Advanced Materials

Epoxy Resin Systems

Safe Handling Guide
Table of Contents

1. Contact Information & Legal Notice ........................................................................................................ 1
   1.1 Emergency Contact Information ........................................................................................................... 1
   1.2 Legal Notice .......................................................................................................................................... 1

2. General Information ................................................................................................................................. 2
   2.1 Epoxy Resins ......................................................................................................................................... 2
      2.1.1 Liquid / MultFunctional Resins ..................................................................................................... 3
      2.1.2 Solid Resins ..................................................................................................................................... 3
      2.1.3 Modified Liquid Resins And Reactive Diluents ............................................................................. 3
   2.2 Curing Agents/Hardeners .................................................................................................................... 4
   2.3 Solvents ................................................................................................................................................ 4
   2.4 Pigments and Fillers .............................................................................................................................. 4
   2.5 The Epoxy Resin System ..................................................................................................................... 4

3. First Aid ................................................................................................................................................... 5
   3.1 Skin ....................................................................................................................................................... 5
   3.2 Eyes ....................................................................................................................................................... 5
   3.3 Inhalation .............................................................................................................................................. 5
   3.4 Ingestion ................................................................................................................................................ 5

4. Hazard Assessment .................................................................................................................................. 6
   4.1 Epoxy Resins ....................................................................................................................................... 6
      4.1.1 Liquid Resins ................................................................................................................................ 6
      4.1.2 Solid Resins ................................................................................................................................... 6
      4.1.3 Modified Liquid Resins ................................................................................................................. 6
   4.2 Curing Agents/Hardeners .................................................................................................................... 7
   4.3 Solvents ............................................................................................................................................... 7
   4.4 Reactive Diluents .................................................................................................................................. 7
   4.5 Fillers ................................................................................................................................................... 7
   4.6 The Epoxy Resin System ..................................................................................................................... 7-8

5. Potential Exposures .................................................................................................................................. 9
   5.1 Handling and Processing ...................................................................................................................... 9-10
   5.2 Waste Disposal ................................................................................................................................... 9-10

6. Work Place Controls ............................................................................................................................... 11
   6.1 Engineering Controls ........................................................................................................................... 11
   6.2 Personal Protective Equipment ........................................................................................................... 12
      6.2.1 Eye Protection ................................................................................................................................ 12
      6.2.2 Gloves .......................................................................................................................................... 12-14
      6.2.3 Chemical-Resistant Clothing ....................................................................................................... 15
      6.2.4 Respirators ................................................................................................................................. 15
   6.3 Work Practices And Personal Hygiene ................................................................................................. 16
   6.4 Training ............................................................................................................................................... 16

7. Glossary ................................................................................................................................................... 17

8. Additional Information ............................................................................................................................. 17
1. Contact Information & Legal Notice

1.1 Emergency Contact Information

24 Hour Emergency Hotline

IN CASE OF A TRANSPORTATION
EMERGENCY CALL:

CHEMTREC 1-800-424-9300
International (call collect) 703-527-3887

Huntsman Advanced Materials Americas Inc.

8 am to 5 pm Central Phone: (800) 257-5547
24-hour Emergency Phone: (800) 328-8501
International Emergency Phone: (409) 727-0831

www.huntsman.com

1.2 Legal Notice

This manual is intended to provide general information to persons who manufacture, use, or handle epoxy resin systems. This manual is not intended to be a “how-to” manual, nor is it a prescriptive guide. Individual companies may need to vary approaches to particular practices described in the Manual based on specific factual circumstances, the practicality and effectiveness of particular actions, or economic and technological feasibility.

This manual is not intended to be a substitute for in-depth training or specific requirements, nor is it intended to define or create legal rights or other obligations. All persons involved in manufacturing, using or handling epoxy resin systems have an independent obligation to ascertain that their actions are in compliance with current federal, state and local laws and regulations, and should consult legal counsel concerning such matters.

Huntsman makes no warranty or representation, either expressed or implied, with respect to the accuracy or completeness of the information contained in the Manual; nor assumes any liability or responsibility for any use, or the results of such use, of any information, procedure, conclusion, opinion, product, or process disclosed in this Manual.

Epoxy resin systems users are encouraged to consult the current Huntsman MSDS for specific guidance and updates on safe handling and use. Should you have specific questions about information contained in the Manual, please contact Huntsman for further information.
2. General Information

Epoxy systems are mixtures made up of varying amounts of several components. The main components of epoxy resin systems are the epoxy resin and the curing agent (also known as hardener). In addition, other components of the epoxy system may include solvents, reactive diluents and fillers. The following sections describe typical properties of these common epoxy resin system components.

2.1 Epoxy Resins

Epoxy resins are a family of synthetic resins including products which range from liquids to solids. They are typically formed by reacting hydroxyl functional compound with epichlorohydrin. The most common resins are produced by reacting epichlorohydrin with bisphenol A or bisphenol F. The structures for these three molecules are shown below.

![Epichlorohydrin](image1)

![Bisphenol A](image2)

![Bisphenol F](image3)

Typically, epichlorohydrin and either bisphenol A (shown below) or bisphenol F are reacted together to form the epoxy.

![Reaction](image4)

Reaction conditions, including the amount and ratio of the starting materials will determine the value of n. The three general classes of epoxy resins are liquid, solid, and modified liquid.
2.1.1 Liquid / MultiFunctional Resins

The liquid resins have lower molecular weights and are viscous, sticky materials. They typically have a value of \( n \) less than 3. Multifunctional resins are either liquids or solids containing more than two epoxy functionalities in the same molecule. Some common uses for liquid epoxy resins include coatings applications, fiber reinforced composites, flooring, adhesives, tooling, inks and electrical casting systems. Multifunctional epoxies provide high temperature performance required for some advanced composite applications.

2.1.2 Solid Resins

Solid resins have a higher molecular weight, with \( n \) typically having a value greater than 3. These are generally cross-linked through the hydroxyl or epoxy groups. Some common uses include powder coatings, general purpose molding compounds, adhesives, composites and electronic applications.

2.1.3 Modified Liquid Resins And Reactive Diluents

These can be either liquid or solid resins that are modified by the addition of organic solvents or reactive diluents. Some epoxy resins are also supplied as dispersions in water in which case they are referred to as “waterborne resins.” The solvent or water will typically evaporate out of the system during the curing process.

Reactive diluents are chemicals that lower the viscosity of the epoxy resin; however, unlike organic solvents, they do not evaporate out of the system during the curing process as they become chemically bound within the cured system. Reactive diluents are typically based on mono-functional phenolic compounds or can be based on mono-, di-, or tri-functional alcohols.
2.2 Curing Agents/Hardeners

The purpose of the epoxy curing agent or hardener is to chemically react with the epoxy resin reactive sites (functional groups) to form a fully crosslinked or cured polymer. Just as there are many epoxy resins, there is a wide selection of curing agents that are commonly used and which can contribute to the characteristics of the final products. Amines are the most widely used curing agents for epoxy resin systems. The amine curing agents fall into several chemical families that include the aliphatic amines, cycloaliphatic amines, and aromatic amines. Anhydrides are another class of curing agents for epoxy resin systems. Some typical structures are shown below.

| Aliphatic Amine  | \[
\begin{array}{c}
H_2N-\text{CHR}NHR_2 \\
\end{array}
\] |
|------------------|----------------------------------|
| Cycloaliphatic amine | \[
\begin{array}{c}
\text{NH}_2 \\
\text{NH}_2 \\
\end{array}
\] |
| Aromatic amine | \[
\begin{array}{c}
\text{NH}_2 \\
\end{array}
\] |
| Anhydride | \[
\begin{array}{c}
\text{O} \\
\text{O} \\
\text{R'} \text{O} \text{R''} \\
\end{array}
\] |

2.3 Solvents

Organic solvents may be present in the epoxy resin system formulations or may be used for cleaning the equipment. Examples of solvents typically used in epoxy resin systems include ketones, esters, aromatic hydrocarbons, glycol ethers, and alcohols.

2.4 Pigments and Fillers

Fillers are added to epoxy resins to enhance the properties of the cured resin system. The properties most commonly enhanced with fillers include: thermal, mechanical, electrical, and chemical and/or flame resistance. Examples of fillers are fiberglass, silica, calcium carbonate and powdered metals. Pigments are used to provide a specific color and opacity.

2.5 The Epoxy Resin System

Many formulated epoxy resin systems are two-component systems. The epoxy resin and various other ingredients are formulated as one component of the system while the hardener and other ingredients or additives form the other component. Just prior to their application, the two components are thoroughly mixed together in the appropriate ratio as directed by the manufacturer.
3. First Aid

3.1 Skin
If the skin or clothing becomes contaminated with epoxy resin systems immediately wash with soap and water. Remove contaminated clothing and launder before reuse. Destroy and properly dispose of contaminated shoes and other leather items. Seek immediate medical attention.

3.2 Eyes
If the eyes become contaminated, immediately flush eyes with water for at least 15 minutes. Seek immediate medical attention.

3.3 Inhalation
If respiratory distress is experienced, remove person to fresh air. Seek immediate medical attention.

3.4 Ingestion
If the material is accidentally ingested, do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Seek immediate medical attention.
4. Hazard Assessment

As mentioned earlier, the main components of epoxy resin systems are the epoxy resin and the curing agent. The system may also contain solvents, reactive diluents and fillers. In general, epoxy resin systems can present some health hazards; however, they can be handled safely as long as some appropriate precautions are taken. The hazards associated with the specific epoxy resin system being handled will depend on the hazardous nature of the components. Always consult the material safety data sheet (MSDS) of the specific products which are being handled. The following sections describe potential hazards associated with the various components of epoxy resin systems.

4.1 Epoxy Resins

Epoxy resins are a family of synthetic resins including products which range from liquids to solids. The hazards vary depending on which type of resin is being used.

4.1.1 Liquid resins

These are mild to moderate irritants to the skin, eyes and mucous membranes. The potential for irritation is increased by their “sticky” nature which may lead to prolonged skin contact. These resins are generally mild to moderate dermal (skin) sensitizers in susceptible individuals. Inhalation exposure is not expected due to the low volatility of the resins; however, if heated, sprayed, or spread over unventilated surfaces these resins can cause respiratory irritation.

4.1.2 Solid resins

These are not readily absorbed through the skin and present a low risk of skin irritation. Direct contact with solutions of these resins can cause mild to moderate irritation of the skin and the eyes, principally because the solvents “de-fat” the skin. When crushed to a fine powder, the materials should be considered an irritant dust; inhalation and skin contact should be avoided. Solid resins are generally low to mild sensitizers.

4.1.3 Modified liquid resins

These resins should be handled with the same precautions as those in solution in organic solvents. They are mild to moderate skin irritants. These low molecular weight resins and the reactive diluents are moderate to strong sensitizers. Their sensitizing potential tends to increase with decreasing molecular weight. Epoxy components with significant volatility may cause irritation to skin, eyes and respiratory tract; however, inhalation is normally not a hazard except under certain conditions of use, i.e., heating, spraying, or applications over large surface areas. Certain modified resins, such as cycloaliphatic epoxy resins, have been shown to cause skin cancer in laboratory animals.

Table 1 summarizes the hazards associated with epoxy resins.
4.2 Curing Agents/Hardeners

The aliphatic amines, cycloaliphatic amines and anhydride curing agents may cause irritation or damage to the skin, eyes, and lungs. Some aliphatic and cycloaliphatic amines are skin sensitizers. Solid anhydride curing agents may cause sensitization in workers exposed to the curing agent dust. The aromatic amines are not strong irritants; however some of them are skin sensitizers. Some aromatic amines may be absorbed through the skin and cause damage to organs such as the liver and interfere with the blood's ability to carry oxygen. Some aromatic amines are known to cause cancer in laboratory animals.

Table 1 summarizes the hazards associated with epoxy curing agents.

4.3 Solvents

Solvents commonly used in epoxy resin applications present a flammability hazard. These solvents may also present other specific health hazards. Contact with solvents will cause “de-fatting” and drying of the skin which may increase the risks of skin irritation. Some solvents are readily absorbed through the skin and their absorption may be enhanced if the skin is abraded or irritated. They also have the ability to dissolve other chemicals present with the epoxy resin system and to carry them through the skin.

The inhalation of solvent vapors or mists may cause respiratory irritation and depression of the central nervous system. This may result in dizziness and sleepiness, lack of coordination, loss of equilibrium, unconsciousness, and even death, if severe overexposure occurs.

Table 1 summarizes the hazards associated with solvents.

4.4 Reactive Diluents

Typically, the reactive epoxy diluents fall into the chemical family known as glycidyl ethers. Because of their lower vapor pressure, the reactive diluents tend to vaporize more readily than the epoxy resins and therefore present greater risks of inhalation. The reactive diluents are also likely to be much stronger sensitizers than the standard epoxy resins.

Table 1 summarizes the hazards associated with reactive diluents.

4.5 Fillers

Fillers added to epoxy resin formulations may present a potential inhalation and dermal contact hazard. They can cause mechanical damage to the skin which may increase the risk of irritation of the epoxy resin system. Since fillers are generally handled in the liquid matrix of the epoxy resin system, their potential to present an inhalation hazard is low. However, fillers may present some risks of inhalation when they are being handled in the dry state or when machining or grinding the cured epoxy products. Inhalation exposure to fillers such as crystalline silica or fiberglass should be avoided as it may result in delayed lung injury.

Table 1 summarizes the hazards associated with fillers.

4.6 The Epoxy Resin System

The individual components of the epoxy resin system are blended together for final application. The hazards of the system may change as the individual components are blended together.
### Table 1. Typical Exposure Effects Associated with Epoxy Resin Systems

<table>
<thead>
<tr>
<th>Epoxy Resin Systems Components</th>
<th>Examples/Types</th>
<th>Dermal Exposure</th>
<th>Inhalation Exposure</th>
<th>Ingestion Exposure</th>
</tr>
</thead>
</table>
| Liquid Epoxy Resins           | Based on the reaction product of epichlorohydrin and bisphenol A or bisphenol F | • Mild to moderate irritants  
• Mild to moderate sensitizers | • Low volatility, but can cause irritation if heated, sprayed, or spread over unventilated surfaces | Low toxicity |
| Solid Epoxy Resins            | Based on the reaction product of liquid epoxy resin and bisphenol A or bisphenol F | • Mild to moderate irritants and mild sensitizers  
• Not readily absorbed through the skin | • Low volatility, but can cause irritation if crushed or ground | Low toxicity |
| Modified Epoxy Resins         | Liquid epoxy resins with added reactive diluents or solvents | • Mild to moderate irritants  
• Moderate to strong sensitizers | • Low volatility, but can cause irritation if heated, sprayed, or spread over unventilated surfaces | Low toxicity |
| Curing Agents                 | Based on aliphatic and cycloaliphatic amine | • Irritants, sensitizers, corrosive  
• Absorbed through skin | • Respiratory irritants | High toxicity |
|                               | Based on aromatic amine | • Sensitizers, long term health effects  
• Absorbed through skin | • Respiratory irritants | Moderate to high toxicity |
|                               | Based on anhydride | • Corrosive, severe sensitizers | • Dusts may be irritants | High toxicity |
| Reactive Diluents             | Glycidyl ethers | • Moderate to strong sensitizers | • Moderate volatility, can cause irritation | Low toxicity |
| Solvents                      | Ketones, esters, aromatic hydrocarbons, glycol ethers, alcohols | • De-fats and dries skin  
• Some may be absorbed  
• May carry other components through skin | • High volatility  
• Irritation  
• CNS depression (e.g., dizziness, loss of coordination) | Low to high toxicity; long term effects |
| Fillers                       | Fiberglass, silica, calcium carbonate, powdered metal pigments | • Some may be absorbed | • Dust inhalation, can cause irritation | Low toxicity |

Consult MSDS, label, or company bulletin for details on the specific products you are using.
5. Potential Exposures

This section summarizes potential exposures associated with several epoxy resin systems production processes and tasks. Section 6 addresses what to do to minimize human exposure.

5.1 Handling and Processing

Potential exposures vary with the process or task to be performed. Closed systems with engineering controls are often used to prevent workers from exposure to epoxy resin systems, however, occasionally open areas with limited controls are used and the potential for exposure increases. Dermal exposure is the most likely route of exposure, however if particular curing agents or solvents are being used, inhalation exposure may also be a problem. For most applications there is always a potential for eye exposure; therefore, eye protection is recommended for all applications. Potential exposures for several production processes and tasks are listed in Table 2.

Any production process or handling involving potential hand contact may result in dermal exposure. Any involving a solvent or curing agent may result in dermal and/or inhalation exposure.

5.2 Waste Disposal

Cured epoxy system wastes can typically be disposed of as inert solids. When disposing of uncured epoxy resin and hardener wastes, their respective hazard classification must be taken into account to ensure that they are disposed of safely and in accordance with local and state regulations. Always consult the individual components material safety data sheets (MSDS) prior to their disposal.

An empty drum and/or any other kind of package that has contained some epoxy resin or hardener should be handled with the same precautions as the original product, and disposed of in accordance with applicable local regulations. In case of a chemical release or spill to the soil, it should be contained immediately to avoid soil and/or water contamination. Any kind of release to the environment should be avoided.
<table>
<thead>
<tr>
<th>Processes</th>
<th>Exposure Potential</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament Winding / Pultrusion</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Resin Transfer Molding</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Pre-preg and Laminate Production</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Flooring, Grouting, and Hand Applications</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Coating</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Exposure Potential</th>
<th>Comments</th>
</tr>
</thead>
</table>
| Unloading / Mixing / Pouring  
- hose connect/disconnect  
- drum pump cleaning/handling  
- dumping/pouring | High | Medium | Low | Potential for material to splash on workers when these tasks are undertaken |
| Cutting/Machining/Finishing | High | High | Low | These operations tend to generate dust which increases the potential for inhalation exposure |
| Clean up | High | High | Low | Potential for hazardous effects increases due to solvent use |
| Maintenance | High | Medium | Low | Opening a closed system increases the risks for skin and inhalation exposure |
| Spraying | High | High | Low | Spraying the coatings causes generation of aerosols which increase the potential for inhalation exposure |
| Brushing | High | Medium | Low | Good ventilation and suitable personal protective equipment should limit risks of exposure |
| Hand Lay-up | High | Medium | Low | Suitable protective equipment must be worn to prevent skin contact |
6. Work Place Controls

Three major work place controls can protect those working with epoxy resin systems from the two major health hazards (skin contact and inhalation of vapors):

- adequate ventilation
- proper personal protective equipment and clothing
- good housekeeping

The following four sections describe methods for achieving good work place controls for epoxy resin systems.

6.1 Engineering Controls

Engineering controls are the most effective work place controls and should be implemented first. Engineering controls include process or equipment modifications that reduce the amount of potentially hazardous material to which an employee may be exposed. Isolation and ventilation are the primary controls utilized when working with epoxy resin systems.

Isolation, or enclosure of a process or work operation to reduce the number of employees being potentially exposed, is a standard industrial hygiene control measure. Due to the potential for irritation and sensitization to epoxy resin systems, the handling and use of epoxy compounds should, if possible, be restricted to designated areas, preferably separated from the rest of the plant. Examples of isolation are spray booths, enclosed curing and mixing rooms, and glove bag systems.

Ventilation is the standard method of controlling employee exposure to airborne vapors of epoxy resins and solvents. Ventilation involves controlling air flows to reduce exposures. Local exhaust ventilation systems capture the contaminant at the source and either filter or remove it from the work area. The ventilation system needs to be designed such that vapors, aerosols and dusts are pulled away from, and not into, the breathing zone of the workers. A constant supply of fresh non-contaminated air should be available to the workers at all times. Examples of local exhaust ventilation systems are draw down exhaust tables, slot hoods, dust extraction systems, and portable vapor/dust collectors. Good general ventilation which effectively minimizes the accumulation of vapors is essential in all work areas. Care has to be taken to ensure that ventilation systems are utilized and maintained as designed. Some basic rules for good ventilation controls are:

- Check that the ventilation system is on and operating before starting any work involving epoxy resin systems.
- For the ventilation system to operate properly, inspections and maintenance must be done on a periodic basis. This includes such items as checking the flow rate, and checking the condition of the duct work, motors, filters, and belts.
- Verify electrical classification

Additional information on ventilation design is outlined in *INDUSTRIAL VENTILATION, Manual of Intended Practice* (see section 8, Additional Information, page 18).
6.2 Personal Protective Equipment

6.2.1 Eye Protection

Examples of eye protection are: safety glasses with side shields, chemical goggles, full-face respirators, and face shields with glasses or goggles. The type of eye protection required is dependent on the hazard assessment for the specific applications. When there is danger of vapor, aerosol or dust exposure, such as when mixing, spraying, or pumping material under pressure, the eyes must be protected by chemical goggles at a minimum. Goggles may also need to be worn when grinding or trimming solid-cured epoxy product.

6.2.2 Gloves

Selecting appropriate chemical-resistant gloves for use with epoxy resin systems involves matching the characteristics of the glove with the requirements of the tasks being performed. These requirements may be classified as physical and/or chemical.

Production task requirements will need to be determined for the specific work situation. Glove resistance characteristics can also be classified as physical and/or chemical. Physical characteristics of production tasks and glove resistance are dexterity, wet grip and cut, tear, puncture, and abrasion resistance. Chemical characteristics of production tasks include type of epoxy resin system, solvents used and degree of contact. Chemical characteristics of glove resistance are permeation and degradation.

Information on glove characteristics can generally be obtained from the manufacturers of the specific gloves being considered. While it is most useful to have chemical resistance information with the specific glove models and process chemicals being used, Table 3 provides some guidelines which can be used for generic chemical-resistant glove materials. Latex and medical gloves typically do not provide adequate protection; therefore it is recommended that these types of gloves NOT be used when handling epoxy resin systems. Table 4 contains data from recent testing that was performed on three of our products. ARALDITE® MY 0600 resin is a multifunctional epoxy resin (CAS nr. 71604-74-5), ARALDITE® DY-K resin is an epoxy compound often used as a reactive diluent (CAS nr. 2210-79-9, o-cresol glycidyl ether) and ARALDITE® DY-P resin is a different epoxide often used as a reactive diluent (CAS nr. 3101-60-8, p-tert butyl phenyl glycidyl ether).

Replacement time should be considered when selecting the most appropriate glove. It may be more effective to select a glove with lower chemical resistance but which is replaced frequently than to select a more resistant glove which is reused many times. Regardless of the replacement time chosen for your glove use program, gloves should be replaced whenever signs of wear or degradation are noticed. Typical signs include swelling, softening, cracking, tears, holes, or discoloration of the glove material.
Table 3. Gloves: Chemical Resistance Generalizations

<table>
<thead>
<tr>
<th>Generic Glove Material</th>
<th>Epoxy Resins Liquid or Solid</th>
<th>Modified Epoxy Resins</th>
<th>Hardeners/ Curing Agents</th>
<th>Solvents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethyl Vinyl Alcohol (EVAL laminate)</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>Butyl Rubber</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Good</td>
</tr>
<tr>
<td>Nitrile butyl rubber (NBR)</td>
<td>Excellent</td>
<td>Good</td>
<td>Fair</td>
<td>Fair</td>
</tr>
<tr>
<td>Neoprene</td>
<td>Excellent</td>
<td>Good</td>
<td>Fair</td>
<td>Fair</td>
</tr>
<tr>
<td>Polyvinyl (PVC)</td>
<td>Excellent</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
</tr>
</tbody>
</table>

**Breakthrough as defined in ASTM F-739-96**

- **Excellent**: breakthrough time > 480 min
- **Good**: breakthrough time > 20 min
- **Fair**: breakthrough time < 20 min
- **Poor**: glove material degradation occurred during testing
Table 4. Glove Resistance to Three Huntsman Resins

<table>
<thead>
<tr>
<th>Resin / Glove</th>
<th>Ansell Edmont HyFlex® Lite (11-600) polyurethane</th>
<th>MAPA Professional Stanzoil (334 NL34) neoprene</th>
<th>Ansell Edmont Sol-Vex® (37-145) nitrile</th>
<th>North Safety Products Butyl industrial gloves (B174)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ARALDITE® MY 0600</strong></td>
<td>Result: Rapid penetration detected</td>
<td>No permeation detected at minimum detectable permeation¹</td>
<td>No permeation detected at minimum detectable permeation</td>
<td>No permeation detected at minimum detectable permeation</td>
</tr>
<tr>
<td>Breakthrough Detection Time</td>
<td>&lt; 5 minutes</td>
<td>&gt; 480 minutes</td>
<td>&gt; 480 minutes</td>
<td>&gt; 480 minutes</td>
</tr>
<tr>
<td><strong>ARALDITE® DY-K</strong></td>
<td>Result: Rapid penetration detected</td>
<td>Permeation detected</td>
<td>Permeation detected</td>
<td>No permeation detected at minimum detectable permeation²</td>
</tr>
<tr>
<td>Breakthrough Detection Time</td>
<td>&lt; 1 minute</td>
<td>122 minutes</td>
<td>139 minutes</td>
<td>&gt; 480 minutes</td>
</tr>
<tr>
<td><strong>ARALDITE® DY-P</strong></td>
<td>Result: Rapid penetration detected</td>
<td>Permeation detected</td>
<td>No permeation detected at minimum detectable permeation³</td>
<td>No permeation detected at minimum detectable permeation</td>
</tr>
<tr>
<td>Breakthrough Detection Time</td>
<td>&lt; 1 minute</td>
<td>281 minutes</td>
<td>&gt; 480 minutes</td>
<td>&gt; 480 minutes</td>
</tr>
</tbody>
</table>

Note 1: Minimum detectable permeation rate for ARALDITE® MY 0600 is 0.062 μg/cm²/min
Note 2: Minimum detectable permeation rate for ARALDITE® DY-K is 0.14 μg/cm²/min
Note 3: Minimum detectable permeation rate for ARALDITE® BY-P is 0.029 μg/cm²/min
6.2.3 Chemical-Resistant Clothing

Chemical-resistant clothing is recommended to prevent skin contact. The same material and use characteristics described for gloves also apply to chemical resistant clothing. A wide selection of disposable aprons, coveralls, lab coats, and sleeves is available. Contaminated clothing and other contaminated personal protective equipment (PPE) should be removed and discarded in a manner that will not cause additional exposure.

6.2.4 Respirators

Respirators come in different types, air-supplied or air-purifying. Air-supplied respirators provide the user with an external source of clean breathing air while air-purifying respirators make use of adsorbents and filters to remove chemical vapors and particulates from the workplace air.

Respirators may be required where:

- airborne solvent (vapor and aerosol) levels are high
- dust levels are high (resin mixing, finishing, repair)
- irritating odors are present
- respiratory sensitizers are involved.

Selection of appropriate respiratory protective equipment requires consideration of workplace conditions.

If air purifying or air supplied respirators are used, 29 CFR 1910.134\(^1\) requires a written Respiratory Protection Program be implemented documenting medical evaluations, fit tests, change out programs, maintenance schedules and employee training.

\(^1\)This is a US regulation; similar regulations may be applicable in other regions.
6.3 Work Practices And Personal Hygiene

It is essential that the employee use good work practices. Safety instructions and operating procedures for specific tasks must be written, communicated and enforced. Some fundamental and easily implemented work practices that can be used to minimize exposures when working with epoxy resin systems include:

- reading the MSDS and understanding the potential hazards of each chemical being used
- following the proper procedures for production and control equipment
- using proper maintenance, and cleaning of personal protective equipment
- maintaining a personal hygiene program, which includes provisions for clean up and adequate clothing storage
- laundering or disposing of contaminated clothing
- disposing of contaminated leather articles, such as belts and shoes
- maintaining good housekeeping
- inspecting and maintaining production and control equipment
- providing good supervision
- providing separate eating, drinking and smoking facilities
- hand washing when leaving the work environment, especially before eating, drinking, smoking or applying cosmetics.

6.4 Training

The safe use and handling of epoxy resin systems require that all employees who work with these systems be trained in safe handling procedures. At a minimum, the training program should address the identification and understanding of the following items:

- labels, material safety data sheets (MSDS), and product information bulletins
- health and safety hazards
- emergency procedures
- first aid procedures
- work place controls
- choosing the correct personal protective equipment for the job
- safe handling procedures

OSHA Standard 29 CFR 1910.1200² requires employers to develop a written Hazard Communication Program, which must include:

- A list of all hazardous materials used in the workplace. This list needs to be reviewed annually and updated as new materials enter the workplace.
- The procedures used to collect and maintain an MSDS for each chemical used in the workplace. The MSDS’s must be readily available to the employees at each worksite.
- A description of labeling system used for chemical containers
- The procedures used to ensure that all containers are properly labeled
- The methods of training and providing hazardous material information to employees
- Procedures for safely conducting non-standard work practices.

²This is a US regulation; similar regulations may be applicable in other regions.
7. Glossary

**Corrosive**
A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

**De-fat**
Action in which solvents permeate the skin and cause the natural body oils and fat layer in the skin surface to be removed causing dry skin leading to increased skin cracking and drying allowing for increased potential for skin reactions.

**Exposure**
Having bodily contact with a material, including inhalation, oral, eye, and dermal (skin) contact.

**Exposure Limit/Guideline**
An air concentration of a material to which nearly all working persons can be exposed day after day without adverse effects. Exposure limits/guidelines are most commonly used as a point of reference in assessing workplace exposures.

**Hazard**
The potential of the material to cause harm.

**Irritant**
A chemical, which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of the contact.

**Route of Exposure**
The path by which a material enters the body, most commonly the mouth (ingestion), skin (dermal absorption) or respiratory tract (inhalation).

**Sensitizer**
A substance that may cause an allergic reaction in some individuals after repeated exposure. Epoxy resin system components may be skin sensitizers, pulmonary sensitizers or both.

**Toxicity**
The sum of adverse effects resulting from exposure to a material, generally by the mouth (ingestion), skin (dermal absorption) or respiratory tract (inhalation).

8. Additional Information


Epoxy Resins and Curing Agents, Association of Plastics Manufacturers in Europe, Avenue E. Van Nieuwenhuyse 4, Box 3, B-1 160 Brussels, Phone number: (011) 322-675-3297; 1996.


