


Image Cover Sheet

CLASSIFICATION UNCLASSIFIED	SYSTEM NUMBER 61745 
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TITLE

LEGISLATION AND STANDARDS ASSOCIATED WITH THE TEMPORARY STORAGE OF
FLAMMABLE MATERIALS AT DRES - CFB SUFFIELD RALSTON, ALBERTA

System Number:

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DRES

CONTRACT REPORT 19/89

LEGISLATION AND STANDARDS ASSOCIATED WITH THE
TEMPORARY STORAGE OF FLAMABLE MATERIALS AT DRES

R. Zuback

Ballistech Systems Inc

Medicine Hat, Alta

Oct 1988

DEFENCE RESEARCH ESTABLISHMENT SUFFIELD, RALSTON, ALBERTA

"This work was carried out for DRES under contract. The accuracy of the information presented herein is the responsibility solely of the contractor and is NOT to be construed as an Official Department of National Defence position unless so designated by other authorizing documents."

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UNCLASSIFIED

INDUSTRIAL HYGIENE, TOXICOLOGY, AND MATERIAL
SAFETY DATA SHEET



NOTE: NO REPRESENTATION IS MADE AS TO THE ACCURACY OF THE INFORMATION
HEREIN. SEE PAGE 7 FOR CONDITIONS UNDER WHICH DATA ARE FURNISHED.

Trade Name and Synonyms 70808 PROPYLENE OXIDE	
Manufacturer's Name Texaco Chemical Company	Emergency Telephone No. (409) 722-8381
Address 4800 Fournace Place P.O. Box 430 Bellaire, TX 77401	
Chemical Name and/or Family or Description Alkylene Oxide	
THIS PRODUCT IS CLASSIFIED AS: <input checked="" type="checkbox"/> HAZARDOUS BY DEFINITION NO.(S) 1,2,5,6,7,10 NOT HAZARDOUS: <input type="checkbox"/> ON ATTACHED EXPLANATION SHEETS	
WARNING STATEMENT: DANGER! EXTREMELY FLAMMABLE CAUSES SEVERE EYE BURNS MAY CAUSE IRRITATION TO SKIN HARMFUL IF INHALED	
OCCUPATIONAL CONTROL PROCEDURES	
Protective Equipment (Type)	
Eyes:	Chemical type goggles with face shield must be worn. Do not wear contact lenses.
Skin:	Protective clothing such as uniforms, coveralls or lab coats should be worn. Launder or dry clean when soiled. Gloves resistant to chemicals and petroleum distillates required.
Inhalation:	Supplied air respiratory protection for cleaning large spills or upon entry into tanks, vessels, or other confined spaces.
Ventilation:	Local exhaust ventilation recommended
Permissible Concentrations:	
Air:	TLV = 20 ppm for propylene oxide averaged over an 8 hour daily exposure (ACGIH 1984-85) OSHA P.E.L. 100ppm. Texaco 10 ppm.
EMERGENCY AND FIRST AID PROCEDURES	
First Aid	
Eyes:	Flush thoroughly with water for at least fifteen minutes. Get immediate medical attention.
Skin:	Remove contaminated clothing. Wash exposed areas with soap and water. Get medical attention. Wash clothing before reuse. Destroy contaminated shoes.
Ingestion:	Give large quantities of water, then induce vomiting immediately. Get immediate medical attention. Do not make an unconscious person vomit. Never give anything by mouth to an unconscious person.
Inhalation:	Remove to fresh air; if not breathing apply artificial respiration. Get medical attention. Keep affected person warm and at rest.
Other Instructions:	None.



PHYSIOLOGICAL EFFECTS:		Code No. 70808
Effects of Exposure		
Acute:		
Eyes:	Believed to be extremely irritating with possible permanent eye injury.	
Skin:	Believed to be moderately irritating. Believed to cause redness, edema, or drying of skin. Confined contact may cause frostbite.	
Respiratory System:	May cause irritation of upper respiratory tract. Symptoms include headache, drowsiness, weakness and dizziness.	
Chronic:	Propylene oxide has caused cancer in laboratory animals.	
Other:	P.O. has caused maternal and fetal toxicity in laboratory animals	
Sensitization Properties:		
Skin:	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Unknown <input type="checkbox"/>	Respiratory: Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown <input checked="" type="checkbox"/>
Median Lethal Dose (LD₅₀ LC₅₀) (Species)		
Oral	LD ₅₀ (rat) = 1.14 g/kg; moderately toxic	
Inhalation	LC ₅₀ (mouse) = 1740 ppm/4 hour	
Dermal	Believed to be 1-3 g/kg (rabbit); slightly toxic	
Other	N. D.	
Irritation Index, Estimation of Irritation (Species)		
Skin	Believed to be 3.0-5.0/8.0 (rabbit); moderately irritating	
Eyes	Believed to be 80-110/110 (rabbit); extremely irritating	
Symptoms of Exposure	See above.	
FIRE PROTECTION INFORMATION		
Ignition Temp. °F.	869	Flash Point °F. (Method) -35 F (PMCC)
Flammable Limits (%)	Lower 1.8	Upper 36.0
Products Evolved When Subjected to Heat or Combustion: Irritating aldehydes, acids, ketones and carbon monoxide.		
Recommended Fire Extinguishing Agents And Special Procedures: According to the NFPA Guide 325M, water soluble, flammable liquid fires may be extinguished by dry chemical, foam, or carbon dioxide. Water may be ineffective on flames, but should be used to keep fire-exposed containers cool. If a leak or spill has not ignited, use water spray to disperse the vapors and to provide protection for persons attempting to stop the leak.		
Unusual or Explosive Hazards: Vapors heavier than air, may travel, be ignited at remote locations and flash back. Explosive air-vapors mixtures may occur.		

N.D. - Not Determined N.A. - Not Applicable
 < - Less Than > - Greater Than



ENVIRONMENTAL PROTECTION Code No. 70808

Waste Disposal Method:
 Re-evaluation of product may be required by user at the time of disposal, since the product uses, transformations, mixtures and processes may change classification to non-hazardous or hazardous for reasons other than, or in addition to ignitability and reactivity. (See Remarks for Waste Classification)

Procedures in Case of Breakage or Leakage. (Transportation Spills Call CHEMTREC (800) 424-9300)
 Eliminate all ignition sources including internal combustion engines and power tools. Ventilate area. Avoid breathing vapor. Use SCBA or supplied-air mask for lg spills or in confined areas. Contain spill. Remove with inert absorbant. Avoid all personal contact

Remarks:
 Waste Classification: Product (as presently constituted) has the RCRA characteristic of ignitability and reactivity and if discarded in its purchased form would have the hazardous waste numbers D001 and D003.

PRECAUTIONS

DANGER! EXTREMELY FLAMMABLE
 CAUSES SEVERE EYE BURNS
 MAY CAUSE IRRITATION TO SKIN
 HARMFUL IF INHALED

Propylene oxide has caused cancer in laboratory animals.
 Do not get in eyes. Avoid breathing vapor or mist.
 Keep container closed. Keep away from heat, sparks, and flames.
 Avoid prolonged contact with skin.
 Use only in well-ventilated locations.
 Wash thoroughly after handling.

Requirements for Transportation, Handling and Storage:
 Transport, handle and store in accordance with OSHA Regulation 1910.106 and applicable DOT regulations. Do not contact propylene oxide with copper or other acetylide forming metals.

DOT Proper Shipping Name: Propylene Oxide
 DOT Hazard Class (if applicable): Flammable liquid, UN 1280 RQ

CHEMICAL AND PHYSICAL PROPERTIES

Boiling Point (°F) 93.4 Vapor Pressure 442 (mmHg)
 Specific Gravity .8305 (H₂O=1) Vapor Density 2.0 (Air=1)
 Appearance and Odor colorless liquid, ether type odor
 pH of undiluted product 7.0 Solubility sol.
 Percent Volatile by Volume 100 Evaporation < 1 (=1)
 Viscosity 0.3 cSt @ 20C Other -
 Hazardous Polymerizations Occur Do not occur
 The Material Reacts Violently With: (If others is checked below, see additional comments on page 6 for further details)
 Air _____ Water _____ Heat _____ Strong Oxidizers _____ Others None of These _____

N.D. - Not Determined N.A. - Not Applicable
 < - Less Than > - Greater Than 3



COMPOSITION	Code
	70808

Chemical/Common Name	CAS No.	Exposure Limit	Range in %
*Oxirane, methyl-	75569	20ppm TWA ACGIH 100ppm OSHA 10ppm Texaco	100.00

*Hazardous according to OSHA (1910.1200) or one or more state Right-To-Know lists.



PRODUCT SHIPPING LABEL

Code No. 70808

70808 PROPYLENE OXIDE

DANGER! EXTREMELY FLAMMABLE
 CAUSES SEVERE EYE BURNS
 MAY CAUSE IRRITATION TO SKIN
 HARMFUL IF INHALED

Propylene oxide has caused cancer in laboratory animals.
 Do not get in eyes. Avoid breathing vapor or mist.
 Keep container closed. Keep away from heat, sparks, and flames.
 Avoid prolonged contact with skin.
 Use only in well-ventilated locations.
 Wash thoroughly after handling.

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a doctor. Wash skin with soap and plenty of water. If inhaled, remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call a doctor.

In case of fire use water spray, foam, dry chemical or CO2.

Chemical/Common Name	CAS No.	Range in %
*Oxirane, methyl-	75569	100.00

*Hazardous according to OSHA (1910.1200) or one or more state Right-To-Know lists.

	HMIS	
Health	: 2	Reactivity : 2
Flammability:	4	Special : -

DOT Proper Shipping Name: Propylene Oxide
 DOT Hazardous Class : Flammable liquid, UN 1280 RQ

CAUTION: Misuse of empty containers can be hazardous. Empty containers can be hazardous if used to store toxic, flammable or reactive materials. Cutting or welding of empty containers might cause fire, explosion or toxic fumes from residues. Do not pressurize or expose to open flame or heat. Keep container closed and drum bungs in place.

HEALTH EMERGENCY TELEPHONE: (914) 831-3400 (EXT. 204)

Texaco Inc.
 2000 Westchester Avenue
 White Plains, New York 10650

For Additional Information Concerning:
 Fuels/Lubricants/Antifreezes
 call (914) 831-3400 (EXT.204)
 Chemicals
 call (512) 459-6543
 Transportation Spills
 call CHEMTREC (800) 424-9300



ADDITIONAL COMMENTS	Code No. 70808
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TEXACO INTENDS TO COMPLY FULLY WITH PROVISIONS OF THE TOXIC SUBSTANCES CONTROL ACT STATE OF MICHIGAN CRITICAL MATERIALS ACT (REVISED 1987)
 No critical materials present.

This material reacts violently with acids and bases.
 This product is listed as a "Hazardous Substance" under Section 101(14) of CERCLA ("Superfund") and, if released in quantities equal to or in excess of 100 lbs., must be reported immediately to the National Response Center, telephone 1-800-424-8802.

To determine applicability or effect of any law or regulation with respect to the product, users should consult his legal advisor or the appropriate government agency. Texaco does not undertake to furnish advice on such matters

By <u>F. E. Bentley</u>	Title <u>Coordinator of Product Safety</u>	
Date <u>10-30-87</u>	<input type="checkbox"/> New	<input checked="" type="checkbox"/> Revised, Supersedes <u>07-01-86</u>

N.D. - Not Determined N.A. - Not Applicable
 < - Less Than > - Greater Than



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EXPLANATION OF THE INDUSTRIAL HYGIENE, TOXICOLOGY, AND MATERIAL SAFETY DATA SHEET

PRODUCT INFORMATION

Trade Name and Synonyms

Refer to the code number and name under which the product is marketed and the common commercial name of the product.

Manufacturer's Name and Address Self explanatory.

Chemical Name and/or Family or Description

Refer to chemical, generic, or descriptive name of single elements and compounds.

For purposes of this form, a product is defined as hazardous if it possesses one or more of the following characteristics: (1) has a flash-point below 200 degrees Fahrenheit, closed cup or subject to spontaneous heating; (2) has a threshold limit value as established by the American Conference of Governmental Industrial Hygienists and/or the Occupational Safety and Health Administration (with exception to petroleum oil mist); (3) a single dose oral LD50 below 500 mg/kg; (4) causes burns to the skin in the short-term exposure or is systemically toxic by skin contact; (5) has been demonstrated to be a skin or eye irritant or causes respiratory irritation; (6) may cause skin or respiratory sensitization; (7) has teratogenic, mutagenic or other toxic effects; (8) may cause asphyxia or pneumoconiosis; (9) in the course of normal operations may produce dusts, gases, fumes, vapor, mist, or smoke which have one or more of the above characteristics; (10) contains a component which may be carcinogenic according to NTP (National Toxicology Program), IARC (International Agency for Research on Cancer), OSHA (Occupational Safety and Health Administration), EPA (Environmental Protection Agency) and/or NCI (National Cancer Institute.); (11) has a median LC50 (RATS) in air of 200 ppm or less by volume of gas or vapor or 2.0 mg/l or less of mist, fume or dust when administered by continuous inhalation for one hour; (12) is a hazard as identified in the Product Shipping Label on page 5.

OCCUPATIONAL CONTROL PROCEDURES

(Consult your Industrial Hygienist or Occupational Health Specialist.)

Protective Equipment

Type of protective equipment that is necessary for the safe handling and use of this product.

Ventilation

Normal means adequate to maintain permissible concentrations.
Ventilation type, i.e. local exhaust, mechanical, etc

Permissible Concentrations

Indicates worker exposure limits, such as the Threshold Limit Value (TLV) as established by the American Conference of Governmental Industrial Hygienists or standards, promulgated by the Occupational Safety and Health Administration (e.g., PEL).

TLV-Time Weighted Average (TWA) is the concentration in air averaged over an 8 hour daily exposure.

TLV-Ceiling (C) is the ceiling limit on concentration that should not be exceeded during any part of the working day.

"Skin" Notation (ACGIH) indicates that dermal absorption can contribute to overall exposure following direct contact or exposure to airborne material.

Permissible Exposure Level (PEL) is the time weighted concentration in air averaged over an 8 hour daily exposure.

EMERGENCY AND FIRST AID PROCEDURES

Administer first aid and emergency procedures in case of eye and/or skin contact, ingestion and inhalation.

PHYSIOLOGICAL EFFECTS

Acute Exposures (Eye, Skin, Respiratory System)

Refers to the most common effects that would be expected to occur from direct contact with the product.

Chronic

Refers to the effects that are most likely to occur from repeated or prolonged exposure.

Sensitizer

Means a substance which will cause on or in normal living tissue, through an allergic or photodynamic process, a hypersensitivity which becomes evident on reapplication of, or exposure to, the same substance.

Median Lethal Dose or Concentration (LD50,LC50)

Refers to that dose or concentration of the material which will produce death in 50 per cent of the animals. For inhalation, exposure time is indicated.

Irritation Index

Refers to an empirical score (Draize Method) for eye and skin irritation when tested by the method described. If numbers are not available, an estimated score indicates whether or not the material is an irritant.



FIRE PROTECTION INFORMATION

Ignition Temperature

Refers to the temperature in degrees Fahrenheit, at which a liquid will give off enough flammable vapor to ignite and burn continuously for 5 seconds.

Flash Point (Method used)

Refers to the temperature in degrees Fahrenheit, at which a liquid will give off enough flammable vapor to ignite.

Flammable Limits

Refers to the range of gas or vapor concentration (percent by volume in air) which will burn or explode if an ignition source is present. Lower means the lower flammable limit and upper means the upper flammable limit given in percent.

Products Evolved When Subjected to Heat or Combustion.

The products evolved when this material is subjected to heat or combustion. Includes temperature at which oxidation or other forms of degradation occurs.

Recommended Fire Extinguishing Agents and Special Procedures

Specifies the fire fighting agents that should be used to extinguish fires. If unusual fire hazards are involved or special procedures indicated, this is specified.

Unusual Fire or Explosive Hazards

Specifies hazards to personnel in case of fire, explosive danger.

ENVIRONMENTAL PROTECTION

Specifies how this product may be disposed.

Indicates precautions necessary in the event that leakage or breakage occurs. Included are (a) clean-up procedures, (b) personal protective equipment if necessary, (c) hazards that may be created, i.e. fire, explosion, etc.

PRECAUTIONS

Label that is required or recommended.

Requirements for Transportation, Handling and Storage

Specifies handling and storage procedures. Gives ICC, DOT, or other regulations related to safety and health for transportation.

CHEMICAL AND PHYSICAL PROPERTIES

Boiling Point (or Range)

In degrees Fahrenheit or Celsius Boiling Point at 760 mmHg.

Vapor Pressure

Pressure exerted when a solid or liquid is in equilibrium with its own vapor.

Specific Gravity

The ratio of the density of the product to the density of water.

Vapor Density

The ratio of the density of the vapor at saturation concentration (20 degrees Celsius or 68 degrees Fahrenheit) to the density of air at 760 mmHg.

Appearance and Odor

Refers to the general characterization of the material, e.g. powder, colorless liquid, aromatic odor, etc.

pH

Refers to the degree of acidity or basicity of the material in a specific concentration.

pH1-5 - STRONGLY ACIDIC
pH5-7 - WEAKLY ACIDIC
pH7-9 - WEAKLY BASIC
pH9-14 - STRONGLY BASIC

Solubility

Refers to the solubility of a material by weight in water at room temperature. The term negligible, less than 0.1 %; slight, 0.1 to 1%; moderate, 1 to 10%; appreciable, 10% or greater. Gives solubility in organic solvents where appropriate.

Percent Volatile By Volume

Refers to the amount volatilized at 20 degrees Celsius or 68 degrees Fahrenheit when allowed to evaporate.

Evaporation

Gives the rate of evaporation compared to a standard

Viscosity

Measure of flow characteristics in Kinematic viscosity in Centistokes.

Hazardous Polymerization

Hazardous polymerization is that reaction which takes place at a rate which produces large amounts of energy. Indicates whether it may or may not occur and under what storage conditions.

Does the Material React Violently

Indicates whether the material will react violently, releasing large amounts of energy when exposed under conditions listed.

Composition

Components of the product as required by OSHA (1910.1200) and one or more state Right to Know laws.

ATTACHMENT C

EXCERPTS FROM
DANGEROUS GOODS GUIDE TO INITIAL EMERGENCY RESPONSE 1986

SHIPPING NAME	GUIDE	PIN
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Potassium sulphide, hydrated	27	UN1847
Potassium superoxide	22	UN2466
Propadiene, inhibited	04	UN2200
Propane	04	UN1978
Propanethiols	14	UN2402
n-Propanol	11	UN1274
Propargite	25	NA2765
Propargyl alcohol	14	NA1986
Propionaldehyde	11	UN1275
Propionic acid	27	UN1848
Propionic anhydride	27	UN2496
Propionitrile	14	UN2404
Propionyl chloride	20	UN1815
Propionyl peroxide	24	UN2132
n-Propyl acetate or Propyl acetate	12	UN1276
normal Propyl alcohol	11	UN1274
Propylamine	15	UN1277
n-Propyl benzene	13	UN2364
Propyl chloride	12	UN1278
n-Propyl chloroformate	27	UN2740
Propylene	04	UN1077
Propylene chlorohydrin	28	UN2611
1,2-Propylenediamine	15	UN2258
Propylene dichloride	13	UN1279
Propyleneimine, inhibited	15	UN1921
Propylene oxide	11	UN1280
Propylene tetramer	13	UN2850
Propyl formates	12	UN1281
n-Propyl isocyanate	20	UN2482
Propyl mercaptan	14	UN2402
n-Propyl nitrate	14	UN1865
Propyltrichlorosilane	27	UN1816

SHIPPING NAME	GUIDE	PIN
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Pyrethrins	34	NA9184
Pyridine	14	UN1282
Pyrophoric alloys, n.o.s.	18	UN1383
Pyrophoric liquids, n.o.s.	18	UN2845
Pyrophoric metals, n.o.s.	18	UN1383
Pyrophoric solids, n.o.s.	17	UN2846
Pyrosulphuryl chloride	26	UN1817
Pyroxylin plastic	16	UN2006
Pyroxylin solution or solvent	12	UN2059 UN2060
Pyrrolidine	11	UN1922
Quinoline	27	UN2656
Radioactive material, fissile, n.o.s.	30	UN2918
Radioactive material, excepted package, - instruments or articles - limited quantity of material - articles manufactured from natural uranium or depleted uranium or natural thorium - empty packaging	30	UN2910
Radioactive material, low specific activity (LSA), n.o.s.	30	UN2912
Radioactive material, n.o.s.	30	UN2982
Radioactive materials, special form, n.o.s.	30	UN2974
Radioactive materials, surface contaminated objects	30	UN2913
Rags, oily	16	UN1856
Rare gases and Nitrogen, mixtures	05	UN1981
Rare gases and Oxygen, mixtures	08	UN1980
Rare gases mixtures	05	UN1979
Receptacles, small, with flammable gas	04	UN2037
Refrigerant gases, n.o.s.	05	UN1078

**GUIDE
11****LIQUIDS: FLAMMABLE – Miscible****Potential Hazards****Fire or
Explosion**

May be ignited by heat, sparks or flames.
Many vapours are heavier than air.
Vapours may form explosive mixtures with air.
Vapours may travel to a source of ignition and flash back.
Containing vessels may explode when heated.

Health

Some vapours are irritating or poisonous.
Fire may produce irritating, poisonous and/or corrosive gases.
Runoff may pollute waterways.

Emergency Action

General: Isolate hazard area.
Keep upwind.
Keep unnecessary people away.
Keep out of low areas.

Protective Clothing: Wear SCBA and full protective clothing.

Evacuation: If rail or road tanker is involved in a spill or fire, consider initial evacuation for 1000 m in all directions.

Fire

Small Fire: Use dry chemical, CO₂, alcohol foam or water spray.
Large Fire: Use alcohol foam, water spray or fog.
Do not use water jet.
Move containing vessels from fire area if without risk.
Cool containing vessels with flooding quantities of water until well after fire is out.

Fire Involving Tanks:
Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
Withdraw immediately in case of rising sound from venting safety devices or discolouration of tank.
ALWAYS stay away from tank ends.

Spill or Leak

ELIMINATE all ignition sources.
Do not touch spilled material.
Stop leak if without risk.
Use water spray to reduce vapours.
Dike to prevent entry into waterways, sewers, basements or confined areas.
Absorb with earth, sand or other non-combustible material.
Call for assistance on disposal.

First Aid

Remove to fresh air.
Apply artificial respiration if victim is not breathing.
Administer oxygen if breathing is difficult.
Remove contaminated clothing and shoes.
In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes.
Keep victim warm and quiet.
Obtain immediate medical care.
Ensure that attending medical staff are aware of identity of product(s) involved.

ATTACHMENT B

MATERIAL SAFETY DATA SHEET
(TEXACO CHEMICAL COMPANY)

LEGISLATION AND STANDARDS
ASSOCIATED WITH THE
TEMPORARY STORAGE OF FLAMMABLE
MATERIALS AT DRES - CFB SUFFIELD
RALSTON, ALBERTA

FINAL REPORT BSI R/8829

CONTRACT NO. W-7702-8-R036/01-SG

prepared for:

DEPARTMENT OF NATIONAL DEFENCE
DEFENCE RESEARCH ESTABLISHMENT SUFFIELD
RALSTON, ALBERTA

prepared by:

BALLISTECH SYSTEMS INCORPORATED
1920 - 10th AVENUE NW
MEDICINE HAT, ALBERTA
T1A 7E4

OCTOBER 1988

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ATTACHMENTS

- A. Excerpts - National Fire Code of Canada-1985
- B. Material Safety Data Sheet (MSDS) - Texaco Chemical Company
- C. Excerpts - Dangerous Goods Guide to Initial Emergency Response-1986 - Transport Canada

SUMMARY

This study report is submitted to the Department of National Defence, DRES in fulfillment of the requirements DSS Contract W-7702-8-R036/01-SG "DEVELOPMENT OF TEMPORARY FLAMMABLE STORAGE FACILITIES at DEFENCE RESEARCH ESTABLISHMENT SUFFIELD".

This report was prepared by Mr. Raymond Zuback and the Medicine Hat staff of Ballistech Systems Incorporated.

The author wishes to extend special acknowledgement and thanks to the following people for their assistance and cooperation in providing information required for this project:

Mr. Robert Grundie - Chief Inspector
Labour Canada, Calgary, AB

Mr. Ronald Pang - General Manager and Chief Analyst
Tracer Analytical Laboratories Inc., Medicine Hat, AB

Mr. David Reid - Fire Chief
CFB Suffield, AB

1.0 BACKGROUND

The Defence Research Establishment Suffield has identified an immediate requirement to store, temporarily, drums of commercially available, flammable materials for use in fuel air explosive (FAE) and other research projects at DRES. Although there are well defined standards associated with permanent, commercial storage of hazardous materials, the temporary storage of relatively small research/development quantities is relatively less well defined.

~~2.0 OBJECTIVES~~

The objectives of this study were:

- a. to conduct an investigation into applicable regulations and standards associated with the temporary storage of flammable and other hazardous materials, and
- b. to recommend guidelines for the design of temporary storage facilities for flammable materials, compressed gases and caustic chemicals basis.//

3.0 SPECIAL CONSIDERATIONS

A summary of the special considerations relevant to this study is as follows:

- a. the flammable material will be propylene oxide;
- b. the storage containers will be steel drums;
- c. all materials will be located in a controlled access area, removed from the general public, other buildings and facilities;
- d. protection from the sun will be required;
- e. protection from grass fires is essential;
- f. use of prevailing winds to provide natural ventilation is desirable;
- g. facilities are identified as temporary field storage;
- h. material handling equipment must be capable of safely accommodating 200 kg drums;
- i. safe disposal of used drums will be required; and,

- j. specific application of rules and regulations relating to the storage of non-defined compressed gases and/or caustic materials used in R & D projects.

4.0 SCOPE

Research in the form of personal interviews with responsible officials and a review of the documentation listed below has provided the information requested and is detailed in the following paragraphs.

4.1 LABOUR CANADA BUILDING STANDARDS

Labour Canada provides standards for:

- a) buildings,
- b) occupied buildings,
- c) shelters.

Following a review of the specifications for the required facility, Mr. Grundie, Area Inspector for Labour Canada, concluded that the structure would fall under the category of a shelter. His assessment was based upon:

- d) the facility will not be occupied by D.R.E.S. personnel,
- e) access will be controlled at all times, and;
- f) the proposed structure will require minimal fire protection.

Based upon his recommendations, the next step taken was to contact the Base Fire Chief, Mr. Reid, who explained that the Department of National Defence uses the National Fire Code of Canada - 1985 (NFC) as their guideline for establishing fire protection standards on DND property. Sections applicable to this type of storage facility are provided in 4.2 below and detailed in Attachment A.

4.2 NATIONAL FIRE CODE OF CANADA - 1985 "STORAGE, HANDLING AND USE OF FLAMMABLE AND COMBUSTIBLE LIQUIDS"

Sections of the NFC identified as applicable to the construction specifications detailed in the Contract Demand and in Attachment B are:

Section 4 - General

- a. Sub Section 4.1.5. Fire Prevention and Protection
- b. Sub Section 4.1.6. Drainage and Waste Disposal
- c. Sub Section 4.1.7. Ventilation
- d. Sub Section 4.1.8. Handling of Flammable and Combustible Liquids
- e. Sub Section 4.1.9. Liquid Spills and Leaks

Section 4.2 - Container Storage of Flammable and Combustible Liquids

- f. Sub Section 4.2.2. General
- g. Sub Section 4.2.3. Drums, Portable Containers and Prepackaged Containers
- h. Sub Section 4.2.11. Outdoor Container Storage

4.3 TEXACO CHEMICAL COMPANY - MSDS HEALTH, SAFETY AND ENVIRONMENTAL ASPECTS

The Material Safety Data Sheet issued by the manufacturer of propylene oxide, Texaco Chemical Company, and supplied by the D.R.E.S. Scientific Authority, was presented to Mr. R. Pang of Tracer Analytical Laboratories for review and comment. His study has confirmed that the information pertaining to health, safety and environmental aspects of propylene oxide as detailed in the American Occupational Safety and Health Administration Regulation, OSHA 1910.106, corresponds to Canadian regulations found in Transport Canada's Dangerous Goods Guide to Initial Emergency Response - 1986. Detailed information appears in Attachment B.

4.4 TRANSPORT CANADA - DANGEROUS GOODS GUIDE TO INITIAL EMERGENCY RESPONSE - 1986

This publication provides general information on a broad spectrum of hazardous substances. Titled guides are organized into two main sections; the first describes the general properties and potential hazards, and the second outlines suggested emergency actions. It was invaluable when used to compare American Industrial and Safety Specifications with Canadian regulations and guidelines. An excerpt of the guide covering propylene oxide appears in Attachment C.

5.0 CONCLUSIONS

This study concludes the following:

- a. the only identifiable legislation which provides standards for temporary storage facilities for flammable or combustible materials is the National Fire Code of Canada 1985, Sub Section 4.2.11. This article defines quantities, allowable flash points, physical clearances, building restrictions and spill protection required for outdoor storage areas;
- b. the application of existing regulations is apparently left to the interpretation of individual authorities;
- c. the recommended scope of construction, security, fire protection and personnel safety as detailed in the Statement of Work meets or exceeds current applicable standards.

6.0 RECOMMENDATIONS

This study recommends the following guidelines for the economical design and operation of temporary storage facilities used for D.R.E.S. experimental purposes:

- a. hazardous materials to be used for R & D purposes should be stored on a short term basis only;
- b. all hazardous materials must be located in a controlled access area, removed from the general public, other buildings and facilities;
- c. the storage and handling of propylene oxide and other combustible, flammable or caustic materials, including their used containers must be in accordance with the guidelines defined in:
 - i) the National Fire Code of Canada-1985
 - ii) Transport Canada's Dangerous Goods Guide to Initial Emergency Response-1986
 - iii) Texaco Chemical Company's Material Safety Data Sheet for Propylene Oxide (refer to "CAUTION" on page 5);
- d. protection from the sun should be provided by a fire resistant steel and concrete shelter, without utilities, which utilizes the prevailing winds as much

as possible to provide natural ventilation and maximum heat dissipation;

- e. the compound area adjacent to the storage facility must be completely sterilized and compacted with gravel to reduce the risk from prairie fires. A fire guard surrounding the area should also be considered;
- f. sufficient emergency fire and personal protection equipment as detailed in the references listed in paragraph 6.0(c), should be provided and maintained by D.R.E.S./CFB Suffield personnel;
- g. placards and warning signs identifying hazards, restrictions and emergency instructions must be displayed throughout the area; and,
- h. sufficient copies of the following publications be procured from the sources indicated:

National Fire Code of Canada, Publication #NFCC-23175

Available from:

National Research Council
Deputy Secretary - Associate Committee for the
National Fire Code
Ottawa, ON
K1A 06R

Dangerous Goods Guide to Initial Emergency Response -
1986, Catalogue #T22-44/1986E

Available from:

Canadian Government Publishing Centre
Supply and Services Canada
Ottawa, ON
K1A 0S9

Industrial Hygiene, Toxicology, and Material Safety
Data Sheet, Code #70808

Available from:

Texaco Chemical Company
4800 Fournace Place
P.O. Box 430
Bellaire, Texas
USA
77401

EXCERPTS FROM
NATIONAL FIRE CODE OF CANADA 1985

SUBSECTION 4.1.5. FIRE PREVENTION AND PROTECTION

4.1.5.1. Unless otherwise required in this Part, all fire prevention and protection requirements for areas directly involved in the storage, handling and use of *flammable* and *combustible liquids* shall comply with this Subsection.

Portable extinguishers **4.1.5.2.** Portable extinguishers shall be provided and maintained as required elsewhere in this Part and in Part 6.

Additional extinguishers **4.1.5.3.** In addition to extinguishers required in Article 4.1.5.2., additional fire protection equipment shall be provided where there are special hazards of operation, dispensing or storage.

Open flames **4.1.5.4.** Open flames and spark-producing devices shall not be used in a manner that will create a fire hazard in areas described in Article 4.1.5.1.

Smoking prohibited **4.1.5.5.** Except for *acceptable* designated smoking areas, smoking shall not be permitted in areas described in Article 4.1.5.1., and signs that conform to Article 2.4.2.3. shall be prominently posted in those areas.

Removal of combustibles **4.1.5.6.(1)** Areas described in Article 4.1.5.1. shall be kept clean and free of ground vegetation and accumulations of combustible materials not essential to operations.

(2) Cleaning rags shall be stored in receptacles conforming to Article 2.4.1.10.

Fire safety plan **4.1.5.7.(1)** A fire safety plan which includes the following measures shall be prepared for areas described in Article 4.1.1.1.:

- (a)** the emergency procedures to be used in case of fire, including sounding the fire alarm, notifying the fire department, instructing personnel on procedures to be followed when the fire alarm sounds and confining, controlling and extinguishing the fire.
- (b)** the appointment, organization and instruction of designated personnel to carry out fire safety duties.
- (c)** the control of fire hazards, and
- (d)** the maintenance of facilities provided for the safety of personnel.

(2) Personnel in areas where *flammable* or *combustible liquids* are stored, handled or used shall be instructed in the fire emergency procedures described in the fire safety plan in Sentence (1) before they are given any responsibility for fire safety.

(3) The fire safety plan shall be retained on site for reference by the *authority having jurisdiction* and personnel.

Access paths **4.1.5.8.** Required aisles and other access paths shall be maintained to permit the unobstructed movement of personnel and fire department apparatus so that fire fighting operations can be carried out in any part of an area used for the storage, use or handling of *flammable* or *combustible liquids*.

Welding and cutting **4.1.5.9.** Welding and cutting operations shall conform to Part 5.

SUBSECTION 4.1.6. DRAINAGE AND WASTE DISPOSAL

Spillage **4.1.6.1.(1)** Except at *service stations*, appropriate measures to prevent spills of *flammable* or *combustible liquids* from entering public sanitary and storm sewer systems and natural waterways shall be provided by grading the site or sloping the floor to divert the spill or by providing noncombustible sills, curbs or dikes of sufficient height to contain it or divert it to a drainage system conforming to Article 4.1.6.2.

(2) When dikes are provided to contain accidental spillage in Sentence (1), they shall conform to Subsection 4.3.7.

4.1.6.2.(1) A drainage system designed to drain spills of *flammable or combustible liquids* shall terminate at a location which will not create a hazard to public health or safety by contaminating any potable water source, underground stream or waterway, or by entering any sanitary or storm sewer.

Drainage locations

(2) Closed drainage systems shall be equipped with a trap.

SUBSECTION 4.1.7. VENTILATION

4.1.7.1. Ventilation shall be provided for hazardous areas and processes in conformance with the National Building Code of Canada and with the requirements of this Part. (See Appendix A.)

SUBSECTION 4.1.8. HANDLING OF FLAMMABLE AND COMBUSTIBLE LIQUIDS

4.1.8.1. All *flammable and combustible liquids* shall be stored in *acceptable storage tanks* or containers.

Storage

4.1.8.2. *Flammable liquids* shall not be dispensed into metal containers unless the containers are electrically connected to the fill stem or rest on a metallic floorplate which is electrically connected to the fill stem.

Grounding

4.1.8.3.(1) Under *acceptable* conditions, *flammable liquids* shall be drawn from or transferred into containers or *storage tanks* within a *building*

- (a) through a closed piping system conforming to Section 4.4,
- (b) by means of an *acceptable* pump on the top of the *storage tank* or container, or
- (c) by gravity through an *acceptable* self-closing valve.

Transfers

(See Appendix A.)

(2) The transfer of *flammable or combustible liquids* by means of non-inert gas pressure applied to a container or *storage tank* shall not be permitted.

4.1.8.4. When *acceptable, moveable storage tanks* may be used for dispensing *flammable or combustible liquids* into the fuel tanks of vehicles or other motorized equipment.

Dispensing into fuel tanks

SUBSECTION 4.1.9. LIQUID SPILLS AND LEAKS

4.1.9.1.(1) Maintenance and operating procedures shall be established to prevent the escape of *flammable and combustible liquids* to areas where they would create a fire hazard.

Procedures to prevent spills

(2) Except as provided in Sentence (3), all reasonable steps shall be taken to recover escaped liquid and to remove or treat the contaminated soil.

(3) Liquid spilled or leaked on a nonabsorbing surface shall be removed with the aid of an absorbent and disposed of in an *acceptable* manner or shall be flushed to a location conforming to Article 4.1.6.2.

SECTION 4.2 CONTAINER STORAGE OF FLAMMABLE AND COMBUSTIBLE LIQUIDS

SUBSECTION 4.2.2. GENERAL

Restricted storage

4.2.2.1. *Flammable and combustible liquids* shall not be stored in or adjacent to *exits*, elevators or principal routes that provide *access to exits*.

Fencing

4.2.2.2. An outside storage area for *flammable or combustible liquids* shall be fenced in an *acceptable* manner where necessary to prevent the entry of unauthorized personnel.

SUBSECTION 4.2.3. DRUMS, PORTABLE CONTAINERS AND PREPACKAGED CONTAINERS

Containers

4.2.3.1.(1) The storage, handling and use of less than 230 L of *flammable or combustible liquids* shall be permitted only in the following containers:

- (a) *drums and prepackaged containers* meeting the requirements of the Canadian Transport Commission Regulations for the Transportation of Dangerous Commodities.
- (b) *portable containers* of metal or plastic conforming to CSA-B376, "Portable Containers for Gasoline and Other Petroleum Fuels."
- (c) portable fuel tanks conforming to CSA-B306, "Portable Fuel Tanks for Marine Use," and
- (d) safety cans conforming to ULC-C30, "Metal Safety Cans."

Markings

4.2.3.2. Except as provided in Articles 4.2.3.1. and 4.2.3.3., all *drums and prepackaged containers for flammable or combustible liquids* shall be distinctly marked or labelled in easily legible type which is in contrast to any other printed matter on the label with a warning to indicate that the material in the container is flammable, that it should be kept away from heat, sparks and open flames and that it should be kept closed when not in use.

4.2.3.3. Markings referred to in Article 4.2.3.2. are not required when the *drum or prepackaged container* is labelled in conformance with the requirements of the Canadian Transport Commission Regulations for the Transportation of Dangerous Commodities or the Hazardous Products (Hazardous Substances) Regulations of Canada P.C. 1970-373.

Glass or plastic containers

4.2.3.4. Except as permitted in Article 4.2.3.5., the storage, handling and use of *flammable and combustible liquids* in glass or plastic *prepackaged containers* shall be permitted only if the required liquid purity (such as ACS analytical reagent grade or higher) would be affected by storage in metal containers or if the liquid would cause excessive corrosion of the metal containers.

4.2.3.5. The storage and use of *flammable and combustible liquids* having a *flash point* less than 60°C in containers other than those in Article 4.2.3.1. of more than 0.6 L capacity in the case of *flammable liquids* and 4.6 L in the case of *combustible liquids* shall not be permitted within a *building*.

Maximum capacity permitted

SUBSECTION 4.2.11. OUTDOOR CONTAINER STORAGE

Quantities

4.2.11.1. Except as provided in Article 4.2.11.4., the quantity of *flammable and combustible liquids* stored in *drums, portable containers and prepackaged containers* in outdoor storage areas shall conform to Table 4.2.11.A.

Different flash points

4.2.11.2. Where 2 or more liquids with different *flash points* are stored outdoors in containers that form a single pile, the maximum total quantity permitted in the pile shall be equal to that permitted for the liquid with the lowest *flash point*.

Table 4.2.11.A.
Forming Part of Article 4.2.11.1.

OUTDOOR CONTAINER STORAGE			
Type of Liquid	Maximum Total Quantity per Pile, L	Minimum Distance Between Piles, m	Minimum Distance to a Property Line or to a Building on the Same Property, m
Flammable, with <i>flash point</i> less than 22.8°C	4 700	1.5	6
Flammable, with a <i>flash point</i> from 22.8°C to 37.8°C	16 450	1.5	6
Combustible, with a <i>flash point</i> less than 60°C	32 900	1.5	6
Combustible, with a <i>flash point</i> at or above 60°C	83 250	1.5	6
Column 1	2	3	4

Access lanes

4.2.11.3. A lane at least 3 m wide shall be provided in outdoor storage areas to permit the approach of fire department vehicles to within 60 m of each container.

Clearances

4.2.11.4. The clearances required in Article 4.2.11.1. do not apply where not more than 4 700 L of *flammable or combustible liquids* are stored adjacent to a *building* on the same property provided the *building* is 1 storey in *building height* and is used for the storage or handling of *flammable or combustible liquids* or the exposed wall has a *fire-resistance rating* of at least 2 h and has no opening within 3 m of such outdoor storage.

Spill protection

4.2.11.5. Outdoor storage areas for *flammable or combustible liquids* shall be designed to accommodate possible spillage in conformance with Subsection 4.1.6.

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