluted with water and if alkali is added. It is the partly polymerized complex that permits effective bonding between a resin and a hydroxylic surface. The diluted Volan® should be neutralized to a pH of 6.2. Once the solution has been neutralized, no additional pH adjustment should be made, even though the pH can drop as the solution ages and polymerization proceeds. Any precipitated complex due to over-neutralization or mixing with incompatible material should be discarded. Precipitated complex will not produce surfaces that permit effective bonding.

Suggested Uses

Size for Glass Fiber Roving Reinforcement

By far the most important use for Volan® is as a finish for glass fiber roving, which is then used as the reinforcement agent in unsaturated polyester resins. Volan® is a key component of the “chrome” size, which is applied by padding on strands at the bushings during glass fiber manufacture. The effectiveness of Volan® with standard polyvinyl acetate binders is related to its compatibility with the emulsion stabilizer system used in the polyvinyl acetate.

Volan® also serves as an anti-static agent. Chopped strands and rovings sized by treatment with Volan® combine rapid wetting and good laminate strengths with ease of cutting and low static charge. Processors recognize all these properties as vital to trouble-free processing, particularly with gun rovings.

Coating on Silica Microspheres or Fillers

Volan® bonding agents can be used as both an adhesion promoter and anti-static surface coating on silica microspheres. The presence of a Volan® coating increases the bonding of the microspheres or filler to the polymer substrate, and also gives easy-flowing handling characteristics.

Finish for Glass Fabric Reinforcement

Volan® is usually applied to glass fabric by a treating and washing step known throughout the industry as the “A” finish. This finish was qualified under military specification MIL-F-9118A, dated October 11, 1954.

Typical laminate performance of the “A” finish on 181-type glass fabric is shown in **Tables 3** and **4**.

Volan® and Volan® L may be applied to any heat-cleaned glass fabric. The only difference in applying Volan® L is the amount of neutralizer required, due to its lower chloride content.

Preparation of Treating Solutions of Volan® or Volan® L

1. Make a solution of 1.5 to 2.0% by weight of Volan® or Volan® L in water.
2. Neutralize diluted Volan® or Volan® L to a pH of 6.0–6.5 by adding 2.2 parts of 1% NH₃ solution for each part of Volan® or Volan® L commodity.

Application to Glass Cloth (“A” Type Finish)

1. Dip fabric to a loading of 0.50–0.80% commodity or 0.03–0.05% chromium on dry basis weight of fabric. This requires a wet add-on of approximately 40%.
2. Dry and heat-cure (dryness, with a surface temperature of about 120°C [248°F]).
3. Wash the fabric in water by immersion, spraying, or both.
4. Dry again. The glass temperature must not exceed 120°C (248°F).

Coupling Agent on Pigments and Mica Fillers

When used as a coupling agent on pigments or fillers, Volan® bonding agents promote polymer reinforcement by activating the filler surfaces. Any tendency for the mica or filler not to adhere to the polymer resin is eliminated by making the different surfaces compatible. Rapid wetting of the pigment and subsequent enhancement of film or laminate strengths are recognized benefits of using fillers coated with Volan®.

Metal Surface Preparation for Bonding

In critical bonding applications such as honeycomb-to-metal, Volan® may offer one-step degreasing, cleaning, and surface activation. A solution of Volan® in acetone or other solvent can serve as the primary grease or film remover, while depositing a complex surface monomer for polyimide or epoxy co-bonding.

Adhesion Promoter for Inks

As a component or activating agent for printing inks, Volan® aids in the cure of polymer resins used in ink formulations, and also promotes adhesion to paper and other substrates containing calcium carbonate or titanium dioxide.

Storage and Handling

Volan® and Volan® L are OSHA Class 1B flammable mixtures with a Tag Closed Cup flash point of 2°C (36°F). Keep container closed and away from heat, sparks, and open flames. Use with adequate ventilation and ground all handling equipment. Electrical

Table 3
Typical Laminate Properties—"A" Finish With Volan®
181 Glass Fabric—Reinforced Polyester Resin (61% glass content—0.122 in. laminate thickness)

Finish	Flexural Strength Pa (× 10 ³ psi)		Flexural Modulus × 10 ³ Pa (× 10 ⁶ psi)		Compressive Strength Pa (× 10 ³ psi)		Tensile Strength Pa (× 10 ³ psi)	
	Dry	2-hr Boil	Dry	2-hr Boil	Dry	2-hr Boil	Dry	2-hr Boil
Distilled Water	409 (59.3)	252 (36.6)	17 (2.5)	16.5 (2.4)	278 (40.3)	92 (13.4)	298 (43.3)	263 (38.2)
Volan®	559 (81.2)	411 (59.6)	21 (3.1)	20 (2.9)	334 (48.5)	251 (36.5)	320 (46.4)	329 (47.8)
Volan® L	550 (79.8)	469 (68.1)	21 (3.1)	21 (3.0)	349 (50.6)	281 (40.8)	333 (48.4)	340 (49.3)

Table 4
181 Glass Fabric—Reinforced Epoxy Resin

Finish	Resin System	% Glass	Flexural Strength Pa (× 10 ³ psi)		Flexural Modulus × 10 ³ Pa (× 10 ⁶ psi)	
			Dry	2-hr Boil	Dry	2-hr Boil
Volan®	100 parts "EPON" 828,* 90 parts "NADIC" ** methyl anhydride, 1 part Benzyl dimethylamine	76.3	655 (95.0)	620 (90.0)	28 (4.1)	25 (3.7)
Volan® L	100 parts "EPON" 828, 15 parts metaphenylene diamine	77.9	637 (92.4)	458 (66.4)	27 (3.9)	28 (4.0)

*Shell Chemical Company
 **Allied Chemical Company

equipment in the area should be explosion-proof. OSHA regulations for flammable and combustible liquids are contained in Title 29 of the Code of Federal Regulations (CFR) Section 1910.106 and must be followed when handling Volan®.

Store Volan® in cool areas out of direct sunlight. Storage at temperatures above 43°C (109°F) for extended periods may cause degradation of the complex.

Solutions of Volan® are corrosive. Glass, Monel,¹ polyethylene, and polyvinyl chloride are acceptable materials of construction.

In case of spills or leaks, eliminate all sources of ignition and evacuate the area until the vapors have dispersed. Wear full chemical-proof suit with air supply. Soak up with sand, earth, or other noncombustible absorbent material and dispose of in covered metal containers. Obey federal, state, and local regulations for reporting releases. The CERCLA reportable quantity for generic ignitables is 45 kg (100 lb).

Volan® waste material may be an RCRA hazardous waste due to its generic flammability and toxicity characteristics.

Dispose of Volan® in accordance with federal, state, and local regulations. If approved, Volan® may be incinerated or drained to a chemical sewer leading to a waste treatment plant.

Personal Safety and First Aid Health Hazards

The chromium in all Volan® products is completely in the trivalent state. Unlike the hexavalent form, CR (VI), which can be toxic, the trivalent form, CR (III), is an essential trace mineral.

Volan® and Volan® L cause eye burns and irritation of skin, nose, and throat. No skin sensitization was observed in animal tests.

The U.S. Department of Labor (OSHA) has ruled that an employee's exposure to the following components of Volan® and Volan® L shall not exceed the indicated airborne exposure limits (time weighted average for 8-hour work shift of a 40-hour week²); see the MSDS:

Isopropyl alcohol—Skin	400 ppm; 980 mg/m ³
Acetone	750 ppm; 1800 mg/m ³
Chromium (III) as Cr	0.5 mg/m ³

¹ Registered U.S. trademark of International Nickel Co. Inc.

² Due to changing government regulations, such as those of the Department of Transportation, Department of Labor, U.S. Environmental Protection Agency, and the Food and Drug Administration, references herein to governmental requirements may be superseded. Each user should consult and follow the current governmental regulations, such as Hazard Classification, Labeling, Food Use Clearances, Worker Exposure Limitation, and Waste Disposal Procedures for the up-to-date requirements for the product described in this literature.

Safety Precautions

Do not get in eyes. Avoid contact with skin and clothing and avoid breathing vapor or mist. Use with sufficient ventilation to keep employee exposures below recommended exposure limits; see the MSDS. Wash thoroughly after handling. Wear chemical splash goggles and acid-proof rubber gloves when handling. Wear additional protective equipment when appropriate.

First Aid

In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash clothing before reuse.

If large amounts are inhaled, remove the person to fresh air. If the person is not breathing, give artificial respiration. If the person's breathing is difficult, give

oxygen. Call a physician. If Volan® is swallowed, do not induce vomiting. Give two glasses of water or activated charcoal slurry. Call a physician.

Shipping Containers

Volan® Bonding Agents are available in bulk, 300-gal semi-bulk tanks, 55-gal (208 L) polyethylene-lined non-returnable drums, and 15-gal polyethylene-lined drums. The Volan® drum contains 450 lb (204 kg) net, and the Volan® L drum contains 410 lb (186 kg) net.

Volan® Bonding Agents are regulated as Hazardous Materials by the Department of Transportation (DOT). The DOT proper shipping name for Volan® and Volan® L is FLAMMABLE LIQUID, CORROSIVE, N.O.S. and the DOT Hazard Class is Flammable Liquid (49 CFR 172.101, Hazardous Materials Table). The United Nations identification number is UN 2924.

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