

# Epoxy Vinyl Ester Resins Corrosion Resistance Guide

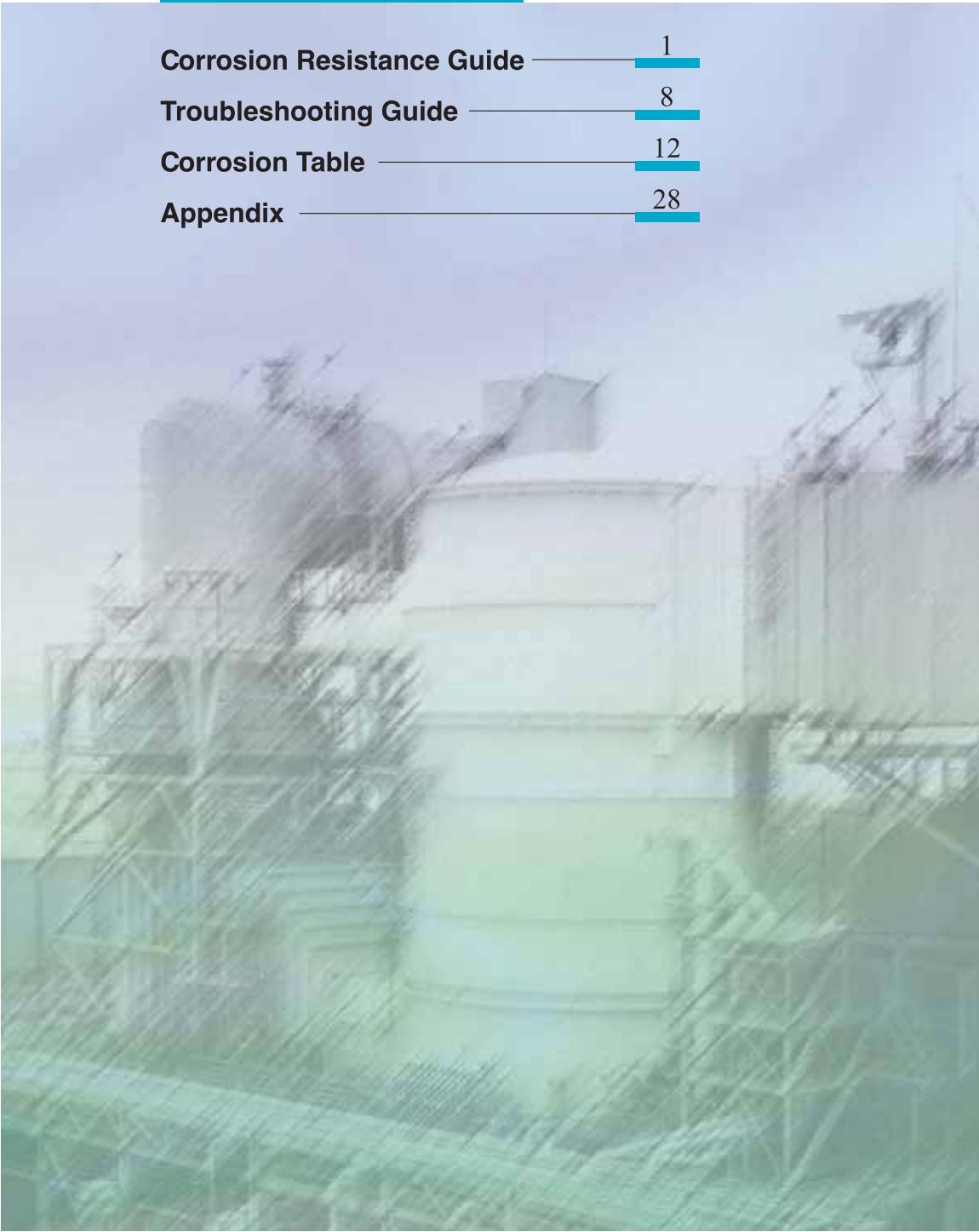


TAIWAN INNOVALUE  
WINNER

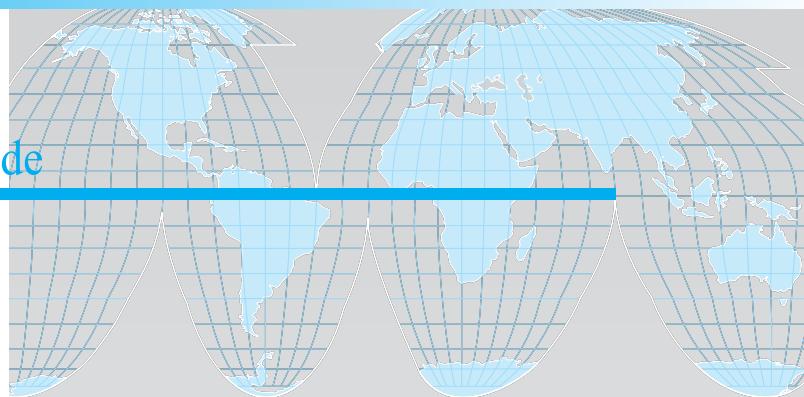


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# Epoxy Vinyl Ester Resins Corrosion Resistance Guide



## FOREWORD

SWANCOR epoxy vinyl ester resins are designed to meet the demands of the Fiber Reinforced Plastic (FRP) industry when corrosion resistance performance is critical. SWANCOR and SWANCOR CHEMPULSE resins are manufactured with unique technology and it has been proved that the resins present excellent chemical resistant properties, also maintaining good physical properties in recommended environments in practical field experience.

This guide is designed to assist the designers and fabricators in selecting the suitable resins for FRP parts which will be exposed to highly corrosive environments. It is important to note that these recommendations are intended as a guide only. Construction of laminates can vary from shop to shop and it is beyond Swancor's control, therefore no warranty will be made by Swancor based on information given in this guide. It is highly advisable that fabricators should conduct small-scale evaluation under specific conditions of intended applications before starting full-scale production.



We trust the information and data provided in this bulletin are based on our best knowledge. The recommendations or suggestions herein are made without any warranty, guaranty or implications and it is customer's responsibility to evaluate the material in their laboratory to confirm if it is appropriate before use. No liability for any damage caused due to the statement herein is to be taken. No freedom of use of any Swancor intellectual properties are granted.

# Epoxy Vinyl Ester Resins Corrosion Resistance Guide

## THE PRODUCT FAMILY

### SWANCOR and

### SWANCOR CHEMPULSE 901 Resins

These resins are Bisphenol-A type epoxy vinyl ester resins dissolved in styrene monomer. They are standard resins and the most widely used grade in FRP. They are commonly used for various fabrications such as hand lay-up, spray-up, pultrusion, filament winding and infusion etc. They present excellent mechanical properties, toughness and fatigue resistance. They also provide excellent chemical resistance against most of alkalis, acids, salt solutions and solvents that are typically used in industries.

### SWANCOR 905 Resins

These resins are Brominated Bisphenol-A type epoxy vinyl ester resins dissolved in styrene monomer, used for flame retardant applications. This material provides the excellent physical properties, and chemical resistance as good as SWANCOR or SWANCOR CHEMPULSE 901 resins, meanwhile offering excellent flame retardant capability meeting the AFPA classification based on ASTM E84 standard.



### SWANCOR 907 Resins

These resins are Novolac type epoxy vinyl ester resins dissolved in styrene monomer. The resins combine superior corrosion resistance against strong acids, oxidizing chemicals and solvents, while retaining excellent mechanical properties at elevated temperature. Some resins are designed to provide extremely high service temperature for specific application requirement.

### SWANCOR 980 Resins

These resins are Elastomer-Modified epoxy vinyl ester resins dissolved in styrene monomer. The resins present improved tensile elongation and toughness combining inherent toughness of the epoxy resin chemistry and additional reactive elastomers in production. These resins offer increased adhesion strength and also superior resistance to abrasion and severe mechanical stress. The excellent performance of their impact resistance makes them the best choice for sport parts like helmet or structure applications.

# Epoxy Vinyl Ester Resins Corrosion Resistance Guide

## CORROSION TESTING

The listing provides the maximum service temperature at different chemical environments of each SWANCOR or SWANCOR CHEMPULSE epoxy vinyl ester resins according to the ASTM C581 standard, and the criteria are:

- the known maximum temperature at which equipment made with SWANCOR or SWANCOR CHEMPULSE epoxy vinyl ester resins has given satisfactory service in field operation.
- the retention of various physical properties, based on NBS PS15-69 standard, such as Barcol hardness, flexural strength/modulus and weight change of the specimen in the lab test showing good condition.

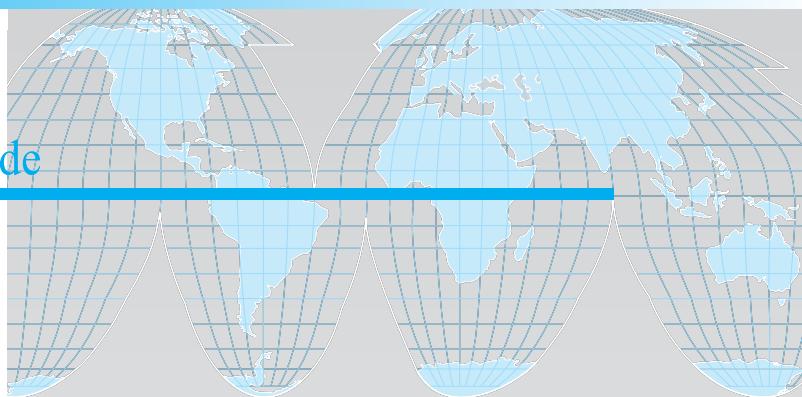
It is possible to show good service at temperatures considerably higher than those shown in the table if:

- the exposure or contact is intermittent, or
- the contact is with fumes, or
- spill is occurring.

In applying a resin building an FRP equipment for a specific environment, factors other than maximum service temperature are important including:

- Design suitability
- Type of reinforcement
- Curing system and condition
- Impurities in environment

When user encounters the following problems, They have to contact Swancor. Our chemists at our R&D team are experienced and well prepared to assist customers in providing suggestions and solutions when:



- exposure conditions is near the maximum temperature shown, or
- the environment is mixed chemicals and unlisted in corrosion table, or
- exposure chemicals are not clear.

Swancor will carry out a corrosion test according to ASTM C581, and the results will be sent to customers.

## INQUIRIES

Inquiries about the other chemicals, should be directed to:

SWANCOR IND. CO. LTD.  
NO. 9 INDUSTRY SOUTH 6 ROAD,  
NANTOU CITY 54066, TAIWAN  
TEL : 886-49-2255420 FAX : 886-49-2251534  
[swancor@swancor.com](mailto:swancor@swancor.com)

Such inquiries should include:

- The common name and, when possible, the chemical name
- Concentration of the chemical compounds.
- pH, if it is an aqueous system
- Operational temperature
- Maximum operational temperature
- Pressure
- Use in food and drug applications should be described if any

If the inquiry includes several chemical compounds, the following information is of importance.

- Are these chemicals stored separately, each in an individual tank?
- Are they stored alternately in a single tank?

# Epoxy Vinyl Ester Resins

## Corrosion Resistance Guide

### LAMINATE CONSTRUCTION

Composite products designed for corrosion resistance typically utilize a structural laminate and a corrosion barrier. NBS PS 15-69 "Custom Contact-Molded Reinforced Polyester Chemical Resistant Process Equipment" is a good guide for product design. Glass fibers contribute physical strength but have little or no corrosion resistance in many environments. Resins provide corrosion resistance and convey stress into the glass fiber but have insufficient physical strength if un-reinforced. Consequently a resin-rich corrosion barrier is necessary to protect a high glass content structural laminate.

### CORROSION BARRIER

In accordance with general industry practice, corrosion barrier is typically 3.0 mm (100 mils) thick and consists of a surfacing veil saturated to a 90% resin content, followed by two layers of 450 g/m<sup>2</sup> (1.5 oz/ft<sup>2</sup>) chopped strand mat impregnated with about 70% resin.

Several surfacing veil types are available. The ones most frequently used are made from "C" glass or from synthetic polyester. The surfacing veil layer should be 0.3 mm (10 mils) thick. Corrosion resistance is improved with thicker veils but the laminate is more prone to cracking.

Chopped strand mat reinforcement consists of a felted matrix of chopped strand "E" or "ECR" glass fibers, 0.5 inch(13mm)to 2.0 inch(51mm)long and loosely held together by a styrene-soluble resin binder. Two layers of a 450 g/m<sup>2</sup> (1.5 oz/ft<sup>2</sup>) mat are generally used with the surfacing veil to form the corrosion barrier. For highly corrosive environments, the corrosion barrier could be 6 mm (200 mils) or 15mm (500 mils).

### STRUCTURAL LAYER

The structural layer is designed to meet the physical property requirements. Additives such as thixotropes can be used in the structural layer. Woven roving is commonly used in alternate layers with chopped strand mats in the structural layer of laminates, and forms the primary structure of many large hand lay-up vessels.

### TOPCOAT

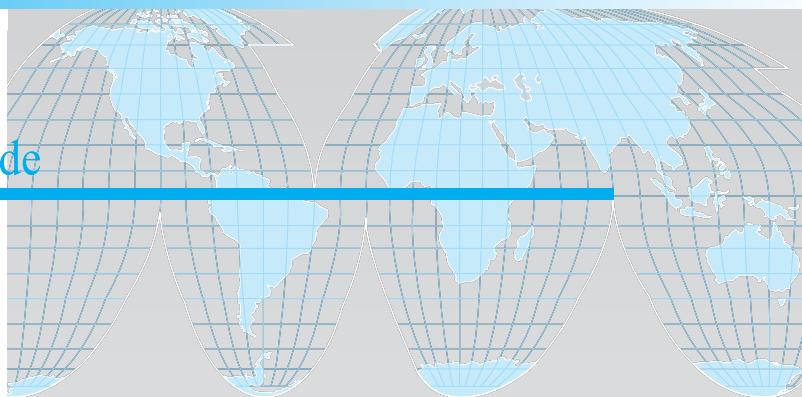
Topcoat is often used to protect the exterior of composite product from weathering and from the effects of occasional exposure to corrosive agents. 0.4% paraffin wax is often added in order to improve the cure on the air-contacting surface. Caution: Wax topcoats should not be used between laminate layers because they may interfere with adhesion of one layer to the other.

Thixotropic agents may be used to prevent the topcoat from flowing down on an inclined surface or dripping from a vertical surface. UV absorber or pigments with UV light absorption capability may be added to improve weathering-resistant properties. A fast-gelling curing system is recommended.

### PROCESS INFORMATION

Experience has shown that mostly, the service failure of FRP is caused by incorrect or mis-use of fabrication technique or procedure. The following recommendations may be helpful in this regard.

# Epoxy Vinyl Ester Resins Corrosion Resistance Guide



## CURING SYSTEM

One of the most important factors governing the corrosion resistance of composites is the degree of cure that the resin attains. For general service, it is recommended that the laminate reach a minimum of 90% of the clear cast Barcol hardness value listed by the resin manufacturer.

Standard catalysts, such as Methyl Ethyl Ketone Peroxide (MEKP) and Benzol Peroxide (BPO) can be used with SWANCOR or SWANCOR CHEMPULSE epoxy vinyl ester resins. Cumene Hydroperoxide (CHP) is recommended to be used with SWANCOR 907 epoxy vinyl ester resins. MEKP and CHP are normally used with promoters, typically Cobalt Naphthenate (CoNap) or Cobalt Octoate (CoOct), and accelerators typically Dimethyl Aniline (DMA). BPO is normally used with DMA promoter with no need of cobalt.

The optimum ratio range of MEKP (with 55% active content) to CoNap or CoOct (with 6% cobalt content) is 3/1 to 10/1. When DMA accelerator is used in curing formulation, the ration of MEKP to CoNap or CoOct is less critical. The usage rate of DMA (conc. 100%) is 0.05- 0.20%. Caution: The Cobalt salt promoter should never be mixed directly with a peroxide catalyst (such as MEKP). Mixing would cause a violent reaction and a fire or explosion could result.

For optimum results, the ratio range of 98% BPO to 100% DMA should be from 10/1 to 15/1. Ratio outside that range may not gel, or may gel and under-cure. As a result, high degree of cure may never occur, even with post-curing.

## AIR INHIBITION

When using an open mold method, atmospheric oxygen may inhibit the curing of an exposed FRP surface. If air inhibition occurs, under-cure may occur and result in reduced chemical resistance of FRP.

There are various ways to prevent oxygen in air from affecting the curing process. The side of the part contacting with air can be covered with a matching mold or with plastic film; or a paraffin wax solution can be added to the resin before fabrication starts.

## MOISTURE INFLUENCE

In addition to a significant reduction in the quality of the finished product, moisture considerably slows curing with Cobalt/MEKP systems. Resin should be prevented from direct contact with water, e.g. rain. Humidity in the air can be detrimental, especially if cold resin is warming up to room temperature in the open air.

It is important to ensure that no condensation of moisture occur when storing reinforcing material, veils, thixotropic agents and fillers.

## SECONDARY BONDING

All laminate surfaces which are no longer tacky when they are wiped with a cleaning wool soaked with acetone should be sanded or ground to a rough surface before lamination fabrication continues.

# Epoxy Vinyl Ester Resins

## Corrosion Resistance Guide

### POST-CURE

The performance of composite products in some environments can be enhanced by post-curing the finished components. Post-curing a composite provides benefits in two-fold: driving the curing reaction to completion with increasing the cross-linking density and eliminating un-reacted function sites.

As far as to maximum effectiveness, post-cure should be performed as soon as possible after the composite has gelled and the exotherm has subsided. Under ideal conditions, the composite should be post-cured for 4 hours at around 80°C/176°F. For a large component, the post-cure time should be extended.

If the laminate is applied to a substrate with a different coefficient of thermal expansion, cracks can form or the coating can peel off at temperatures over 60°C/140°F. In such case, post-cure should be processed under 60°C/140°F, or a suitable primer is recommended for the interfacial adhesion. For example, SWANCOR 984 is suitable as a primer to line old FRP, carbon steel, stainless steel or concrete.

### FOOD CONTACT

SWANCOR or SWANCOR CHEMPULSE 901, SWANCOR 905 and SWANCOR 907 epoxy vinyl ester resins, when properly formulated and cured, will comply with the US Food Drug and Cosmetic Act (FDA) Regulations 21 CFR 177.2420.

The following procedure can help to achieve FDA compliance:

1. Use a formulation that low styrene residual is produced, for example, CoOct/MEKP or CoOct/CHP curing system.
2. Thoroughly clean the final part to remove any dust or dirt prior to post-cure.
3. Post-cure with dry heat for 2 hours at 90 °C/194°F or 4 hours at 80 °C/176°F.
4. Treat the part with steam or allow it to immerse in hot water bath for 8-16 hours at 70 °C/158°F or higher temperature.
5. Wash the part with detergent and rinse it thoroughly before placing in service.

Steam-treatment can only be performed after post-cure and it is not considered to replace post-cure.

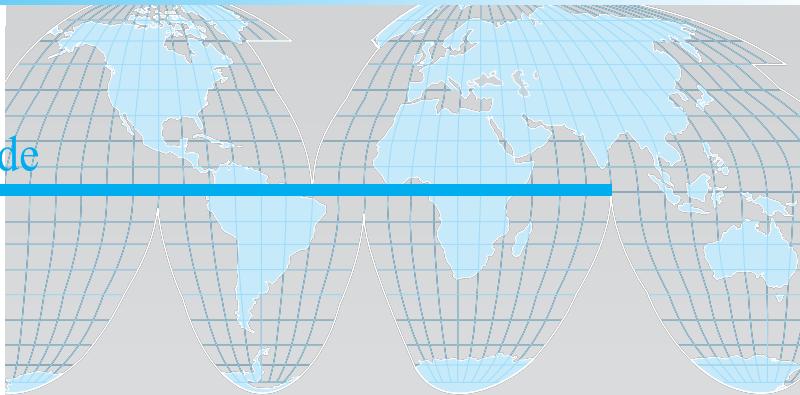
# Epoxy Vinyl Ester Resins Corrosion Resistance Guide

## INTERPRETING THE DATA

Whenever fluorine, fluorine compounds and hot alkaline chemicals are encountered, an organic synthetic veil must be used, such as Nexus or Afbab VL. Some related products of SWANCOR or SWANCOR CHEMPULSE resins are unlisted in the table but the given values apply to all members of the related products. In the following table, a blank indicates that no full data are available. "NR" means "Not Recommended".and "All" means the resin is suitable for use under the maximum temperature despite the concentration of specific chemical.

Footnotes used in the table are explained below.

1. Double synthetic surface veil should be used in corrosion barrier layer.
2. BPO/DMA curing system is more suitable.
3. Double C-veil should be used in corrosion barrier layer.
4. Post-cure is recommended
5. If service is marginal, use SWANCOR 977.
6. Maybe suitable if using SWANCOR 977, check with Swancor for specific recommendation.
7. • The catalyst system has to be BPO/DMA.
  - The double corrosion barrier should be 200 mils (6mm) with a double synthetic veil.
  - All glass to be ECR.
  - Postcuring is required.
  - No thixotropic agents should be used.
8. 500 mils (15mm) corrosion barrier should be used.
9. 200 mils (6mm) corrosion barrier should be used with a double C-veil. All glass to be acid resistant ECR glass.



# Epoxy Vinyl Ester Resins Troubleshooting Guide

**TABLE 1.**  
**PROBLEM FOR AMBIENT TEMPERATURE CURE**

PROBLEM	PEROXIDE	
	MEKP or CHP	BPO
Resin gels too slowly or does not gel	<ul style="list-style-type: none"> <li>▲ Check usage rate or ratio           <ul style="list-style-type: none"> <li>- MEKP or CHP more than 1.0%</li> <li>- MEKP/CoNap ratio &gt; 3/1</li> <li>- CoOct or CoNap more than 0.15%</li> <li>- If temperature &lt; 25°C, DMA is required</li> </ul> </li> <li>▲ Check additive effect           <ul style="list-style-type: none"> <li>- Some pigments or additives, e.g. UV absorber, will retard gelling and check effect before use</li> </ul> </li> <li>▲ Review environment condition           <ul style="list-style-type: none"> <li>- Water will affect gelling</li> </ul> </li> <li>▲ Others           <ul style="list-style-type: none"> <li>- Poor mixing</li> <li>- Ambient temperature too low</li> <li>- Check active concentration of MEKP, CHP or CoNap</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▲ Check usage rate or ratio           <ul style="list-style-type: none"> <li>- BPO more than 0.8%</li> <li>- BPO/DMA ratio &gt; 5/1</li> </ul> </li> <li>▲ Check active concentration of BPO</li> <li>▲ Poor agitation: longer mixing time is required for BPO to disperse in resin</li> <li>▲ Check additive effect: same as in left</li> <li>▲ Others           <ul style="list-style-type: none"> <li>- temperature too low</li> <li>- DMA is not 100% active</li> </ul> </li> </ul>
Resin does not harden after gelling	<ul style="list-style-type: none"> <li>▲ Check usage rate or ratio           <ul style="list-style-type: none"> <li>- MEKP/CoNap ratio &gt; 3/1</li> <li>- If temperature &lt; 25°C, DMA is required.</li> <li>- MEKP &gt; 1.0%</li> </ul> </li> <li>▲ Check to see if problem is on surface.           <ul style="list-style-type: none"> <li>Add wax at final topcoat for better surface cure</li> </ul> </li> <li>▲ Resin contact with metals can adversely affect the cure</li> </ul>	<ul style="list-style-type: none"> <li>▲ Check usage rate or ratio           <ul style="list-style-type: none"> <li>- BPO more than 0.8%</li> <li>- BPO/DMA ratio &gt; 5/1, preferably 10/1</li> </ul> </li> <li>▲ Others: same as in left</li> </ul>

# Epoxy Vinyl Ester Resins Troubleshooting Guide

**TABLE 1.(Continued)**  
**PROBLEM FOR AMBIENT TEMPERATURE CURE**

PROBLEM	PEROXIDE	
	MEKP or CHP	BPO
Resin gels too fast	<ul style="list-style-type: none"> <li>- Reduce DMA usage level</li> <li>- If MEKP &gt; 1.0%, reduce MEKP</li> <li>- Add Acetylacetone (2,4-P)</li> <li>- Check resin temperature and choose recommended usage from Swancor literature</li> <li>- Check and see if resin is exposed to sunlight. Reduce DMA or MEKP or add Acetylacetone (2,4-P)</li> </ul>	<ul style="list-style-type: none"> <li>- Reduce usage level of BPO or DMA and maintain ratio of BPO/DMA greater than 5/1</li> <li>- Others: same as in left</li> </ul>
Exotherm too high and a whitening laminate or crack occurs	<ul style="list-style-type: none"> <li>- Reduce or eliminate DMA usage</li> <li>- Use Trigonox 239A</li> <li>- Use CHP with SWANCOR 907 and 900</li> <li>- Do not build thick laminate, preferably make thinner lay-ups then allow exotherm to subside before continuing lamination</li> <li>- Reduce peroxide usage as low as 1.0%</li> </ul>	<ul style="list-style-type: none"> <li>- Exotherm of BPO/DMA is higher than MEKP</li> <li>- Build thinner lay-ups and allow exotherm to subside before continuing lamination</li> </ul>

NOTE: The active content of curing formulation components in this table are specified as follow.

Chemical	Active Content (%)
MEKP	55%
CHP	80%
BPO	98%
DMA	100%
CoNap or CoOct	6%

# Epoxy Vinyl Ester Resins Troubleshooting Guide

**TABLE 2.**  
**PROBLEMS CAUSED IN LAMINATING**

PROBLEM	CAUSE	SOLUTION
Sagging on vertical or ceiling	- Gel time too long - Resin viscosity too low - Too thick laminates at one coat	- Control 15-30 minutes gel time - Add 0.8-1.5% fumed silica - Reduce laminates thickness at one coat
Poor fiber wet-out	- Gel time too short - Improper fiber mat or clothes  - Improper lay-up sequence	- Get time longer than 15 minutes - Choose easy-to-wet fiber usually powder type mat has better wetting than emulsion type  - Apply some resin on the surface before placing fiber mat
Too many bubbles	- Air entrained in reinforcement after impregnated with resin  - Too many bubbles exist in resin	- Hand lay-up with brushes, squeezers or serrated rollers.  - Apply a liberal quantity of resin before applying reinforcement. - Add some defoamer - Allow the resin sitting for a few minutes for releasing the air. When MEKP is added, catalyzed resin will generate some bubbles by itself.
Roller picks up fibers when working on mat	- Fabrication start close to limit of gel time - Styrene evaporation  - Rolling too fast	- Longer gel time.  - Adjust fans, dip rollers in styrene or fresh resin for re-wetting - More deliberate rolling

# Epoxy Vinyl Ester Resins Troubleshooting Guide

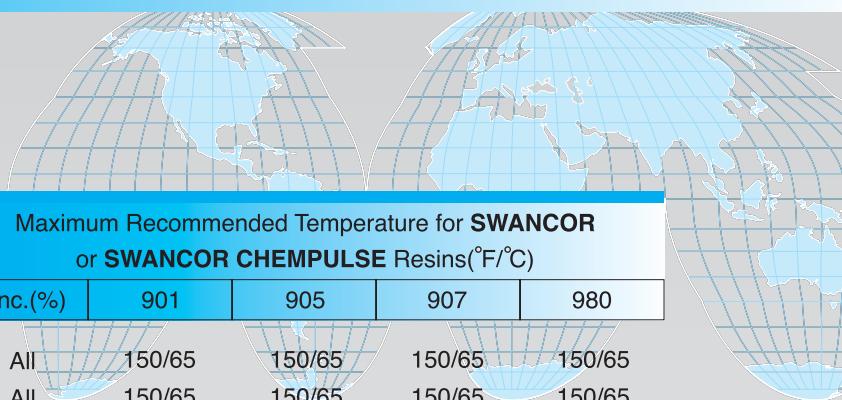
**TABLE 3.**  
**PROBLEM OCCURRED AFTER RESIN HAS CURED**

PROBLEM	CAUSE	SOLUTION
Tacky surface	<ul style="list-style-type: none"> <li>- Air inhibition</li> <li>- Poor curing or low Barcol hardness</li> <li>- High humidity or raindrops on uncured surface</li> </ul>	<ul style="list-style-type: none"> <li>- Add wax into final topcoat</li> <li>- Refer to table 1.</li> <li>- Prevent fabrication under such condition</li> <li>- Add more DMA</li> </ul>
Fiber print-through	<ul style="list-style-type: none"> <li>- No topcoat and surfacing veil</li> <li>- Coarse woven reinforcement</li> <li>- Resin-poor surface</li> </ul>	<ul style="list-style-type: none"> <li>- Apply 2-layers of surfacing veil and topcoat</li> <li>- Use mat on outer layer</li> <li>- Fabricate a resin-rich surface</li> </ul>
De-bonding when laying up on cured surface	<ul style="list-style-type: none"> <li>- Cured material is not unsaturated polyester or epoxy vinyl ester resins</li> <li>- Resin has cured completely*</li> <li>- Final coat contains wax</li> <li>- The cured resin is SWANCOR 907 or SWANCOR 900</li> </ul>	<ul style="list-style-type: none"> <li>- Grind surface to make it rough</li> </ul>
<p>* Rub the surface with styrene monomer. If surface is tacky, then there is no problem for re-layup. If surface is not tacky, then it is necessary to grind the surface.</p>		
Delamination from concrete substrate	<ul style="list-style-type: none"> <li>- Laitance exists on the surface</li> <li>- Primer is not suitable or not used</li> <li>- Strength of concrete is inadequate</li> <li>- Concrete is too wet</li> <li>- Dirty concrete surface</li> </ul>	<ul style="list-style-type: none"> <li>- Remove it before applying primer</li> <li>- Use SWANCOR 984 concrete primer</li> <li>- Compression strength of concrete should be higher than 3,000 psi</li> <li>- Moisture content lower than 10% before applying primer</li> <li>- Remove all dirt, oil and contamination</li> </ul>
Delamination from metal substrate	<ul style="list-style-type: none"> <li>- Surface is not sand-blasted</li> <li>- Surface is too wet</li> <li>- Primer is not cured well</li> <li>- Dirty metal surface</li> </ul>	<ul style="list-style-type: none"> <li>- Sand-blasting metal surface to Sa2<sup>1/2</sup> (white metal)</li> <li>- Dry the surface</li> <li>- Check the suitable usage rate of curing system based on temperature of metal</li> <li>- Remove all dirt, oil and contamination</li> </ul>

Chemical	Conc.(%)	Maximum Recommended Temperature for SWANCOR or SWANCOR CHEMPULSE Resins(°F/°C)			
		901	905	907	980
A					
Acetaldehyde <sup>6</sup>	100	NR	NR	NR	NR
Acetic Acid	1-25	210/99	210/99	210/99	150/65
	26-50	180/82	180/82	180/82	
	51-75	150/65	150/65	150/65	
Acetic Anhydride	100	NR	NR	100/38	NR
Acetone	100	NR	NR	NR	NR
Acrylic Acid	25	100/38	100/38	100/38	100/38
Acrylic Latex	All	120/49	120/49	120/49	120/49
Acrylonitrile	All	NR	NR	NR	NR
Adipic Acid	23	180/82	180/82	180/82	
Alcohol, Butyl	100	120/49	120/49	120/49	NR
Alcohol, Ethyl	10	150/65	150/65	150/65	150/65
	95	80/27	80/27	100/38	NR
Alcohol, Isopropyl <sup>5</sup>	10	150/65	150/65	150/65	150/65
	100	120/49	120/49	120/49	NR
Alcohol, Methyl (Methanol) <sup>5,6</sup>	5	120/49	120/49	120/49	
	100	NR	NR	100/38	NR
Alcohol, Methyl Isobutyl <sup>5</sup>	10	120/49	120/49	150/65	150/65
Alcohol, Secondary Butyl <sup>5</sup>	10	150/65	150/65	150/65	150/65
Allyl Chloride	All	80/27	80/27	80/27	NR
Alum	Sat'd	210/99	210/99	250/121	180/82
Aluminum Chloride	Sat'd	210/99	210/99	250/121	180/82
Aluminum Fluoride	All	80/27	80/27	80/27	80/27
Aluminum Hydroxide	100	180/82	180/82	200/93	180/82
Aluminum Nitrate	All	210/99	210/99	210/99	180/82
Aluminum Potassium Sulfate	Sat'd	210/99	210/99	250/121	180/82
Ammonia Aqueous <sup>1</sup>	100	180/82	180/82	200/93	180/82
Ammonia Gas	100	100/38	100/38	100/38	100/38
Ammonia	Liquified Gas	NR	NR	NR	NR
Ammonium Acetate	>0.5	80/27	80/27	100/38	NR
Ammonium Bicarbonate	1-50	160/71	160/71	160/71	160/71
Ammonium Bisulfite	All	150/65	150/65	150/65	
Ammonium Carbonate	All	150/65	150/65	150/65	150/65
Ammonium Chloride	All	210/99	210/99	210/99	180/82

■ " NR " means " Not Recommended "

■ For notes, please see page 7.



## Chemical

Maximum Recommended Temperature for SWANCOR  
or SWANCOR CHEMPULSE Resins(°F/°C)

	Conc.(%)	901	905	907	980
Ammonium Citrate	All	150/65	150/65	150/65	150/65
Ammonium Fluoride <sup>1</sup>	All	150/65	150/65	150/65	150/65
Ammonium Hydroxide <sup>1</sup>	5	180/82	180/82	150/65	180/82
	10	150/65	150/65	100/38	150/65
	20	150/65	150/65	100/38	150/65
	29	100/38	100/38	100/38	100/38
Ammonium Nitrate	Sat'd	210/99	220/104	150/65	180/82
Ammonium Persulfate	All	210/99	210/99	210/99	180/82
Ammonium Phosphate	All	210/99	210/99	210/99	180/82
Ammonium Sulfate	Sat'd	210/99	220/104	250/121	180/82
Amyl Acetate <sup>6</sup>	100	70/21	NR	120/49	NR
Aniline <sup>6</sup>	All	NR	NR	70/21	NR
Aniline Hydrochloride	All	180/82	180/82	180/82	
Aniline Sulfate	All	210/99	210/99	210/99	
Arsenious Acid	19°Be	180/82	180/82	180/82	150/65
<b>B</b>					
Barium Acetate	All	180/82		180/82	
Barium Carbonate	All	180/82	180/82	180/82	180/82
Barium Chloride	All	210/99	210/99	210/99	180/82
Barium Hydroxide	All	150/65	150/65	150/65	150/65
Barium Sulfate	Sat'd	210/99	210/99	250/121	180/82
Barium Sulfide	All	180/82	180/82	180/82	
Beer	All	120/49	NR	NR	NR
Benzene <sup>5</sup>	100	NR	NR	100/38	NR
Benzene Sulfonic Acid	All	150/65	150/65	150/65	150/65
Benzoic Acid	Sat'd	210/99	210/99	210/99	180/82
o-Benzoyl Benzoic Acid	All	210/99	210/99	210/99	150/65
Benzyl Alcohol	All	NR	NR	100/38	NR
Benzyl Chloride	100	NR	NR	80/27	NR
Black Liquor Recovery		325/163	325/163	400/204	
Furnace gasses					
Bleaches					
Calcium Hypochlorite <sup>7</sup>	All	180/82	180/82	100/38	180/82
Chlorine Dioxide <sup>1,2,4</sup>	All	180/82	200/93	200/93	

■ " NR " means " Not Recommended "

■ For notes, please see page 7.

Chemical	Maximum Recommended Temperature for SWANCOR or SWANCOR CHEMPULSE Resins(°F/°C)				
	Conc.(%)	901	905	907	980
Sodium Hypochlorite <sup>1,2,4</sup>	1-5	150/65	150/65	120/49	120/49
	5-15	180/82	180/82	120/49	150/65
Boric Acid	>0.5	210/99	210/99	210/99	180/82
Brass Plating Solution		180/82	180/82	180/82	180/82
3% Copper Cyanide					
6% Sodium Cyanide					
1% Zinc Cyanide					
3% Sodium Carbonate					
Bromine, Liquid	100	NR	NR	NR	NR
Bromine, Water	5	180/82	180/82	200/93	
Bronze Plating Solution <sup>1</sup>		180/82	180/82	190/88	
4% Copper Cyanide					
5% Sodium Cyanide					
3% Sodium Carbonate					
4.5% Rochelle Salts					
Butyl Acetate <sup>5,6</sup>	100	NR	NR	80/27	NR
Butyl Benzyl Phthalate, BBP	100	180/82	180/82	210/99	
Butyl Carbitol, BC	100	100/38	100/38	100/38	
Butyl Cellosolve, BCS	100	100/38	100/38	100/38	
Butylene Glycol, BG	100	160/71	160/71	180/82	
Butyric Acid	1-50	210/99	210/99	210/99	
	100	80/27	80/27	120/49	
<b>C</b>					
Cadmium Chloride	All	210/99	210/99	210/99	180/82
Cadmium Cyanide Plating Solution <sup>1</sup>		180/82	180/82	180/82	150/65
3% Cadmium Oxide					
10% Sodium Cyanide					
1% Caustic Soda					
Calcium Bisulfite	All	210/99	210/99	210/99	180/82
Calcium Carbonate	All	180/82	180/82	180/82	180/82
Calcium Chlorate	All	210/99	210/99	210/99	180/82
Calcium Chloride	Sat'd	210/99	210/99	250/121	180/82
Calcium Hydroxide <sup>1</sup>	100	210/99	210/99	210/99	180/82
Calcium Hypochlorite <sup>7</sup>	All	180/82	180/82	100/38	180/82
Calcium Nitrate	All	210/99	210/99	210/99	180/82
Calcium Sulfate	All	210/99	210/99	210/99	180/82

■ " NR " means " Not Recommended "  
 ■ For notes, please see page 7.

## Chemical

Maximum Recommended Temperature for **SWANCOR**  
or **SWANCOR CHEMPULSE** Resins(°F/°C)

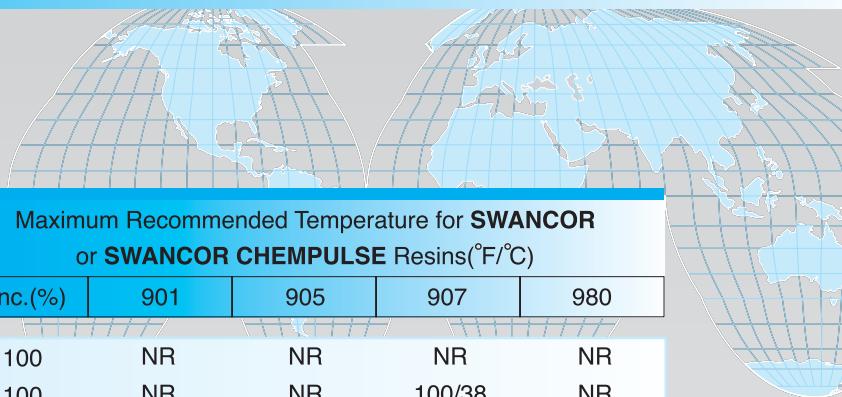
	Conc.(%)	901	905	907	980
Calcium Sulfite	All	210/99	210/99	210/99	180/82
Cane Sugar Liquor	All	180/82			
Caprylic Acid	100	180/82	180/82	210/99	180/82
Carbon Acid		150/65	150/65	150/65	
Carbon Dioxide, Gas		325/165	325/165	400/205	180/82
Carbon Disulfide <sup>6</sup>	100	NR	NR	NR	NR
Carbon Monoxide, Gas		325/165	325/165	400/205	180/82
Carbon Tetrachloride	100	150/65	150/65	180/82	
Carbowax (PEG)	100	150/65	150/65	180/82	150/65
Castor Oil	100	160/71	160/71	160/71	160/71
Carboxy Methyl Cellulose	10	150/65	150/65	150/65	150/65
Chlorinated Brine Liquors (caustic chlorine cell)				190/88	
Chlorinated Wax	All	180/82	180/82	180/82	
Chlorine Dioxide, Air <sup>1,2,4</sup>	15	200/93	200/93	200/93	
Chlorine Dioxide, Wet Gas <sup>1,2,4</sup>	Sat'd	180/82	180/82	180/82	180/82
Chlorine, Dry Gas <sup>3,4,8</sup>	100	210/99	220/104	250/121	180/82
Chlorine, Wet Gas <sup>3,4,8</sup>	100	210/99	220/104	250/121	180/82
Chlorine, Liquid	Sat'd Cl <sub>2</sub>	NR	NR	NR	NR
Chlorine, Water	All	180/82	180/82	150/65	
Chloroacetic Acid	25	120/49	120/49	150/65	
	50	100/38	100/38	100/38	
	Conc.	NR	NR	NR	NR
Chlorobenzene <sup>6</sup>	100	NR	NR	100/38	NR
Chloroform <sup>5,6</sup>	100	NR	NR	NR	NR
Chlorosulfonic Acid	100	NR	NR	NR	NR
Chrome Plating Bath <sup>1</sup>		120/49	120/49	150/65	120/49
19% Chromic Acid with Sodium Fluorosilicate and Sulfate					
Chromic Acid <sup>6</sup>	10	150/65	150/65	150/65	150/65
	20	120/49	150/65	150/65	120/49
	30	NR	NR	NR	NR
Chromium Sulfate	All	210/99	210/99	210/99	180/82
Citric Acid	All	210/99	210/99	210/99	150/65
Coconut Oil	100	180/82	180/82	200/93	180/82
Copper Chloride	Sat'd	210/99	220/104	250/121	180/82
Copper Cyanide	All	210/99	210/99	210/99	180/82

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■ For notes, please see page 7.

Chemical	Maximum Recommended Temperature for SWANCOR or SWANCOR CHEMPULSE Resins(°F/°C)				
	Conc.(%)	901	905	907	980
Copper Fluoride	All	210/99	210/99	210/99	210/99
Copper Nitrate	All	210/99	210/99	210/99	180/82
Copper Cyanide Plating Solutions:		160/71	160/71	160/71	160/71
10.5% Copper and 14% Sodium Cyanide					
6% Rochelle Salts					
Copper Brite Plating		160/71	160/71	190/88	
Caustic - Cyanide					
Copper Plating Solution <sup>1</sup>		180/82	180/82	180/82	180/82
45% Copper Fluoborate					
19% Copper Sulfate					
8% Sulfonic					
Copper Matte Dipping Bath <sup>3,8</sup>		180/82	200/93	200/93	180/82
30% Ferric Chloride					
19% Hydrochloric					
Copper Pickling Bath		200/93	200/93	200/93	
10% Ferric Sulfate					
Copper Sulfate	Sat'd	210/99	210/99	250/121	180/82
Corn Oil	100	180/82	180/82	210/99	150/65
Corn Starch		Slurry	210/99		
Corn Sugar	All	180/82			
Cottonseed Oil	100	210/99	210/99	210/99	150/65
Cresylic Acid <sup>6</sup>	100	NR	NR	NR	NR
Crude Oil, Sour	100	210/99	210/99	250/121	150/65
Crude Oil,Sweet	100	210/99	210/99	250/121	150/65
Cyclohexane	100	120/49	120/49	150/65	
Cyclohexanone		120/49	120/49	150/65	120/49
<b>D</b>					
Detergents, Organic	100	160/71	160/71	200/93	160/71
Diallyl Phthalate (DAP)	All	180/82		210/99	150/65
Di-Ammonium Phosphate	>0.5	210/99	210/99	210/99	180/82
Dibromophenol <sup>5,6</sup>	100	NR	NR	100/38	NR
Dibutyl Ether <sup>5,6</sup>	100	80/27		180/82	
Dichlorobenzene <sup>6</sup>	100	NR	NR	120/49	NR
Dichloroethane <sup>1,2</sup>	100	NR	NR	80/27	NR
Dichloroethylene <sup>6</sup>	100	NR	NR	NR	NR

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## Chemical

Maximum Recommended Temperature for SWANCOR  
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	Conc.(%)	901	905	907	980
Dichloromethane <sup>6</sup>	100	NR	NR	NR	NR
Dichloropropane <sup>6</sup>	100	NR	NR	100/38	NR
Dichloropropene <sup>5,6</sup>	100	NR	NR	80/27	NR
Diesel Fuel <sup>5</sup>	100	180/82	180/82	210/99	150/65
Diethanol Amine <sup>5</sup>	100	120/49	120/49	150/65	
Diethyl Amine <sup>6</sup>	100	NR	NR	NR	NR
Diethyl Benzene <sup>6</sup>	100	100/38	100/38	150/65	NR
Diethyl Carbonate <sup>6</sup>	100	NR	NR	100/38	NR
Diethylene Glycol	100	180/82	180/82	210/99	180/82
Diethylhexyl Phosphoric Acid (in Kerosene)	20	180/82	180/82	180/82	
Diethyl Sulfate	100	100/38	100/38	120/49	NR
Diisobutylene	100	100/38	100/38	100/38	80/27
Diisobutyl Phthalate	100	150/65	150/65	150/65	
Diisopropanol Amine	100	120/49	120/49	150/65	100/38
Dimethyl Formamide <sup>6</sup>	100	NR	NR	NR	NR
Dimethyl Morpholine <sup>5,6</sup>	100	NR	NR	120/49	NR
Dimethyl Phthalate (DMP)	100	150/65	150/65	180/82	
Diocyl Phthalate (DOP)	100	150/65	150/65	210/99	150/65
Dipropylene Glycol	100	180/82	180/82	210/99	150/65
DMA 4 Weed Killer	100	120/49	120/49	120/49	
DMA 6 Weed Killer	100	120/49	120/49	120/49	
Dodecyl Alcohol	100	150/65	150/65	180/82	120/49

## E

ELECTROSOL (Antistatic Agent)	All	150/65	150/65	150/65	
Epichlorohydrin <sup>5,6</sup>	100	NR	NR	80/27	NR
Epoxidized Soybean Oil	100	150/65	150/65	150/65	150/65
Esters, Fatty Acids	100	180/82	180/82	180/82	150/65
Ethyl Acetate, EAC <sup>6</sup>	100	NR	NR	70/21	NR
Ethyl Acrylate, EA <sup>6</sup>	100	NR	NR	80/27	NR
Ethyl Benzene <sup>6</sup>	100	80/27	80/27	120/49	
Ethyl Bromide <sup>6</sup>	100	NR	NR	NR	NR
Ethyl Chloride <sup>6</sup>	100	NR	NR	80/27	NR
Ethyl Ether <sup>6</sup>	100	NR	NR	NR	NR
Ethylene Chlorohydrin	100	100/38	100/38	100/38	NR
Ethylene Glycol (EG)	All	210/99	210/99	210/99	150/65

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Chemical	Maximum Recommended Temperature for SWANCOR or SWANCOR CHEMPULSE Resins(°F/°C)				
	Conc.(%)	901	905	907	980
Ethylene Glycol Monobutyl Ether <sup>5,6</sup>	100	100/38	100/38	100/38	NR
Ethyl Sulfate	100	80/27	80/27	100/38	100/38
<b>F</b>					
Fatty Acids	All	210/99	210/99	250/121	160/65
Ferric Chloride	All	210/99	210/99	210/99	180/82
Ferric Nitrate	All	210/99	210/99	210/99	180/82
Ferric Sulfate	All	210/99	210/99	210/99	180/82
Ferrous Chloride	All	210/99	210/99	210/99	180/82
Ferrous Nitrate	All	210/99	210/99	210/99	180/82
Ferrous Sulfate	All	210/99	210/99	210/99	180/82
8-8-8 Fertilizer		150/65	150/65	150/65	150/65
Fertilizer- Urea Ammonium Nitrate		150/65	150/65	150/65	150/65
Flue Gas, Dry		325/163	325/163	400/204	
Fluoboric Acid <sup>1,4</sup>	All	210/99	210/99	210/99	150/65
Fluosilicic Acid <sup>1,4</sup>	10	180/82	180/82	180/82	150/65
	11-35	100/38	100/38	100/38	100/38
Formaldehyde	All	120/49	120/49	150/65	
Formic Acid	10	180/82	180/82	180/82	150/65
	50	120/49	120/49	120/49	NR
Freon 11		80/27	80/27	100/38	NR
Fuel Oil	100	180/82	180/82	210/99	150/65
Furfural <sup>5,6</sup>	10	100/38	100/38	120/49	
	100	NR	NR	NR	NR
<b>G</b>					
Gas, Natural		210/99	210/99	210/99	210/99
Gasoline, Auto		180/82	180/82	180/82	150/65
Gasoline, Aviation		180/82	180/82	180/82	150/65
Gasoline, Ethyl	100	180/82	180/82	180/82	
Gasoline, Sour		180/82	180/82	180/82	
Gluconic Acid	50	180/82	180/82	180/82	150/65
Glucose	100	180/82			
Glutaric Acid	50	120/49	120/49	120/49	
Glycerine	100	210/99	210/99	210/99	150/65

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## Chemical

Glycolic Acid	
Glyoxal	
Gold Plating Solution	
23% Potassium Ferrocyanide	
0.2% Potassium Gold Cyanide	
0.8% Sodium Cyanide	

Maximum Recommended Temperature for **SWANCOR**  
or **SWANCOR CHEMPULSE** Resins(°F/°C)

Conc.(%)	901	905	907	980
70	100/38	100/38	100/38	100/38
40	100/38	100/38	100/38	100/38

210/99      210/99      210/99      180/82

## H

N-Heptane	100	210/99	210/99	210/99	180/82
Hexane	100	160/71	160/71	160/71	
Hexylene Glycol		150/65	150/65	150/65	150/65
Hot Stack Gas		325/163	325/163	400/204	
Hydraulic Fluid	100	180/82	180/82	180/82	180/82
Hydrazine <sup>6</sup>	100	NR	NR	NR	NR
Hydrobromic Acid	0-25	180/82	180/82	180/82	180/82
	25-50	150/65	150/65	150/65	150/65
	50-60	100/38	100/38	100/38	100/38
Hydrochloric Acid <sup>9</sup>	0-20	180/82	210/99	230/110	180/82
	20-32	150/65	150/65	180/82	150/65
	37	100/38	100/38	120/49	
Hydrocyanic Acid	All	210/99	210/99	210/99	180/82
Hydrofluoric Acid <sup>1,4</sup>	10	150/65	150/65	150/65	150/65
	20	100/38	100/38	100/38	100/38
Hydrofluosilicic Acid <sup>1</sup>	10	180/82	180/82	180/82	150/65
Hydrogen Bromide, Wet Gas	100	180/82	180/82	180/82	180/82
Hydrogen Chloride, Dry Gas	100	210/99	210/99	350/177	180/82
Hydrogen Fluoride, Dry Vapor (if wet max 100°F/40°C) <sup>1,4</sup>		180/82	180/82	180/82	180/82
Hydrogen Peroxide <sup>2,4</sup>	0-30	150/65	150/65	150/65	150/65
Hydrogen Sulfide, Dry Gas	All	210/99	210/99	230/110	180/82
Hydrogen Sulfide, Aqueous	All	210/99	210/99	210/99	180/82
Hydrosulfite Bleach		180/82	180/82	180/82	180/82
Hypochlorous Acid <sup>7</sup>	10	100/38	100/38	100/38	100/38

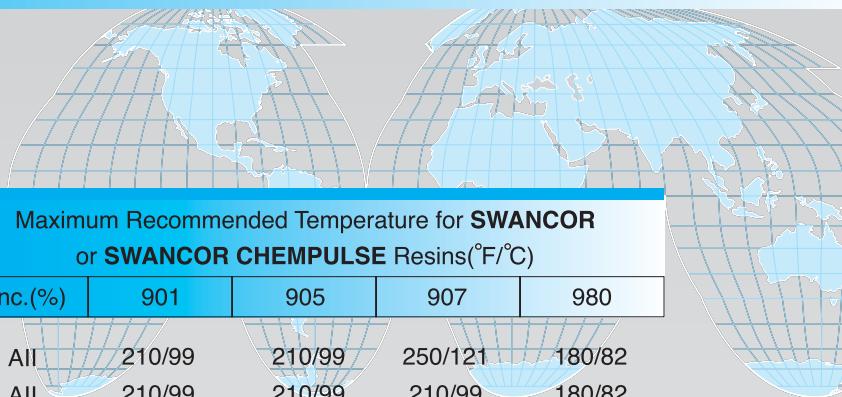
## I

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Chemical	Maximum Recommended Temperature for SWANCOR or SWANCOR CHEMPULSE Resins(°F/°C)				
	Conc.(%)	901	905	907	980
Iron Plating Solution  45% FeCl <sub>2</sub> ; 15% CaCl <sub>2</sub> ; 20% FeSO <sub>4</sub> ; 11% (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>		180/82	180/82	250/121	180/82
Iron and Steel Cleaning Bath  9% Hydrochloric 23% Sulfuric	9	180/82	180/82	210/99	180/82
Isopropyl Amine	0.5-50	100/38	100/38	100/38	NR
Isopropyl Palmitate	100	210/99	210/99	230/110	150/65
Itaconic Acid	40	140/60	140/60	140/60	140/60
<b>J</b>					
Jet Fuel	100	140/60	140/60	140/60	140/60
<b>K</b>					
Kerosene	100	180/82	180/82	180/82	150/65
<b>L</b>					
Lactic Acid	All	210/99	210/99	210/99	150/65
LASSO Herbicide <sup>5,6</sup>		NR	NR	120/49	NR
Latex	All	120/49	120/49	120/49	120/49
Lauric Acid	All	210/99	210/99	210/99	150/65
Lauroyl Chloride	100	100/38		120/49	
Lead Acetate	Sat'd	210/99	210/99	230/110	
Lead Nitrate	All	210/99	210/99	210/99	210/99
Lead Plating Solution <sup>1,4</sup>  8% Lead 0.8% Fluoboric Acid 0.4% Boric Acid		180/82	180/82	180/82	
Levulinic Acid	Sat'd	210/99	210/99	230/110	
Linseed Oil	100	210/99	210/99	230/110	150/65
Lithium Bromide	Sat'd	210/99	210/99	250/121	180/82
Lithium Sulfate	All	210/99	210/99	210/99	180/82
<b>M</b>					
Magnesium Bisulfite	All	210/99	210/99	210/99	180/82
Magnesium Carbonate	All	180/82	180/82	180/82	180/82

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## Chemical

Maximum Recommended Temperature for **SWANCOR**  
or **SWANCOR CHEMPULSE** Resins(°F/°C)

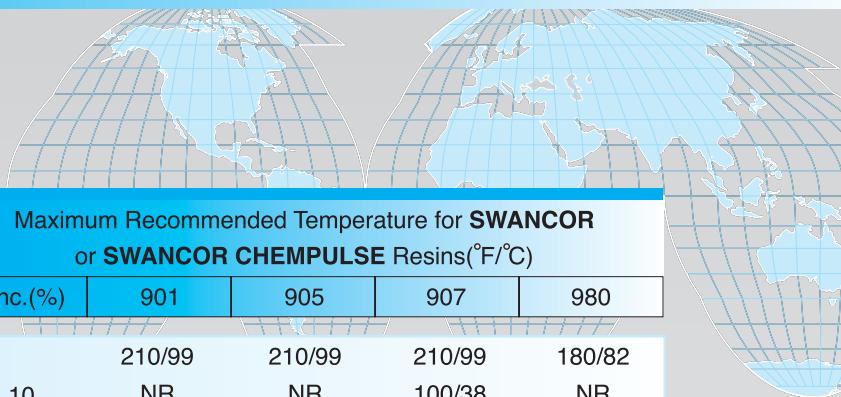
	Conc.(%)	901	905	907	980
Magnesium Chloride	All	210/99	210/99	250/121	180/82
Magnesium Hydroxide	All	210/99	210/99	210/99	180/82
Magnesium Sulfate	Sat'd	210/99	210/99	250/121	180/82
Maleic Acid	All	180/82	180/82	210/99	180/82
Mercuric Chloride	All	210/99	210/99	210/99	180/82
Mercurous Chloride	All	210/99	210/99	210/99	180/82
Methacrylic Acid	25	100/38	100/38	120/49	100/38
Methylene Chloride <sup>6</sup>	100	NR	NR	NR	NR
Methyl Ethyl Ketone <sup>6</sup> (MEK)	100	NR	NR	70/21	NR
Methyl Isobutyl Carbitol <sup>6</sup>	100	NR	NR	NR	NR
Methyl Isobutyl Ketone <sup>6</sup> (MIBK)	100	80/27	80/27	120/49	NR
Methyl Methacrylate (MMA)		NR	NR	80/27	NR
Methyl Styrene	100	80/27	80/27	120/49	NR
Mineral Oils, Aliphatic	100	210/99	210/99	250/121	150/65
Molybdenum Disulfide	100	200/93	200/93	200/93	150/65
Monochloroacetic Acid <sup>6</sup>	100	NR	NR	NR	NR
Monoethanolamine <sup>6</sup>	100	80/27	80/27	100/38	NR
Motor Oil		210/99	210/99	250/121	150/65
Myristic Acid	100	210/99	210/99	250/121	150/65
<b>N</b>					
Naphtha	100	180/82	180/82	210/99	180/82
Naphthalene	100	210/99	210/99	210/99	180/82
Nickel Chloride	All	210/99	210/99	210/99	180/82
Nickel Nitrate	All	210/99	210/99	210/99	180/82
Nickel Plating <sup>1,4</sup>		180/82	180/82	180/82	180/82
8% Lead					
0.8% Fluoboric Acid					
0.4% Boric Acid					
Nickel Plating		180/82	180/82	180/82	180/82
11% Nickel Sulfate					
2% Nickel Chloride					
1% Boric Acid					
Nickel Plating		180/82	180/82	180/82	180/82
44% Nickel Sulfate					
4% Ammonium Chloride					

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Chemical	Maximum Recommended Temperature for SWANCOR or SWANCOR CHEMPULSE Resins(°F/°C)				
	Conc.(%)	901	905	907	980
<b>4% Boric Acid</b>					
Nickel Sulfate	All	210/99	210/99	210/99	180/82
Nitric Acid <sup>4</sup>	5	150/65	150/65	180/82	150/65
	20	120/49	120/49	150/65	120/49
	40	NR	NR	100/38	NR
Nitric Acid Fumes <sup>4</sup>		180/82	180/82	180/82	180/82
Nitrobenzene <sup>5,6</sup>	100	NR	NR	100/38	NR
<b>O</b>					
OAKITE Rust Stripper		180/82	180/82	180/82	150/65
Octanoic Acid	100	180/82	180/82	210/99	
Oil, Sour Crude	100	210/99	210/99	250/120	150/65
Oil, Sweet Crude	100	210/99	210/99	250/120	150/65
Oleic Acid	All	210/99			
Oleum (Fuming Sulfuric)		NR	NR	NR	NR
Olive Oil	100	210/99			
Oxalic Acid	Sat'd	120/49	120/49	120/49	
<b>P</b>					
Palmitic Acid	100	210/99			
Peanut Oil	100	180/82			
Perchloroethylene <sup>5,6</sup>	100	80/27	80/27	120/49	NR
Perchloric Acid	10	150/65	150/65	150/65	150/65
	30	100/38	100/38	100/38	100/38
Peroxide Bleach		210/99	210/99	210/99	180/82
2% Sodium Peroxide 96%					
0.025% Epsom Salts					
5% Sodium Silicate 42°Be					
1.4% Sulfuric Acid 66°Be					
Phenol	100	NR	NR	NR	NR
Phenol Sulfonic Acid	100	NR	NR	NR	NR
Phosphoric Acid	All	210/99	210/99	220/104	180/82
Phosphoric Acid Fumes		210/99	210/99	250/121	180/82
Phosphorous Pentoxide	0-54	210/99	210/99	210/99	180/82
Phosphorous Trichloride	100	NR	NR	NR	NR
Phthalic Acid	All	210/99	210/99	210/99	

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## Chemical

Maximum Recommended Temperature for **SWANCOR**  
or **SWANCOR CHEMPULSE** Resins(°F/°C)

Conc.(%)	901	905	907	980
Pickling Acids, Sulfuric and Hydrochloric	210/99	210/99	210/99	180/82
Picric Acid, Alcoholic <sup>5,6</sup>	10	NR	NR	100/38
Polyvinyl Acetate Latex (PVAC)	All	210/99	210/99	210/99
Polyvinyl Alcohol (PVA)	100	180/82	180/82	180/82
Polyvinyl Chloride Latex with 35 parts DOP		120/49	120/49	120/49
Potassium Aluminum Sulfate	Sat'd	210/99	210/99	250/121
Potassium Bicarbonate <sup>1</sup>	All	180/82	180/82	180/82
Potassium Bromide	All	210/99	210/99	210/99
Potassium Carbonate <sup>1</sup>	50	180/82	180/82	150/65
Potassium Chloride	All	210/99	210/99	210/99
Potassium Dichromate	All	210/99	210/99	210/99
Potassium Ferricyanide	All	210/99	210/99	210/99
Potassium Ferrocyanide	All	210/99	210/99	210/99
Potassium Hydroxide <sup>1,4</sup>	45	150/65	150/65	80/27
Potassium Nitrate	All	210/99	210/99	210/99
Potassium Permanganate	All	210/99	210/99	210/99
Potassium Persulfate	All	210/99	210/99	210/99
Potassium Sulfate	All	210/99	210/99	210/99
Propionic Acid	50	180/82	180/82	180/82
	100	NR	NR	100/38
Propylene Glycol	100	210/99	210/99	210/99
Pulp Paper Mill Effluent		180/82	180/82	180/82
Pyridine	100	NR	NR	NR

## R

Rayon Spin Bath 140/60

## S

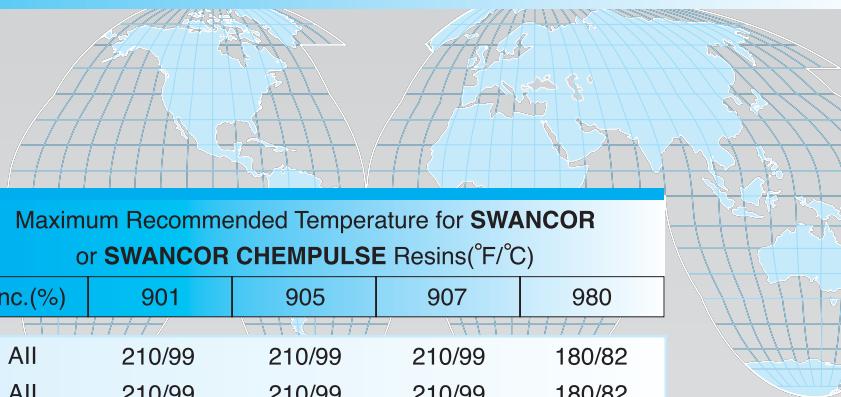
Salicylic Acid	All	160/70			
Sebacic Acid	All	210/99	210/99	210/99	180/82
Selenius Acid	All	210/99	210/99	210/99	180/82
Silver Nitrate	All	210/99	210/99	210/99	180/82
Silver Plating Solution <sup>1</sup>	180/82			180/82	150/65
4% Silver Cyanide					
7% Potassium Cyanide					

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■ For notes, please see page 7.

Chemical	Maximum Recommended Temperature for SWANCOR or SWANCOR CHEMPULSE Resins(°F/°C)				
	Conc.(%)	901	905	907	980
5% Sodium Cyanide 2% Potassium Carbonate					
Soaps	All	210/99	210/99	210/99	
Sodium Acetate	All	210/99	210/99	210/99	
Sodium Alkyl Aryl Sulfonates	All	180/82	180/82	180/82	150/65
Sodium Aluminate <sup>1</sup>	All	160/70	160/70	120/49	120/49
Sodium Benzoate	100	180/82	180/82	180/82	180/82
Sodium Bicarbonate <sup>1</sup>	100	180/82	180/82	180/82	180/82
Sodium Bifluoride <sup>1</sup>	All	120/49	120/49	120/49	120/49
Sodium Bisulfate	All	210/99	210/99	210/99	180/82
Sodium Bisulfite	Sat'd	210/99	210/99	210/99	180/82
Sodium Bromate	All	210/99	210/99	210/99	180/82
Sodium Bromide	All	210/99	210/99	210/99	180/82
Sodium Carbonate <sup>1</sup>	All	180/82	180/82	150/65	180/82
Sodium Chlorate	All	210/99	210/99	210/99	180/82
Sodium Chloride	All	210/99	210/99	210/99	180/82
Sodium Chlorite, pH<6, Scrubber		170/77	170/77		
Sodium Chlorite, pH<6,Bleaching		180/82	196/91	199/93	
Sodium Chlorite, pH>6	All	180/82	180/82	180/82	180/82
Sodium Chromate	All	210/99	210/99	210/99	180/82
Sodium Cyanide	All	210/99	210/99	210/99	
Sodium Dichromate	All	210/99	210/99	210/99	180/82
Sodium Diphosphate	All	210/99	210/99	210/99	180/82
Sodium Ferricyanide	All	210/99	210/99	210/99	
Sodium Ferrocyanide	All	210/99	210/99	210/99	180/82
Sodium Fluoride <sup>1</sup>	All	180/82	180/82	180/82	180/82
Sodium Fluorosilicate <sup>1,2</sup>	All	120/49	120/49	120/49	120/49
Sodium Hexametaphosphates	All	180/82	180/82	180/82	180/82
Sodium Hydroxide <sup>1,4</sup>	5	180/82	180/82	100/38	150/65
	10	180/82	180/82	100/38	150/65
	25	180/82	180/82	100/38	150/65
	50	210/99	180/82	100/38	150/65
Sodium Hydrosulfide	All	180/82	180/82	180/82	180/82
Sodium Hypochlorite <sup>7</sup>	0-5	150/65	150/65	120/49	120/49
	5-15	180/82	180/82	120/49	150/65
Sodium Lauryl Sulfate (SLS)	All	160/71	160/71	160/71	

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 ■ For notes, please see page 7.



## Chemical

Maximum Recommended Temperature for **SWANCOR**  
or **SWANCOR CHEMPULSE** Resins(°F/°C)

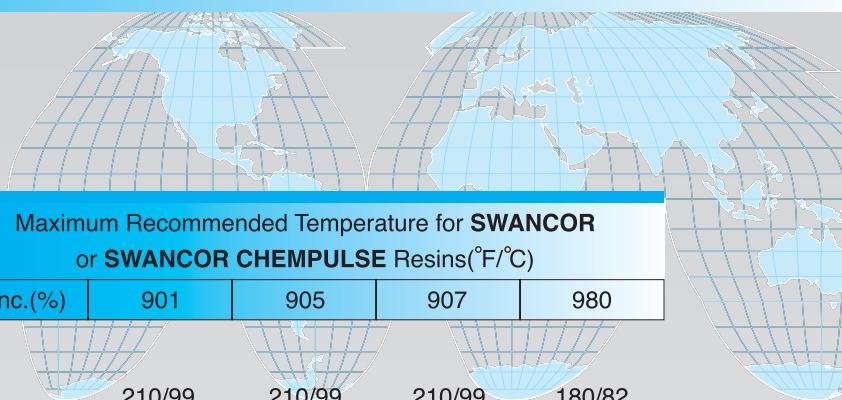
	Conc.(%)	901	905	907	980
Sodium Mono-Phosphate	All	210/99	210/99	210/99	180/82
Sodium Nitrate	All	210/99	210/99	210/99	180/82
Sodium Nitrite	All	210/99	210/99	210/99	180/82
Sodium Persulfate	All	210/99	210/99	210/99	180/82
Sodium Silicate	All	210/99	210/99	210/99	180/82
Sodium Sulfate	All	210/99	210/99	210/99	180/82
Sodium Sulfide	All	210/99	210/99	210/99	180/82
Sodium Sulfite	All	210/99	210/99	210/99	180/82
Sodium Tetraborate	All	180/82	180/82	180/82	180/82
Sodium Thiocyanate	All	180/82	180/82	180/82	180/82
Sodium Thiosulfate	All	180/82	180/82	180/82	180/82
Sodium Tripolyphosphate	All	210/99	210/99	210/99	180/82
Sodium Xylene Sulfonate	All	160/71	160/71	160/71	
Sorbitol Solutions	All	160/71	160/71	180/82	
Sour Crude Oil	100	210/99	210/99	250/121	150/65
Soya Oil	All	210/99	210/99	210/99	150/65
Stannic Chloride	All	210/99	210/99	210/99	180/82
Stannous Chloride	All	210/99	210/99	210/99	180/82
Stearic Acid	All	210/99	210/99	210/99	150/65
Styrene <sup>5</sup>	100	NR	NR	120/49	NR
Succinonitrile	All	80/27	80/27	100/38	NR
Sugar, Beet and Cane Liquor	All	180/82			
Sugar, Sucrose	All	210/99			
Sulfamic Acid	25	150/65	150/65	150/65	150/65
Sulfanilic Acid	All	210/99	210/99	210/99	180/82
Sulfated Detergents	All	160/70	160/70	180/82	160/70
Sulfur Dioxide, Wet SO <sub>2</sub>		180/82	180/82	210/99	180/82
Sulfur Trioxide/Dry	Fumes	210/99	210/99	300/149	180/82
Sulfuric Acid	0-50	210/99	210/99	210/99	180/82
Sulfuric Acid	51-70	180/82	180/82	180/82	180/82
Sulfuric Acid <sup>2</sup>	71-75	100/38	100/38	180/82	100/38
Sulfuric Acid	Over 75	NR	NR	NR	NR
Sulfurous Acid	10	120/49	120/49	120/49	120/49
Superphosphoric Acid	105%	210/99	210/99	210/99	180/82
	76% P <sub>2</sub> O <sub>5</sub>				

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■ For notes, please see page 7.

Chemical	Maximum Recommended Temperature for SWANCOR or SWANCOR CHEMPULSE Resins(°F/°C)				
	Conc.(%)	901	905	907	980
<b>T</b>					
Tall Oil		210/99	210/99	220/104	
Tannic Acid	All	210/99	210/99	210/99	150/65
Tartaric Acid	All	210/99	210/99	210/99	150/65
Tetrachloroethylene <sup>5,6</sup>	100	80/27	80/27	120/49	NR
Tetrasodium Ethylenediaminetetraacetic Acid <sup>1</sup>	All	180/82	180/82	150/65	180/82
Thioglycolic Acid <sup>5,6</sup>	All	NR	NR	100/38	NR
Thionyl Chloride	100	NR	NR	NR	NR
Tin Fluoborate Plating Bath <sup>1</sup>		210/99	210/99	210/99	180/82
18% Stannous Fluoborate					
7% Tin					
9% Fluoboric Acid					
2% Boric Acid					
Toluene <sup>5,6</sup>	100	80/27	80/27	120/49	NR
Toluene Sulfonic Acid (PTSA)	All	180/82	200/93	210/99	
Transformer Oils					
Mineral Oil Types		210/99	230/110	300/149	
Chloro-Phenyl Types		NR	NR	NR	NR
Trichloroacetic Acid	50	100/38	100/38	100/38	
Trichloroethane <sup>5,6</sup>	100	100/38	100/38	120/49	NR
Trichloroethylene <sup>6</sup>	100	NR	NR	NR	NR
Trichloromonofluoromethane <sup>1,5,6</sup>	100	80/27	80/27	100/38	NR
Trichlorophenol <sup>5</sup>	100	NR	NR	NR	NR
Tricresyl Phosphate (TCP)	100	160/71	160/71	160/71	
Tridecylbenzene Sulfonate	All	210/99	210/99	210/99	180/82
Triethanolamine	100	120/49	120/49	150/65	
Trimethylene Chlorobromide <sup>6</sup>	100	NR	NR	100/38	NR
Trisodium Phosphate	Sat'd	210/99	210/99	250/121	180/82
Turpentine	100	150/65	150/65	210/99	100/38
Tween Surfactant	All	210/99	210/99	210/99	150/65
<b>U</b>					
Urea	0-50	160/71	160/71	160/71	150/65

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## Chemical

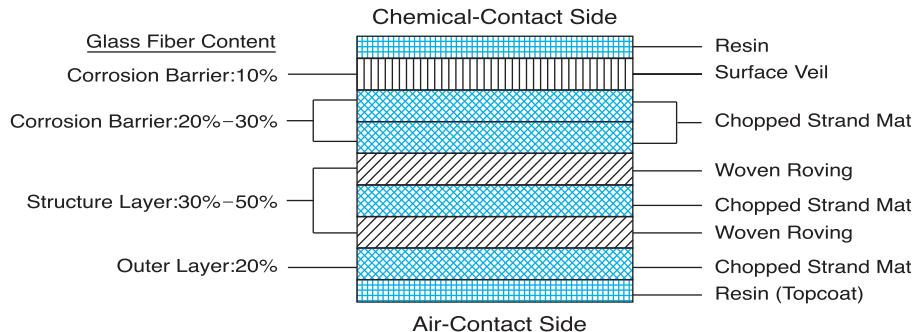
	Conc.(%)	901	905	907	980
<b>V</b>					
Vegetable Oils		210/99	210/99	210/99	180/82
Vinegar		210/99	210/99	210/99	150/65
Vinyl Acetate <sup>6</sup> VAC	100	NR	NR	NR	NR
Vinytoluene	100	80/27	80/27	120/49	NR
<b>W</b>					
Water					
Deionized <sup>4</sup>	100	180/82	180/82	180/82	180/82
Distilled <sup>4</sup>		180/82	180/82	180/82	180/82
Sea		180/82	180/82	180/82	180/82
White Liquor (Pulp Mill) <sup>1,4</sup>		180/82	180/82	100/38	180/82
<b>X</b>					
Xylene <sup>5,6</sup>	100	80/27	80/27	120/49	NR
<b>Z</b>					
Zinc Chlorate	Sat'd	210/99	210/99	250/121	180/82
Zinc Nitrate	Sat'd	210/99	210/99	250/121	180/82
Zinc Plating Solution <sup>1,4</sup>		180/82	180/82	100/38	180/82
9% Zinc Cyanide					
4% Sodium Cyanide					
9% Sodium Hydroxide					
Zinc Plating Solution <sup>1</sup>		200/93	200/93	200/93	180/82
49% Zinc Fluoborate					
5% Ammonium Chloride					
6% Ammonium Fluoroborate					
Zinc Sulfate	All	210/99	210/99	250/121	180/82

■ " NR " means " Not Recommended "

■ For notes, please see page 7.

## APPENDIX

### 1. Typical construction of chemical process equipment according to Product Standard of National Bureau of Standards, NBS PS15-69



### 2. ASTM Reinforced Plastics Related Standards

#### ▲ STANDARDS FOR CORROSION RESISTANT EQUIPMENT

- ASTM D2105 Standard Specifications for Longitudinal Tensile Properties of Reinforced Thermosetting Plastic Pipe and Tube
- ASTM D2143 Standard Specifications for Cyclic Pressure Strength of Reinforced, Thermosetting Plastic Pipe
- ASTM D2310 Standard Specifications for Reinforced Thermosetting Resin Pipe
- ASTM D2517 Standard Specifications for Reinforced Thermosetting Plastic Gas Pressure Pipe and Fittings
- ASTM D2924 Standard Specifications for External Pressure Resistance of Plastic Pipe
- ASTM D2925 Standard Specifications for Beam Deflection of Reinforced Thermosetting Resin Pipe Under Full Bore Flow, Measuring
- ASTM D2992 Standard Specifications for Obtaining Hydrostatic Design Basis for Reinforced Thermosetting Resin Pipe and Fittings
- ASTM D2996 Standard Specifications for Filament Wound Reinforced Thermosetting Resin Pipe
- ASTM D2997 Standard Specifications for Centrifugally Cast Reinforced Thermosetting Plastic Pipe
- ASTM D3184 Standard Specifications for Reinforced Thermosetting Resin Sewer Pipe
- ASTM D3262 Standard Specifications for Reinforced Plastic Mortar Sewer Pipe
- ASTM D3299 Standard Specifications for Filament Wound Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks
- ASTM D4097 Standard Specifications for Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks
- ASTM D4162 Standard Specifications for Reinforced Thermosetting Resin Sewer Pipe and Industrial Pressure Pipe
- ASTM D4163 Standard Specifications for Reinforced Thermosetting Resin Pressure Pipe

#### ▲ MECHANICAL PROPERTIES OF COMPOSITES

- ASTM D256 Test Method for Impact Resistance of Plastic and Electrical Insulation Materials
- ASTM D638 Test Method for Tensile Properties of Plastics
- ASTM D648 Test Method for Deflection Temperature of Plastic Under Flexural Load
- ASTM D695 Test Method for Compressive Properties of Rigid Plastics
- ASTM D790 Test Method for Flexural Properties of Unreinforced and Reinforced Plastic and Electrical Insulating Materials
- ASTM D2583 Test Method for Indentation of Hardness of Rigid Plastics by Means of a Barcol Impressor
- ASTM D2584 Test Method for Ignition Loss of Cured Reinforced Resins

#### ▲ CORROSION RESISTANCE OF COMPOSITES

- ASTM C581 Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures Intended for Liquid Service
- ASTM C582 Specifications for Contact Molded Reinforced, Thermosetting Plastic Laminates of Corrosion Resistant Equipment
- ASTM D3615 Test Methods for Chemical Resistance of Thermoset Molding Compounds Used in the Manufacture of Molded Fittings
- ASTM D3681 Test Methods for Chemical Resistance of Reinforced Thermosetting Resin Pipe in a Deflected Condition
- ASTM D4398 Test Methods for Determining the Chemical Resistance of Fiberglass Reinforced Thermosetting Resins by One-Sided Panel Exposure

#### ▲ FIRE RETARDANT PROPERTIES

- ASTM D2863 Test Methods for Measuring the Minimum Oxygen Concentration to Support Candle-like Combustion of Plastics (Oxygen Index)
- ASTM E84 Test Methods for Surface Burning Characteristics of Building Materials
- ASTM E662 Test Methods for Specific Optical Density of Smoke

#### ▲ WEATHERABILITY PROPERTIES

- ASTM E4329 Operating Light and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Plastics

#### ▲ THERMAL AND ELECTRICAL PROPERTIES

- ASTM D149 Test Methods for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
- ASTM D150 Test Methods for A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials
- ASTM D257 Test Methods for D-C Resistance or Conductance of Insulating Materials
- ASTM D495 Test Methods for High Voltage, Low Current, Dry Arc Resistance of Solid Electrical Insulation
- ASTM D696 Test Methods for Coefficient of Linear Thermal Expansion of Plastics



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