



PHI-94-001633  
INIT 07/14/94



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**FYI-0794-1039**  
**PHILLIPS PETROLEUM COMPANY**

BARTLESVILLE, OKLAHOMA 7 704  
918 681-5856

Corporate Engineering  
JOHN J. MOON  
Manager, Environment and Consumer Protection

**Contains No CBI**

October 2, 1984

CHIPS Information  
Cyclohexane

Mr. Arthur Stern  
Acting Executive Secretary (TS-792)  
TSCA Interagency Testing Committee  
402 M Street, SW  
Washington, DC 20460

94 JUL 14 AM 9  
RECEIVED  
OPPT/CBIC

Dear Mr. Stern:

As a manufacturer, Phillips is pleased to reply to the Interagency Testing Committee's (ITC) request for information related to potential human exposure to Cyclohexane (CAS #110-82-7). Information in the following attachments is submitted to assist the committee in making as complete and comprehensive a study as possible.

1. Phillips' Toxicity Study Summary of Cyclohexane.
2. Cyclohexane Material Safety Data Sheets.
3. Plant Information.
  - a. Cyclohexane Monitoring Data
  - b. Cyclohexane Production Levels
  - c. Number of Exposed Employees
  - d. Cyclohexane Emissions Control Systems within Phillips
  - e. Cyclohexane Emissions by Plant

If you have questions, please contact Russell Cook at (918) 661-4642.

*John J. Moon*  
Very truly yours,

JJM:scw-029  
Attachments (3)



# industrial hygiene and toxicology

PHILLIPS PETROLEUM COMPANY HUMAN RESOURCES - MEDICAL DIVISION BARTLESVILLE, OK 74004 918 661-6000

## TOXICITY STUDY SUMMARY

### CYCLOHEXANE

#### Acute Oral Toxicity

Albino rats of the Sprague-Dawley strain weighing 200-300 g were selected as the experimental animals. Five male and five female animals were given a single dose of 5000 mg/kg by oral gavage. Test material was administered neat. The animals were then observed for 14 days. Pharmacotoxic signs and symptoms included depression, slight depression, salivation, and soft feces, 1 hour postdose to Day 1. All animals appeared normal from Day 2 through termination of study. All animals gained weight during the study. On Day 14 of the observation period all animals were euthanized. Thorough necropsies were conducted on each animal. There were no gross pathological findings related to test material administration. Since no test animals died the oral LD50 for cyclohexane is considered to be greater than 5000 mg/kg.

#### Acute Dermal Toxicity

Albino rabbits of the New Zealand White/Dutchland strain weighing 2 to 3 kg were selected as the experimental animals. Three male and three female animals were dosed by the dermal route at a level of 2000 mg/kg. Twenty-four hours prior to dosing, the test site of each animal was clipped free of hair. The test material application site consisted of approximately 10% of the total body surface. Neat, liquid test material was applied to the back of each animal. Test material was held in contact with the skin for 24 hours by means of a non-absorbent binder. The binders were removed at the end of 24 hours and any remaining test material was wiped off. The animals were then observed for 14 days. Pharmacotoxic signs and symptoms included erythema on Day 1 ranging from very slight in two males and two females to well-defined in one female. Erythema on Day 3 was noted as very slight in two males and two females and had cleared by Day 7. Edema on Day 1 ranged from very slight in one male and three females to slight in one male and cleared by Day 3. Epidermal scaling was noted in one female on Day 10. With the exception of phonation upon application, all rabbits appeared normal throughout the study. All six rabbits gained weight between initiation and termination. On Day 14 of the observation period all the animals were euthanized and submitted to thorough necropsy. There were no gross pathological findings related to test material administration. Since none of the test animals died the dermal LD50 for cyclohexane is considered to be greater than 2000 mg/kg.

### Acute Inhalation Toxicity

Albino rats of the Sprague-Dawley strain weighing 200-350 g were selected as the experimental animals. Five male and five female animals were individually housed in stainless steel wire mesh cages which were placed in a glass and stainless steel exposure chamber. The animals were exposed to vaporized test material for 4 hours at a nominal concentration of 32.88 mg/L (actual concentration  $\geq$  4044.17 ppm\*\*). The animals were then observed for 14 days. Pharmacotoxic signs and symptoms during exposure included tremors, hyperactivity, rapid respiration, and lying prostrate in cage. One animal exhibited ataxia. No exposure-related trends were apparent in the mean body weight data. On Day 14 of the observation period all the animals were euthanized and submitted to thorough necropsy. Gross pathological signs included one animal with a dilated renal pelvis. However, there were no pathological trends related to test material administration. Since no test animals died the acute inhalation LC50 for cyclohexane is considered to be greater than 4044.17 ppm.

### Respiratory Tract Irritancy

Male mice of the outbred SPF (CD-1,COBS) strain weighing 20-25 g were selected as the experimental animals. A group of four animals was exposed head only to vaporized test material at a nominal concentration of 32.83 mg/L (actual concentration  $\geq$  4139.39 ppm\*\*). Each animal was housed in an individual plethysmograph to permit monitoring of respiration. After the animals became acclimatized they were exposed to vaporized test material for 1 minute and permitted to recover for 10 minutes while being exposed to room air only. Following this the animals were exposed to vaporized test material for 1 minute, then to room air for 5 minutes. During this time their respiratory patterns were continually monitored.

An extremely slight reduction in respiration rate was noted in only one of the four test animals during both of the exposure periods. This animal also exhibited very slight respiratory pauses which might be indicative of some upper airway irritation. However, increased respiratory rates were noted in the other three test animals during both of the exposures, and no consistent shift in breathing patterns was noted in these animals that would be indicative of any upper airway irritation. Based on these results, exposure to cyclohexane at 4139.33 ppm did not appear to produce upper airway irritancy in mice.

### Eye Irritancy (Unwashed)

Six young adult albino rabbits of the New Zealand White/Dutchland strain were selected as the experimental animals. At least 24 hours prior to the start of the test, the left eye of each animal was stained with fluorescein dye and examined for corneal damage. Any animal with corneal damage was rejected and replaced with a healthy animal. One-tenth ml of liquid test material was instilled into the conjunctival sac of the left eye of each animal. The eye was then gently held closed for 1 second and released. The untreated right eye of each rabbit served as a control. The eyes were scored according to the Draize\* system at 1, 24, 48 and 72 hours, and at 4 and 7 days postinstillation.

In this study the following results were noted. Excessive blinking and rubbing was exhibited by all six rabbits upon instillation. At 1 hour

postinstillation, corneal opacity, involving up to 25% of the cornea, was noted in one rabbit and iritis was noted in another rabbit. Conjunctival redness was noted in five rabbits with conjunctival chemosis in one rabbit. All ocular lesions had cleared by 24 hours. No conjunctival discharge was noted in any of the six rabbits. The overall eye irritation index for cyclohexane was 3.7 at 1 hour and 0.0 at 24 hours through 7 days postinstillation.

#### Eye Irritancy (Washed)

Six young adult albino rabbits of the New Zealand White/Dutchland strain were selected as the experimental animals. At least 24 hours prior to the start of the test, the left eye of each animal was stained with fluorescein dye and examined for corneal damage. Any animal with corneal damage was rejected and replaced with a healthy animal. One-tenth ml of liquid test material was instilled into the conjunctival sac of the left eye of each test animal. The treated eyes were held closed for 4 seconds then washed with 40 ml of tap water. The untreated right eye of each animal served as a control. The eyes were scored according to the Draize\* system at 1, 24, 48 and 72, and at 4 and 7 days postinstillation.

In this study the following results were noted. Conjunctival redness was noted in four rabbits at 1 hour postinstillation and had cleared by 24 hours. No corneal opacity, iritis, conjunctival chemosis, or discharge was noted in any of the six rabbits. The overall eye irritation index for cyclohexane was 1.3 at 1 hour and 0.0 at 24 hours through 7 days postinstillation.

#### Primary Dermal Irritation

Three male and three female young adult rabbits of the New Zealand White/Dutchland strain were selected as the experimental animals. The animals were clipped free of hair and 0.5 ml of liquid test material was applied to one abraded and to one non-abraded site. The sites were rotated over various areas of clipped skin. Abrasions were minor incisions through the stratum corneum but not deep enough to disturb the dermis or to produce bleeding. Test material was introduced to each application site under a 1 square inch gauze patch of double thickness. The patches were secured in place and the entire trunk of each animal was wrapped with a non-absorbent binder. The animals were then immobilized in stocks for 24 hours. After the 24 hour exposure period, the binders and patches were removed and the skin wiped to remove any test material still remaining. The skin reactions were then evaluated, according to the Draize\* system, 24 and 72 hours following the initial application of test material.

In this study the following results were noted. No erythema, edema, or other dermal effects were noted at 24 or 72 hours after administration of the test material. The primary skin irritation index for cyclohexane was calculated to be 0.0.

#### Ames Test

Five Salmonella typhimurium tester strains, TA1535, TA1537, TA1538, TA98 and TA100, were utilized as the experimental organisms. Each strain was exposed

to a minimum of five test compound doses both with and without metabolic activation by an Aroclor-induced rat liver microsomal fraction. The test compound dose levels were determined by a preliminary multidose-ranging study with the optimal concentration allowing survival of about 50% of the cells. Cyclohexane solubilized at approximately 50 mg/ml in dimethylsulfoxide. The maximum dose selected for the mutagenicity test was approximately 5200 ug/plate because it exhibited growth inhibition.

The mutagenicity assay was done directly by the plate incorporation method. Each of 2 ml of complete top agar, 0.1 ml of an overnight broth culture of each tester strain, 0.1 ml of the test compound or diluent and 0.5 ml of the S-9 mix, for the activated tests only, were combined, mixed thoroughly, and poured onto VBE minimal agar plates. Each concentration of the compound and the positive and negative controls were plated in triplicate. Plates were gently rotated and tilted to assure uniform distribution of the top agar, allowed to harden on an even surface for 1 hour, inverted and put in a dark  $37 \pm 0.5^\circ\text{C}$  incubator. After 2 days, the colonies on both test and control plates were counted using an electronic colony counter and the density of the background growth was noted.

Exposure to seven graded doses of the test material in the presence of and in the absence of metabolic activation did not increase the reversion to histidine prototrophy of S. typhimurium strains TA1535, TA1537, TA1538, TA98 or TA100. Therefore cyclohexane is not considered to be mutagenic in this test system.

#### Mouse Lymphoma Forward Mutational Assay

This assay was performed with the TK+/- phenotype of L5178Y mouse lymphoma cells from subline 3.7.2C using a minimum of eight test compound doses with and without metabolic activation by an Aroclor-induced rat liver microsomal fraction. Appropriate negative, solvent, and positive controls were included with each assay. The test compound dose levels were determined by a preliminary multidose-ranging study with the highest dose tested being selected to give approximately 50-90% inhibition of suspension cell growth depending on the solubility of the compound. Cyclohexane solubilized at approximately 50 mg/ml in dimethylsulfoxide. The maximum dose selected for the mutagenicity test was 100 ug/ml because it exhibited 65% growth inhibition in the presence of metabolic activation.

Each test concentration was prepared to contain the test dose in 0.1 ml volumes. Six million precleaned TK+/- cells in 6 ml of F<sub>10</sub>P were added to centrifuge tubes. An additional 4 ml of the S-9 mix were added to half of the tubes. Immediately thereafter, 0.1 ml of the 100x concentrations of the test chemical dilutions or the positive controls, and 0.1 ml of the solvent were added to the appropriate tubes. Each tube was mixed, gassed with a mixture of CO<sub>2</sub> and air, and incubated at  $37 \pm 0.5^\circ\text{C}$  on a revolving roller drum for 4 hours. Following this incubation the tubes were centrifuged and the treatment solutions decanted. The cells were washed twice with F<sub>10</sub>P and resuspended in 20 ml F<sub>10</sub>P after the second wash. The tube cultures were then gassed and reincubated for a 2 day expression time. The cell cultures were readjusted to  $3.0 \times 10^5$  cells/ml as necessary. At the end of the expression period, a

sample of each of the cultures was centrifuged and the cells resuspended at 500,000 viable cells/ml in F10P. The concentrated cells were serially diluted and appropriate dilutions were plated in triplicate in cloning medium with and without TFT. Approximately 500,000 cells were plated on each of 3 selective medium plates containing 2 ug/ml TFT, and 100 cells were cloned on each of 3 non-selective plates for each test concentration and a control tube. The plates were incubated for 12± 2 days. The mutant colonies (TK-/-) were counted on the selective TFT containing plates and the survivors (TK+/- and TK-/-) were counted on the non-selective medium plates.

Exposure to eight graded doses of the test material in the presence of and in the absence of metabolic activation increased the induction of forward mutations in L5178Y mouse lymphoma cells at the T/K locus. However, the increases in forward mutations were not dose related and did not meet the criteria for a positive result. Therefore cyclohexane is not considered to be mutagenic in this test system.

#### In Vitro Sister Chromatid Exchange

This assay was performed using Chinese Hamster Ovary Cells and a minimum of five test compound doses with and without metabolic activation by an Aroclor-induced rat liver microsomal fraction. Appropriate negative, solvent and positive controls were included with each assay. The test compound dose levels were determined by a preliminary multidose-ranging study with the highest concentration of the chemical tested depending upon its solubility. Cyclohexane solubilized at approximately 50 mg/ml in dimethylsulfoxide. The maximum dose selected for the mutagenicity test was approximately 25 µg/ml because it exhibited growth inhibition.

Cells were treated in an exponential stage of growth by setting up cultures with 2 to 5 x 10<sup>5</sup> cells per 25 cm<sup>2</sup> flask, 24 hours prior to treatment. Cells were exposed to the chemical for 2 hours, washed twice and then 5-bromodeoxyuridine (Brd U) was added to each culture. All cultures were sampled a minimum of 24 hours after addition of Brd U to ensure completion of two full cell cycles. Duplicate cultures were set up for each dose level and all controls. Twenty-four hours after the above initiation of the cultures, the cells were treated with the test chemical in the presence of an S-9 rat liver activation system for 2 hours and washed twice in a balanced salt solution. The cells were then sampled and treated as described above. Two hours after, colcemid (0.2 µg/ml) was added to each tube and metaphases were collected by mitotic shake-off. The cells were swollen in a 0.075M KCL hypotonic, and washed three times in an acetic alcohol fixative. Slides were prepared and stained. Fifty cells in the metaphase stage of mitosis were scored at each dose level for the number of sister chromatid exchanges (SCE).

Exposure to five graded doses of the test material in the presence of and in the absence of metabolic activation did not show statistically significant increases in the number of SCE's per chromosome. Therefore cyclohexane is not considered to be mutagenic in this test system.

HR:210A

\*Draize, J.H., "Appraisal of the Safety of Chemicals in Foods, Drugs, and Cosmetics", Assoc., Food and Drug Officials of the U.S., Austin, Texas 1959.

\*\*Actual concentrations were calculated from the total hydrocarbon analyzer response reported in methane equivalents.

11/30/83

DATE March, 1982

## MATERIAL SAFETY DATA SHEET

("ESSENTIALLY SIMILAR" TO FORM OSHA-20)

WHERE APPLICABLE, THIS PRODUCT HAS BEEN REPORTED FOR THE EPA'S CHEMICAL SUBSTANCE INVENTORY.

SECTION I - IDENTIFICATION OF PRODUCT			
MANUFACTURERS NAME <b>PHILLIPS CHEMICAL COMPANY</b>	EMERGENCY TELEPHONE NUMBERS	DURING BUSINESS HOURS (918) 661-3665	OUTSIDE BUSINESS HOURS (918) 661-6118
ADDRESS (NUMBER, STREET, CITY, STATE, & ZIP CODE) <b>BARTLESVILLE, OK 74004</b>	PRODUCT NO. <b>N24820</b>		
TRADE NAME <b>Cyclohexane - 85%</b>	CHEMICAL NAME AND SYNONYMS <b>Cyclohexane</b>		
CHEMICAL FAMILY <b>Cycloparaffins</b>	CHEMICAL FORMULA <b>(CH<sub>2</sub>)<sub>6</sub></b>		
DOT SHIPPING NAME <b>Cyclohexane</b>	HAZARD CLASS <b>Flammable Liquid</b>	ID NUMBER <b>UN1145</b>	

SECTION II - HAZARDOUS COMPONENTS OF MIXTURES			
INGREDIENTS	CAS NUMBER	% BY WT.	THRESHOLD LIMIT VALUE (UNITS)
Cyclohexane	110-82-7	85	300 ppm
Isomeric Hydrocarbons		15	

SECTION III - TYPICAL PHYSICAL DATA	
BOILING POINT (°F) <b>177°F (80.6°C)</b>	APPEARANCE AND ODOR <b>Colorless liquid, slight pungent odor</b>
VAPOR PRESSURE <b>3.2 psia at 100°F (165 mm Hg at 100°F)</b>	SPECIFIC GRAVITY (H <sub>2</sub> O = 1) <b>0.77 (50/60°F)</b>
VAPOR DENSITY (AIR = 1) <b>2.8</b>	PERCENT VOLATILE BY VOLUME (%) <b>100</b>
SOLUBILITY IN WATER <b>Negligible</b>	EVAPORATION RATE <b>(Butyl Acetate = 1) &gt;1</b>

SECTION IV - FIRE AND EXPLOSION - HAZARD DATA			
FLASH POINT (METHOD) <b>0°F (TCC, ASTM D-56)</b>	FLAMMABLE LIMITS (% BY VOLUME)	LeL <b>1.3</b>	UeL <b>8.0</b>
FIRE EXTINGUISHING MEDIA <b>Dry chemical, carbon dioxide (CO<sub>2</sub>), or foam.</b>			
SPECIAL FIRE FIGHTING PROCEDURES <b>Shut off source. Use water spray or fog to cool exposed equipment and containers.</b>			
For large fires, or fires in confined areas, self-contained breathing apparatus may be necessary			
UNUSUAL FIRE AND EXPLOSION HAZARDS			

NO GUARANTY IS MADE AS TO THE ACCURACY OF ANY DATA OR STATEMENT CONTAINED HEREIN. WHILE THIS MATERIAL IS FURNISHED IN GOOD FAITH, NO WARRANTY EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS OR OTHERWISE IS MADE. THIS MATERIAL IS OFFERED ONLY FOR YOUR CONSIDERATION, INVESTIGATION AND VERIFICATION AND PHILLIPS, INCLUDING ITS DIVISIONS, AFFILIATES AND SUBSIDIARIES, SHALL NOT IN ANY EVENT BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH ITS PUBLICATION. LIKEWISE, NO STATEMENT MADE HEREIN SHALL BE CONSTRUED AS A PERMISSION OR RECOMMENDATION FOR THE USE OF ANY PRODUCT IN A MANNER THAT MIGHT INFRINGE EXISTING PATENTS.

(SEE REVERSE SIDE)

**SECTION V - HEALTH HAZARD DATA**

**THRESHOLD LIMIT VALUE:** OSHA PEL for cyclohexane is 300 ppm.

**EFFECTS OF OVEREXPOSURE:**

**Inhalation:** May produce dizziness, exhilaration, nausea and unconsciousness.  
**Eye contact:** May produce a moderate amount of irritation.

**EMERGENCY AND FIRST AID PROCEDURES:**

**Inhalation:** Remove to fresh air and administer oxygen. If not breathing, apply artificial respiration. Obtain medical assistance.  
**Eye contact:** Irrigate with running water for a minimum of 15 minutes. If irritation persists, refer to a physician.  
**Ingestion:** Do not induce vomiting. Refer to a physician.

**SECTION VI - REACTIVITY DATA**

STABILITY	UNSTABLE		CONDITIONS TO AVOID:
	STABLE	X	
<b>INCOMPATIBILITY (MATERIALS TO AVOID FOR PURPOSES OF TRANSPORT, HANDLING AND STORAGE ONLY):</b> Oxygen and strong oxidizing materials.			
<b>HAZARDOUS DECOMPOSITION PRODUCTS:</b>			
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID:
	WILL NOT OCCUR	X	

**SECTION VII - SPILL OR LEAK PROCEDURES**

**STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:**

**Contain spill. Evacuate, protect from ignition, absorb in earth or sawdust. Refer to Section VIII and contact appropriate safety personnel for respirator requirements. Keep out of water sources and sewers.**

**WASTE DISPOSAL (INSURE CONFORMITY WITH ALL APPLICABLE DISPOSAL REGULATIONS):**

**Incinerate under controlled conditions.**

**SECTION VIII - PERSONAL PROTECTION INFORMATION**

**RESPIRATORY PROTECTION:** NIOSH approved equipment per requirements of 29 CFR Part 1910.134 (OSHA) and ANSI Z88.2.

VENTILATION	LOCAL EXHAUST	Recommended
	MECHANICAL (GENERAL)	Recommended
	SPECIAL OR OTHER	

**PROTECTIVE GLOVES:** Neoprene  
**EYE PROTECTION:** Goggles if splashes could occur.  
**OTHER PROTECTIVE EQUIPMENT:**

**SECTION IX - HANDLING AND STORAGE PRECAUTIONS**

**PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:**

**Protect from ignition. Provide for means of controlling leaks and spills. Store in cool, well-ventilated area. Bond and ground during liquid transfer.**

**OTHER PRECAUTIONS:**

**MATERIAL SAFETY DATA SHEET**  
 ("ESSENTIALLY SIMILAR" TO FORM OSHA-20)

WHERE APPLICABLE, THIS PRODUCT HAS BEEN REPORTED FOR THE EPA'S CHEMICAL SUBSTANCE INVENTORY.

SECTION I - IDENTIFICATION OF PRODUCT			
MANUFACTURERS NAME <b>PHILLIPS CHEMICAL COMPANY</b>	EMERGENCY TELEPHONE NUMBERS	DURING BUSINESS HOURS (918) 661-3865	OUTSIDE BUSINESS HOURS (918) 661-8118
ADDRESS (NUMBER, STREET, CITY, STATE, & ZIP CODE) <b>BARTLESVILLE, OK 74004</b>	PRODUCT NO.		
TRADE NAME <b>Cyclohexane, 98 and 99.5% purity</b>	CHEMICAL NAME AND SYNONYMS <b>Cyclohexane</b>		
CHEMICAL FAMILY <b>Cycloparaffins</b>	CHEMICAL FORMULA <b>C<sub>6</sub>H<sub>12</sub></b>		
DOT SHIPPING NAME <b>Cyclohexane</b>	HAZARD CLASS <b>Flammable Liquid</b>	ID NUMBER <b>UN1145</b>	

SECTION II - HAZARDOUS COMPONENTS OF MIXTURES			
INGREDIENTS	CAS NUMBER	% BY WT.	THRESHOLD LIMIT VALUE (UNITS)
<b>Cyclohexane</b>	<b>110-82-7</b>	<b>100</b>	<b>300 PPM</b>

SECTION III - TYPICAL PHYSICAL DATA	
BOILING POINT (°F) <b>177.3°F (80.7°C)</b>	APPEARANCE AND ODOR <b>Colorless liquid, slight pungent odor.</b>
VAPOR PRESSURE <b>3.26 psia (170 mm Hg) at 100°F (80.7°C)</b>	SPECIFIC GRAVITY (H <sub>2</sub> O = 1) <b>0.78 (60/60°F)</b>
VAPOR DENSITY (AIR = 1) <b>2.9</b>	PERCENT VOLATILE BY VOLUME (%) <b>100</b>
SOLUBILITY IN WATER <b>Negligible</b>	EVAPORATION RATE <b>(butyl acetate = 1) &gt; 1</b>

SECTION IV - FIRE AND EXPLOSION - HAZARD DATA						
FLASH POINT (METHOD) <b>-4°F (ASTM D56, TCC)</b>	FLAMMABLE LIMITS (% BY VOLUME)	<table border="1"> <tr> <td>LeL</td> <td>UeL</td> </tr> <tr> <td><b>1.3</b></td> <td><b>8.3</b></td> </tr> </table>	LeL	UeL	<b>1.3</b>	<b>8.3</b>
LeL	UeL					
<b>1.3</b>	<b>8.3</b>					
FIRE EXTINGUISHING MEDIA <b>Dry chemical, carbon dioxide (CO<sub>2</sub>) or foam.</b>						
SPECIAL FIRE FIGHTING PROCEDURES <b>Shut off source. Use water fog or spray to cool exposed equipment and containers.</b>						
<b>For large fires, or fires in confined areas, self-contained breathing apparatus may be necessary.</b>						
UNUSUAL FIRE AND EXPLOSION HAZARDS						

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**SECTION V - HEALTH HAZARD DATA**

**THRESHOLD LIMIT VALUE:** OSHA PEL for cyclohexane is 300 ppm.

**EFFECTS OF OVEREXPOSURE:**

**Inhalation:** May produce dizziness, exhilaration, nausea, stupor and unconsciousness.  
**Eye contact:** May produce a moderate amount of irritation.

**EMERGENCY AND FIRST AID PROCEDURES:**

**Inhalation:** Remove patient to fresh air and administer oxygen. Apply artificial respiration. If not breathing call physician.  
**Ingestion:** Do not induce vomiting. Call physician.  
**Eye contact:** Flush with running water for a minimum of 15 minutes. If irritation persists refer to a physician.

**SECTION VI - REACTIVITY DATA**

STABILITY	UNSTABLE		CONDITIONS TO AVOID:
	STABLE	X	
INCOMPATIBILITY (MATERIALS TO AVOID FOR PURPOSES OF TRANSPORT, HANDLING AND STORAGE ONLY):			Oxygen and strong oxidizing materials.
HAZARDOUS DECOMPOSITION PRODUCTS:			
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID:
	WILL NOT OCCUR	X	

**SECTION VII - SPILL OR LEAK PROCEDURES**

**STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:**

**Contain spill. Ventilate, protect from ignition, absorb in earth or sawdust. Keep out of water sources and sewers. Refer to Section VIII and contact appropriate safety personnel for respirator requirements.**

**WASTE DISPOSAL (INSURE CONFORMITY WITH ALL APPLICABLE DISPOSAL REGULATIONS):**

**Incinerate under controlled conditions.**

**SECTION VIII - PERSONAL PROTECTION INFORMATION**

<b>RESPIRATORY PROTECTION:</b>		NIOSH approved equipment per requirements of 29 CFR Part 1910.134 (OSHA) and ANSI Z88.2.
VENTILATION	LOCAL EXHAUST	Recommended
	MECHANICAL (GENERAL)	Recommended
	SPECIAL OR OTHER	
<b>PROTECTIVE GLOVES:</b>		Needed if skin contact is unavoidable.
<b>EYE PROTECTION:</b>		Goggles
<b>OTHER PROTECTIVE EQUIPMENT:</b>		

**SECTION IX - HANDLING AND STORAGE PRECAUTIONS**

**PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING:**

**Protect from ignition. Provide means of controlling leaks and spills. Store in cool, well-ventilated area. Bond and ground during liquid transfer.**

**OTHER PRECAUTIONS:**

0012

PLANT INFORMATION

Item a. Cyclohexane Monitoring Data: TLV = 300 ppm (1050  $\mu\text{g}/\text{m}^3$ )

Method: a. Personnel samples (pers) - Charcoal tube, G.C. analysis, ~ one l/min rate with personnel pump. Charcoal tube in breathing zone.

b. Area samples (area) - Same as "a" but in a fixed stationary location.

<u>Location(1)</u>	<u># Samples</u>	<u>Arithmetic Mean Avg. Conc. (ppm)</u>	<u>Max. Conc. (ppm)</u>	<u>Std. Deviation</u>
KC	305 pers	0.23	6.25	0.62
	129 area	0.20	3.80	0.52
PRC	693 pers	0.54	66.5	3.8
	152 area	0.39	13.7	1.48
WC	20 area	0.26	0.44	0.33
SW	2287 pers	0.22	112.97	2.46

(1) KC = Kansas City Refinery (now closed); PRC = Puerto Rico Core Refinery; WC = Woods Cross Refinery; SW = Sweeny Refinery; BOR = Borger.

Item b. Cyclohexane Production:

	<u>Bor</u>	<u>SW</u>	<u>PRC</u>
1983 Actual Production, M bbls.	555.8	3.0	184.8
1984 Estimated from July, M bbls*	586.3	439.3	2226.0

\*Includes actual production to August 1, and projected to end-of-year. Note differences in annual production due to demand.

Item c. Employee Exposure:

Approximately 200 employees at the three facilities have the intermittent potential for cyclohexane exposure.

Item d. Cyclohexane Emissions Control Systems:

Storage Tanks - Internal floating roof  
- Pressurized roof  
- Fixed roof - VRU Flare

Numerous Emission Points - Flared

Fugitive Emissions - Preventive Maintenance Programs

0 0 1 3

Item e. Cyclohexane Emission Data by Plant:

1. Sweeny Refinery (information/data from 1980 TACB Emission Inventory\*)

TANKAGE

<u>Source #</u>	<u>Material Stored</u>	<u>Tank Capacity</u>	<u>Vapor Control</u>	<u>HC Emissions</u>
#37	Cyclohexane (366)	196,000 gal.	Pressurized roof	0.1 tons/yr.
#38	Cyclohexane (366)	196,000 gal.	Pressurized roof	0.1 tons/yr.
#227	Cyclohexane (366)	984,000 gal.	Int. Floating Roof	0.9 tons/yr.
#94	Cyclohexane (366)	204,000 gal.	Fixed Roof-VFU to Flare	0.1 tons/yr.
#95	Cyclohexane (366)	204,000 gal.	Fixed Roof-VRU to Flare	0.1 tons/yr.
#222	Cyclohexane (366)	989,000 gal.	Int. Floating Roof	1.4 tons/yr.

TRUCK LOADING

<u>Source #</u>	<u>Material Loaded</u>	<u>Vapor Loss</u>
#L10	Cyclohexane (99.5%)	0.010 tons/yr.
#L16	Cyclohexane (98%)	0.037 tons/yr.

OTHER SOURCES

<u>Process ID. #</u>	<u>Unit #</u>	<u>Name</u>	<u>Process Product</u>	<u>HC Emissions</u>
P15	15	Benzene Isomerization	Cyclohexane	--
P19	19	Benzene Hydrogenation	Cyclohexane (99%)	--

Freeport Terminal

Loading Dock	--	Cyclohexane	89.2 tons/yr
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\*Emission Points are numerous, but in most cases are flared.

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2. Borger Refinery (information/data from 1979 TACB Emission Inventory)

TANKAGE

<u>Source #</u>	<u>Material Stored</u>	<u>Tank Capacity</u>	<u>Vapor Control</u>	<u>HC Emissions Estimated</u>
1012	Cyclohexane	420,000 gal.	Int. Floating Roof	1.0 tons yr.
1013	Cyclohexane	420,000 gal.	Int. Floating Roof	1.0 tons yr.
2510	Cyclohexane	1,050,000 gal.	Int. Floating Roof	1.0 tons yr.
251	Cyclohexane	105,000 gal.	Int. Floating Roof	0.0 tons yr.
252	Cyclohexane	105,000 gal.	Int. Floating Roof	0.0 tons yr.
253	Cyclohexane	105,000 gal.	Int. Floating Roof	0.0 tons yr.
1522	Cyclohexane	630,000 gal.	Int. Floating Roof	1.0 tons yr.
2553	Cyclohexane	1,050,000 gal.	Int. Floating Roof	1.0 tons yr.

OTHER SOURCES

<u>Process ID.#</u>	<u>Name</u>	<u>Process Product</u>	<u>VOC Emissions</u>
P-2-1	NGL Heavy Ends Fract.	Cyclo. (85%)	58 ton/yr
P-6	Hexane Isomerization	Cyclo. (85%)	58 ton/yr

Emission Point #'s are numerous but in most cases are flared.

3. Puerto Rico Core

TANKAGE

<u>Source #</u>	<u>Material Stored</u>	<u>Tank Capacity</u>	<u>Vapor Control</u>	<u>HC Emissions</u>
200	Cyclohexane	1,946,952 gal.	Int. Floating Roof	2.4 tons/yr
300	Cyclohexane	150,570 gal.	Int. Floating Roof	.55 tons/yr
310	Cyclohexane	150,612 gal.	Int. Floating Roof	.55 tons/yr
320	Cyclohexane	150,612 gal.	Int. Floating Roof	.55 tons/yr
330	Cyclohexane	150,612 gal.	Int. Floating Roof	.55 tons/yr
340	Cyclohexane	2,965,452 gal.	Int. Floating Roof	8.2 tons/yr

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