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Document Title	INITIAL SUBMISSION: EPICHLOROHYDRIN TOXICITY AND SAFETY BULLETIN WITH COVER LETTER DATED 102792		
Chemical Category	EPICHLOROHYDRIN		

8(e)

# CAP

(COMPLIANCE AUDIT PROGRAM)

11607

## TSCA CONFIDENTIAL BUSINESS INFORMATION

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NOTE: Peter provides data entry in CBITS for the 8(e) CAP Documents.

8EHQ-1092-11609  
Contains No CBI



**RHÔNE-POULENC INC.**  
CN 7500, CRANBURY, NJ 08512-7500  
TELEPHONE: (609) 395-8300



8EHQ-92-11609  
INIT 10/30/92

October 27, 1992

**CERTIFIED MAIL**  
**RETURN RECEIPT REQUESTED**  
**P 416 555 375**



86920009884

Document Processing Center (TS-790)  
Attn: Section 8(e) Coordinator (CAP Agreement)  
Office of Toxic Substances  
Environmental Protection Agency  
401 M Street, S.W.  
Washington, D.C. 20460

02 OCT 30 4 11 PM '92

RE: Report Submitted Pursuant to the TSCA Section 8(e) Compliance  
Audit Program

CAP ID NO.: 8ECAP - 0004

RP CAP REPORT NO.: RPS - 0303

Dear Sir/Madam:

On behalf of Rhône-Poulenc Inc. (RPI, CN5266, Princeton, NJ 08543-5266) and its subsidiaries, the attached report is being submitted to the Environmental Protection Agency (EPA) pursuant to the Toxic Substances Control Act (TSCA) Section 8(e) Compliance Audit Program (CAP Agreement) executed by RPI and EPA (8ECAP - 0004).

The enclosed report provides information on the following chemical substance:

- Chemical Name: Epichlorohydrin
- CAS Registry No.: 106-89-8
- CAS Registry Name: Chloromethyloxirane

The title of the enclosed report is:

Epichlorohydrin Toxicity and Safety Bulletin

The following is a summary of the adverse effects in this report.

The enclosed information is being submitted under Section 8(e) CAP, because EPA may not have been aware of all of the results summarized in these documents at the time they were issued. For example, the acute toxicity data may not have been known to EPA in 1977. These data show epichlorohydrin to be moderately toxic via inhalation resulting in cyanosis followed by muscular relaxation of the extremities. Similar effects were observed following oral, dermal, and subcutaneous exposures. Epichlorohydrin was also reported to be irritating and to produce dermatitis and allergic skin reactions.

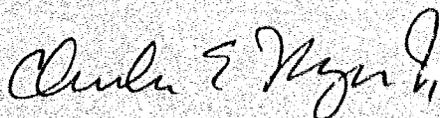
RPI does not claim any portion of the information in this submission to be TSCA confidential business information (TSCA CBI).

RPI has not previously submitted any TSCA Section 8(e) notices or premanufacture notification on the subject chemical substance.

In total, RPI is submitting three copies of the enclosed report and this cover letter: an original and two copies.

Further questions regarding this submission may be directed to Dr. Glenn S. Simon, Director of Toxicology at (919)549-2222 (Rhône-Poulenc, P.O. Box 12014, 2 T.W. Alexander Drive, Research Triangle Park, NC 27709).

Sincerely,



Charles E. Moyer, Jr., Ph.D.  
Director, Product Safety  
(609)860-3589

CEMjr/mm  
Enclosure

## Interoffice Memorandum

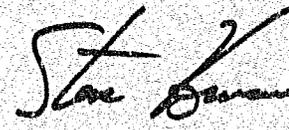
TO (Name and Location)	DATE
Mr. W. J. Collida	February 10, 1977
FROM (Name and Location)	REFERENCE NO.
S. P. Krivan	SPK 061-77

Subject: Epichlorohydrin Toxicity & Safety Bulletin  
(Shell) 6-76

CAP ID No. 5-LV-025-1  
Reviewed for Sec. 8 (e)  
Compliance Program  
On 9-6-91 By OS

Attached is comprehensive information regarding the hazards and safe handling controls for Epichlorohydrin (117A-5). The highlights of this information includes:

- \* Epi vapors may not be detectable until vapor concentrations reach 10 ppm, or higher.
- \* OSHA regulations do not permit exposures exceeding 5 ppm.
- \* Absence of odor does not assure low enough exposure levels.
- \* Approved respiratory protection must be supplied to all persons who may be exposed to 5 ppm, or greater, averaged over an eight-hour period.
- \* All persons potentially exposed to contact must be advised of dangers and correct procedures.
- \* Recommended handling procedures, protective equipment, etc.



Steve Krivan

/mb  
Enclosure

cc: Mr. E. M. Davis  
Mr. C. H. Howard  
Mr. J. M. Spalding



# SHELL CHEMICAL COMPANY

A DIVISION OF SHELL OIL COMPANY

ONE SHELL PLAZA

P.O. BOX 2463

HOUSTON, TEXAS 77001

January 13, 1977

CAP ID No. 5-LV-025-0005  
Reviewed for Sec. 8 (e)  
Compliance Program  
On 9-6-91 By JB

Celanese Coatings  
1495 South 11th Street  
Louisville, Kentucky 40210

Attn: Mr. Harold Hammers, Purchasing Agent

Gentlemen:

## EPICHLOROHYDRIN TOXICITY AND SAFETY BULLETIN 6-76

In the belief that occasional refamiliarization with the hazards associated with chemicals is desirable, we wish to make sure that you have all of the information available to us on epichlorohydrin (ECH) to permit you to handle this toxic material safely. Accordingly, we are attaching a summary of the most pertinent information known to us on the hazards of epichlorohydrin. Also included are recommended practices which have enabled this material to be used safely on a broad industrial scale.

Epichlorohydrin is included with other compounds in a study on mice of carcinogenic activity by direct-acting alkylating agents and related compounds via one or more routes of administration. Epichlorohydrin was reported as being at the borderline incidence.<sup>1</sup> Tumorigenic activity was also attributed to epichlorohydrin in an earlier study of organic peroxides and epoxides but because of the lack of control data or details of methodology, the significance of this work is difficult to assess.<sup>2</sup> A summary of these reports is included in the compilation of toxicity data included with this bulletin. Also attached are copies of the Documentation of the Threshold Limit Value (TLV) for epichlorohydrin and of the Shell Chemical Material Safety Data Sheet (OSHA) MSDS-508.

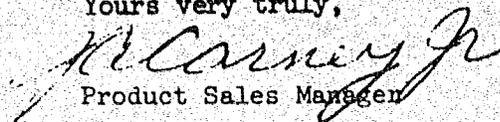
The Occupational Safety and Health Administration (OSHA) regulations do not permit employee exposure to concentrations exceeding 5 parts per million (5ppm) averaged over an 8-hour work-shift (29CFR1910.1000(a)(2)). It should be stressed that the odor of ECH may not be detectable until vapor concentrations reach 10 ppm or higher. Further, its vapor may deaden the sense of smell. Therefore, odor is not an adequate warning system. Absence of odor does not assure low enough exposure levels; work place monitoring is required in any case where such exposures are likely. Approved respiratory protection must be supplied to all persons who may be exposed to concentrations in excess of 5 ppm averaged over an 8-hour period. Personal protection equipment also must be used to prevent skin and eye contact. All persons who are potentially exposed to contact with epichlorohydrin must be made aware of all the dangers involved and they must be advised of the correct procedures to be followed

in handling this product. Information on a Gas-Liquid Chromatographic Method for analysis of epichlorohydrin in the work environment is available on request to Shell Chemical Company.

It must be stressed that epichlorohydrin is a toxic material. Contact with high concentrations may be fatal. Therefore, all human contact with this material must be avoided. Epichlorohydrin also is a significant potential fire hazard (OSHA and NFPA Class I(C)). Fumes from the combustion of epichlorohydrin contain hydrogen chloride and, under certain conditions, phosgene and carbon monoxide which are toxic. Contact with high concentrations of these combustion fumes may be fatal. Therefore, uncontrolled fires and all human contact with fumes of burning epichlorohydrin must be avoided. Special training must be given to persons working with epichlorohydrin or who may be called upon to fight fires or contain spills or leaks involving this product.

We appreciate your continuing interest in our products and their safe use. If you have questions or desire further information, please let us know. We will advise you promptly of any new information that becomes available.

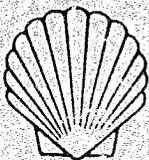
Yours very truly,

  
Product Sales Manager

P.S. During the course of preparing this information, The Wall Street Journal published an article September 30, 1976, stating, "In a report not yet released publicly, researchers at the National Institute for Occupational Safety and Health recommended that an environmental limit of 0.5 parts of the chemical for each million parts of air be allowed in factory areas...". A copy of the article is attached. This article appears to refer to the same tumorigenic studies by Van Duuren that have been cited in the attached information. It refers also to potential mutagenic and carcinogenic effects suggested by findings in bacteria and other lower organisms not yet observed in higher animals or humans. We believe that extensive animal tests which have been planned by the Manufacturing Chemists Association and supported by Shell and several other chemical companies, together with those planned by the National Cancer Institute, will indicate the significance of the findings reported by The Wall Street Journal. Meanwhile, appropriate precautions should be taken as we have suggested in the attached information. At the same time, we believe there is no valid toxicologic basis for classifying epichlorohydrin with vinyl chloride or bis (chloromethyl) ether as might be inferred from The Wall Street Journal article.

<sup>1</sup>Van Duuren, B. L.; Goldschmidt, B. M.; Katz, C.; Seidman, I.; and Paul, J. S.; Journal National Cancer Institute Vol. 53, 3, p. 695, September, 1974.

<sup>2</sup>Kotin, P. and Falk, H. L., Radiation Res. Suppl. 3, 193-211 (1963).



# SHELL CHEMICAL COMPANY

A DIVISION OF SHELL OIL COMPANY

ONE SHELL PLAZA

P.O. BOX 2463

HOUSTON, TEXAS 77001

January 13, 1977

Celanese Coatings  
1495 South 11th Street  
Louisville, Kentucky 40210

Attn: Mr. Harold Hammers, Purchasing Agent

## EPICHLOROHYDRIN TOXICITY AND SAFETY

Periodically we have provided detailed information on our products summarizing what we know of their toxicologic properties and recommending safe handling practices. In keeping with this practice, we enclose the following information on epichlorohydrin.

"Epichlorohydrin Toxicity and Safety Bulletin"  
"Epichlorohydrin Safety Notice"

Epichlorohydrin is a dangerous material. Therefore, we urge you to convey this information to all those who potentially may come in contact with this product as a result of your operations or activities. This would include your employees, your co-workers, your carriers, your warehousemen and distributors, and your customers. Appropriate advice should be given also for products made from epichlorohydrin to the extent that potentially hazardous amounts of unreacted epichlorohydrin are contained therein.

The "Epichlorohydrin Toxicity and Safety Bulletin" is the more authoritative and comprehensive reference for advising of potential hazards and for planning and judging safe practice in use, handling and distribution. There is no new information available to us to indicate that epichlorohydrin should be considered more toxic or a more significant hazard than heretofore. Nevertheless, we have decided to revise information previously available, so that it will contain the very latest information and thinking.

The "Safety Notice" is a simplified supplement to the more comprehensive "Toxicity and Safety Bulletin." We urge you to take the opportunity offered by the availability of our new abbreviated "Safety Notice" for review by all who may be concerned with the handling and use of epichlorohydrin. The "Safety Notice" is designed in a form to encourage wide distribution and reading. Every step should be taken to encourage employees to read the Notice and keep it close at hand for ready reference. Supervisory personnel should be prepared to answer questions and provide clarification and understanding. The more comprehensive "Toxicity and Safety Bulletin" should aid in this respect. We hope the "Safety Notice" will prompt more thorough study of the detailed "Toxicity and Safety Bulletin" which should be made available to all.

The "Safety Notice" is intended as a telegraphic alert to the potential hazards, the principal precautions to be observed, and response actions in case of accidents. This telegraphic style with emphasis on toxicity and potential dangers may be alarming to some, but we believe increased awareness is worth this risk.

In reviewing this information, you will note the following additional material, not supplied previously:

1. On November 21, 1975, OSHA announced the availability of a draft Technical Standard for occupational exposure to epichlorohydrin (FR 40 54033 (1975)). This draft maintains the 5 ppm concentration averaged over an eight-hour work day as the maximum limit of exposure for a worker. This is unchanged from the level indicated in our previous letter. We cannot predict when the final standard will be promulgated or if there will be significant changes.
2. Recently, the Materials Transportation Bureau of the Department of Transportation (DOT) proposed extensive revisions to the Hazardous Materials Regulations (Docket Number HM-103 and HM112). These were published in Federal Register 41, No. 74, pp 15972-16131, April 15, 1976; amendments were published in FR41, No. 183, pp 40614-4069; September 20, 1976, and the complete amended revisions were published in FR41, No. 188, pp 42364-42638, September 27, 1976. For shipping purposes, the "shipping name" for epichlorohydrin is "Flammable Liquid - NOS." In addition, the revised DOT regulations call for multiple labelling of materials meeting more than one hazard class when shipped in packages. Hence, because epichlorohydrin also qualifies as a Class B poison by inhalation, packages of epichlorohydrin (drums and sample containers) must carry both the FLAMMABLE LIQUID and POISON labels effective January 1, 1977.
3. The Material Safety Data Sheet and other information now in your possession may report a flash point of 100°F. This value was obtained by the Tag Open Cup method. The revised Data Sheet and "Toxicity and Safety Bulletin" report the figure of 87°F obtained by the Tag Closed Cup which is the method specified by DOT, which became effective January 1, 1976, to determine the proper flammability classification for epichlorohydrin.
4. In reviewing the information we have provided previously, we concluded it would be desirable to include additional information on recommended safe handling practices beyond that contained in our Material Safety Data Sheet. An appropriate section has been added to the attached bulletin.

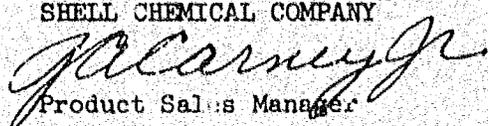
- 5. During the course of preparing this information, The Wall Street Journal published an article September 30, 1976, stating, "In a report not yet released publicly, researchers at the National Institute for Occupational Safety and Health recommended that an environmental limit of 0.5 parts of the chemical for each million parts of air be allowed in factory areas...". A copy of the article is attached. This article appears to refer to the same tumorigenic studies by Van Duuren that have been cited in the attached information. It refers also to potential mutagenic and carcinogenic effects suggested by findings in bacteria and other lower organisms not yet observed in higher animals or humans. We believe that extensive animal tests which have been planned by the Manufacturing Chemists Association and supported by Shell and several other chemical companies, together with those planned by the National Cancer Institute, will indicate the significance of the findings reported by The Wall Street Journal. Meanwhile, appropriate precautions should be taken as we have suggested in the attached information. At the same time, we believe there is no valid toxicologic basis for classifying epichlorohydrin with vinyl chloride or bis (chloromethyl) ether as might be inferred from The Wall Street Journal article.

Additional copies of our "Safety Notice" and "Toxicity and Safety Bulletin" are available on request, and we would welcome any comments you may have as to how this information might be improved.

Because it is important that adequate warning be provided to anyone who handles or uses epichlorohydrin, we ask that you acknowledge receipt of this letter and its enclosures by countersigning and returning to us an enclosed copy.

Very truly yours,

SHELL CHEMICAL COMPANY



Product Sales Manager

Acknowledged \_\_\_\_\_

Signature \_\_\_\_\_

Company and Title \_\_\_\_\_

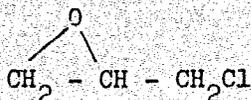
- Enclosures - "Epichlorohydrin Safety Notice", June, 1976 - (10)
- "Epichlorohydrin Toxicity and Safety Bulletin" June, 1976 - (3)
- Shell Chemical Material Safety Data Sheet (OSHA) MSDS 508-4 - (4)
- Documentation of the Threshold Limit Values for Substances in Workroom Air (Fourth Edition 1974) - Epichlorohydrin - (3)
- "Exposure of Workers to Epichlorohydrin Should Be Slashed, Federal Scientists Say", Wall Street Journal, 8, September 30, 1976

SC-179-76

EPICHLOROHYDRIN TOXICITY AND SAFETY BULLETIN

PROPERTIES AND ESSENTIAL INFORMATION  
FOR  
SAFE HANDLING AND USE  
OF  
EPICHLOROHYDRIN

## EPICHLOROHYDRIN



### 1. NAMES

Chemical Names: Epichlorohydrin, 1-chloro-2,3-epoxypropane, gamma-chloropropylene oxide

Common Name: Epichlorohydrin (Often abbreviated to ECH or Epi)

Chemical Formula: C<sub>3</sub>H<sub>5</sub>OCl

Molecular Weight: 92.5

### 2. PHYSICAL DATA

Physical State	Liquid
Boiling Point (760 mm Hg)	115°C (239°F)
Specific Gravity (H <sub>2</sub> O=1)	1.18 (20/20°C)
Vapor Density (air = 1 at boiling point of ECH)	3.19
Melting Point	-58°C (-72°F)
Vapor Pressure at 20°C (68°F)	13 mm Hg
Solubility in water, %w at 20°C (68°F)	6.6
Evaporation rate (butyl acetate = 1)	1.35
Flash Point (Tag Closed Cup)	30.6°C (87°F)
Autoignition temperature	415.6°C (780°F)
Flammable limits in air, %V	
Lower	3.8
Upper	21.0
Appearance and odor	Colorless liquid with an irritating, chloroform-like odor
OSHA Threshold Limit Value	5 ppm or 19 mg/M <sup>3</sup> averaged over an 8-hour day

### 3. HAZARDS

#### 3.1 Health Hazards

EPICHLOROHYDRIN IS A TOXIC, SEVERELY IRRITATING COMPOUND. THE LIQUID CAN BE FATAL IF SWALLOWED. IT CAN CAUSE SEVERE BURNS AND PERMANENT INJURY IF CONTACTED WITH THE SKIN OR EYES. THE VAPORS ARE SEVERELY IRRITATING TO THE EYES, NOSE, THROAT AND LUNGS. REPEATED OR PROLONGED EXPOSURE CAN CAUSE SEVERE AND LASTING LUNG, LIVER AND KIDNEY INJURY. HIGH CONCENTRATIONS CAN CAUSE DEATH.

Some people become sensitized on exposure to epichlorohydrin and show allergic skin reactions on subsequent exposure to very small quantities.

Epichlorohydrin has been reported to cause tumors at the injection site in mice when it was experimentally injected under the skin. The significance of these findings with regard to human effects is not known but appropriate caution is advised.

Animal inhalation studies have been authorized to determine the potential hazard from long-term exposure to the vapors. The results of these studies will be made public as soon as they become available.

THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) REGULATIONS DO NOT PERMIT EMPLOYEE EXPOSURE TO CONCENTRATIONS EXCEEDING 5 PARTS PER MILLION (5ppm) AVERAGED OVER AN 8-HOUR WORK-SHIFT. Such low concentrations are not detectable by smell. Therefore, work-place air monitoring is required to be sure that concentrations are below 5 ppm. If the odor of epichlorohydrin is detected, action must be taken at once to avoid exposure.

Employees should be instructed to leave the area or don approved respiratory equipment. The source of the leak should be eliminated or sufficient additional exhaust ventilation should be provided to bring epichlorohydrin concentrations within the safe level as indicated by personnel monitoring.

##### 3.1.1 Acute Effects

The liquid or vapor is a potent eye and respiratory irritant. It is markedly irritating when instilled in the eye and intensely irritating to the depilated skin of laboratory animals leading to widespread necrosis. In man, contact of the liquid with the skin produces, at first, a slight transient burning sensation which may be followed several hours later by blistering and pain in the region of contact.

In one set of experiments, the concentration that killed 50% of the test rats ( $LC_{50}$ ) was found to be 500 ppm for 4 hours exposure. The exposed animals showed gradual development of cyanosis followed by muscular relaxation of the extremities, but not narcosis. Rats exposed repeatedly to 120 ppm for

6 hour periods showed lung, liver and kidney injury; some respiratory distress was observed at 56 ppm, while 9 ppm was reported to produce no effects.

Epichlorohydrin has been shown by animal experiments to be irritating and systemically toxic by the oral, percutaneous and subcutaneous routes, as well as by inhalation of the vapor. Death of animals at high dosage levels is attributed to the action of epichlorohydrin on the central nervous system and/or the respiratory tract, particularly on the respiratory center. The cumulative toxicological action of epichlorohydrin is believed to be due to its nephrotoxic action. Animals show local irritation and symptoms of systemic intoxication following the absorption of the liquid through the intact skin.

Epichlorohydrin produced muscular paralysis and gradual depression of respiration leading to death after a single 30-minute exposure of mice to 3,330 ppm of vapor, the repeated application of the liquid (0.5 ml/kg) to the skin of rats, and the repeated oral administration of the liquid (0.1 ml/kg) to mice. Regardless of the route of administration, toxic doses of epichlorohydrin produced a similar chain of symptoms which differed mainly in the time of onset. In general, there was gradual development of cyanosis followed by muscular relaxation of the extremities. These symptoms developed very slowly and in many instances they were observed for several days before respiration became markedly depressed prior to death. Despite depression of respiration and skeletal musculature, a narcotic state was not observed. Only minor pathological changes consisting mainly of congestion of the internal organs, were observed on examination of the organs of the deceased mice.

The only symptom of distress following the oral administration of lethal doses of epichlorohydrin to rats was sluggishness, but deaths occurred within 24 hours. Autopsy findings in the rats consisted largely of congestion of the lungs, liver, kidneys, and stomach and congestion and hemorrhages in the intestines. Hemorrhages and congestion in the lungs were seen in most rats exposed to lethal concentrations of vapor.<sup>1</sup>

Epichlorohydrin has been widely used in industry in a safe manner. However, ECH can produce dermatitis and allergic skin reactions. An occasional case of sensitization in humans with resulting intolerance to very small quantities of the substance has been reported.

### 3.1.2 Long-Term Chronic Effects

Epichlorohydrin is one of a series of chemicals included in a recent study of carcinogenic activity. The chemicals were administered by one or more routes (on the intact skin, subcutaneous injection and intraperitoneal injection) to mice by Van Duuren, et al.<sup>2</sup> In the report on this study, the incidence of sarcomas at the site of the injection and tumors at sites distant from the area of administration was tabulated for all test and control groups. No significant difference was found between the incidence of these distant

tumors in treated animals and the incidence in no treatment control groups. Epichlorohydrin was found not to be a mouse-skin carcinogen on direct application. It had a low order of activity in initiation-promotion experiments, and was found to be of borderline activity by subcutaneous injection.

In some early work on the neoplastic activity of organic peroxides and epoxides in mice, Kotin and Falk<sup>3</sup> reported that epichlorohydrin demonstrated tumorigenic activity. However, neither control data nor methodology was defined and the significance of their observations is difficult to assess. Nevertheless, their observations, together with those of Van Duuren, et al, dictate the use of precautions in handling epichlorohydrin.

Because of our concern with toxic substances, Shell, in conjunction with several other chemical companies, is supporting an extensive animal testing program administered by the Manufacturing Chemists Association to enable some assessment of the extent and nature of the occupational hazard which might arise from long term (chronic) inhalation exposure to low concentrations of epichlorohydrin. We shall inform you of the significant results as they become available. Extensive epidemiological studies also are underway to determine if any human effects have become apparent from long term work experience under conditions intended to limit exposure to low concentrations of ECH because of a long-known appreciation of its acute toxicity. When completed, findings from this study also will be made available.

### 3.1.3 Subacute Effects

Rats did not gain weight normally when exposed to 32 ppm of vapor 7 hours a day, 5 days a week for 91 days. Exposure of rats to 16 ppm of vapor 7 hours a day, 5 days per week, for 91 days produced a significant increase in the size of the kidneys of the animals. Questionable or trace amounts of urinary coporphyrins were also detected at the 16 ppm level.<sup>1</sup>

### 3.1.4 Local Effects

Discoloration with occasional superficial desquamation (peeling or scaling) was noted a few hours after application of epichlorohydrin (1-2 ml/kg) to the skin of rats. More intense local irritation and symptoms of systemic intoxication were observed in these animals the following day. Repeated application of epichlorohydrin (0.5 ml/kg) to the skin of rats caused widespread superficial necrosis (dead tissue). The affected areas were dry, parchment-like and brown. The local effects gradually disappeared without complications in surviving rats.

Liquid epichlorohydrin is reported to produce only a slight and transient burning sensation when in first contact with the skin of man. Blistering and deep-seated pain in the contact area, however, may occur several hours after the time of the initial contact. Hypersensitive individuals may

develop an allergic-type of dermatitis following overexposure to vapors or following direct contact of the liquid with the skin. The liquid is also highly irritating to the eyes.

### 3.1.5 Industrial Experience

There have been no cases of serious pulmonary injury or systemic toxicity observed coincident with our manufacture or handling of epichlorohydrin. One case of skin burns resulting from prolonged contact with the liquid, however, required hospitalization for two days. There were no systemic aftereffects and the patient recovered without aftereffects. Eye conditions resulting from either overexposure to vapor or direct contact with the liquid have not been severe and in no instance has there been a reported loss of corneal substance or impairment of vision. An occasional case of sensitization with resulting intolerance to very small quantities of epichlorohydrin is reported infrequently coincident with handling this chemical. Most industrial injuries and the most common complaints have resulted from liquid contact; frequently, burns of the feet occur due to continued wearing of contaminated leather shoes despite efforts to decontaminate them by washing both the inner and outer surface. Leather articles wet with epichlorohydrin must be destroyed to prevent reuse.

### 3.1.6 Pulmonary Irritation

Epichlorohydrin vapor can produce various degrees of local irritation or injury to the tissues of the respiratory tract. Evidence of overexposure to the vapor is ordinarily manifested by subjective complaints of eye, nose or throat irritation; there may also be sneezing or perhaps bleeding at the nose in more severe cases. These symptoms, which have been seen only on occasion, have not proven of lasting severity and respond readily to medical treatment.

Although not observed in man, experimental data indicate that injury to the lungs can also be produced by overexposure to epichlorohydrin vapor. Accordingly, latent signs of shortness of breath, painful and uncontrolled coughing or grey cyanosis should be carefully watched for in all cases of vapor exposure.

### 3.1.7 Systemic Intoxication

Although human intoxication by epichlorohydrin has not been seen to date, experimental data on animals suggests that kidney damage may occur. Symptoms referable to the gastrointestinal tract may be the earliest manifestation of epichlorohydrin intoxication in man. Hence, workers with complaints of nausea, vomiting, dyspepsia, loss of appetite, or discomfort in the liver region should be carefully observed and, if necessary, removed from further exposures to epichlorohydrin.

3.1.8 Animal Experimentation Data (Summary)<sup>1</sup>

DOSE RESPONSE LEVEL	SPECIES	ROUTE OF EXPOSURE	EXPOSURE TIME	DOSE OR CONCENTRATION	MORTALITY
LC <sub>50</sub>	Mice	Inhalation	4 hours	707 ppm	-
-	Mice	Inhalation	30 minutes	8,300 ppm	20/20 in 24 hours
-	Mice	Inhalation	60 minutes	2,370 ppm	0/30
-	Mice	Inhalation	7 x 60 min/day	2,370 ppm	5/10
LC <sub>50</sub>	Rats	Inhalation	4 hours	500 ppm	-
-	Rats	Inhalation	8 hours	250 ppm	4/6
LC <sub>50</sub>	Guinea Pigs	Inhalation	4 hours	561 ppm	-
LC <sub>50</sub>	Rabbits	Inhalation	4 hours	445 ppm	-
LD <sub>50</sub>	Rats	Oral	-	0.28 ml/kg	-
LD <sub>100</sub>	Mice	Oral	-	0.601 gm/kg	15/15
LD <sub>50</sub>	Mice	Oral	-	0.238 gm/kg	-
-	Mice	Oral	-	0.096 gm/kg/day	15/15 after 21 doses
LD <sub>50</sub>	Guinea Pigs	Oral	-	0.178 gm/kg	-
LD <sub>50</sub>	Rabbits	Oral	-	0.283 gm/kg	-
LD <sub>50</sub>	Rabbits	Percutaneous	-	0.88 ml/kg	-
-	Rats	Percutaneous	-	0.5 ml/kg/day	6/10 after 3 applications
LD <sub>50</sub>	Rats	Intravenous	-	0.154 gm/kg	-
LD <sub>50</sub>	Mice	Intravenous	-	0.178 gm/kg	-

### TOXICITY REFERENCES

1. Smyth, H. F. and Pozzani, U. C., Mellon Institute, Personal Communication, 1958.
2. Van Duuren, B. L., Goldschmidt, P. M., Katz, C., Seldman, I., and Paul, J. S., Journal National Cancer Institute, Vol. 53, 3, pg. 695, September, 1974.
3. Kotin, P. and Falk, H. L., Radiation Res. Suppl. 3, 193-211 (1963).

### 3.1.9 Warning Properties

Epichlorohydrin has an irritating, chloroform like odor, but its presence is not detectable by odor at concentrations below about 10 ppm. In one experiment, sensory perception limits determined by responses of unconditioned personnel during or after 5 minutes of exposure to vapor were:

#### SENSORY PERCEPTION LIMITS

Threshold, Odor	50	10-12 ppm
Threshold, Odor	100	25 ppm
Threshold, Eye and Nose Irritation		100 ppm

At 25 ppm the odor is recognized by most people; one report indicated eye and nose irritation only at levels exceeding 100 ppm while another stated that 40 ppm at the site of a spill caused immediate eye, nose and throat irritation. The earliest symptoms of intoxication may be referable to the gastrointestinal tract (nausea, vomiting, abdominal discomfort) or pain in the region of the liver; labored breathing, cough, and cyanosis may be evident; the onset of chemical pneumonitis may occur several hours after exposure.

NOTE: Absence of odor does not necessarily mean that the concentration is within safe limits. Olfactory fatigue or other factors may also affect the sense of smell.

### 3.2 Fire and Explosion Hazards

EPICHLOROHYDRIN IS FLAMMABLE AND CAN FORM EXPLOSIVE MIXTURES WITH AIR AT ELEVATED TEMPERATURES WITHIN CERTAIN LIMITS. OPEN FLAMES, SMOKING, STATIC ELECTRICITY, AND ALL OTHER SOURCES OF IGNITION ARE TO BE AVOIDED WHEN WORKING WITH THE MATERIAL. The vapors are heavier than air and may travel along the ground and be ignited by sparks or open flames at locations remote from the site at which epichlorohydrin is handled. Epichlorohydrin may polymerize and burst its container when heated in a fire.

TOXIC GASES AND VAPOR SUCH AS HYDROGEN CHLORIDE, AND UNDER CERTAIN CIRCUMSTANCES, CARBON MONOXIDE AND PHOSGENE, ARE RELEASED IN A FIRE INVOLVING EPICHLOROHYDRIN.

According to OSHA Safety and Health Regulations Part 1910.106, epichlorohydrin is classified as a Class IC flammable liquid. Epichlorohydrin must be stored in tightly closed containers in a cool, well ventilated area away from any ignition source.

### 3.3 Reactivity Hazards.

Because of its high reactivity, exploratory syntheses with epichlorohydrin should be first undertaken on a small scale, with due caution, to observe the speed of the reaction and the amount of heat evolved. Temperature control is simplified by using a diluent (often an excess of the second reactant is satisfactory) or by adding the epichlorohydrin slowly as the reaction progresses. In recovering epichlorohydrin from a reaction product, continuous distillation is preferable to large-scale batch distillation to avoid heating large volumes of epichlorohydrin which may inadvertently contain catalytic or reactive substances.

Addition of epichlorohydrin to the second reactant is the preferred method of addition in order to avoid high concentrations of unreacted epichlorohydrin in the reaction system. The reaction could accelerate suddenly; the heat evolved could exceed the heat removal capacity of the system and lead to a runaway reaction.

Epichlorohydrin and its derivatives which contain the epoxide group are generally unstable in the presence of acids, caustics, and such bases as ammonia and amines. Epichlorohydrin can react violently with chemically active metals such as sodium, zinc, magnesium, aluminum and their alloys. Epichlorohydrin, glycidol, and glycidyl ethers have been observed to react vigorously and explosively with strong sulfuric acid and with anhydrous metal halides, such as stannic, aluminum, and ferric chlorides, even when these reagents were slowly added to the epoxide at room temperature.

Connections between epichlorohydrin feed vessels and the reaction equipment must be designed to avoid inadvertent contamination of the feed container.

## 4. ENGINEERING CONTROL OF HAZARDS (See NFPA No. 30)

### 4.1 Regulations

The design, installation and operation of epichlorohydrin facilities should comply with the federal rules and regulations of Title 39, Chapter VII, Part 1910, "Occupational Safety and Health Standards." These regulations are based on the mandatory provisions of the standards promulgated by the American National Standards Institute (ANSI) and the National Fire Protection Association (NFPA). Part 1910 also requires compliance with Title 29, Chapter XIII, Part 1518, "Safety and Health Regulations for Construction," and with the Walsh-Healey Act, Title 41-CFR, Part 50-204. The facilities also should comply with any state or local regulations that are more stringent than those mentioned above. The data and recommendations contained in this bulletin are of more specific nature pertaining to epichlorohydrin.

## 4.2 Building Design

4.2.1 Equipment and vessels containing epichlorohydrin preferably should be isolated from other facilities by walls and floors of fire resistive construction.

At least two means of exit should be provided from each separate room or building in which epichlorohydrin is stored, handled or used. No portions of such a room or building should be farther than 75 feet from the nearest exit. Additional exits should be provided depending upon the number of persons in the building. All exit doors should open out in the direction of travel and should be provided with panic hardware. Fire doors should open out in the direction of travel and be of an approved type. (See NFPA Standard No. 101, Life Safety Code.)

4.2.2 Operations where large quantities of epichlorohydrin are used should preferably be in the open or housed in well-ventilated one story buildings.

4.2.3 Buildings containing packaged epichlorohydrin must be designed so that vapors cannot concentrate and form flammable mixtures. Adequate low level exhaust ventilation should be provided to remove these vapors should leakage occur.

4.2.4 Provisions should be made for adequate spacing of chemical storage buildings from other buildings and processing equipment.

4.2.5 Circumstances of use and the accident potential may require segregation of floor drains from sanitary or process sewer systems.

## 4.3 Equipment Design

4.3.1 The technical problems of designing equipment, providing adequate ventilation, and formulating operating procedures which ensure maximum security and economy can be handled best by experienced engineers and safety and fire protection specialists.

4.3.2 Relief valve discharges and intentional vapor releases should be collected for recovery or disposed of by burning if concentrations would subject personnel to exposure exceeding 5 ppm.

4.3.3 For equipment handling liquid epichlorohydrin (inside a confined area), safety shields should be considered for stuffing boxes and mechanical seals. Caution should be used to insure that the shield does not mask leaks and corrosion and provide a false sense of security.

4.3.4 Losses from the equipment to the work environment must be limited so that the time weighted exposure of personnel does not exceed 5 ppm by volume. Area and/or personnel monitoring is recommended to assure such control.

4.3.5 In piping system designs, particular emphasis must be given to avoid the possibility of inadvertent mixing of epichlorohydrin with other chemicals.

#### 4.4 System Types

##### 4.4.1 Totally Enclosed Systems

Totally enclosed systems are recommended for processes using epichlorohydrin as a raw material. The opening of equipment during operation for adding or removing materials should be avoided to prevent escape of epichlorohydrin.

A commercial combustible gas indicator is useful for periodic inspections, or to locate sources of small leaks.

##### 4.4.2 Partially Enclosed Systems

Processes where solid materials are in contact with epichlorohydrin usually are totally enclosed, but part of the equipment may be opened periodically to remove solids. By hot water conditioning, ventilation, steaming and washing the equipment, epichlorohydrin vapors can be removed from the residual materials. Eye and skin contact and inhalation of vapors must be avoided in handling the residue.

4.4.3 Personnel should not enter equipment unless proper precautions are taken to ensure conditions are safe for entry.

For enclosed systems that are continuously or periodically pressured with inert gas from a central supply, positive means of preventing backup of flammable, corrosive or toxic materials into the supply system should be furnished.

4.4.4 Equipment that is periodically filled with epichlorohydrin should be vented thru a scrubbing system and then to the outside atmosphere. Vents may be protected with flame arresters approved for this material. However, flame arresters are subject to plugging, particularly from corrosive epichlorohydrin vapors in contact with damp air. If used they should be so located that they can be frequently inspected and maintained. Vented epichlorohydrin should not enter the atmosphere where people will be exposed.

#### 4.5 Ventilation

Good ventilation is essential in rooms or areas where epichlorohydrin is handled to prevent the unsafe accumulation of explosive mixtures and/or concentrations that result in time weighted exposures of people in excess of the threshold limit value of 5 ppm. The type of ventilation needed will depend upon such factors as temperature, dead spaces, convection currents, wind direction, etc., which must be considered by the engineer designing the system in determining equipment location, type and capacity. Laboratory work

should be done in a hood to avoid exposure and introduction of vapors into the workroom air. If mechanical ventilation is used, periodic monitoring should be employed to assure suitable control.

#### 4.6 Air Analysis

4.6.1 Chemical analysis of the air for epichlorohydrin in the work area will give a measure of the effectiveness of engineering control of the vapors. It may be used to detect leakage of epichlorohydrin vapors from equipment and also to estimate the order of magnitude of the health and fire hazard existing in work areas.

4.6.2 Epichlorohydrin vapor concentration in air near or within the explosive range (3.8 to 21% by volume in air) is most easily determined by the use of a standard combustible gas indicator. Measurements meaningful in terms of health hazard must be made with a procedure having a sensitivity of at least 1 ppm.

#### 4.7 Electrical Equipment

To help insure safe operation, wiring should be installed in accordance with Section 500 of the National Electrical Code, NFPA No. 70, Class 1, Group D, Division 1 or 2, the latter depending on the specific operation involved in a particular location. Motors, controls, switches, relays, lights, etc. should be explosion-proof, or as otherwise stated in this code. No heating apparatus capable of reaching 80% of the autoignition temperature of 416°C should be used.

#### 4.8 Overheating

Automatic temperature controls are recommended for processes where epichlorohydrin is heated, but even with these, close supervision is necessary in the event of control system failure.

#### 4.9 Static Electricity (Reference: NFPA No. 77, Static Electricity)

4.9.1 Sparks from static electricity can ignite epichlorohydrin vapor and air mixtures where the epichlorohydrin concentration is within the explosive limits.

4.9.2 Epichlorohydrin flowing through or being discharged from a line generates static electricity. All equipment and piping should be continuously bonded together and then to a ground system.

4.9.3 Before epichlorohydrin is poured or discharged from one metal container to another, the two vessels shall be bonded and grounded so that the resistance to ground does not exceed one megohm. All metal surfaces with which epichlorohydrin comes in contact should be bonded so that the resistance to ground does not exceed one ohm. Any ground that is adequate for power circuits or lightning

protection is considered adequate for protection against static electricity. Electrical conductivity should be checked periodically. Where drive belts are necessary, conductive belts are recommended. Pulley and drive shafts should be grounded to avoid static accumulation.

## 5. PERSONAL SAFETY

### 5.1 Employee Education and Training

5.1.1 Before undertaking any training of the employees who are engaged in handling or processing epichlorohydrin, the supervisor should be thoroughly familiar with the contents of this bulletin. He must make certain that each person handling the material is aware of the precautions necessary to maintain a safe operation. Professional medical advice is recommended in organizing and implementing safety indoctrination and handling procedures.

5.1.2 It is the supervisor's responsibility, of course, to periodically check his employees to make certain they are following instructions and precautions as directed.

### 5.2 Personal Protective Equipment

#### 5.2.1 Availability and Use

Personal protective equipment is not an adequate substitute for good, safe working conditions, adequate ventilation, and intelligent conduct by those working with epichlorohydrin. It is, however, in many instances the only practical means of personnel protection, particularly in emergency situations. The proper use of personal protective equipment requires training of all who may have to use the equipment. The following personal protective equipment should be used when indicated:

#### 5.2.2 Eye Protection

Epichlorohydrin as a liquid or vapor is capable of causing serious eye burns. Hence, it is imperative that the eyes be protected.

(a) Chemical Safety Goggles - Cup-type plastic or rubber framed liquid and gas tight goggles, equipped with approved impact resistant glass or plastic lenses, should be worn whenever there is danger of the liquid or gaseous material coming in contact with the eyes. Goggles should be carefully fitted.

(b) Spectacle-Type Safety Goggles - Metal or plastic rim safety spectacles with unperforated side shields may be used in laboratories where continuous eye protection is desirable, but the severity of exposure is low. Spectacles, however, should not be used where complete eye protection is needed, since they do not afford protection from splashes or vapor. In all cases persons who wear contact lenses should wear chemical safety goggles as minimum eye protection.

(c) Face Shields - Plastic shields (full face type) with forehead protection may be worn in addition to chemical safety goggles where complete face protection is desirable. Chemical safety goggles always should be worn as added protection where there is danger of material striking the eyes from underneath or around the sides of the face shield. Face shields alone should not be used as a substitute for chemical safety goggles.

### 5.2.3 Respiratory Protection

Severe exposure to epichlorohydrin vapors may occur in tanks during equipment cleaning and repairs, when decontaminating areas following spills, or in case of failure of piping or equipment. Employees who may be subject to such exposures should be provided with proper respiratory protection and trained in its use and care.

Where respirators are needed, the appropriate respirator should be selected from Tab. 2 and supervision should ensure that the employee uses the respirator provided.

Respirators should be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

A respiratory protection program should be instituted in accordance with Section 1910.134 (b), (d), (e), and (f).

NOTE: Respiratory protective equipment must be carefully maintained, inspected, cleaned and sterilized at regular intervals and always after each use.

CAUTION: Filter-type respirators do not offer protection against gases or O<sub>2</sub> deficiency and are unsuitable for use when working with epichlorohydrin.

TABLE 2

RESPIRATORY PROTECTION FOR EPICHLOROHYDRIN

CONDITION	PERMISSABLE RESPIRATORY PROTECTION
Vapor Concentration	
50 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
250 ppm or less	Any supplied-air respirator with a full facepiece, helmet or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 250 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode. (Supplied-air suits may be necessary.)
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors and acid gases. Any escape self-contained breathing apparatus.

#### 5.2.4 Head Protection

"Hard" hats should be worn where there is danger from falling objects or overhead leaks or spills. If "hard" hats are not considered necessary, rubber or plastic hats or caps may be worn to give protection against liquid leaks or splashes.

#### 5.2.5 Foot Protection

Rubber or neoprene safety shoes with built-in steel toe caps are recommended for workers handling bulk containers of epichlorohydrin. Rubber overshoes may be worn over leather safety shoes. If leather shoes become contaminated with epichlorohydrin, they should be removed immediately and the feet washed thoroughly with soap and water. The shoes should be destroyed and socks laundered. Rubber or Neoprene gives temporary protection if splashed with epichlorohydrin. It must be washed after use or destroyed.

#### 5.2.6 Body, Skin and Hand Protection

5.2.6.1 It is imperative that contaminated clothing be removed promptly and laundered. As a general hygienic measure, facilities for personal cleanliness should be provided. Employees who handle epichlorohydrin should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, using toilet facilities, and at the end of the day.

5.2.6.2 Protective clothing made of an impervious material, such as rubber, polyethylene, or Neoprene, may be worn to protect the skin against epichlorohydrin splashes. Rubber is penetrated slowly by epichlorohydrin and rubber articles wet by epichlorohydrin should be washed off immediately. Polyvinyl chloride (PVC) is penetrated more readily than rubber and is suitable only for temporary protection. Protective clothing should be discarded at the first sign of deterioration. If gross contamination occurs, discard these garments. Routine replacement of all garments should be done on a periodic basis.

### 6. FIRE FIGHTING

#### 6.1 General

"Alcohol-type" foam is an effective extinguishing agent for epichlorohydrin. Carbon dioxide and dry chemical extinguishers are suitable for use on small epichlorohydrin fires. Use water spray to keep fire-exposed containers cool, and water spray may be used to flush burning spills away from exposure.

#### 6.2 Special Hazards

When fighting epichlorohydrin fires there may be toxic fumes. Burning epichlorohydrin produces toxic and irritating hydrogen chloride gas. Under certain conditions, lethal phosgene and carbon monoxide gases also may be formed. These fumes are highly corrosive when exposed to moist air. Firemen should be equipped with suitable self-contained breathing apparatus.

## 7. SHIPPING, LABELING, HANDLING AND STORAGE

### 7.1 Shipping

#### 7.1.1 DOT Classification and Regulations\*

According to Department of Transportation regulations, epichlorohydrin is classified as a Flammable Liquid. Beginning January 1, 1977, each package must bear the DOT "POISON" label as well as the "FLAMMABLE LIQUID" label now required. For transportation purposes, it is listed as flammable liquid, NOS. Shipments must be made in specification containers when transported by rail, water, highway or air. All pertinent Federal regulations regarding loading, handling, container, type, size, marking, and labeling must be followed.

#### 7.1.2 Usual Shipping Containers - Type and Size

Authorized containers for surface shipment of epichlorohydrin are indicated in DOT paragraph 173.119. Most commonly used containers for this commodity are:

(a) Specification DOT 103W, 104W, 111A60W-1 and 111A100W-1.

(b) Specification MC 306 or 307 Tank Motor Vehicles, excluding those with aluminum tanks may be used. Proper outages must be allowed as required by loading temperature and type of container, see 173.116.

(c) Specification 17C, 17E, 5 or 5A steel drums. Shell is switching from 17E 18 gauge drums to more robust 17C drums with reinforced chines, beginning October 1, 1976. Only unphosphatized or iron phosphatized drums and unplated fittings should be used.

### 7.2 Labeling

#### 7.2.1 Dot Requirements

7.2.1.1 Beginning January 1, 1977, each Package must bear the DOT "Poison" label as well as the "Flammable Liquid" label now required. Before that date, compliance is voluntary.

7.2.1.2 The proper shipping name is Flammable Liquid, NOS-Epichlorohydrin.

7.2.1.3 For required DOT hazardous labels per container, see 172.419 and 172.430.

7.2.1.4 For required DOT "Flammable" placard for motor vehicle, tank cars, or boxcars, see 172.521 and 172.542.

\*DOT regulations are published in Title 49 CFR, Parts 170-189, Government Printing Office, Washington, D.C.

7.2.1.5 Required DOT marking of "THIS SIDE UP" for hazardous liquids. 172.312.

7.2.1.6 Required DOT "Empty" Placard. 172.525.

### 7.2.2 Precautionary Labeling

All containers of epichlorohydrin should bear a precautionary label. A reduced size copy of the drum label now used by Shell is shown in the accompanying figure. The text is designed for the product as shipped for industrial use. It should be used in addition to or in combination with any specific wording required by law. Since individual statutes, regulations or ordinances may require that particular information be displayed in a particular manner, or that a specific label or placard be affixed to a container, the use of this text will not necessarily insure compliance with such laws. Such laws include the Federal Hazardous Substances Labeling Act, Federal Insecticide, Fungicide and Rodenticide Act, Occupational Safety and Health Act and similar state and municipal legislation.

### 7.3 Handling

#### 7.3.1 Handling - General

7.3.1.1 All precautions must be taken to guard against health and fire hazards wherever epichlorohydrin is handled. The area should be posted with NO SMOKING or other appropriate warning signs as required by the operation. If leaks or spills occur, only properly trained and protected personnel should remain in the area. Leaking containers should be removed to the outdoors or to an isolated, well ventilated area, and the contents transferred to other suitable containers. Large spills should be diked and pumped into disposal vessels or containers. Residues and small spills should be removed with an absorbent, drummed and sealed. Epichlorohydrin should not be permitted to enter drains or sewers where there is danger of vapors becoming ignited. Epichlorohydrin is heavier than water and moderately soluble in water. Epichlorohydrin will sink and slowly dissolve in water if sufficient water is present.

SPILLS MUST NOT BE PERMITTED TO ENTER A PUBLIC WATER SUPPLY. IF SUCH AN INCIDENT OCCURS OR IS THREATENED, THE APPROPRIATE AUTHORITIES SHOULD BE NOTIFIED IMMEDIATELY.

For the purpose of complying with Section 1910.178, location classified as hazardous locations due to the presence of epichlorohydrin shall be Class I, Group C.

NET WEIGHT  
5.30 POUNDS



MADE IN U.S.A.



FOR EMERGENCY ASSISTANCE  
CALL (800) 771-0700  
OR (214) 343-4000

# epichlorohydrin

**FLAMMABLE LIQUID N.O.S. FOR INDUSTRIAL USE ONLY**



## DANGER!

**FLAMMABLE. MAY BE FATAL IF INHALLED. HARMFUL IF ABSORBED THROUGH SKIN OR SWALLOWED. MAY PRODUCE SEVERE SKIN OR EYE BURNS. IRRITATING TO EYES. MAY CAUSE ALLERGIC SKIN REACTION.**

Keep away from heat, sparks, and flames of any sort. Keep container closed. Use with adequate ventilation. Do not get in eyes, on skin, or on clothing. Do not take food, drink, or tobacco. Wash thoroughly after handling.

**FIRST AID: CALL A PHYSICIAN.** If SWALLOWED, induce vomiting by sipping liquid down throat or by giving soapy water to drink. Repeat until vomit is clear. Never give anything by mouth to an unconscious person.

If INHALED, remove to fresh air. If not breathing, give artificial respiration. Preferably mouth to mouth. If breathing is difficult, use a respirator.

**IN CASE OF CONTACT:** Immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing, wash skin with soap and water, wash contaminated impervious protective clothing immediately. Cleanse contaminated shoes and other leather articles, wash all other apparel thoroughly. Before reuse, wash in hot water.

**IN CASE OF FIRE:** Use water spray, alcohol foam, dry chemical, or CO<sub>2</sub>. Do not use water directly on liquid. Small spills with absorbent, turn and seal. Flush spill area with water. Keep Epichlorohydrin out of public water systems and sewerage. Notify authorities if this happens or is threatened. Wipe up spilled liquid with absorbent material. Wash hands and face with soap and water. Use self-contained breathing apparatus or full-face air-line respirator to avoid inhalation of product vapor or toxic and corrosive fumes from fire.

Shell Chemical Company  
P.O. Box 1000  
Houston, Texas 77001

## 7.4 Drums, Metal

### 7.4.1 Handling

When a carload or truckload of drums containing epichlorohydrin is received, the truck doors or the doors on both sides of the car, as the case may be, should be opened to allow thorough ventilation of the vehicle before it is entered. The interior should be monitored for epichlorohydrin concentration to determine whether it is safe to enter. Each shipment should be examined for leaking drums.

### 7.4.2 Emptying

7.4.2.1 Drums should be opened in a well ventilated area.

7.4.2.2 Drums and fittings should never be struck with tools or other hard objects which may cause sparking.

7.4.2.3 To remove the plug from a drum of epichlorohydrin the operator should wear goggles and use a bung or plug wrench. He should place the drum with the bung up, stand to one side, and face away during the operation. After the plug starts to loosen, it should be given not more than one full turn. If internal pressure exists, it should be allowed to escape to the atmosphere. Then only should the operator loosen the plug further and remove it.

7.4.2.4 The preferable safe method for emptying drums is by hand pump, or approved spark-proof electrical pumps. If drums are emptied by gravity, the faucets should be self-closing, and the bunghole fitted with a breather vent device. The use of pressure for emptying drums is unsafe. Inert gas padding of drums not to exceed 1 psig during unloading is recommended.

### 7.4.3 Disposal

7.4.3.1 Metal drums to be returned to the supplier must be completely drained and all openings (for bungs, plugs, etc.) must be closed tightly. DOT regulations, concerning return labeling, should be observed. Before a metal drum is discarded, it should be thoroughly scoured to remove traces of epichlorohydrin. Used drums should only be sent to qualified reconditioners. Otherwise they should be crushed or pierced before discarding to prevent reuse. The use of drums for other purposes is not recommended.

## 7.5 Bulk Containers

### 7.5.1 Tank Trucks

#### 7.5.1.1 Unloading

(a) The use of tank trucks is authorized by DOT Regulations. Sections 177.834, 177.837 and 177.841 of those regulations must be followed

where applicable. Local rules, regulations and ordinances must also be observed.

(b) Tank trucks should be visually inspected for leaks before they are allowed to enter the plant. If there is a leak, they should be moved to a safe location and the shipper notified immediately.

(c) The shipper should be consulted for details on proper unloading procedures.

(d) DOT Regulations, Section 177.834 (i) require that tank motor vehicles be attended during loading and unloading. If it becomes necessary for the attendant to leave the operation, transfer of epichlorohydrin must be stopped and the system secured.

(e) Only qualified and properly instructed employees should operate the truck and make the hook-up of the hose from the tank truck to the receiving tank.

(f) Contents of the tank truck and the piping line to the receiving vessel should be checked before epichlorohydrin is transferred.

(g) DOT Regulations, Section 177.837(a) require that the truck engine should be stopped and not started again during the entire unloading operation unless it is necessary to operate the pump by power take-off or to use the truck engine to operate compressors for gas pressure unloading.

(h) Truck brakes should be set, the wheels chocked.

(i) Isolate unloading area from traffic.

(j) All containers filled from the truck shall be bonded (electrically connected) and grounded to the truck before filling operations are started.

(k) The operating mechanism for unloading valves or faucets should have a secondary control, remote from the fill openings and discharge faucets, for use in the event of accidents or fire during delivery operations. The control mechanism should have a fusible section which will permit valves to close automatically in case of fire.

(l) Air pressure should never be used for unloading tank trucks of epichlorohydrin. It is preferable to unload from the bottom by means of a pump with the top vented to the receiving vessel. Use of inert gas pads or closed unloading systems to prevent vapor discharge to the atmosphere is recommended. If inert gas pressure is used, positive protection should be provided to ensure that the tank cannot be overpressured.

(m) Immediately before unloading is started, check all valves and connections so as to be sure flow will be properly directed. When flow has been started re-examine all valves, fittings, etc., for leaks. Should repairs be necessary, stop unloading procedure until repairs can be completed and spills cleaned up.

#### 7.5.1.2 Damage Enroute

In case a tank truck becomes damaged enroute so that it cannot proceed safely to destination, every effort should be made to park it where it will not endanger traffic, public or property. The police and fire department should be notified. Follow Shell Chem Card precautions (No. SCC 74334). For emergency assistance only, call Shell (713) 473-9461 or CHEMTREC, (800) 424-9300.

#### 7.5.2 Tank Cars

##### 7.5.2.1 Unloading

(a) Because of the flammable and toxic properties of epichlorohydrin the unloading of tank cars containing it is a hazardous operation. Detailed instructions regarding unloading procedures set forth in the MCA Manual sheet TC-4 are a recommended guide to assist unloaders in performing this operation safely.

(b) Shippers' instructions should always be followed and all caution markings on both sides of tank and domes should be read and observed.

(c) See that the train or engine crew accurately spots the car at the unloading line. The unloading track should be level. The brakes should be set, wheels chocked by standard rail clamps, blue warning signs placed and other safe practices followed as outlined in MCA TC-4.

(d) Where it appears beneficial, the use of derailleurs is encouraged during unloading operations. Wheel chocks are required by DOT regulation 174.561 a(2) as well as caution signs described in DOT Regulation 174.561 (3). Signs must be so placed on the track or car as to give necessary warning to persons approaching the car from the open end or ends of the siding; these must be used until the car is unloaded and disconnected from discharge connection.

(e) Car number should be compared with that on shipping papers or invoice to verify contents of car and avoid mixing of products. In addition, a sample should be taken to verify the contents.

(f) Tank cars should preferably be unloaded through the dome connection rather than through the bottom outlet. About mid-year 1977, all Shell tank cars for epichlorohydrin service will be equipped only for dome unloading. Air pressure must never be used for this purpose. Use of a pump or controlled inert gas pressure is the recommended method. If bottom unloading

is necessary, MCA Sheet TC-4 (1969 revision) should be used to determine safe procedure. Tank cars approved for bottom unloading must be equipped with valving approved by the American Association of Railroad's Committee on Tank Cars and consistent with DOT Regulations. The purpose of such valving is to contain the product and control the flow during unloading. As an added precaution, it is desirable where practical and where conditions warrant, to apply a supplementary control in the unloading system to provide a secondary and remotely actuated closure in the event of accidents involving fire or car movement. The car should be vented to a closed system during unloading.

(g) If gas pressure is used in place of pumping, pressure must not exceed the pressure setting of relief device on rail car or receiving tank.

(h) If tank car will be unloaded by pump, make sure that the car is continually vented, preferably back to the receiving vessel, or is padded with an inert gas.

(i) Immediately before unloading is started, check all valves and connections so as to be sure flow will be properly directed. When flow has been started re-examine all valves, fittings, etc., for leaks. Should repairs be necessary, stop unloading procedure until repairs can be completed and spills cleaned up.

#### 7.5.2.2 Return Precautions

(a) As soon as the tank car is completely unloaded, all valves must be made tight, the unloading connections removed, and all other closures made tight. DOT Regulations, Section 172.510(c) concerning return empty placarding must be observed.

### 7.6 Storage (See NFPA No. 30)

#### 7.6.1 Indoor Storage

(a) When filled drums or other containers are stored indoors, they should be stored in noncombustible well-ventilated structures. When stored in separate storage rooms, trapped floor drains should be provided. The floors should be pitched to the drains, and the drains should lead to safe location through proper trapping. In case no drains are provided, 4" curbs or a drained gutter, covered with appropriate grill, should be constructed at door openings. All storage areas should be provided with automatic sprinkler systems or other fire extinguishing system suitable for interior storage.

(b) Incompatible materials, as described in Section 3.3, should not be stored in the same area.

## 7.6.2 Bulk Storage

(a) The storage of epichlorohydrin in above and below ground tanks poses certain problems relating to such factors as size of vents, diking, and separation distances, which depend upon other variables such as tank size, tank design and tank protection. It is recommended that tank storage requirements be determined through consultation with qualified fire protection engineers.

(b) Bulk storage systems should be installed and used in accord with NFPA Codes for flammable liquid storage and with local codes and ordinances.

(c) Bulk storage systems should provide positive assurance against inadvertent mixing of epichlorohydrin with other chemicals.

## 8. TANK AND EQUIPMENT CLEANING AND REPAIRS

(See MCA Safety Guide SD-10, "Recommended Safe Practices and Procedures - Entering Tanks and Other Enclosed Spaces")

### 8.1 Preparation of Tanks and Equipment

8.1.1 Equipment and tank cleaning and repair should be under the direction of thoroughly trained personnel who are fully familiar with all of the hazards and the safeguards necessary for the safe performance of the work. All precautions pertaining to education, protective equipment and health and fire hazards should be reviewed and understood.

### 8.2 Tank or Equipment Cleaning

8.2.1 Tanks and equipment, pumps, lines and valves should always be drained and thoroughly cleaned before being repaired. Workmen should never be allowed to repair equipment while it is in operation and the lines in service. Pipelines into or out of the tank should be disconnected, preferably by removing a small section of line and blanking.

8.2.2 Post danger signs prominently to prohibit smoking, use of spark generating tools or equipment, flames of any sort, or any other source of ignition and the presence of unauthorized personnel in the area where tank or equipment is to be cleaned.

8.2.3 The preferred method of cleaning a tank consists of draining the tank as completely as possible, filling with water, draining, steaming thoroughly, and ending with an additional water fill (for cooling) and drain. The number of water rinses and steaming time required will vary considerably with the particular process involved (e.g., the presence of solids with absorbed liquid) and will have to be determined by experience. Cleaning can be accomplished by water alone, but the time required can be long; steaming should be used except where other factors prohibit its use (e.g., insulation which might be overheated).

NOTE: The following precautions should be taken.

- (a) The effluent water and steam will almost certainly contain enough residual epichlorohydrin to present a breathing hazard in the nearby areas. Therefore, appropriate warnings and respiratory equipment should be used. Effluent waters must be drained into a waste chemical disposal system.
- (b) Epichlorohydrin will likely be trapped under scale or absorbed in any solids present. This possibility must be carefully checked.

8.2.4 The tank or equipment should then be purged with fresh air and the atmosphere within it should be tested for epichlorohydrin vapors and oxygen content.

### 8.3 Preparing for Tank Entry and Work Within Tank

8.3.1 Special ventilation and a continuous fresh air supply are required during the entire time men are cleaning, inspecting, or repairing the tank. A satisfactory method of ventilation is the use of an "air mover" which pulls fresh air through the tank by induction. Care must be taken to assure that the air source is not contaminated. Connect ground wire on air mover to keep static electricity from accumulating.

8.3.2 No workman should enter a tank or vessel that does not have a manhole opening large enough to admit him while wearing his safety harness, lifeline, and respiratory protective equipment. It should be ascertained that the tank or vessel can be left by the original entrance. At least one other person should be observing operations from outside the tank at all times.

8.3.3 Proper personal protective clothing and equipment should be worn by anyone entering a tank for inspection, cleaning, or repairs.

8.3.4 Danger signs should be placed suitably to indicate when workmen are in the tank.

8.3.5 Lock electrical switches in the off position, remove drive belts, and otherwise completely safeguard against accidentally starting the agitation equipment or other moving parts located inside the tank or adjacent to the entrance.

8.3.6 The portable electric lights and power tools should be in good condition and the metal noncurrent carrying parts should be electrically bonded to ground.

8.3.7 It should be ascertained that all sources of ignition have been eliminated from the vicinity of the tank and that vapor flow from tank is controlled.

8.3.8 In addition to protecting the workmen actually engaged in cleaning and repairing the tank, attention should be paid to the protection of workers in nearby areas.

8.3.9 During the course of the work, frequent tests should be made to determine that the vapor level in the tank is being maintained within the safe range. This precaution is necessary because residues not completely removed by washing may recontaminate the tank atmospheres.

#### 8.4 Emergency Rescue

8.4.1 A supplied-air respirator (hose mask) or self-contained breathing apparatus, together with rescue harness and lifeline should always be located outside the tank entrance for rescue purposes, regardless of the type of respiratory equipment or air supply which is provided for employees inside the tank. The air intake of the hose mask should be kept in an uncontaminated area.

8.4.2 One man stationed on the outside of the tank should keep the workmen in the tank under observation and another man should be nearby and instantly available with self-contained breathing apparatus and necessary equipment to aid in the rescue if a man in the tank is overcome. Protective clothing should be worn by those entering the tank.

8.4.3 Under no circumstances should a rescuer enter a tank to remove a victim of overexposure without proper respiratory protection, a safety harness and an attached lifeline. The free end of the lifeline should be manned by an attendant located outside the tank. Another attendant should be in view of the outside attendant at all times or in constant communication with him.

8.4.4 If a tank cleaner or repairman is overcome by fumes, he should be removed to fresh air immediately. Artificial respiration should be applied if breathing has stopped, and a physician summoned at once. The rescuer must wear proper respiratory equipment and protective clothing.

#### 8.5 Repairs to Tanks or Equipment

8.5.1 Repairs to interiors or exteriors of tanks or equipment, should be permitted only after thorough cleaning and testing of the tank to make sure it is free of vapors and after a work permit has been issued by an authorized person.

8.5.2 In all cases, if repair work is interrupted, the tank atmosphere should be checked thoroughly and a new work permit issued before resumption of work.

## 9. WASTE DISPOSAL

9.1 All federal, state and local regulations regarding health and environmental pollution must be observed. The agency concerned should be contacted for advice.

9.2 All quantities of epichlorohydrin or waste material contaminated with it should be removed to a dispersal area and burned under supervised conditions. Burning of epichlorohydrin produces hydrogen chloride, and under certain conditions phosgene and carbon monoxide gases which are lethal in high concentrations. Tests should be conducted at operating conditions for hazardous gas emissions.

9.3 Water contaminated with epichlorohydrin should be drained to a controlled area. If this is not possible, contaminated water must be diluted with copious amounts of water.

9.4 When a waste disposal problem arises as a result of a major spill or equipment rupture, only properly protected and trained personnel should remain in the area. Notify authorities immediately if epichlorohydrin enters into or threatens to enter any public water system or sewer.

## 10. MEDICAL MANAGEMENT

### 10.1 Preventive Health Measures

#### 10.1.1 Environmental Monitoring and Control

Epichlorohydrin may be used safely provided workers are adequately instructed and supervised in the proper means of handling it. Contact with skin and eyes, as well as the inhalation of vapors must be avoided. Emergency showers and eye baths must be provided and adequately maintained in any area where potential exposure to epichlorohydrin exists.

Five ppm has been established by OSHA as the limit for employee exposure averaged over an 8-hour work shift.

As noted in Section 3.1.9, this concentration is lower than can be detected by odor, therefore, area and/or personnel monitoring should be used to ensure that the concentrations are in the safe level. Approved respiratory equipment (see Section 5.2.3) should be readily available for immediate use whenever the possibility exists that employees may be exposed to concentrations above the 5 ppm limit.

### 10.2 Employee Education

Employees should be instructed in all the hazards of this compound. They should be instructed on the use and location of all emergency equipment,

such as safety showers, eye fountains, respirators, and protective clothing. Employees should be provided with properly fitting safety goggles, which must be worn at all times when working in an area where epichlorohydrin is used or handled.

Any contact with liquid epichlorohydrin must be treated immediately by washing or showering with copious amounts of water for at least 15 minutes and simultaneously removing all contaminated clothing. Affected skin areas should be washed thoroughly with soap or mild detergent and water. Medical attention should be obtained at once. Leather articles cannot be decontaminated, therefore, contaminated shoes and other leather apparel should be discarded and destroyed. Other contaminated clothing should be washed thoroughly or destroyed if not readily decontaminated.

Avoid vapor inhalation. Any symptoms of exposure to epichlorohydrin, such as eye or respiratory irritation, should be reported and medical assistance obtained immediately. If the odor of epichlorohydrin is detected or monitoring shows epichlorohydrin concentrations above 5 ppm, the area should be evacuated. All sources of ignition should be extinguished and the supervisor notified immediately. Only personnel wearing approved protective equipment should be in the area. The source of the vapor should be located and the leak should be eliminated and/or mechanical ventilation increased to bring concentrations down to safe levels.

Employees should wear properly fitting chemical safety goggles when handling or using epichlorohydrin. Impervious (rubber) clothing and a full face shield, in addition to the goggles, must be worn when there is danger of contact with the liquid.

### 10.3 Physical Examination

Before being assigned to handling epichlorohydrin, all individuals should have a complete preplacement examination. Individuals with disease of the liver, kidney, heart, or respiratory tract should not be assigned to jobs where exposure to epichlorohydrin may occur.

Annual periodic examinations with special attention to lung, liver, and kidney function are recommended.

### 10.4 Suggestions to Physicians

Immediate removal from exposure and thorough decontamination are essential. Adequate decontamination requires at least 15 minutes' irrigation with copious amounts of water. If respiratory distress develops, rest and oxygen administration may be helpful. Intermittent positive pressure breathing may help prevent pulmonary edema. Any significantly exposed individual should be followed with liver and kidney function studies for at least 60 days. Treatment is symptomatic and supportive if kidney and liver injury occur. Chemical

burns of the eye should be treated by a physician experienced in dealing with chemical eye injuries, after immediate and adequate decontamination with plain water.

## 11. FIRST AID

### 11.1 General Principles

In cases of eye or skin exposure to epichlorohydrin, the chemical must be removed immediately.

After severe exposure to the vapor of epichlorohydrin, it is important to maintain adequate respiration - artificial respiration should be instituted if needed. Until medical help is obtained, patient should be kept at rest. He should be kept comfortably warm but not hot.

### 11.2 Contact with Skin

In case of skin contact, immediately get under shower and remove all clothing. Wash thoroughly with flowing water for at least 15 minutes; scrub affected skin area with soap and mild detergent and water. Seek medical attention.

### 11.3 Contact with Eyes

If eye contact occurs, immediate irrigation of eye with clean water is indicated. Continue irrigation for at least 15 minutes. Seek medical attention.

### 11.4 Inhalation

Exposed persons should go or be taken at once to an uncontaminated area. Oxygen administration may be helpful but should be given only by adequately trained individuals. If breathing has ceased, give artificial respiration. Contact medical help promptly. Avoid contamination from victim to rescuer.

### 11.5 Ingestion

In case of ingestion (if patient is conscious), give large quantities of bland fluid such as water or milk and induce vomiting by tickling the back of the throat with a finger or a blunt object. **GET MEDICAL ATTENTION AT ONCE.**

**NEVER GIVE ANYTHING BY MOUTH OR ATTEMPT TO CAUSE VOMITING IN AN UNCONSCIOUS PATIENT.**



# SHELL CHEMICAL COMPANY

A DIVISION OF SHELL OIL COMPANY

ONE SHELL PLAZA

P.O. BOX 2463

HOUSTON, TEXAS 77001

January 13, 1977

*Sent to Joe Collins  
087*

Celanese Coatings  
1495 South 11th Street  
Louisville, Kentucky 40210

Attn: Mr. Harold Hammers, Purchasing Agent

## EPICHLOROHYDRIN TOXICITY AND SAFETY

Periodically we have provided detailed information on our products summarizing what we know of their toxicologic properties and recommending safe handling practices. In keeping with this practice, we enclose the following information on epichlorohydrin.

"Epichlorohydrin Toxicity and Safety Bulletin"  
"Epichlorohydrin Safety Notice"

Epichlorohydrin is a dangerous material. Therefore, we urge you to convey this information to all those who potentially may come in contact with this product as a result of your operations or activities. This would include your employees, your co-workers, your carriers, your warehousemen and distributors, and your customers. Appropriate advice should be given also for products made from epichlorohydrin to the extent that potentially hazardous amounts of unreacted epichlorohydrin are contained therein.

The "Epichlorohydrin Toxicity and Safety Bulletin" is the more authoritative and comprehensive reference for advising of potential hazards and for planning and judging safe practice in use, handling and distribution. There is no new information available to us to indicate that epichlorohydrin should be considered more toxic or a more significant hazard than heretofore. Nevertheless, we have decided to revise information previously available, so that it will contain the very latest information and thinking.

The "Safety Notice" is a simplified supplement to the more comprehensive "Toxicity and Safety Bulletin." We urge you to take the opportunity offered by the availability of our new abbreviated "Safety Notice" for review by all who may be concerned with the handling and use of epichlorohydrin. The "Safety Notice" is designed in a form to encourage wide distribution and reading. Every step should be taken to encourage employees to read the Notice and keep it close at hand for ready reference. Supervisory personnel should be prepared to answer questions and provide clarification and understanding. The more comprehensive "Toxicity and Safety Bulletin" should aid in this respect. We hope the "Safety Notice" will prompt more thorough study of the detailed "Toxicity and Safety Bulletin" which should be made available to all.

The "Safety Notice" is intended as a telegraphic alert to the potential hazards, the principal precautions to be observed, and response actions in case of accidents. This telegraphic style with emphasis on toxicity and potential dangers may be alarming to some, but we believe increased awareness is worth this risk.

In reviewing this information, you will note the following additional material, not supplied previously:

1. On November 21, 1975, OSHA announced the availability of a draft Technical Standard for occupational exposure to epichlorohydrin (FR 40 54033 (1975)). This draft maintains the 5 ppm concentration averaged over an eight-hour work day as the maximum limit of exposure for a worker. This is unchanged from the level indicated in our previous letter. We cannot predict when the final standard will be promulgated or if there will be significant changes.
2. Recently, the Materials Transportation Bureau of the Department of Transportation (DOT) proposed extensive revisions to the Hazardous Materials Regulations (Docket Number HM-103 and HML12). These were published in Federal Register 41, No. 74, pp 15972-16131, April 15, 1976; amendments were published in FR41, No. 183, pp 40614-4069; September 20, 1976, and the complete amended revisions were published in FR41, No. 188, pp 42364-42638, September 27, 1976. For shipping purposes, the "shipping name" for epichlorohydrin is "Flammable Liquid - NOS." In addition, the revised DOT regulations call for multiple labelling of materials meeting more than one hazard class when shipped in packages. Hence, because epichlorohydrin also qualifies as a Class B poison by inhalation, packages of epichlorohydrin (drums and sample containers) must carry both the FLAMMABLE LIQUID and POISON labels effective January 1, 1977.
3. The Material Safety Data Sheet and other information now in your possession may report a flash point of 100°F. This value was obtained by the Tag Open Cup method. The revised Data Sheet and "Toxicity and Safety Bulletin" report the figure of 87°F obtained by the Tag Closed Cup which is the method specified by DOT, which became effective January 1, 1976, to determine the proper flammability classification for epichlorohydrin.
4. In reviewing the information we have provided previously, we concluded it would be desirable to include additional information on recommended safe handling practices beyond that contained in our Material Safety Data Sheet. An appropriate section has been added to the attached bulletin.

5. During the course of preparing this information, The Wall Street Journal published an article September 30, 1976, stating, "In a report not yet released publicly, researchers at the National Institute for Occupational Safety and Health recommended that an environmental limit of 0.5 parts of the chemical for each million parts of air be allowed in factory areas...". A copy of the article is attached. This article appears to refer to the same tumorigenic studies by Van Duuren that have been cited in the attached information. It refers also to potential mutagenic and carcinogenic effects suggested by findings in bacteria and other lower organisms not yet observed in higher animals or humans. We believe that extensive animal tests which have been planned by the Manufacturing Chemists Association and supported by Shell and several other chemical companies, together with those planned by the National Cancer Institute, will indicate the significance of the findings reported by The Wall Street Journal. Meanwhile, appropriate precautions should be taken as we have suggested in the attached information. At the same time, we believe there is no valid toxicologic basis for classifying epichlorohydrin with vinyl chloride or bis (chloromethyl) ether as might be inferred from The Wall Street Journal article.

Additional copies of our "Safety Notice" and "Toxicity and Safety Bulletin" are available on request, and we would welcome any comments you may have as to how this information might be improved.

Because it is important that adequate warning be provided to anyone who handles or uses epichlorohydrin, we ask that you acknowledge receipt of this letter and its enclosures by countersigning and returning to us an enclosed copy.

Very truly yours,

SHELL CHEMICAL COMPANY

*J. Carney*  
Product Sales Manager

Acknowledged \_\_\_\_\_

Signature \_\_\_\_\_

Company and Title \_\_\_\_\_

Enclosures - "Epichlorohydrin Safety Notice", June, 1976 - (10)  
 "Epichlorohydrin Toxicity and Safety Bulletin" June, 1976 - (3)  
 Shell Chemical Material Safety Data Sheet (OSHA) MSDS 508-4 - (4)  
 Documentation of the Threshold Limit Values for Substances in  
 Workroom Air (Fourth Edition 1974) - Epichlorohydrin - (3)  
 "Exposure of Workers to Epichlorohydrin Should Be Slashed, Federal  
 Scientists Say", Wall Street Journal, 8, September 30, 1976

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