

Revised January 1989

Fact Sheet	
 The logo for the California Department of Health Services (dhs) is located in the top-left corner of the table. It features a green outline of the state of California. Overlaid on the map is a caduceus (a staff with two snakes and wings) in orange and yellow. Below the map, the letters 'dhs' are written in a large, bold, black font. Underneath 'dhs', the words 'DEPARTMENT OF HEALTH SERVICES' are written in a smaller, black, sans-serif font.	<p style="text-align: center;">Hazard Evaluation System and Information Service</p> <p style="text-align: center;">850 Marina Bay Parkway Building P, 3rd Floor Richmond, CA 94804</p> <p style="text-align: center;">(866) 282-5516</p>

Fluorocarbons

(Freons)

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Health Hazard Summary: *The most common effect of overexposure to fluorocarbons is irritation of the skin. Fluorocarbons can also affect your nervous system, causing symptoms similar to drunkenness. If used with adequate ventilation, the commonly used fluorocarbons rarely cause human health problems other than mild skin irritation.*

HOW TO FIND OUT IF YOU ARE WORKING WITH FLUOROCARBONS

"Fluorocarbon" is a general name for a class of widely used industrial solvents. Although there

are many different fluorocarbons, most of them share the same general properties. However, in order to use fluorocarbon products safely, you still need to know *which* fluorocarbon you're using. The specific chemical names for some of the most-used fluorocarbons are listed on page 3. Some of the common names and trade names for fluorocarbons in general are:

CFC	FC	Halon
Algofrene ^R	Arcton ^R	Arklone ^R
Blaco-Tron ^R	Freon ^R	Frigen ^R
Genesolv ^R	Genetron ^R	Isotron ^R
Ucon ^R		

Five fluorocarbons account for almost all fluorocarbon use: FC-12, FC-11, FC-22, FC-113 and FC-114. Some of the commonest uses are listed in the box to the right, along with the specific compounds which are most likely to be used for each purpose.

In addition, fluorocarbons are often treated as "inert ingredients" in many products such as pesticides.

Many brand name products actually contain a mixture of a fluorocarbon plus one or two other ingredients. Some of these products are listed in the box on page 2. In some cases, the other ingredients are more hazardous than the fluorocarbon.

Under the state and federal Hazard Communication Standards (California *GISO 5194* and U.S. *29 CFR 1910.1200*), your employer must tell you if you are working with any hazardous substances and must train you to use them properly.

If you think you may be exposed to hazardous chemicals at work, ask to see the Material Safety Data Sheets (MSDSs) for the products you are using. An MSDS lists the hazardous chemical contents of a product, describes its health and safety hazards, and gives methods for using, storing and disposing of it safely. The MSDS should also include information on fire and explosion hazards, reactivity, first aid, and procedures for handling leaks and spills. Your employer must have an MSDS for any workplace product that contains a hazardous substance, and must make it available to employees on request.

This Fact Sheet is an aid for worker training programs. It does not take the place of a Material Safety Data Sheet.

<u>Use</u>	<u>Fluorocarbons Most Likely to Be Used</u>
cleaning and degreasing	FC-113 or FC-11
air conditioning and refrigeration	FC-22, FC-12, or FC-11
foam blowing	FC-11
aerosol propellants	FC-12, FC-11, or (in cosmetics) FC-114
plastics manufacture	FC-12, FC-22, or FC-142b
fire extinguishers	FC-13B1 or FC-12B2

Some Products That Contain Fluorocarbons

Freon TF ^R	FC-113 (100%)
Freon TA ^R	FC-113 & acetone (89%/11%)
Freon TE ^R	FC-113 & ethanol (96%/4%)
Freon TE-35 ^R	FC-113 & ethanol (65%/35%)
Freon TMC ^R	FC-113 & methylene chloride (50%/50%)
Freon TES ^R	FC-113 & ethanol & nitromethane (95%/4%/1%)
Freon TMS ^R	FC-113 & methanol & nitromethane (94%/6%/1%)
Freon TP-35 ^R	FC-113 & isopropanol (65%/35%)
Freon TWD-602 ^R	FC-113 & water & detergent (91%/6%/3%)
Genetron 500 ^R	FC-12 & FC-152a (74%/26%)
Genetron 502 ^R	FC-115 & FC-22 (51%/49%)

HOW FLUOROCARBONS ENTER AND AFFECT YOUR BODY

Fluorocarbons enter your body when you breathe their vapors in the air. Small amounts of the liquid can also be absorbed through your skin, particularly with lengthy skin contact. The most common effect of overexposure to fluorocarbons is irritation of the skin. Overexposure to fluorocarbons in the air most commonly affects your skin, respiratory tract, or nervous system, as described below.

Skin, Eyes, Nose and Throat: Fluorocarbons, like other organic solvents, can dissolve your skin's natural protective oils. Frequent skin contact with liquid fluorocarbons can cause dryness, redness, flaking, cracking, and dermatitis (skin rash). If air concentrations are kept below Cal/OSHA's Permissible Exposure Limits (PELs - see "Legal Exposure Limits" on page 3), fluorocarbons probably will not irritate your eyes, nose, or throat.

Nervous System: Fluorocarbons, like other organic solvents, can affect your central nervous system (your brain) the same way drinking alcohol does. Moderate overexposure for brief periods can cause effects which last for only a short time. For the commonly used fluorocarbons, these effects can occur at exposure levels of about 1000-5000 "ppm" (see "Legal Exposure Limits"). These effects can increase your chances of having accidents. At very high exposure levels, fluorocarbons and other solvents can cause disorientation, and may make you pass out.

Some studies suggest that repeated, frequent overexposure to some organic solvents over months or years can have long-lasting and possibly permanent effects on the nervous system. The exposure levels at which these effects occur are not known, and the effects have not been studied in workers exposed only to fluorocarbons.

The symptoms of these long-term effects include fatigue, poor muscle coordination, difficulty concentrating, loss of short-term memory, and personality changes such as increased anxiety, nervousness, and irritability.

Effects of Fluorocarbons on the Nervous System

headache	nausea	lightheadedness
weakness	vomiting	dizziness
tiredness	slurred speech	feeling "high"
confusion	loss of balance	poor coordination

Liver: One infrequently used fluorocarbon, FC-21, causes liver damage in animals repeatedly exposed to 200 ppm or more. For this reason, FC-21 has a lower Permissible Exposure Limit than other fluorocarbons. Whether this effect occurs in humans has not been studied. Other fluorocarbons have not caused liver damage in animals.

Heart: During overexposure to fluorocarbons, your heart becomes more sensitive to adrenalin. Strenuous exercise or lack of oxygen, combined with severe overexposure (well over 5000 ppm), could cause your heart to fail. Warning symptoms could include dizziness and palpitations (skipped heartbeats). However, lower-level exposures, even over a long period of time, have not been found to have any effect on the heart.

Cancer: In animal studies, FC-11 and some rarely-used fluorocarbons (FC-134a, FC-143a) did not cause cancer. FC-22, which is used mainly in refrigeration and air conditioning, caused a slight increase in cancer in animals exposed to a very high level (50,000 ppm) over their lifetime. Two rarely-used fluorocarbons, FC-31 and FC-133a, also caused cancer in animals. No research has been done to find out whether fluorocarbons can cause cancer in humans. However, based on the available information, *if* there is any risk of cancer from exposure to the commonly used fluorocarbons, it is likely to be very low.

Reproductive System: In rats, inhalation of FC-22 at very high levels (50,000 ppm) during pregnancy resulted in birth defects. Inhalation of lower levels (10,000 ppm) had no effect. Exposure of male rats at 50,000 ppm had no effect. Commonly-used fluorocarbons probably do not affect human reproduction. However, a pregnant woman should minimize her exposure to any organic solvent, including fluorocarbons, until their effects have been studied more thoroughly.

TESTS FOR EXPOSURE OR MEDICAL EFFECTS

Fluorocarbons are mostly eliminated from your body within a day or so. There is no medical or laboratory test that can accurately measure the amount of fluorocarbons in your body, or that can identify any damage that fluorocarbons might cause. Therefore, testing is not recommended or legally required.

However, it is generally recommended that workers who are frequently exposed to fluorocarbons or other hazardous substances receive a complete physical examination, including an occupational and medical history, at the beginning of employment. Periodic follow-up examinations are also recommended.

LEGAL EXPOSURE LIMITS

California's Division of Occupational Safety and Health (DOSH, or Cal/OSHA) sets and enforces workplace chemical exposure limits.

Cal/OSHA has established workplace Permissible Exposure Limits (PELs) for some fluorocarbons. Cal/OSHA's PELs for fluorocarbons are listed in the table below. By law, your **average** exposure during any single 8-hour workday must not exceed the PEL. Your exposure may legally be above the PEL at times, but only if it is below the PEL at other times, so that your **average** exposure for any 8-hour workshift is not higher than the PEL.

For FC-12 and FC-113, Cal/OSHA has also set "*excursion*" limits which must not be exceeded for more than 30 minutes during any 8-hour workshift, and "*ceiling*" limits which must never be exceeded at any time. The PELs for fluorocarbons are usually expressed as "ppm" (parts of the chemical per million parts of air), or sometimes as " mg/m^3 " (milligrams of the chemical per cubic meter of air). PELs have not been established for infrequently-used fluorocarbons whose potential health effects have not been studied.

If you have any of the symptoms described above while you are working with fluorocarbons, you may be exposed at more than the legal exposure limits. Talk to your supervisor and/or your union. If any worker might be exposed to a substance at more than the legal exposure limit, the

employer must measure the amount of the chemical in the air in the work area (Cal/OSHA regulation *GISO 5155*). You have the right to see the results of such monitoring relevant to your work (California *GISO 3204* and U.S. *29 CFR 1910.20*).

You also have the right to see and copy your own medical records and records of your exposure to toxic substances. These records are important in determining whether your health has been affected by your work. If your employers have such records, they must keep them and make them available to you for at least 30 years after the end of your employment.

PERMISSIBLE EXPOSURE LIMITS FOR FLUOROCARBONS

Number	Chemical Name	Chemical Formula	PEL	
			ppm	mg/m ³
FC-11	trichlorofluoromethane	CCl ₃ F	1000	5600
FC-12	dichlorodifluoromethane	CCl ₂ F ₂	1000*	4950*
FC-12B2	dibromodifluoromethane	CBr ₂ F ₂	100	860
FC -13B1	bromofluoromethane	CBrF ₃	1000	6100
FC-21	dichlorodifluoromethane	CHCl ₂ F	10	42
FC-22	chlorodifluoromethane	CHClF ₂	1000	3500
FC-112	1,1,2,2-tetrachloro-1,2-difluoroethane	CCl ₂ FCCl ₂ F	500	4170
FC-112a	1,1,1,2-tetrachloro-2,2-difluoroethane	CCl ₃ CClF ₂	500	4170
FC-113	1,1,2-trichloro-1,2,2-trifluoroethane	CCl ₂ FCClF ₂	1000**	7600
FC-114	1,2-dichlorotetrafluoroethane	CClF ₂ CClF ₂	1000	7000
FC-115	chloropentafluoroethane	CClF ₅	1000	6320

* The FC-12 "excursion" limit is 2500 ppm, the "ceiling" limit is 6200 ppm.

** The FC-113 "excursion" limit is 1500 ppm; the "ceiling" limit is 2000 ppm.

REDUCING YOUR EXPOSURE

Your employer is required to protect you from being exposed to chemicals at levels above the

legal limits. See the "Resources" section on page 4 for information about how Cal/OSHA and Cal/OSHA Consultation Service can help you and your employer.

Substitution: The most effective way to reduce hazardous chemical exposures is to use safer chemicals in place of more dangerous ones. However, the health and safety hazards of other organic solvents must be considered before choosing them as a substitute. Generally, fluorocarbons are less hazardous than most other organic solvents.

Engineering Controls: When possible, employers must use engineering and administrative controls rather than personal protective equipment to prevent overexposures. Engineering control methods include installing ventilation, changing work practices, or changing the work process. Containers should be tightly covered to prevent evaporation. Some work processes can be isolated, enclosed, or automated to reduce exposures.

Local exhaust ventilation systems ("hoods") are the most effective type of ventilation control. These systems capture contaminated air at its source before it spreads into the air in your breathing zone.

Personal Protective Equipment: When engineering controls cannot sufficiently reduce exposures, a respirator must be worn and a respiratory protection program must be developed, as outlined by Cal/OSHA regulations (*GISO 5144*). An industrial hygienist or other knowledgeable person should be consulted to ensure that the equipment is appropriate and is used correctly. Improper respiratory equipment may not provide adequate protection.

Fluorocarbons have poor warning properties, so the cartridge or canister on an air-purifying respirator could wear out and need replacement without your knowing that it was no longer effective. Therefore, only a supplied-air respirator or an SCBA is approved.

If frequent and prolonged skin contact with fluorocarbons is necessary or if splashes may occur, personal protective equipment such as gloves, goggles, or faceshields should be worn. Protective clothing should be made of a material which is resistant to the specific fluorocarbon you are using. For instance, neoprene rubber is reported to be resistant to FC-12 and FC-113. Even the most resistant materials will be penetrated quickly and should be replaced often.