

1. PUBLIC HEALTH STATEMENT

This public health statement tells you about hydraulic fluids and the effects of exposure.

The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites make up the National Priorities List (NPL) and are the sites targeted for long-term federal cleanup. Hydraulic fluids have been found in at least 10 of the 1,428 current or former NPL sites. However, it's unknown how many NPL sites have been evaluated for these substances. As more sites are evaluated, the sites with hydraulic fluids may increase. This is important because exposure to these substances may harm you and because these sites may be sources of exposure.

When a substance is released from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. This release does not always lead to exposure. You are exposed to a substance only when you come in contact with it. You may be exposed by breathing, eating, or drinking the substance or by skin contact.

If you are exposed to hydraulic fluids, many factors determine whether you'll be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with it. You must also consider the other chemicals you're exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

1.1 WHAT ARE HYDRAULIC FLUIDS?

Hydraulic fluids are a very large class of materials that are used in machines and equipment to transfer pressure from one point to another. They are used in many ways including all fluids for car automatic transmissions, brakes, and power steering. Hydraulic fluids are also used in many machines like tractors and other farm equipment, forklift trucks, bulldozers, and other construction equipment, and airplanes. In industry, hydraulic fluids are used in machines that push, lift, pull, turn, and hold things. This profile covers only three of the many types of hydraulic

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fluids: (1) mineral oil, (2) organophosphate ester, and (3) polyalphaolefin. These types are among the most commonly used today. The trade names of typical hydraulic fluids covered in this profile include Durad[®], Fyrquel[®], Skydrol[®], Houghton-Safe[®], Pydraul[®], Reofose, Reolube[®], and Quintolubric[®]. Hydraulic fluids used in cars are not specifically covered in this profile.

Some hydraulic fluids have a bland oily smell, while others have no smell. Mineral oil and polyalphaolefin hydraulic fluids are mixtures that have oil in them and will burn. Oil-in-water hydraulic fluids (a special type of mineral oil hydraulic fluid) do not burn because they contain water. Organophosphate ester hydraulic fluids are mostly made without oil and will not burn unless there is a flame directly on them; once the flame is removed, these fluids will stop burning. Because they do not burn, organophosphate ester hydraulic fluids are used in airplanes and other places where fumes are very undesirable.

Mineral oil hydraulic fluids are produced from crude oil. Organophosphate ester and polyalphaolefin hydraulic fluids are manufactured. All hydraulic fluids contain many ingredients which reduce wear, make the fluid flow better, and make it thinner when it is cold. More than 200 million gallons of hydraulic fluids are sold each year in the United States. See Chapters 3 and 4 for more information on hydraulic fluids.

1.2 WHAT HAPPENS TO HYDRAULIC FLUIDS WHEN THEY ENTER THE ENVIRONMENT?

Hydraulic fluids can enter the environment from spills and leaks in machines that use them and from leaky storage tanks. If spilled on soil, some of the ingredients in the hydraulic fluids mixture may stay on the top, while others may sink into the groundwater. How fast the ingredients move through soil depends on many things. These include how much is spilled, how much rain falls on the spill, and the type of soil (for example, hydraulic fluids will move quickly in sandy soil, but will move slower in heavy clay). In water, some ingredients of hydraulic fluids will transfer to the bottom and stay there. Fish may contain some hydraulic fluid ingredients if they live near places that make or use a lot of it. Eventually, the ingredients of hydraulic fluids are degraded in the environment, but complete degradation may take more than a year. Scientists know a little about

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how some of the ingredients in hydraulic fluids break down in the environment, but they know almost nothing about how toxic these breakdown products are. See Chapters 4 and 5 for more information on what happens to hydraulic fluids in the environment.

1.3 HOW MIGHT I BE EXPOSED TO HYDRAULIC FLUIDS?

Exposures to hydraulic fluids occur mainly in workers using hydraulic equipment and in people who work on cars or tractors that use the fluids. Most people are exposed when fluids spill or leak on the skin, when the fluid is changed, or when the fluid reservoirs are filled. Low levels of hydraulic fluids may occur in the air near machines that use them. Understanding environmental levels of hydraulic fluids is very difficult because the ingredients in hydraulic fluids are used in many products other than hydraulic fluids. For example, mineral oil is an ingredient in both motor oil and mineral oil hydraulic fluids. In the environment, mineral oil from both sources would appear to be the same. Polyalphaolefin hydraulic fluids have chemical components and potential applications similar to mineral oil hydraulic fluids.

The ingredients in organophosphate ester hydraulic fluids also have many uses, but are usually not detected in the environment. They do not have as many uses as mineral oils and polyalphaolefins. When detected, concentrations of organophosphate esters range from 1 to 20 parts per billion (ppb) in water, 0.0002 to 1.31 ppb in drinking water, and less than 100 to greater than 6,300,000 ppb in sediments. In general, organophosphate esters are found near places where they are manufactured. People most likely to be exposed to hydraulic fluids include car, truck, tractor, industrial equipment, and airplane mechanics and repair technicians, and maintenance workers in heavy industry like car assembly plants, foundries, steel mills, paper mills, and plants that manufacture appliances or other large or small household or commercial items. Polyalphaolefin hydraulic fluids are often used in military equipment. See Chapter 5 for more information on how you might be exposed to hydraulic fluids.

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1.4 HOW CAN HYDRAULIC FLUIDS ENTER AND LEAVE MY BODY?

Very little is known about how mineral oil hydraulic fluids, polyalphaolefin hydraulic fluids, and organophosphate ester hydraulic fluids enter and leave your body. Some information exists about how some of the chemical components in the organophosphate ester hydraulic fluids enter and leave your body.

We know that chemical components of mineral oil hydraulic fluids can enter the body if you swallow them or they come in contact with your skin because health effects have occurred in people after they swallowed or had prolonged skin contact with certain mineral oil hydraulic fluids. Health effects have occurred in animals after they breathed, swallowed, or had skin contact with organophosphate ester hydraulic fluids. We do not know if mineral oil hydraulic fluids or polyalphaolefin hydraulic fluids will enter your body from your lungs if you breathe them as vapor or oil mist.

We know that some chemical components of organophosphate ester hydraulic fluids can enter your body from your lungs if you breathe them. Some organophosphate esters rapidly enter your body. Certain components of organophosphate ester hydraulic fluids are found in blood and urine within 1 hour of having them on your skin. Within 6 hours after animals swallow large amounts of certain components of organophosphate ester hydraulic fluids, they enter the blood and are found throughout the body, especially in fat. Organophosphate esters leave the body in the urine and feces within several days. More information can be found in Chapter 2.

1.5 HOW CAN HYDRAULIC FLUIDS AFFECT MY HEALTH?

This toxicological profile discusses only three classes of hydraulic fluids: mineral oil hydraulic fluids, polyalphaolefin hydraulic fluids, and organophosphate ester hydraulic fluids. The classes are based on the major chemicals found in the hydraulic fluids. However, hydraulic fluids are often complex mixtures of many chemical components. A particular hydraulic fluid can differ in

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its chemical components from another hydraulic fluid even if the two fluids are in the same class. Thus, effects of exposure may differ.

Very little is known about how mineral oil hydraulic fluids and polyalphaolefin hydraulic fluids will affect your health. There are reports of health effects in people exposed to these classes of hydraulic fluids. After drinking mineral oil hydraulic fluid, a child developed pneumonia and bleeding in the intestines and then died. A man whose hands and forearms were heavily exposed to mineral oil hydraulic fluids in his job developed weakness in his hands. This effect was probably caused by one of the organophosphate ester additives of the mineral oil hydraulic fluid. The skin and eyes of animals were red and swollen after contact with certain mineral oil hydraulic fluids and polyalphaolefin hydraulic fluids. Animals breathing very high levels of polyalphaolefin hydraulic fluids became drowsy and had congested lungs and trouble breathing. We do not know if mineral oil hydraulic fluids or polyalphaolefin hydraulic fluids will cause birth defects, reproductive effects, or cancer.

There have been reports of people being poisoned from swallowing cooking oil or medicines contaminated with organophosphate esters. Outbreaks of brain, nerve, and muscle problems due to organophosphate contamination have happened in the United States and other countries. If you get certain organophosphate ester hydraulic fluids on your skin, it may be irritated and turn red. There are no reports of people breathing or swallowing this type of fluid. Studies in animals suggest that if you breathe or swallow large amounts of certain organophosphate ester hydraulic fluids, you may have nervous system problems. Certain organophosphate ester hydraulic fluids affect the nervous system of animals in two different ways. The first type of effect occurs within a few hours of breathing, swallowing, or skin contact. The organophosphate ester part of the hydraulic fluid rapidly inhibits the activity of important enzymes in the nervous system causing multiple symptoms including tremors, sweating, diarrhea, and difficulty breathing. The second effect involves damage to nerves. The symptoms of this type of damage are general weakness, weakness of the arms and legs, and paralysis. These symptoms of nerve damage can occur several weeks after exposure has stopped. If you have been exposed once to organophosphate ester hydraulic fluids, the symptoms of enzyme inhibition will disappear before the weakness

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occurs. Not all types of these fluids cause both types of nervous system damage. In animal studies, not all animals that have symptoms of enzyme inhibition have nerve damage. Both of these types of nervous system damage can occur after one or several exposures.

Cows eating grass containing organophosphate ester hydraulic fluid had difficulty producing milk for their young. We do not know if this will also occur in people. We do not know if organophosphate ester hydraulic fluids will cause birth defects, affect fertility, or cause cancer.

The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and EPA have not classified mineral oil hydraulic fluids, polyalphaolefin hydraulic fluids, and organophosphate ester hydraulic fluids for carcinogenic effects.

1.6 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO HYDRAULIC FLUIDS?

Hydraulic fluids themselves cannot be measured in blood, urine, or feces, but certain chemicals in them can be measured. Aliphatic hydrocarbons, which are major components of mineral oil hydraulic fluids and polyalphaolefin hydraulic fluids, can be detected in the feces. Certain components of organophosphate ester hydraulic fluids leave the body in urine. Some of these fluids inhibit the enzyme cholinesterase. Cholinesterase activity in blood can be measured. Because many other chemicals also inhibit cholinesterase activity in blood, this test is not specific for organophosphate ester hydraulic fluids. This test is not available at most doctor's offices, but can be arranged at any hospital laboratory. See Chapters 2 and 6 for more information.

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1.7 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?

Federal government recommendations exist to protect people's health from mineral oil hydraulic fluids.

Mineral oil is the major chemical component of mineral oil hydraulic fluids. Mineral oil belongs to a larger class of chemicals called petroleum distillates. The Occupational Safety and Health Administration (OSHA) regulates petroleum distillate and mineral oil mist levels in workplace air. The occupational exposure limits for an 8-hour workday, 40-hour workweek are 2,000 milligrams per cubic meter (mg/m^3) in air for petroleum distillates and $5 \text{ mg}/\text{m}^3$ for mineral oil mists. The National Institute for Occupational Safety and Health (NIOSH) recommends an exposure limit of $350 \text{ mg}/\text{m}^3$ of petroleum distillates for a 10-hour workday, 40-hour workweek.

1.8 WHERE CAN I GET MORE INFORMATION?

If you have any more questions or concerns, please contact your community or state health or environmental quality department or

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop E-29
Atlanta, GA 30333

This agency can also provide you with information on the location of occupational and environmental health clinics. These clinics specialize in the recognition, evaluation, and treatment of illness resulting from exposure to hazardous substances.

