



Working Safely with Casting Resins

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EXECUTIVE SUMMARY

Dillon Consulting Limited (Dillon) was retained by I.A.T.S.E. Local 891 to develop safe work guidelines for film industry personnel related to working safely with casting resins.

This document can also be used as a guideline for minimizing the potential for exposure to other individuals in the studio or shop who are not working directly with casting resins and related products. A brief summary of potential routes of exposure and health hazards are outlined as well as how to control the potential for exposure to various casting resins by the use of engineering controls, administrative controls and personal protective equipment.

Keep in mind that the degree of controls necessary to protect individuals will depend on a number of factors, such as how much and how long the product is used, and how the product is applied. Therefore, further evaluation, such as exposure monitoring may be required to determine the necessary and/or additional personal protective equipment and ventilation requirements.

Other workplace factors, such as working within confined space or other potentially hazardous conditions have not been considered in these guidelines. **These hazardous situations must be evaluated separately.**

The Safety Bulletins can be used as topics for safety meetings, attached to call sheets, or posted in work areas. The Safety Bulletins are not meant to be a comprehensive safe work procedure in handling casting resins or a replacement for training, but can be used to supplement other training and experience.

The “Working with Casting Resins” checklist can be used as a quick guide for sculptors and alike to make sure that safety precautions are in place before performing resin work.

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Working with Casting Resins Checklist

1.0 INTRODUCTION

Dillon Consulting Limited was retained by I.A.T.S.E. Local 891 to develop safe work guidelines for film industry personnel working with or around casting resins and related products. Although sculptors and model makers use many types of art materials, special precautions are required when using these casting products because of their potential serious health and safety effects.

This project was completed in collaboration with I.A.T.S.E. Local 891 members, Dusty Kelly, Thomas Special Effects, Rod Quinn and International SPF/X. The members have contributed valuable information to this report based on their own knowledge and professional experiences.

2.0 CASTING RESINS

Casting is a technique used by many sculptors and model makers to manufacture props and construction of sets. Resins are commonly cast as a pourable liquid or they are “laid up” by hand with reinforcing fibreglass cloth or carbon fiber. Most pourable resins are cast in separating flexible moulds made out of urethane or silicone moulds or rigid moulds made out of plaster, fibreglass, metal or wood. Sometimes resins are used to make larger scale set pieces, such as pools of water, icicles, crystal geodes, etc.

There are various castable resins available on the market, however polyesters, polyurethanes and epoxy resins are the materials most commonly used by sculptors and model makers. Therefore, the rest of this document will focus mainly on the various health and safety issues surrounding the use of polyester and polyurethane resins, with a brief mention of epoxy resins.

Casting resin systems often work by reacting several chemicals to make the desired product. The resin systems use chemical catalysts, cross-linking agents, accelerators, and diluents in the right amounts to chemically react to each other. It is well known that some of these catalysts, and cross-linking agents are potentially hazardous to workers if proper precautions are not taken.

It is important to remember that work practices other than the manufacturer’s instructions must not be performed since safety precautions and hazard information provided by the manufacturers are based on people using these products in accordance with the instructions. Any deviations from the instructions can be dangerous, with potential harmful consequences to the user and to other people in the area.

If a type of casting resin is not mentioned in this document, read the Manufacturer’s instructions and the Material Safety Data Sheet (obtain one from the supplier if you do

not have one), and be aware of the health and safety precautions before using it.

When working with any hazardous material, always try to look for safer alternatives or safer method of using the product.

3.0 RELEVANT REGULATIONS AND STANDARDS

The British Columbia, *Occupational Health and Safety Regulation (OHSR) (B.C. Reg. 296/97, amended by 185/99 and 253/2001)*, outlines exposure limits (ELs) for certain hazardous ingredients in casting resins.

The following table outlines some of the hazardous ingredients and their ELs in casting resins:

Type of Casting Resin Systems	Related Hazardous Ingredients	WCB Exposure Limit (from Table 5-4)
Polyester Resin	Fibreglass dust/fibre	1 fibre/ml
	Styrene	50 ppm (8 hour) ** 75 ppm (15 min)
	MEKP	1.5 mg/m ³ Ceiling
Polyurethane Resin	MDI (Methylene Bisphenyl Isocyanate)	0.005ppm (8hr), 0.01ppm (C)
	TDI (2,4-Toluene Diisocyanate, 2,6-Toluene Diisocyanate)	0.005ppm (8hr), 0.01ppm (C)
Epoxy Resin	Amine hardeners (various) Triethylenetetramine (TETA) diethylenetriamine	Look up in Table 5-4 No limit, ALARA, Sensitizer 1 ppm (8hr)
	Diglycidyl ethers	0.1 ppm (8hr), 0.5 ppm (C)
** Other standard (ACGIH) has recommended the 8 hr styrene exposure limit of 20 ppm and 40 ppm for the 15 min exposure.		

Also, Part 12 of *B.C. OHSR*, states other regulatory requirements for the use of casting resins, and these requirements have been incorporated into the safety bulletins.

Remember, that most film industry personnel work 10-16 hour shifts. Therefore, the exposure limits in the above table will be lower. For example, for 10-12 hr shifts the above limits must be multiplied by factor of 0.5 (e.g., styrene exposure limit becomes 25 ppm).

In order to measure the potential exposures to these hazardous ingredients to film industry personnel, a qualified industrial hygienist should be consulted to ensure approved sampling techniques are used and results are interpreted accordingly.

WHMIS Regulation (BC Occupational Health and Safety Regulation Part 5.3)

The WHMIS Regulation applies to workplaces using products related to casting resins.

- Production companies must ensure that containers of controlled products are labeled with a supplier label. A workplace label is required when the product is decanted and not used up by the end of the shift.
- A copy of the Material Safety Data Sheet (MSDS) for all controlled product in the shop must be available.
- The MSDS must not be older than 3 years old. Check the revision date.
- Workers handling casting resin products must be instructed in the proper procedures for the safe use, storage, handling and disposal of products.

See Appendix for example Material Safety Data Sheets of common polyester, polyurethane and epoxy resin products.

4.0 SUBSTITUTION

★ **Always consider safer alternative materials or methods before using casting resins.**

- Although there may not be an equivalent substitute for styrene-based, polyurethane or epoxy resins, there are other types of material that sculptors and model makers can use in some cases. For example, if durability of the prop is not an issue, the use of food grade gelatin and propylene glycol mixtures might be feasible.
- There are products on the market that minimize the vapour emissions, such as waxed resins and low styrene emission resins.
- **AVOID using isocyanate-containing products as much as possible.**
- If you have to use resin products and you have a choice between products, choose the product with the smallest styrene or isocyanate component. Check the Material Safety Data Sheet for approximate percentages. Some products contain 30-60% styrene or isocyanates as high as 70-90 %.
- Minimize the use of products containing Toluene Diisocyanate (TDI). If necessary, use products with a Diphenylmethane Diisocyanate (MDI) component that has a much lower vapour pressure (less volatile) than TDI.
- Choose an epoxy resin that contains little or no epichlorohydrin (suspected human carcinogen). Check the MSDS!
- Choose less irritating epoxy curing agents, such as polyamides and cycloaliphatic amines than the aliphatic amines.
- Choose epoxy resins with higher molecular weights that may be less likely to sensitize the skin.
- Choose a single-component epoxy system rather than the two-component system since the hazardous monomers have already reacted to a certain point.
- Choose products with reduced solvent contents or solvent free.

5.0 EDUCATION AND TRAINING

- As discussed in Section 3, WHMIS training is a requirement for all film industry personnel working with and around casting resin products. **Inquire through the SHAPE office (Safety and Health in Arts Production and Entertainment) at (604) 733-4682 or toll free 1-888-229-1455, www.shape.bc.ca for the next scheduled WHMIS course that they are offering.**
- Education and instruction is one of the most important components of ensuring that everyone using and working around casting resin products is protected, and other key film industry personnel, including first aid attendants.
- The instruction session should cover signs and symptoms of overexposure to casting resin products, proper handling procedures, avoidance of spills and good housekeeping practices.
- Educating workers to follow manufacturer's directions is very important to allow the correct chemical reaction to use up all the free monomers and not leave any product unreacted.
- Workers must be instructed in the correct use, limitations and care of personal protective equipment, such as respirators.

6.0 SAFETY BULLETINS

The following Casting Resin Safety Bulletins are attached:

- #1: **Planning and Hazard Communication**
- #2: **Ventilation Systems**
- #3: **Respiratory Protection and Protective Clothing**
- #4: **Medical Monitoring**
- #5: **Use of Polyester Resins**
- #6: **Use of Polyurethane Resins**
- #7: **Use of Epoxy Resins**
- #8: **Working with Finished Plastics**
- #9: **Cleaning and Emergency Procedures**

The contents of the safety bulletins were compiled from reviewing Material Safety Data Sheets of various resin products, literature review, and interviews with select film industry personnel. These safety bulletins can be used as a guideline for film industry personnel working with or around casting resins products.

It should be noted that there maybe unique situations, such as confined space entry, where other health and safety precautions are required in addition to these guidelines. **If you are not sure of what safety precautions are required in a situation, talk to your supervisor, IATSE Occupational Safety and Health, manufacturer's technical support, SHAPE and/or qualified industrial hygienists.**

Attached in the Appendix are examples of Material Safety Data Sheets of commonly used casting resin products. Each product can be a unique formulation depending on the manufacturer and the brand name, so make sure the MSDS for the product being used is obtained and available for reference.

7.0 REFERENCES

Code of Practice for Styrene – Government of Western Australia (2001)

Epoxy Resin Systems Fact Sheet – Department of Health Services, California (1989)

Epoxy Resin Systems Safe Handling Guide – Society of the Plastics Industry (1997)

Focus on Safety Safe Work Practices for Film and Television Production in BC (2001) WCB of BC

Hazardous Substance Fact Sheet Styrene Monomer (1998) New Jersey Department of Health

“Health Effects of Styrene Exposure” (1992) Alberta Human Resources and Employment Workplace Health and Safety

International Chemical Safety Cards on Styrene - WHO/IPCS/ILO

“Monitoring of Workers Exposed to Isocyanates” (1993) Alberta Human Resources and Employment Workplace Health and Safety

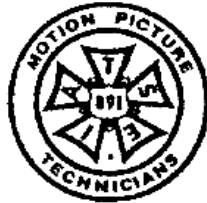
OSHA Synthetic Mineral Fibers

OSHA Technical Links – Styrene (www.osha-slc.gov/SLTC/styrene)

Urethane Resin Systems Data Sheet – United Scenic Artists, Local 829, IATSE

WBC OF BC - Testing for Workplace Hazards “Synthetic Mineral Fibre”

Working with Fibreglass – Government of Western Australia (2000)



Casting Resins Safety Bulletins



CASTING RESINS SAFETY BULLETIN #1:

PRE-PLANNING AND HAZARD COMMUNICATION

- At the planning stage of a production, Construction Co-ordinators should anticipate whether or not casting resins may be used, to look for buildings that can accommodate for such activities. For example, ensure that the building has good general ventilation and enough space to accommodate local exhaust ventilation systems and enclosures.
- Make sure the shop has room for lay-up work and other activities. Lay-up areas should be separated from finishing areas.
- Prior to lay-up of a large piece, a brief safety talk should be held to make everyone working in close proximity to be aware of the health and safety hazards associated with the activity.
- The work area or enclosure area where casting resins are handled or used must be posted with signs to warn of the hazard and what protective equipment is necessary when entering the area. **This is a regulatory requirement!**
- Read the Material Safety Data Sheet (MSDS) for the casting resin products to be used. The MSDSs state precautionary measures to be taken, first aid recommendations and any special handling and disposal procedures associated with a particular product. Ask the manufacturer about any questions about the products. **MSDSs must be kept on site for further reference.**
- Open flames, cutting and welding torches, heaters, high intensity lamps, lighted pipes, cigarettes and other sources of ignition are strictly prohibited from storage areas and immediate work areas of casting resin products. A minimum distance of 50 ft has been suggested as a safe distance from styrene work and ignition sources considering there is good ventilation. **Smoking is strictly prohibited when using casting resins.**
- Large lay-up jobs should be conducted when other people not related to the activity are not in the shop, e.g., after hours or weekends.
- DO NOT perform casting work within confined spaces unless a confined space hazard assessment and safe work procedures have been developed by a qualified person and protective measures are in place.

For more information, contact the Occupational Health and Safety Division at (604) 664-8948.



CASTING RESIN SAFETY BULLETIN #2:

VENTILATION SYSTEM

General Recommendations:

- Perform casting work with effective local exhaust ventilation. General ventilation alone is not adequate for controlling vapours.
- Relying on natural ventilation alone is not effective in reducing exposure to high concentrations of vapours.
- Provide fresh air or make-up air to the room to dilute the airborne contaminant as much as possible. The intake and exhaust vents should be far enough apart so that exhausted air is not brought back into the building. Also, the fresh airflow should pass through the breathing zone of workers before reaching the contaminant source.
- Make sure that the fan is explosion-proof (the fan must not produce sparks, which can act as an ignition source). **Many components of casting resin systems, such as styrene, are very flammable!**
- Change filters as often as necessary.
- Mixing resin products and lay-up work must be performed inside booths or using other ventilation methods away from heat sources. The air above an open container of polyester resin (within 2 feet) can emit as much as 60 –100 ppm of styrene vapours.
- Whenever possible, utilize a certified ventilation engineer combined with an industrial hygienist to design the system, or to inspect the ventilation system.
- Ventilation systems should be inspected and maintained regularly to make sure it is operating as it should.
- Areas should be vented while pieces cure, since pieces will be emitting vapours. Pieces laid-up days before can still emit low levels of vapours if it is a large piece. **Allow enough time for pieces to cure fully (check with the manufacturer for the appropriate curing times.)**

Using Booth Ventilation System:

- One of the most effective methods for controlling resin vapours, such as styrene,



is performing casting work inside an enclosed booth fitted with an extraction fan. This is especially effective for lay-up of large pieces where it is difficult to control with local exhaust ventilation.

Using Local Exhaust Ventilation System:

- Local Exhaust Ventilation (LEV) should be used to control for high concentrations of vapour. A good example of a LEV is a downdraft table where the generated vapour and aerosols are captured below the table surface.
- Enclose the process as much as possible. Make sure that the air velocity at the source of contaminant is strong enough to capture the vapours.
- All ducting should remain in good shape, free of holes and tears. Clean and inspect the ducts regularly since holes and tears will reduce the effectiveness of the ventilation system. Try to minimize the number of bends in the duct as much as possible.
- When new ducts are added to an existing system, ensure that the fan is strong enough to keep sufficient airflow.

During Desk Top Work

- When constructing small pieces of casting product, perform as much of the work as possible (i.e., mixing, lay-up, finishing etc.) with LEV, such as on a downdraft table, and let it cure inside an area equipped with a ventilation system.
- Rollers fitted with guards can reduce droplet formation.
- Use long handled rollers where possible.

For Large Scale Pieces (larger than paint booth, table top)

- Enclose and ventilate large pieces as much as possible.
- Cast large pieces after hours, or weekends, when other people are not around.

Finishing Casting Products

- When sanding, cutting or conducting other activities with power tools that can generate dust, perform your work inside a ventilation booth or use tools with dust collection systems attached.
- Heating finished casting work may decompose to generate toxic gases such as hydrogen cyanide (polyurethane) and styrene oxides.



- Never burn or heat resin products to the point when it starts to change colour, smoke or decompose.

Spray Operations:

- Remember that spray process can generate considerably higher airborne vapour concentration (2-3 times styrene vapour) than the hand lay-up process.
- Spray operations must be conducted in spray booths with adequate exhaust.
- Spray application must only be conducted by trained applicators who are familiar with its proper use and limitations.
- Always wear a supplied air respirator.
- The shop **MUST** be vacated during spraying, so that the piece can be left to cure and the shop is vented overnight.
- During spraying, post a sign warning other people of spray operation in the area. For example, the sign can read *“Spray Operation in Progress- Do Not Enter This Area Unless Wearing Proper Respiratory Protection”*.
- Use airless spray guns whenever possible, to minimize vapour/mist emissions.
- Whenever possible, use low pressure systems that produce a coarse spray to help minimize the generation of airborne aerosols.

For more information, contact the Occupational Health and Safety Division at (604) 664-8948.



CASTING RESIN SAFETY BULLETIN #3:

RESPIRATORS AND PROTECTIVE CLOTHING

Respirators:

- ★ **Remember that wearing the respirator is NOT the first line of defense against exposure. Respirators shall be worn in conjunction with ventilation. The type of respirator required depends of the concentration of vapours, duration of exposure, and presence of other airborne contaminants such as dust or mist.**
- For most casting resin lay-up work (non-isocyanate) typically performed in the industry, it is recommended that as a minimum, a NIOSH-approved half-face air purifying respirator equipped with organic vapour cartridges and dust pre-filter (dust/mist or HEPA filters) be worn while performing activities, such as mixing, manual lay-up, sanding, or finishing pieces. **However, ALL isocyanate work must be performed using approved supplied air systems.**
- For all spraying activity or larger projects, a NIOSH/MSHA-approved full-face supplied air respirator **MUST** be worn for all casting resin work. The spray action will generate high airborne concentrations aerosol and vapour.
- All wearers of respirators are fit tested and fit test record is retained. **Call S.H.A.P.E at (604) 733-4682 for getting fit tested.**
- The respirators and cartridges/filters must be NIOSH/MHSA approved, and are selected, used and maintained in accordance with the CSA Standard Z94.4–93, *Selection, Use and Care of Respirators*.
- Respirators should be stored in a clean environment (e.g, clean zip lock bag, locker) and cleaned regularly according to the manufacturers instructions.

Other Protective Clothing:

- Impervious gloves, such as Poly Vinyl Alcohol gloves for styrene, butyl rubber, Viton, or Poly Vinyl Alcohol for isocyanate-containing products and butyl rubber for epoxy resins should be worn. **Follow the manufacturer's recommendations for the type of glove or ask the glove supplier for the correct type to wear.**
- Everyone working with casting resin products must wear protective clothing, such as disposable coveralls.



- Eye protection such as safety goggles must be worn if there is a splash hazard, or safety glasses must be worn at all times when cutting, or sanding casting products.
- All protective clothing should be removed, stored and/or disposed of in a designated area away from eating areas.

For more information, contact the Occupational Health and Safety Division at (604) 664-8948.



CASTING RESIN SAFETY BULLETIN #4:

MEDICAL MONITORING

The routes of exposure to casting resin products are mainly through inhalation and skin exposure. **Be familiar with the signs and symptoms of overexposure to these hazardous chemicals.**

Chemical	Potential Long Term Health Effects
Styrene	<u>Inhalation</u> : irritating to the eyes, nose and throat, headaches, dizziness <u>Skin</u> : itchy skin and skin rashes
Diisocyanates	<u>Inhalation</u> : asthma-like symptoms <u>Skin</u> : dermatitis, rashes, blistering, reddening
Epoxy Resins	<u>Inhalation</u> : irritating to eyes, nose and throat, asthma-like symptoms <u>Skin</u> : skin redness, itchy skin, skin rashes

If you think you have been overexposed to casting resin chemicals, seek medical attention. A family physician may be able to refer you to an occupational physician in the area if necessary.

- To check for possible styrene overexposure, there is a test available where they analyze for styrene in the blood or the metabolite of styrene (mandelic acid) in the urine.
- Currently there is no specific test to find out if you will develop sensitivity to isocyanate or epoxy resin, however, if you already have respiratory problems such as asthma, bronchitis or emphysema, **you should avoid working with resin products.**
- If you have been diagnosed with isocyanate-induced illness, **AVOID** exposure to isocyanate-containing products entirely, before the respiratory problems become permanent.
- Persons with any history of allergies, heart problems, or respiratory difficulties should not work with sensitizing products.

For more information, contact the Occupational Health and Safety Division at (604) 664-8948.



CASTING RESIN SAFETY BULLETIN #5:

USE OF POLYESTER RESIN SYSTEMS

Polyester resins are commonly used casting resins in the film industry. In polyester casting resins, the primary hazardous chemicals and materials are styrene, Methyl Ethyl Ketone Peroxide (catalyst) and exposure to fiberglass dust.

POTENTIAL HEALTH EFFECTS:

Styrene

- Polyester resin contains styrene monomers (usually 30-60%) and a catalyst is added (MEK Peroxide) to accelerate the polymerization reaction. Styrene is a very volatile and flammable chemical. Styrene can enter the body by two main routes of exposure: inhalation of styrene vapours (primary route) and absorption through the skin with direct contact.
- Styrene vapour is irritating to the eyes, nose and throat. It can cause runny nose, and water, red and itchy eyes, and cough. Breathing in styrene vapours can cause headaches, dizziness, drowsiness, impaired co-ordination and difficulty in concentrating. Health effects of styrene are summarized in the following table:

Styrene Concentrations	Potential Health Effects
About 100 ppm	Mild irritation to nose and throat, headaches, dizziness, fatigue
About 350-500 ppm	Definite irritation
About 500 ppm	Severe irritation
About 700 ppm	Immediately Dangerous to Life and Health (IDLH)

- If liquid resin containing styrene splashes into the eye, it should be flushed out immediately since it can cause permanent damage. If styrene resin comes in contact with your skin, it can dry out your skin and may cause itchiness and skin rashes.
- If a worker is exposed to styrene over a long period of time, it can affect the central nervous system, damage kidneys, liver, nerves and the gallbladder. It has been documented that styrene can also be a sensitizer, where a worker can be working with styrene for many years without symptoms and all of a sudden, they may experience a severe allergic reaction with hives, blistering, swelling and itching. Upon subsequent exposure, very small concentrations can trigger



another allergic reaction. WCB of BC has classified styrene as a K3 – possible human carcinogen.

MEKP

- Methyl Ethyl Ketone Peroxide (MEKP) is a clear colourless liquid added to polyester resins as a catalyst. MEKP is known to be a strong irritant to the eyes, nose and throat. Long term exposures have liver and kidney damage. **Eye contact can cause permanent blindness with few drops, and ingestion can be fatal!**

Fibreglass

- Fibreglass is a synthetic fibre formed by melting glass in a furnace. The molten glass is forced through small holes to make fibres. The fibres are woven to form cloths of various thickness and cut to various lengths depending on the desired product.
- Fibreglass is a chemically inert material, however, they can cause skin and eye irritation and the inhalation of fibres may irritate the upper respiratory tract. The irritation seems to be caused by the rubbing of fibres on the skin, especially at folds of clothing. For most people, the irritation is temporary and a shower usually washes the fibres on the skin.

It is not yet known whether there is increased risk of lung cancer in humans exposed to fibreglass fibres. However, the WCB of BC has classified synthetic mineral fibres as a possible human carcinogen.

RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT:

Protective Clothing: If you are handling resins, wear protective coveralls. Change out of contaminated clothes as soon as possible.

Gloves: Use Viton or polyvinyl alcohol gloves which is resistant against styrene. **Check the MSDS, manufacturer of product, or glove supplier.**

Eye Protection: Eye goggles are recommended to guard against splashing.

Respiratory Protection: For most styrene casting resin lay-up work typically performed in the industry, it is recommended as a minimum that a NIOSH-approved half-face air purifying respirator equipped with organic vapour cartridges and dust pre-filter (dust/mist or HEPA filters) be worn while performing activities, such as mixing, manual lay-up, sanding, or finishing pieces. **Supplied air respirator must be worn during all spray activity or larger projects where adequate ventilation is not feasible.**



See *Casting Resin Safety Bulletin #3 – Respirators and Protective Clothing*, for more detailed information.

GENERAL GUIDELINES:

Warning! Styrene is a very volatile and flammable liquid. Temperatures above 31°C can generate an explosive vapour and air mixtures.

- Prevent electrostatic charges by grounding dispensing containers and use non-sparking tools.
- Keep containers away from direct sunlight and other heat sources and incompatible oxidizing products, strong acids, and catalysts. Catalysts should be stored in cool, dry dark areas.
- Eating, drinking and smoking is prohibited where styrene is handled or stored.
- Good housekeeping is important to prevent spills, fires and accidental ingestion.
- Dispose empty containers properly, even small amounts of unreacted styrene can be a fire hazard. Ask the manufacturer of proper disposal method for the product you are using, most will recommend that the waste catalyst and monomer be disposed of separately.
- It is important to keep work areas clean to prevent spills. Most occupational exposures to isocyanates occur by accidental spills. Clean up all spills immediately to minimize vapour release into work environment. Use sand or vermiculite to soak up liquid and dispose in suitable container.
- **Allow enough time for pieces to cure fully (check with the manufacturer for the appropriate curing times.)**
- Keep covers on containers when not in use. Keep the number of resin products in the shop to a minimum. Order as projects come up.
- Periodically, check the integrity of the containers by inspecting for signs of increased pressure and that the integrity of the containers and seals are maintained.
- Some products may have a shelf life. To dispose of expired products, ask the manufacturer or the supplier for proper disposal procedures.
- Ensure all containers display proper labels in accordance with the WHMIS Regulation.

CASTING RESIN SAFETY BULLETIN #6:



USE OF POLYURETHANE RESIN SYSTEMS

In the film industry, many isocyanate-containing products are commonly used to make a desired prop and construction components with castable soft polyurethane. In polyurethane casting resins, the primary hazardous chemical is isocyanates.

POTENTIAL HEALTH EFFECTS:

Isocyanates

- The routes of exposure to isocyanates are mainly through inhalation and skin exposure during lay-up and curing stage. Once the isocyanate-containing products are cured completely, there is no release of isocyanate vapours unless it is heated enough to break it down into its original components.
- Inhaling even small amounts of isocyanates may sensitize a person causing asthma-like reactions and symptoms. Sensitization may happen within days of exposure or take months or years to develop. It is well known that once sensitized, a person is likely to experience symptoms upon repeated exposure, even in very small concentrations. The properties of chemicals, the amount and duration of exposure, as well as unique individual factors may increase the chances of developing isocyanate-induced asthma.
- Direct skin contact with isocyanate-containing products may cause rashes, blistering and reddening of the skin. Again, repeated skin contact may cause contact dermatitis and skin sensitization. Some recent research has suggested that isocyanate exposure through the skin is very significant in the development of respiratory sensitization. Therefore, AVOID direct skin contact.
- Exposure of isocyanates to the eye can result in eye irritation, temporary blurred vision and cornea damage.

RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT:

Protective Clothing: If you are handling resins, wear protective coveralls. Change out of contaminated clothes as soon as possible.

Gloves: Butyl rubber, Viton, or poly vinyl alcohol are resistant to isocyanate containing products. **Check the MSDS, manufacturer of product or glove supplier.**

Eye Protection: Eye protection will be provided with the full-face piece of the respirator.



Respiratory Protection: A supplied air respirator must be worn when working with products containing isocyanates. See *Casting Resin Safety Bulletin #3 – Respirators and Protective Clothing*, for more detailed information.

GENERAL GUIDELINES:

- **Allow enough time for pieces to cure fully (check with the manufacturer for the appropriate curing times.)**
- It is important to keep work areas clean to prevent spills. Most occupational exposures to isocyanates occur by accidental spills.
- Keep covers on containers when not in use.
- Clean up all spills immediately to minimize vapour release into the work environment. Use sand or vermiculite to soak up liquid and dispose in suitable container.
- Keep the number of isocyanate products in the shop to a minimum. Order as projects come up.
- Store in cool, dry location. Store away from any heat source and direct sunlight.
- Eating, drinking and smoking is prohibited where polyurethane resin is handled or stored.
- Keep away from incompatible substances, such as bases and alcohol that can initiate uncontrollable polymerization. Isocyanates react vigorously with water and ammonia, or strong bases to produce heat and carbon dioxide gas. If this occurs in a sealed container, the container may rupture or explode, releasing isocyanate vapour and CO₂ in the air.
- Periodically, check the integrity of the containers by inspecting for signs of increased pressure and that the integrity of the containers and seals are maintained.
- Some products may have a shelf life. Check with the manufacturer if you are not sure.
- Ensure all containers display proper labels in accordance with the WHMIS Regulation.
- Empty non-returnable containers which contained isocyanates must be decontaminated by filling them with water and allowing them to stand for a



minimum of 48 hours, without being sealed, stopped or closed. After which the containers must be pierced to prevent re-use.

- To decontaminate large drums, use 5% sodium carbonate solution and leaving them to stand for at least 24 hours, with bungs removed to allow CO₂ to escape.
- To dispose of expired products, ask the manufacturer or the supplier for proper disposal procedures.

For more information, contact the Occupational Health and Safety Division at (604) 664-8948.



CASTING RESIN SAFETY BULLETIN #7:

USE OF EPOXY RESIN SYSTEMS

Although not commonly used, epoxy resins are used when tough, durable products are desired or when the master mould is not compatible with other resins. Epoxy resin systems are made up of an epoxy resin and a curing agent (catalyst) when mixed a chemical reaction combines the molecules into long chains. The hardened finished product is almost non-toxic, however exposure to the uncured resin components can be harmful.

The primary hazardous chemicals or materials are the diglycidyl ethers (commonly diglycidyl ether of bisphenol A) and the amines (commonly TETA, DETA). Check the Material Safety Data Sheets for the hazardous ingredients.

POTENTIAL HEALTH EFFECTS:

- Vapours and mist can irritate the nose, eyes and throat. Hardeners are caustic and can produce burns. Some people may develop asthma from the curing agents or a skin allergy. Once sensitized, a minute amount can trigger the allergic reaction for subsequent exposures.
- There are reports that epichlorohydrin contained in some epoxy resins cause cancer in animals. Therefore, WCB of BC has classified epichlorohydrin as a K2 – suspected human carcinogen.

RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT:

Protective Clothing: If you are handling resins, wear protective coveralls. Change out of contaminated clothes as soon as possible

Gloves: Glove material must be evaluated on an individual basis since some chemicals commonly used in epoxy resins are resistant to butyl rubber, but Ethyl Vinyl Alcohol may be better for others. **Check the MSDS, manufacturer of product or glove supplier.**

Eye Protection: Eye goggles are recommended to guard against splashing.

Respiratory Protection: For most epoxy casting resin lay-up work typically performed in the industry, it is recommended as a minimum that a NIOSH-approved half-face air purifying respirator equipped with organic vapour cartridges and dust pre-filter (dust/mist or HEPA filters) be worn while performing activities, such as mixing, manual lay-up, sanding, or finishing pieces. **Supplied air respirator must be worn during all spray activity or larger projects where adequate ventilation is not feasible.** See Casting Resin Safety Bulletin #3 – Respirators and Protective Clothing, for more



detailed information.

GENERAL GUIDELINES:

- Follow proper mixing procedures for two-part systems. **Allow enough time for pieces to cure fully (check with the manufacturer for the appropriate curing times.)**
- Keep work areas clean to prevent spills.
- Keep covers on containers when not in use.
- Clean up all spills immediately to minimize vapour release into work environment. Use sand or vermiculite to soak up liquid and dispose in suitable container.
- Keep the number of resin products in the shop to a minimum. Order as projects come up.
- Store in cool, dry location. Store away from any heat source and direct sunlight.
- Eating, drinking and smoking is prohibited where epoxy resin is handled or stored.
- Keep away from incompatible substances, such as acids, bases and oxidizing material.
- Periodically, check the integrity of the containers to inspect for signs of increased pressure within the containers and to ensure that the integrity of the containers and seals are maintained.
- Some products may have a shelf life. Check with the manufacturer if you are not sure.
- Ensure all containers display proper labels in accordance with the WHMIS Regulation.
- To dispose of expired products, ask the manufacturer or the supplier for proper disposal procedures.

For more information, contact the Occupational Health and Safety Division at (604) 664-8948.



CASTING RESIN SAFETY BULLETIN #8:

WORKING WITH FINISHED PLASTICS

Allow enough time for pieces to cure fully prior to finishing the piece. Usually, the manufacturer can provide technical information sheets with recommended curing times. It is very important that curing times are followed since there will be off gassing of hazardous components of the resin while the chemical reaction is still occurring.

The hazards from working with finished plastics will typically arise from the methods and other products used to fabricate pieces. Processes, such as gluing, cutting, sanding, burning and melting finished plastics can generate toxic vapours and gases, and if the temperature is high enough, the product can decompose into its original hazardous components.

- Do not BURN plastic pieces. Burning can release carbon monoxide and other toxic gases from the decomposition of the plastic.
- Heating of plastics from sawing or cutting can also create enough heat that the plastic may release any unreacted monomers and other chemicals that were bound in the plastic.
- For example, excessive heating or burning finished polyurethane products can release hydrogen cyanide.
- Heating of plastic pieces must be performed in spray booths or other forms of local exhaust ventilation with respiratory protection.
- Air purifying respirators with organic vapour/acid gas cartridges and a dust/mist filter is recommended when heating, gluing, or cutting plastics.
- For extensive heating and/or finishing processes such as during prolonged sanding, and cutting, it is recommended that a supplied air respirator be worn.
- Many adhesives contain solvents that can enter the body through inhalation or contact with the skin. Avoid using chemicals like methylene chloride as an adhesive. It can be absorbed through the skin and is a suspected human carcinogen.
- When using adhesives to glue pieces together, use them in a well ventilated area. If large amounts are utilized, use them inside spray booths or with good local exhaust ventilation.

For more information, contact the Occupational Health and Safety Division at (604) 664-8948.



CASTING RESIN SAFETY BULLETIN #9:

CLEANING AND EMERGENCY PROCEDURES

Cleaning Procedures:

- Eye wash facilities and washing areas must be available near the casting work area.
- If you get isocyanate products on the skin, rinse the skin with diluted rubbing isopropyl alcohol to neutralize the isocyanate, then wash thoroughly with soap and water.
- Do not use acetone or concentrated alcohol on skin to remove resin products. They can remove the natural protective oils from your skin and leave your skin dry and irritated. Instead use soap and water and apply lotion.
- Hands must be thoroughly washed before eating, drinking or smoking.
- Leave contaminated clothing at the workplace. Do not wear contaminated clothing home since you do not want to expose other people to these chemical compounds. Grossly contaminated clothing should be discarded.
- Keep work clothes, whenever possible, in separate lockers from street clothes.
- Changing areas, if provided, should be separate from work and eating areas.

First Aid

- Consult the Material Safety Data Sheet for the specific emergency procedures for the product you are using.
- If you get resin products on the skin or eyes, immediately wash it off or flush. Consult the Material Safety Data Sheet for the recommended washing procedure and flushing times. **Remember, seconds count!**

Fire

- Most polyurethane and polyester resin products contain flammable ingredients and they will burn and release toxic gases such as carbon monoxide, nitrogen oxides, hydrogen cyanide, styrene oxides and other toxic gases.



- Styrene fires should be extinguished with a Class B agent, foam or CO₂.
- For isocyanate fires use dry chemical powder, carbon dioxide or fire fighting foam. Do not use water to extinguish flames.
- For epoxy resin fires, use dry chemical, foam or CO₂.
- The area of the fire must be evacuated immediately. The Fire Department should be notified of the nature of the fire, i.e., styrene or isocyanate product and other chemicals such as hydrogen cyanide, phosgene, and carbon monoxide in the fire.
- After the fire has been extinguished, the area should be inspected by personnel wearing protective equipment to remove any products before unprotected workers are permitted to enter the area.

Spills

- Consult the Material Safety Data Sheet for the spilled product on how to clean up spills and properly dispose of the waste.
- A spill must be cleaned immediately by person wearing appropriate personal protective equipment (PPE). Evacuate anyone in the area not involved in the clean up without proper PPE. This is very important when spill occurs onto or near hot surfaces.
- Immediately cover the resin spill with dry absorbent such as vermiculite or sand, do not use sawdust or shredded paper because of the fire hazard.
- Shovel the waste into a metal container, cover and place the waste outside in a shaded dry area prior to disposal.
- Make sure that the container is not sealed so any pressure build-up can escape. Put containers outside, and follow manufacturer's instructions on neutralizing the product.
- If spill contaminates local sewers or water drain, inform local authorities of the spill.

For more information, contact the Occupational Health and Safety Division at (604) 664-8948.



Example Material Safety Data Sheets of Various Casting Resin Products



MATERIAL SAFETY DATA SHEET

Trade Name: CRYSTAL SHEEN "A"
Chemical Family: Epoxy Resin
Formula: Proprietary
Manufacturer: DOW CHEMICAL CANADA **Supplier:** COAST FIBER-TEK
PO Box 1012, Modeland Rd. 1306 Boundary Road
Sarnia, Ontario N7T 7K7 Burnaby, BC V5K 4T6
Emergency Phone #'s: (403) 998-8282 Tel.# (604) 294-8116

Transportation EMG. Phone # CANUTEK (613) 996-6666
(604) 930-0650

HAZARDOUS INGREDIENTS:

Polymer of Epichlorohydrin & Bisphenol A: 83-98% CAS # 025085-99-8
Alkyl, Glycidyl Ether (C12-C14): 2-17% CAS # 068609-97-2

Exposure Limits: LD50 skin N/A, LD50 oral rat > 2000 mg/kg

PHYSICAL DATA:

Appearance & Odour: Clear (light yellow) liquid, medium viscosity, sweet tarry odour
Vapour Pressure: N/A
Vapour Density: N/A
Solubility in Water: None
Specific Gravity: 1.14 (water=1)

FIRE & EXPLOSION DATA:

Flashpoint & Method: 190.6°C, 375°F PMCC ASTM D-93
Flammable Limits: N/A
Extinguishing Methods: CO₂, dry chemical, foam
Special Equipment & Procedures: Self-contained breathing apparatus & complete protective clothing should be worn fighting chemical fires.

REACTIVITY DATA:

Conditions Contributing to Instability: Excessive heat.
Incompatible Substances: Bases, acids, amines & oxidizing materials.
Hazardous Decomposition Products: CO, CO₂
Hazardous Polymerization: Will not occur by itself.

HEALTH HAZARDS DATA:

NOTE: Health studies have shown that exposure to chemicals pose potential risks which may vary from person to person. Exposure to liquids, vapours, mists or fumes should be minimized.



MATERIAL SAFETY DATA SHEET

Crystal Sheen "A" - Pg 2

PRINCIPAL HEALTH HAZARDS:

- Skin Contact:* May cause an allergic reaction.
Eye Contact: May cause immediate pain & transient irritation.
Ingestion: Small amounts may cause discomfort, large amounts may be toxic.
Inhalation: May cause irritation..

FIRST AID PROCEDURES:

- Skin:* Wash off in flowing water.
Eyes: Flush with warm water for 20 minutes, obtain medical attention.
Ingestion: **INDUCE VOMITING** if large amounts ingested, get medical attention.
Inhalation: Remove to fresh air if effects occur, consult physician if effects persist.

PREVENTIVE MEASURES:

- Skin:* Always apply appropriate barrier cream to exposed skin. Wear impervious gloves (butyl rubber), coveralls and safety footwear.
Eyes: Chemical proof goggles or full face respirator if vapours cause eye irritation.
Ingestion: Wash thoroughly before consuming food stuffs.
Inhalation: Use only in well ventilated areas or use NIOSH or CAS approved respiratory protection with organic vapour cartridges.

CONTROL MEASURES & PRECAUTIONS

Keep container tightly closed. **Do not** consume food, drink or tobacco in work area or material storage areas. Use caution and personal cleanliness to avoid skin and eye contact. Avoid breathing vapours of heated materials. Use paper covering absorbent wipes and suitable disposable containers in work area.

SPILL, LEAK & DISPOSAL METHODS

Review fire and explosion hazards and safety precautions before proceeding with clean up. Restrict access to area. Contain spill to prevent liquid from entering sewers or waterways. Recover free liquid and use an absorbent material (i.e. sand, vermiculite) to soak up balance. Place in suitable container for disposal.

DISPOSAL METHOD

Dispose only in a facility permitted to dispose of hazardous waste by Federal, Provincial and Municipal regulations.

SHIPPING INFORMATION

Shipping Name: N/A
Hazard Class: Non-regulated.
UN/PIN #: N/A
Flashpoint: N/A

The information contained herein is based on data that we believe to be accurate. No warranty either expressed or implied is made. This information is offered solely for your consideration, interpretation and information.

Preparation Date: January 22, 1993

Prepared by: Nigel Poore, 1306 Boundary Road, Burnaby, BC V5K 4T6

Telephone #: (604) 294-8116

Revised Date: April 20, 2001



N/A = Not Available



MATERIAL SAFETY DATA SHEET

Trade Name: FIBERGLASS - CLOTH, MAT, WOVEN ROVING

Chemical Family: N/A

Formula: N/A

Manufacturer: BAY MILL LTD. **Supplier:** COAST FIBER-TEK
201 Hugel Avenue 1306 Boundary Road
Midland, Ontario L4R 4G1 Burnaby, BC V5K 4T6

Emergency Phone #'s: (705) 526-7867

Transportation EMG. Phone # CANUTEC

Tel.# (604) 294-8116

(613) 996-6666

(604) 930-0650

HAZARDOUS INGREDIENTS:

FIBROUS GLASS DUST: CAS # 65-997-17-3

Exposure Limits: TLV mg/m³ - 10

PHYSICAL DATA:

Appearance & Odour: Woven Fiberglass Fabric

Vapour Pressure: N/A

Vapour Density: N/A

Solubility in Water: N/A

Specific Gravity: (H₂O = 1) 2.5

Evaporation Rate: N/A

Boiling Point: N/A

Freezing Point: N/A

pH: N/A

FIRE & EXPLOSION DATA:

Flashpoint & Method: N/A

Flammable Limits: N/A

Extinguishing Methods: Water, foam, carbon dioxide, dry chemical

Special Equipment & Procedures: Self contained breathing apparatus and complete protective clothing.

REACTIVITY DATA:

Conditions Contributing to Instability: Stable

Incompatible Substances: None

Hazardous Decomposition Products: Carbon dioxide, carbon monoxide, hydrocarbons, water.

Hazardous Polymerization: Will not occur.

HEALTH HAZARDS DATA:

NOTE: Health studies have shown that exposure to chemicals pose potential risks which may vary from person to person. Exposure to liquids, vapours, mists or fumes should be minimized.



MATERIAL SAFETY DATA SHEET

Fiberglass Cloth, Mat Woven Roving - Pg 2

PRINCIPAL HEALTH HAZARDS:

<u>Skin Contact:</u>	Minor irritation
<u>Eye Contact:</u>	Minor irritation
<u>Ingestion:</u>	Minor irritation
<u>Inhalation:</u>	Minor irritation

FIRST AID PROCEDURES:

<u>Skin:</u>	Wash with soap & water. If irritation persists see physician
<u>Eyes:</u>	Flush with water for 15 minutes. If irritation persists see physician.
<u>Ingestion:</u>	Give 2 glasses of water. If irritation persists see physician.
<u>Inhalation:</u>	Remove to fresh air.

PREVENTIVE MEASURES:

<u>Skin:</u>	Always apply appropriate barrier cream to exposed skin. Wear impervious gloves (butyl rubber), coveralls and safety footwear.
<u>Eyes:</u>	Chemical proof goggles or full face respirator if vapours cause eye irritation.
<u>Ingestion:</u>	Wash thoroughly before consuming food stuffs.
<u>Inhalation:</u>	Use only in well ventilated areas or use NIOSH approved respiratory protection with organic vapour cartridges.

CONTROL MEASURES & PRECAUTIONS

Keep container tightly closed. Do not consume food, drink or tobacco in work area or material storage areas. Use caution and personal cleanliness to avoid skin and eye contact. Avoid breathing vapours of heated materials. Use paper covering absorbent wipes and suitable disposable containers in work area.

SPILL, LEAK & DISPOSAL METHODS

Review fire and explosion hazards and safety precautions before proceeding with clean up. Restrict access to area. Contain spill to prevent liquid from entering sewers or waterways. Recover free liquid and use an absorbent material (i.e. sand, vermiculite) to soak up balance. Place in suitable container for disposal.

DISPOSAL METHOD

Dispose only in a facility permitted to dispose of hazardous waste by Federal, Provincial and Municipal regulations.

SHIPPING INFORMATION

Shipping Name:
Hazard Class: Non Regulated
UN/PIN #:
Flashpoint:
WHMIS:

The information contained herein is based on data that we believe to be accurate. No warranty either expressed or implied is made. This information is offered solely for your consideration, interpretation and information.

Preparation Date: September 1, 2000

Prepared by: Nigel Poore, 1306 Boundary Road, Burnaby, BC V5K 4T6

Telephone #: (604) 294-8116



Revised Date: May 2, 2001
N/A = Not Available

Working with Casting Resins Checklist