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2235598

March 24, 2011

Katherine Moore
Section Chief - Superfund
Case Development and Cost Recovery
U.S. Environmental Protection Agency, Region 9
75 Hawthorne Street
Mail Code: SFD-7-5
San Francisco, CA 94105
moore.kathi@epa.gov

Lynda Deschambault
Remedial Project Manager
U.S. Environmental Protection Agency, Region 9
75 Hawthorne Street
San Francisco, CA 94105
deschambault.lynda@epa.gov

Re: Likely Error in Omega Chemical Corporation Superfund Site
Remedial Investigation Report – Site A

Dear Ms. Deschambault and Ms. Moore:

I am a senior hydrogeologist with the environmental consulting firm of Dudek. Dudek was recently retained by Palmtree Acquisition Corporation (Palmtree), the sole general partner of a limited partnership which is the successor to Catellus Development Corporation (Catellus). Catellus was one of the former owners of an area of real property at 12128 Burke Street in Santa Fe Springs, California (the Property). The Property is labeled as "**Site A**" in U.S. Environmental Protection Agency's August 2010 Final Remedial Investigation Report (RI) prepared by CH2MHill for Operable Unit 2 of the Omega Chemical Corporation Superfund Site. Site A was the location of a former Nu-Car Prep facility operated by Chrysler Corporation from 1968 through 1988.

In the course of conducting a thorough review of the hydrogeologic and chemical aspects of the groundwater-affected area downgradient of the Omega Chemical site that USEPA calls "Operable Unit 2", and comparing that to Site A, we noticed something in the RI report that appears to be an administrative error. While we are preparing a detailed analysis of some broader issues, we wanted to bring this apparent error to your attention quickly. Because the error concerns what USEPA terms as "sources of

contamination", the error affects Palmtree. We request correction of the error through amendment of a table in the RI, or through supplemental documents.

Specifically, the apparent error is on Table 6-4 appended to the RI after page 6-20 of the text. Table 6-4 is labeled "Summary of Sources of Contamination/Omega Chemical Superfund Site". The table sets out a list of 22 facilities or properties, with their associated "main contaminants". For the "Nu-Car Prep Systems" facility on Slauson Avenue (which encompasses Site A), the table lists ***four*** chemicals: PCE, TCE, Freon-113, and 1,1-DCE. Without addressing the accuracy of the listing of the other chemicals, we strongly believe that CH2MHill's inclusion of Freon-113 on this list is an administrative error, for the reasons stated below.

First, CH2MHill's detailed summary of chemical use and releases from "Chlorinated VOC Source Areas" is contained in Section 5.5.1 of the RI. Site A is one of eight properties listed as a VOC source area, at Section 5.5.1.7. on page 5-18. Yet while the detailed written summary for Site A references a number of chemicals, Freon-113 is notably absent (Freon 11 is mentioned as being found in groundwater wells).

Second, the ultimate conclusion of Section 5.5.1.7, after the detailed written summary, is that:

> The contamination in soil and the elevated concentration of PCE, TCE and 1,1-DCE suggest that Site A is a source of groundwater contamination by these compounds. [pages 5-19]

Again, Freon-113 is not mentioned.

Third, in addition to the fact that CH2MHill did not identify Freon-113 in its Site A summary, the available site information (environmental assessments that include an employee interview[1] and discussions of past chemical usage[2]) do not indicate that Freon-113 was used at the Site A Chrysler facility.

The automobile preparation activities described for Site A in Section 5.5.1.7 of the RI included "painting, tune-up, cleaning and waxing, body work, and car washing." Freon-113 would not have been used in such activities.

The primary use of Freon-113 was as a cleaning solvent[3] with applications in the electronics industry where it has been used to clean solder flux on circuit boards[4]. Freon-113 costs 6 to 7 times more than PCE or other solvent cleaners on a volumetric basis[5]. Cleaning circuit boards called for the unique physical properties of Freon-113 (e.g., boiling point, apolarity, chemical stability, ability to remove solder flux and other circuit board residues) and warranted the higher cost of Freon-113. Since operations at

the Site A Chrysler facility did not include circuit board cleaning, it is logical to conclude that Freon-113 would not have been used as a cleaning solvent at Site A.

Additionally, Freon-113 would not have been used in cars as a refrigerant. Although Freon-113 was originally formulated as a refrigerant, blowing agent, and aerosol propellant (as were other CFCs formulated during the same time period, Freon-11 (trichlorofluoromethane) and Freon-12 (dichlorodifluoromethane, R-12)), Freon-12 was the predominant CFC used as a refrigerant in automobile air conditioning systems[6,7] prior to the implementation of regulation set forth by the Montreal Protocol to protect the stratospheric ozone layer[8,9]. In accordance with this regulation, Freon-12 was slowly phased-out and replaced with hydrogen-substituted CFCs such as R-22 (chlorodifluoromethane)[8,9]. Hence, automobiles being prepped by Chrysler at Site A would have contained Freon-12, not Freon-113.

For these reasons, Dudek, on behalf of Palmtree, requests that USEPA correct this apparent administrative error by deleting the reference to Freon-113 on Table 6-4.

Sincerely,
**DUDEK**

Peter Quinlan, R.G.

References


1. McLaren Environmental Engineering (1989) *Property Transaction Environmental Assessment of Chrysler Land*, pp. 1, 8, 12. Prepared for Santa Fe Pacific Realty Corporation, January 11, 1989.

2. McLaren Environmental Engineering (1990) *Property Assessment*, p. 9. Prepared for Santa Fe Pacific Realty, April 27, 1990.

3. USEPA (1994). *Chemical Summary for Freon-113*, p. 2. Prepared by the Office of Pollution Prevention and Toxics, U.S. Environmental Protection Agency, Washington, DC August 1994. EPA 749-F-94-012a.

4. ICOLP Technical Committee (1991) Conservation and Recycling Practices for CFC-113 and Methyl Chloroform. International Cooperative for Ozone Layer Protection and U.S. Environmental Protection Agency, p. 37. (May 1991).

5. Fisher Scientific (2011) http://www.fishersci.com, accessed March 15, 2011

6. Jung, D. Park, B. and Hyunchul, L. (1999) Evaluation of supplementary/retrofit refrigerants for automobile air-conditioners charged with CFC12, p. 2. *International Journal of Refrigeration* 22, 558-568

7. USEPA (2010) *Auto Air Conditioners and the Ozone Layer: Background* (http://www.epa.gov/ozone/title6/609/consumers/cons2.html, accessed March 16, 2011)

8. USEPA (2007a) Montreal Protocol Regulatory Summary, The 20th Anniversary of the Montreal Protocol on Substances that Deplete the Ozone Layer. (http://www.epa.gov/ozone/downloads/MP20_Reg_Summary.pdf, accessed March 16, 2011)

9. USEPA (2007b) Montreal Protocol Backgrounder, The 20th Anniversary of the Montreal Protocol—A Landmark Environmental Treaty. (http://www.epa.gov/ozone/downloads/MP20_Backgrounder.pdf, accessed March 15, 2011)

# APPENDIX A-REFERENCES

SDMS DOCID# 2181744

# PROPERTY TRANSACTION ENVIRONMENTAL ASSESSMENT OF CHRYSLER LAND 12140 SLAUSON SANTA FE SPRINGS, CALIFORNIA CA037120 FOR SANTA FE PACIFIC REALTY CORPORATION

JANUARY 11, 1989

McLaren Environmental Engineering

CHRYSLER LAND
12140 Slauson
Santa Fe Springs, CA

**Site Description**

Until March 1988, the vacant, 40-acre property located at 12140 Slauson in Santa Fe Springs was operated by Chrysler Corporation as the New Car Preparation Incorporated facility. The facility consists of 17 buildings, the majority of which are open sided, metal framed sheds, and open asphalt areas. The Chrysler site is bounded by light industry to the north and west, light industry and retail stores to the east, and a storm drain canal, railroad and auto facility to the south.

According to Chrysler employees, the site was vacant land until the early 1960's when General Motors began car preparation operations at the site as Dallas Smith Service Corporation. In 1967, Chrysler began using the facility for similar operations under the name of Automotive Precheck. In 1973, the name was changed to New Car Preparation System, Incorporated (Nu Car Prep). Car preparation operations formerly conducted at the site include body work, mechanical work, tune-up, front-end alignment, emissions control testing, painting, washing, detailing, and road performance tests.

**Site Inspection**

McLaren Engineering conducted a preliminary site walk on March 29, 1988 with representatives of Santa Fe Pacific Realty and Chrysler Corporation. A site inspection was then performed by McLaren Engineering on April 20, 1988. On both occasions, Mr. Jim Parker, operations manager for Chrysler Corporation, was available to answer questions and explain past practices at the facility. Figure 1 depicts the property layout and pertinent features discussed below.

According to Mr. Parker, Chrysler has removed all underground tanks and clarifiers known to exist on the property. These include three 10,000-gallon fuel tanks, six 3,000-gallon fuel tanks, and five 550-gallon waste tanks and clarifiers as shown on Figure 63. In addition, 14 hydraulic hoists, 8 service pits, and a carwash basement have been removed by Chrysler.

The majority of the buildings on the site were constructed in the 1960's and early 1970's. During this time period, buildings were frequently constructed with asbestos containing materials. Hanging light ballasts found in both enclosed and open sided buildings may contain Polychlorinated biphenals (PCB's).

A 1988 aerial photograph and various historical blueprints/plot plans dating back to 1963 were obtained from SFPR. These materials were reviewed for facility development patterns, building operations, and locations of underground tanks, pits, clarifiers, paint booths and other features associated with those operations. Particular attention was given to the consistency between information shown on the plans and that reported by Chrysler Corporation.

One drawing showed the facility buildings and the sewer and storm drain system alignment dated July 7, 1973. This particular drawing also indicated that a fuel island and storage shed were located about 50 feet and 20 feet, respectively, from the southern boundary, in the southwest corner of the property. This area was reinspected for any surficial evidence or fill pipe that would indicate a fuel island once existed at this location. Observations revealed a 22 foot by 28 foot delineated area of darker colored asphalt, approximately 25 feet from the southern fence. No fill pipe was found. The location of the darkened asphalt area corresponds more closely with the shed location, as depicted on the drawing.

Mr. Parker who had been with the company at this facility since 1976 was questioned about these findings. He recalls no fuel island ever having existing at the depicted location on the plan. However, he did recall that four to five years ago this approximate area was used to dump trash (i.e., rocks and debris) for the sweeper to collect. The area was asphalted six to eight months ago, which may explain the darker color.

As shown on Figure 1, and discussed above, two concrete service pits from the Front End Building and four service pits from the Tune-Up Building were removed in March, 1988. One Front End Building pit was previously used for undercoating cars and the second pit was used for an alignment machine. Reportedly, the four tune-up concrete pits arranged in tandom were used only six months. According to Colorado Pacific Constructors, Incorporated, (CPC) who were contracted by Chrysler Corporation, all pits were removed as a safety precaution and therefore the excavations were not tested for contamination. According to Mr. David Pond of CPC, the pits were washed out with water and the rinsewater was pumped into tanks for recycling. There is no record of the concrete disposal destination.

The carwash basement, (Figure 1), was removed along with the six service pits. Mr. Parker expressed concern that this basement had collected a large quantity of oil sludge over the years. CPC stated that based on visual inspection at the time of removal, contamination was determined to be of no concern. As with the pits, removal of the

The submittal of the tank removal permits and hazardous material storage permits by Nu Car Prep in 1985 and 1986 resulted from an inspection by DHS of the Nu Car Prep facility on July 12, 1985. In addition to permitting the underground storage tanks, Nu Car Prep was ordered to immediately discontinue the disposal of hazardous waste (paint residue) into a nearby storm drain. DHS files do not indicate what steps were implemented to discontinue the disposal of paint sludge into the storm drain.

Additional items of concern in the field notes compiled by DHS for the Nu Car Prep site are listed below:

- Chlorinated hydrocarbons (trichloroethylene and perchloroethylene) are used at the site;
- A 550-gallon waste oil sump was located at the site. Field notes indicate the sump's contents are disposed of by a registered disposal firm;
- A three stage 750-gallon clarifier and an eight stage 1,250-gallon clarifier were located in the carwash on the site;
- Three paint booths were located at the site; and
- Numerous 55-gallon drums containing oils and solvents were located at the site.

Except for the waste oil sump's contents, the field notes do not indicate how the remaining hazardous materials were stored or disposed.

The DHS file also provided a record of Material Safety Data Sheets for detergents, degreasers, emulsifiers, hydrocarbons, and butyl alcohol which were used in Nu Car Prep operations.

South Coast Air Quality Management District (SCAQMD)

The SCAQMD file indicated that the Chrysler Nu Car Prep facility had two gasoline storage permits, one permit for the use of distillation - recoverable solvents, permits for four spray booths, two applications for spray paints, and one application for distillation solvents.

Regional Water Quality Control Board (RWQCB)

Review of the waste discharge permits and the list of leaking underground tanks provided by the RWQCB - Los Angeles Region indicated no records are associated with the Chrysler Nu Car Prep facility.

SDMS DOCID# 2182374

Santa Fe Pacific Realty
Property Assessment
Prepared by McLaren

CA0370120
Chrysler, 12140 Slauson
Santa Fe Springs, California

April 27, 1990

## Executive Summary

This summary report was prepared on behalf of Brobeck, Phleger, and Harrison and was performed in accordance with our Scope of Work dated October 19, 1989, as clarified in the November 17, 1989 letter from Robert D. Wyatt to Douglas Jones. The tasks were performed in a manner consistent with standard engineering practices. This report is a summary of pertinent information contained in the January 1989 Environmental Assessment Report prepared by McLaren for this property.

The property consists of 40 acres located at 12140 Slauson, Santa Fe Springs, California. At the time of the environmental assessment the property was occupied by Chrysler Corporation and used for car preparation operations, including body and mechanical work, emissions control testing, painting, washing and detailing. The property is currently leased by Atoyan and General Telephone Company of California.

McLaren

Site Name: Chrysler, 12140 Slauson
Parcel #: CA0370120

SITE CHECKLIST (Continued)

UNDERGROUND TANKS/SUMPS (Continued)

CECC collected and analyzed soil samples in March 1989 from eight borings placed in the vicinity of the former tank, pit, and clarifier locations and drilled to a depth of 20 feet. According to the CECC report, results showed less than detectable concentrations of hydrocarbons. Soil samples from a single borehole where chrysler degreasing and cleaning operations were previously located were analyzed for halogenated solvents. Perchloroethylene (PCE) was detected at concentrations of 570 and 55 parts per billion at five and ten feet below grade, respectively. CECC does not expect the low concentrations to present a threat to groundwater.

HAZARDOUS MATERIALS

Chemicals/Quantity/Usage: Unused oils and waste oils from car maintenance operations, acrylic and enamel paints for spray paint operations, detergents and flammable solvents, chlorinated hydrocarbons including trichloroethylene and perchloroethylene used for degreasing and car wash operations. Additional materials include butyl alcohol and emulsifiers.

Storage: Primarily in underground storage tanks (oils) and 55-gallon drums and five-gallon buckets (solvents, paints, and oils).

Disposal: Not documented.

Spills: Oily sludge staining at carwash conveyor belt trench area and excessive oily liquid staining at south end of detail building and at base of hydraulic system in car wash area.

TRANSFORMERS

Transformers on-site?: Yes

No. Liquid: No. Dry: 3 PCB Markings: None documented

PCB: Dry transformers do not contain PCB's.

I.D. Number: None documented

Leakage: None documented

EPA 749-F-94-012a

# CHEMICAL SUMMARY FOR FREON 113

prepared by
OFFICE OF POLLUTION PREVENTION AND TOXICS
U.S. ENVIRONMENTAL PROTECTION AGENCY
August 1994

This summary is based on information retrieved from a systematic search limited to secondary sources (see Appendix A). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of freon 113 are summarized in Table 1.

TABLE 1. CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF FREON 113

| Characteristic/Property | Data | Reference |
|---|---|---|
| CAS No. | 76-13-1 | |
| Common Synonyms | CFC-113; UCON-113; 1,1,2-trichloro-1,2,2-trifluoroethane | HSDB 1994 |
| Molecular Formula | C2Cl3F3 | |
| Chemical Structure | Cl F<br>\| \|<br>F - C - C - Cl<br>\| \|<br>Cl F | |
| Physical State | colorless liquid | Verschueren 1983 |
| Molecular Weight | 187.38 | Verschueren 1983 |
| Melting Point | -35øC | Verschueren 1983 |
| Boiling Point | 48øC | Verschueren 1983 |
| Water Solubility | 170 mg/L | CHEMFATE 1994 |
| Density | 1.5635 at 25øC | HSDB 1994 |
| Vapor Density (air = 1) | 6.5 | Verschueren 1983 |
| KOC | 372 | CHEMFATE 1994 |
| Log KOW | 1.66 | HSDB 1994 |
| Vapor Pressure | 284 mm Hg at 20øC | HSDB 1994 |
| Reactivity | | |
| Flash Point | nonflammable | HSDB 1994 |
| Henry's Law Constant | 5.3 x 10-1 atm m3/mol | HSDB 1994 |
| Fish Bioconcentration Factor | 10 to 30 (estimated) | HSDB 1994 |
| Odor Threshold | 135 ppm (in air) | Verschueren 1983 |
| Conversion Factors | 1 ppm = 7.79 mg/m3 | |
| | 1 mg/m3 = 0.13 ppm | Verschueren 1983 |

## II. PRODUCTION, USE, AND TRENDS

### A. Production

Freon 113, also called trichlorotrifluoroethane or CFC-113, is produced in the U.S. by 2 companies. Table 2 lists producers, plant locations, and plant capacities. Annual capacity is estimated to be 300 million pounds, though production was limited to 177 million pounds in 1993 (Mannsville 1993).

### B. Use

Freon 113 is used primarily as a chlorofluorocarbon (CFC) cleaning solvent. It also has applications as a refrigerant in commercial/industrial air conditioning and industrial process cooling; as a chemical intermediate in the manufacture of high-temperature lubricants; as a foaming or blowing agent; as an intermediate in the manufacture of fluorocarbon resins; and as a solvent or active ingredient in aerosol formulations.

### C. Trends

A ban of the production of CFCs is scheduled to take effect at the end of 1995. One freon 113 producer DuPont has announced plans to cease production of CFCs by the end of 1994.

TABLE 2. U.S. PRODUCERS OF FREON 113

| Company | Plant Location | Plant Capacity (Allowance) (in millions of pounds) |
|---|---|---|
| Allied-Signal | Baton Rouge, LA | 100(48) |
| DuPont | Corpus Christi, TX | 200(129) |

Source: Mannsville 1993.

## III. ENVIRONMENTAL FATE

### A. Environmental Release

Greater than 99% of the 24.6 million pounds of freon 113 released in 1992, was into the atmosphere (TRI92 1994). Only 1916 pounds and 9028 pounds were released to surface and ground waters combined and to land, respectively (TRI92 1994). Due to the high volatility of the chemical, the small amount released to land or ground or surface waters would be expected to enter the atmosphere quickly. Once in the atmosphere, freon 113 diffuses from the troposphere into the stratosphere (U.S. EPA 1983; HSDB 1994). Between 1973 and 1980, freon 113 concentrations in rural and urban areas of the U.S. ranged from 28 ppt to 220 ppt, respectively (HSDB 1994).

### B. Transport

Freon 113's water solubility and vapor pressure indicate rapid volatilization to the atmosphere from surface waters. An estimated half-life for freon 113 in a model river is 4 hours

# Conservation and Recycling Practices for CFC-113 and Methyl Chloroform

**Final Draft**

**May 1991**

# CONSERVATION AND RECYCLING PRACTICES FOR CFC-113 AND METHYL CHLOROFORM

by


## ICOLP Technical Committee*

**John Thome (Chairman)**
**Ray Allen**
**Jonathon Andell**
**Kenneth Beach**
**David Hey**
**Stewart Holm**
**Jim Landers**
**Dara O'Rourke**
**Robert Ramsey**
**Bill Richardson**
**Farzan Riza**
**Richard Szymanowski**
**Peter Thorstensen**

**Stephen O. Andersen**
**U.S. Environmental Protection Agency**


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* ICOLP is the International Cooperative for Ozone Layer Protection. ICOLP corporate member companies include AT&T, Boeing Company, British Aerospace, Compaq Computer Corporation, Digital Equipment Corporation, Ford Motor Company, General Electric, Hitachi Limited, Honeywell, IBM, Matsushita Electric Industrial Company, Mitsubishi Electric Corporation, Motorola, Northern Telecom, Sundstrand, Texas Instruments, and Toshiba Corporation. Industry association affiliates include American Electronics Association, Electronic Industries Association, Japan Electrical Manufacturers Association, and the Halogenated Solvents Industry Alliance (U.S.). Government organization affiliates include the City of Irvine, California, the State Institute of Applied Chemistry (U.S.S.R.), the Swedish National Environmental Protection Agency, U.S. Air Force, and U.S. Environmental Protection Agency (EPA).


John Thome, Ray Allen, Jonathon Andell, and Jim Landers are employed by Motorola; Kenneth Beach is employed by Honeywell; David Hey is employed by ICI (UK); Stewart Holm is employed by the Halogenated Solvents Industry Alliance; Dara O'Rourke and Farzan Riza are employed by ICF Incorporated; Bill Richardson is employed by Digital Equipment Corporation; Robert Ramsey is employed by DuPont de Nemours & Co.; Richard Szymanowski is employed by Northern Telecom; and Peter Thorstensen is employed by Manchester Corporation. We would like to thank the many individuals and companies that provided insight and information that helped produce this manual. This manual was funded by the U.S. EPA and ICOLP.

# In-Line Cleaning Practices

## *Process Description*

In-line cleaning systems (also referred to as conveyorized cleaners) transport the work through the machine on an automated continuous basis. Most of the in-line cleaners that use halogenated solvents are vapor cleaners. In-line cleaners are used in many different industrial applications. However, they are most common in processes where production volumes are large enough to justify the higher capital costs of such equipment.

Except for the parts/conveyor inlet and exit openings, in-line cleaners are usually enclosed. Although this helps to control solvent losses from the system, it does not eliminate them. Most in-line systems have significant emission. In-line cleaning systems are usually custom made for an application.

There are five main types of in-line cleaning systems that use CFC-113 and MCF: cross-rod, monorail, belt, strip, and printed circuit board processing equipment. These systems differ in their methods of loading and unloading parts and in their methods of transporting materials through the cleaning process. Systems are chosen based on the needs of the manufacturing process, including the type of part to be cleaned, type of cleaning required, and speed and space requirements. Exhibit 13 shows one type of in-line cleaning system.

## *Convection*

Excessive air currents around in-line solvent cleaners disturb the vapor blanket within the equipment which causes solvent losses. When excessive air movement is a problem, remove the source or install baffles or partitions on the windward side to divert the draft away from the cleaning unit.

In applications in the electronics industry, solvent cleaning units are often placed immediately following wave solder machines. This reduces the cooling time before cleaning. If the boards are entering the cleaner at a temperature greater than the vapor temperature, the heat will be transferred to the vapor and liquid solvent. This results in an additional heat load which may exceed the condenser's heat adsorption capabilities, resulting in vapor discharge or machine shutdown by the vapor safety thermostat.

Mounting small fans above and below the conveyor to cool the boards before they enter the cleaning machine is one solution to the problem. To prevent disturbing the vapor blanket within the machine, which could result in increased solvent loss, fans should be directed away from the openings of the equipment.

You may wish to consider a number of enhancements to the solvent cleaner. These are hardware add-ons or modifications that require capital expenditures and are not part of the machine optimization aspects previously described.

System enhancements include:

- Increased freeboard height
- Increased cooling system compressor capacity
- Additional cooling coils on inlets and outlets.

Cleaner manufacturers and experts in chilling/refrigeration should be consulted for their expertise. Consider reviewing the condensing effectiveness of your chiller/refrigeration system with the assistance of a knowledgeable contractor. Improved condensing efficiency through additional cooling coils at the entrance and exit of the wash and perhaps through compressor resizing will reduce evaporative and dragout solvent losses. Keep in mind that refrigerant changes can result in losses of other CFCs.

Use gas detectors to give accurate information on the location of emissions and to determine how effective your efforts are.

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## AQUA SOLUTIONSFREON 113 1 LTR

*Fisher Scientific offers many products that do not appear in our catalogs. This may be one of those products, so pictures and detailed descriptions are not available. However, you may be able to order it by adding it to your shopping cart.*

### Item

| Description | Catalog Number | Quantity | Price |
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| FREON 113 1 LTR | NC9207770<br>No.:T8201-1LTR | | Each for $297.12 |

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## Tetrachloroethylene 99%, Acros Organics > 1L

ACROS ORGANICS

**Tetrachloroethylene**

**99%**

**99%**

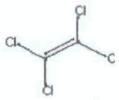
Perchloroethylene

$C_2Cl_4$

$Cl_2C{=}CCl_2$

F.W.165.83

[127-18-4]



### Items Physical Properties

| Description | Catalog Number | Quantity | Price |
|---|---|---|---|
| 1L MSDS | AC13801-0010 Acros Organics No.:138010010 | | Each for $43.86<br>Case of 4 EA for $170.34 |

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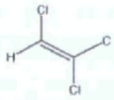
## Trichloroethylene, Stabilized 99+%, Acros Organics > 4x1L, EcoSafPak

ACROS ORGANICS

**Trichloroethylene**
**99+%**
**99+%**
$C_2HCl_3$
$ClCH=CCl_2$
F.W.131.39
*[79-01-6]*




Items | Physical Properties | Safety and Handling

| Description | Catalog Number | Quantity | Price |
|---|---|---|---|
| 4x1L, EcoSafPak MSDS | AC15831-0010 Acros Organics No.:158310010 | | Each for $55.83<br>Case of 4 EA for $184.28 |

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International Journal of Refrigeration 22 (1999) 558–568

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# Evaluation of supplementary/retrofit refrigerants for automobile air-conditioners charged with CFC12

Dongsoo Jung*,[1], Bongjin Park, Hyunchul Lee

*Department of Mechanical Engineering, Inha University, Inchon, South Korea 402-751*

Received 9 December 1998; received in revised form 7 April 1999; accepted 9 April 1999

**Abstract**

In this study, thermodynamic performance of supplementary/retrofit refrigerant mixtures for CFC12 used in existing automobile air-conditioners was examined. A thermodynamic computer analysis of an automobile air-conditioner was carried out for the initial screening of possible mixture candidates, and refrigerant mixtures composed of HCFC22, HFC134a, HCFC142b, RE170 (dimethylether), HC290 (propane), and HC600a (iso-butane) were proposed to supplement CFC12. Also a breadboard type refrigeration test facility was manufactured to verify the performance of the alternative refrigerant mixtures proposed through the computer analysis. Test results showed that HFC134a/RE170 mixture with zero ozone depletion potential is the best long term candidate to supplement CFC12. On the other hand, HCFC22/HFC134a/RE170 and HCFC22/HFC134a/HCFC142b mixtures are good only as short term supplementary/retrofit alternatives since they contain HCFC22. A hydrocarbon mixture of HC290/HC600a showed a good performance but its use in existing automobile air-conditioners should be carefully considered due to its flammability. © 1999 Elsevier Science Ltd and IIR. All rights reserved.

*Keywords:* Air conditioning; Automobile; Refrigerant; R22; R134a; R142b; Dimethylether; Propane; Isobutane

# Evaluation des frigorigènes supplémentaires/de remplacement pour des systèmes de conditionnement d'air automobiles utilisant du CFC12

**Résumé**

*Dans cette étude, les performance thermodynamiques de mélanges de frigorigènes supplémentaires / de remplacement de CFC12 dans des systèmes de conditionnement d'air automobile existants ont été examinés. On a effectué l'analyse thermodynamique d'un conditionneur d'air automobile utilisant une méthode informatique afin d'identifier des mélanges de frigorigènes ayant des caractéristiques recherchées. On a proposé des mélanges de frigorigènes composés de HCFC22, HFC134a, HCFC142b, RE170 (diméthyléther), HC290 (propane) et HC600a (isobutane) comme frigorigènes supplémentaires (en plus de CFC12). Une maquette d'une installation frigorifique a été construite afin de vérifier (par des moyens informatiques) la performance des mélanges de frigorigènes de remplacement proposés. Les résultats ont montré que le mélange de HFC134a/RE170 (qui n'a aucun effet nocif sur l'ozone stratosphérique) est le meilleur candidat pour remplacer le CFC12. Cependant, on a montré que les mélanges HCFC22/HFC134a/RE170 et HCFC22/HFC134a/*

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*HCFC142b représentent une solution supplémentaire / de remplacement provisoire puisq'ils contiennent du HCFC22 ; un mélange d'hydrocarbures (HC290/HC600a) a été performant mais son inflammabilité rend son utilisation dans les systèmes de conditionnement d'air automobile précaire. Cette utilisation doit être assortie de précautions.* © 1999 Elsevier Science Ltd and IIR. All rights reserved.

*Mots clés:* Conditionnement d'air; Automobile; Frigorigène; R22; R134a; R142b; DME; Propane; Isobutane

**Nomenclature**

| | |
|---|---|
| $A$ | heat transfer area ($m^2$) |
| GTD | gliding temperature difference (K) |
| GWP | greenhouse warming potential |
| HTF | heat transfer fluid |
| LMTD | log mean temperature difference. (°C) |
| NARM | nonazeotropic refrigerant mixture |
| ODP | ozone depletion potential |
| $P$ | pressure (kPa) |
| $PR$ | pressure ratio |
| $\Delta P$ | pressure drop (kPa) |
| $Q$ | heat transfer rate or refrigeration capacity. (W) |
| $s$ | entropy of the refrigerant (kJ $kg^{-1}$ $K^{-1}$) |
| $T$ | temperature of the refrigerant (K or °C) |
| TS | temperature of HTF. (K or °C) |
| $U$ | overall heat transfer coefficient. (W $m^{-2}$ $K^{-1}$) |
| VC | volumetric capacity (kJ $m^{-3}$) |
| $\dot{v}$ | volumetric flow rate of air ($m^3$ $s^{-1}$) |

*Greek symbols*

| | |
|---|---|
| $\varepsilon$ | SLHX effectiveness |
| $\eta$ | estimated actual compressor efficiency |
| $\xi$ | isentropic compressor efficiency |

*Subscripts*

| | |
|---|---|
| amb | ambient |
| C | condenser |
| comp | compressor |
| dis | compressor discharge |
| E | evaporator |

## 1. Introduction

For the past few decades, CFCs have been extensively used in refrigeration and air-conditioning fields due to their excellent thermodynamic and chemical characteristics. In 1974, however, Molina and Rowland suggested that CFCs might be responsible for the destruction of the stratospheric ozone layer [1] and since then much efforts were expended to examine if their suggestion was correct. Consequently in 1987, many nations signed the Montreal Protocol to regulate the production and trade of ozone depleting substances, realizing that ozone layer-depletion is a global environmental issue [2]. As a result of this international agreement, CFCs are completely phased out as of January 1996 in the developed countries while they are allowed for further use for another 10 years in the developing countries.

For automobile air-conditioners, CFC12 has been used predominantly until the advent of the Montreal Protocol. CFC12 is a well performing refrigerant with a normal boiling point and molecular weight of −29.79°C and 120.93 kg/kmol, respectively. It, however, has a high ozone depletion potential (ODP) of 0.9 and has been classified as Class I material for the complete phase-out by the Montreal protocol.

In order to fill the gap caused by the phase-out of CFC12, refrigeration and air-conditioning industry has carried out extensive research and development activities to find alternative pure refrigerants without ODP. With these efforts HFC134a has been successfully developed, which has a similar vapor pressure and performance to those of CFC12 and hence has been adopted in new automobile air-conditioners for the past few years.

In many countries, however, the supply of CFC12 is not sufficient for the supplementary/retrofit use in existing automobile air-conditioners originally charged with CFC12 [3–5]. As well known, automobile air-conditioners are often equipped with flexible hoses to absorb the vibration from the body and hence the charged refrigerant leaks through these hoses as well as some other parts such as the compressor rotating shaft etc. Therefore, it is necessary to supplement the refrigerant once in a while.

As time progresses, the use of CFC12 is more difficult and restricted and hence the need for the supplementary/retrofit refrigerants for CFC12 in existing automobile air-conditioners increases rapidly. If HFC134a is used for CFC12 in the existing units, many components including possibly the compressor have to be replaced, which would be too costly for the consumers.

Ozone Layer Protection - Regulatory Programs



# Auto Air Conditioners and the Ozone Layer: Background

This information was developed to help you - the owner of an air conditioned car or truck - understand how efforts to protect the ozone layer will affect you and your vehicle now and in the future. Another fact sheet explains the science of ozone depletion in greater detail.

## Our Threatened Ozone Layer

Scientists worldwide have concluded that chlorofluorocarbons (CFCs, also known by the trade name Freon) deplete the ozone layer. CFCs have been used in the manufacturing of many products, such as foam insulation, electronics equipment, refrigerators and air conditioners. When allowed to escape, these chemicals drift some 30 miles above the Earth to the stratospheric ozone layer - a layer of gas that screens us from the sun's powerful ultraviolet (UV-B) radiation. Once there, CFCs break apart - a process that releases chlorine, which then attacks ozone. A single chlorine atom can destroy more than 100,000 ozone molecules.

The ozone layer is being depleted over Antarctica (the so-called Antarctic ozone hole), but also to a much lesser extent over North America, Europe, and other populated areas. A depleted ozone layer allows more UV-B radiation to reach Earth, harming human, animal, and plant life in many ways. Scientists around the world agree that increased UV-B radiation could over the long run cause a rise in cases of skin cancer and cataracts. Also, increased radiation could damage important food crops and marine ecosystems.

## Protecting the Ozone Layer

The United States and over 190 other countries are working together to protect the ozone layer by phasing out the production of ozone-depleting substances in developed countries by the end of 1995. In addition, the Clean Air Act of 1990 contains requirements that ban the release of refrigerants during the service, maintenance, and disposal of air conditioning and refrigeration equipment and for labeling of products that are manufactured with or contain CFCs. Shops are required by law to use approved recover or recycling equipment when servicing air conditioning systems. Also, the technicians must be certified in the proper use of the equipment.

You can help save the ozone layer by getting professional vehicle service at a shop that uses recycling equipment and by having leaking systems repaired. Recycling and leak repair helps to conserve CFCs and limits the release of the chemicals to the environment.

All automakers are responding to the CFC production phaseout by beginning to produce vehicles with an alternative refrigerant called HFC-134a. This refrigerant does not deplete the ozone layer because it does not contain chlorine. By the end of 1994, virtually all new cars, trucks and vans were equipped with HFC-134a air conditioning systems.

## How does the CFC Phaseout affect your vehicle?

All but the newest designs of vehicle air conditioners use CFC-12 as a cooling agent. CFC-12 is one of the chemicals known to destroy the ozone layer - our planet's protection against harmful rays from the sun. The phaseout of the substance means that production will stop, but it does not mean that you have to stop using or having your air conditioner serviced with CFC-12. The first important step for all vehicle owners with CFC-12 air conditioners involves reducing unnecessary loss of refrigerant. Preventive maintenance, fixing leaks, and recycling at service are key actions to minimize the need for additional refrigerant after the phase-out of production at the end of 1995.

But many vehicles with CFC-12 air conditioners may require service past that date. What choices will these vehicle owners have? For vehicles under warranty, please consult your dealer. For vehicles not under warranty, you have the choice to either continue to service your air conditioner with CFC-12, have the vehicle modified to use HFC-134a, or use another EPA-approved refrigerant.

Despite the halt in production of CFC-12, government and industry are developing programs cooperatively to ensure that some supply of this refrigerant will be available after 1995. While the available supply will be limited and the costs will certainly rise in the future (in part due to a federal tax on CFCs), for many vehicle owners the option of continuing to use CFC-12 may be the most attractive one.

Other owners may decide that it makes more sense to have their air conditioning units modified to accept alternative refrigerants. For example, if you are having major service performed on your CFC-12 air-conditioner, modifying the system to use HFC-134a or another refrigerant may be appropriate. A fact sheet explains the current status of all refrigerants reviewed so far.

The automobile manufacturers are working diligently to identify the required procedures for each of their models that would permit the use of HFC-134a while maintaining reliability and cooling performance. Make sure that your service center uses the manufacturer's recommended alternative refrigerant and follows their recommended procedures. Using substances that have not been thoroughly tested may cause performance and safety problems and void your warranty.

Since the complexity and the cost of modifying a CFC-12 system will vary by make and model of car, the decision to retrofit may make more sense for some vehicles than others. In many cases, retrofit of newer vehicles will require fewer changes and cost less than retrofit of older vehicles. Actual costs of modifying a system to accept an alternative may vary widely.

If you are considering the purchase of a new or used vehicle, ask if the air conditioner uses HFC-134a, and if not, find out about any applicable warranties covering air conditioning service and repair. If you are concerned that the air conditioner might need service after the warranty has expired, you may want to consider buying an "extended warranty" or service contract that covers the air conditioning service costs.

EPA and the automotive industry are working together to make the transition away from ozone-depleting chemicals as smooth as possible, but we need your support and cooperation to make this effort a success.

http://www.epa.gov/ozone/title6/609/consumers/cons2.html
Last updated on Thursday, August 19, 2010

# Montreal Protocol

## Regulatory Summary

*The 20th Anniversary of the Montreal Protocol on Substances that Deplete the Ozone Layer*

### Background

- As part of the U.S. commitment to implementing the *Montreal Protocol on Substances that Deplete the Ozone Layer*, the U.S. Congress amended the Clean Air Act (CAA) in 1990 and 1998, adding provisions to protect the stratospheric ozone layer.
- The CAA Amendments require that EPA develop and carry out regulations for the responsible management of ozone-depleting substances (ODS) in the U.S.
- Title VI of the CAA is the legal framework for U.S. compliance with the Montreal Protocol and its amendments.
- The U.S. has met or accelerated its commitments and deadlines under both the Protocol and the CAA.

**U.S. Production of First-Generation ODS Phased Out on Schedule**

| Chemical Group | Production Phaseout Dates | Deadline Met |
|---|---|---|
| Halons | January 1, 1994 | ✓ |
| Chlorofluorocarbons (CFCs) | January 1, 1996 | ✓ |
| Carbon tetrachloride | January 1, 1996 | ✓ |
| Hydrobromofluorocarbons (HBFCs) | January 1, 1996 | ✓ |
| Methyl chloroform | January 1, 1996 | ✓ |
| Chlorobromomethane | August 18, 2003 | ✓ |
| Methyl bromide | January 1, 2005 | ✓ |

**U.S. Production of Second-Generation ODS Being Phased Out on Schedule**

| Chemical Group | Production Phaseout Dates | Deadline Met |
|---|---|---|
| Hydrochlorofluoro-carbons (HCFCs) | Cut production 35 percent by January 1, 2004 | ✓ **(One year ahead of schedule)** |
| | Cut production 65 percent by January 1, 2010<br>Cut production 90 percent by January 1, 2015<br>Cut production 99.5 per-cent by January 1, 2020<br>Complete phaseout by January 1, 2030 | **On track to meet all future requirements** |

### Regulatory Program Summary

- EPA regulations address ODS in a number of ways, such as:
  - Phasing down the production and import of ODS through a flexible, market-based allowance system;
  - Ensuring proper reclamation and recycling of refrigerants and other ODS to reduce emissions;
  - Providing, through the Significant New Alternatives Policy (SNAP) program, a mechanism for identifying and approving alternatives to ODS. (Through the SNAP

Program, EPA has approved more than 300 alternatives for more than 60 industrial, commercial, and consumer end uses);

- Banning the release of ozone-depleting refrigerants during the service, maintenance, and disposal of air conditioners and other refrigeration equipment;
- Requiring that manufacturers label products either containing or made with the most harmful ODS;
- Granting exemptions allowed under the CAA for uses for which immediate full-scale alternatives are not yet available, such as:
  - Essential uses of chlorofluorocarbons (CFCs) in medical inhalers;
  - Critical uses of the fumigant methyl bromide; and
- Supporting careful management of inventories and encouraging destruction of ODS.

These positive results could not have been achieved without the collaboration of EPA's partners from all sectors of the economy.

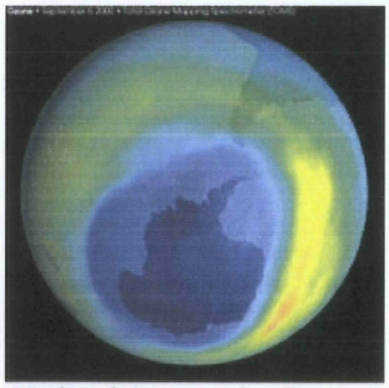
# Montreal Protocol

## Backgrounder

**The 20th Anniversary of the Montreal Protocol – A Landmark Environmental Treaty**

September 16, 2007, marks a historic milestone: the 20th anniversary of the world's most successful international environmental treaty. ***The Montreal Protocol on Substances that Deplete the Ozone Layer*** has been signed by almost every country in the world: more than 190 countries are now Parties to the treaty. Across the planet, major corporations continue to make dramatic strides replacing ozone-depleting substances (ODS) with safer substitutes, which will slow and eventually reverse the thinning of the ozone layer as well as provide important climate benefits. The 20th anniversary provides us with an opportunity to assess the progress made so far, to thank the leaders in governments, the media, industry, and in the nonprofit sector who made it possible, and to recommit ourselves to the goals of the ***Montreal Protocol*** as well as to the vibrant partnerships that will help us realize these goals as we address the challenges ahead.

In 1974, Nobel Prize-winning scientists Sherwood Rowland and Mario Molina posited that chlorofluorocarbons (CFCs) could deplete the stratospheric ozone layer. Subsequent research confirmed that commonly-used chemicals – many of them components of everyday consumer products - were destroying the ozone layer. By 1985, scientists saw a drastic thinning of the ozone layer over Antarctica, an annual phenomenon dubbed the "ozone hole." Research since then has deepened our understanding of the causes and dangerous environmental and human health consequences of ozone depletion, showing that effects appear not just at the poles, but all over the world.



Source: National Aeronautics Space Administration
*Stratospheric ozone thinning over the Antarctic, September 2000*

This is true because a thinner ozone layer allows more ultraviolet radiation to reach the Earth's surface, exposing humans and living systems to additional ultraviolet (UV) radiation. Overexposure to UV can cause a range of health effects, including skin cancer and other skin damage, eye damage leading to cataracts, suppression of the immune system, as well as ecological effects including crop damage, damage to phytoplankton, and potentially the marine food chain. Recognizing these dangers, on September 16, 1987,

world leaders signed the ***Montreal Protocol***. Since then, new scientific proofs of the urgency of ozone damage have led the world community to strengthen the treaty repeatedly.

The treaty is designed to heal the ozone layer by ending production of ODS. In 1990, Congress amended the Clean Air Act to provide a framework for implementing the ***Montreal Protocol*** in the U.S. This framework has not only ensured the U.S. has consistently met or outperformed agreed-upon treaty deadlines for ending reliance on ODS, but also included innovative mechanisms to speed ozone layer protection: adding taxes to the cost of many ODS, requiring that ODS-containing products be labeled, and creating the Significant New Alternatives Policy program, allowing manufacturers and users to identify safer alternatives.

The U.S., historically one of the largest ODS consumers, has been a leader in ending use while at the same time developing and commercializing safer substitutes. We have virtually ended production of the most damaging ODS - including CFCs, carbon tetrachloride, and halons – which were found in common industrial and consumer products such as coolants, refrigerants, aerosol cans, polystyrene cups, fire extinguishers, and packing peanuts. Second-generation replacements, such as hydrofluorochlorocarbons (HCFCs), themselves face production phase-outs, and will no longer be made in the U.S. by 2030. Developing countries are expected to complete their own phase-outs by 2040.

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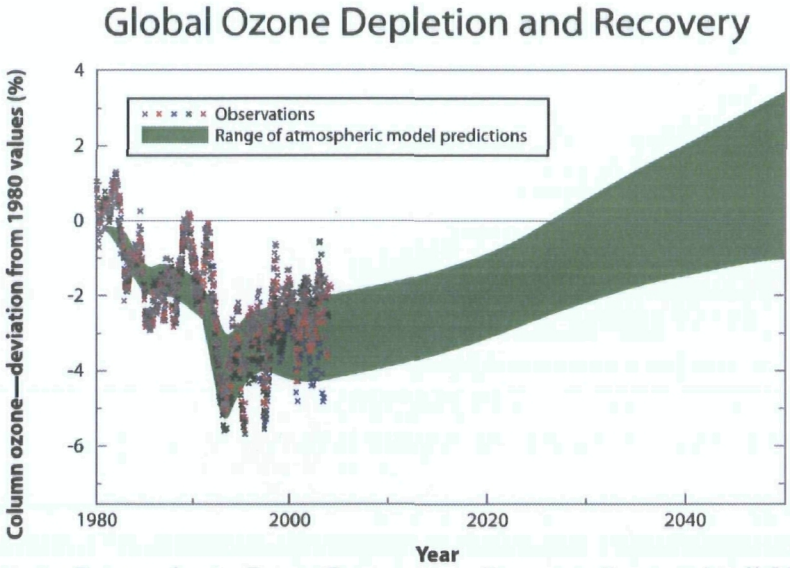
| | Cut production 65 percent by January 1, 2010<br>Cut production 90 percent by January 1, 2015<br>Cut production 99.5 percent by January 1, 2020<br>Complete phaseout by January 1, 2030 | **On track to meet all future requirements** |

Key to the success of the U.S. phase-out has been close collaboration with other Parties to the treaty, and with partners from all sectors of the U.S. economy. Many U.S. corporations have been innovative champions of ozone layer protection, sharing information and technology within industry sectors as well as with developing countries in an effort to create practical, rapid means of transition away from ODS and into safer alternatives.

**The Environmental and Public Health Benefit**

Although the stratospheric ozone layer has not yet healed, the thinning has slowed, and – assuming developed and developing countries continue to meet their ***Montreal Protocol*** goals – scientists anticipate recovery between 2060 and 2075. Efforts to protect the stratospheric ozone layer will produce an estimated $4.2 trillion in societal health benefits in the U.S. during the period from 1990 to 2165, and prevent an estimated 6.3 million premature deaths from skin cancer.




Source: EPA: *Achievements in Stratospheric Ozone Protection - Progress Report.* April 2007.

Since most ODS are also potent greenhouse gases, replacing them with ozone-safe substitutes can also reduce greenhouse gas emissions and slow climate change. Recent research has demonstrated that the climate impact of CFC, HCFC, and HFC emissions, compared to carbon dioxide emissions from fossil fuel combustion fell from about 33 percent in 1990 to about 10 percent in 2000.

As we approach the 20th anniversary, the global success of the ***Montreal Protocol*** stands out as an ever-more significant landmark of international cooperation to avert severe environmental consequences. Major challenges remain, including the final phase-outs of key chemicals that damage the ozone layer, including the agricultural fumigant methyl bromide. In all these areas, decisive leadership has been vital to U.S. contributions to the global success of the Montreal Protocol. Continuing success in completing the important agenda of future work that faces the Parties will rely just as heavily on partnerships, vision, and the willingness to make difficult decisions and implement them rigorously.