1. PUBLIC HEALTH STATEMENT

This statement was prepared to give you information about hydrazines and to emphasize the human health effects that may result from exposure to these chemicals. 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 clean-up activities. Hydrazines have been found in at least 8 of the 1,430 current or former NPL sites. However, the total number of NPL sites evaluated is not known. As more sites are evaluated, the number of sites at which hydrazines are found may increase. This information is important because exposure to hydrazines may cause harmful health effects and because these sites are potential or actual sources of human exposure to hydrazines.

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 can be exposed to a substance only when you come in contact with it. You may be exposed by breathing, eating, or drinking substances containing the substance or by skin contact with it.

If you are exposed to substances such as hydrazines, many factors will determine whether harmful health effects will occur and what the type and severity of those health effects will be. These factors include the dose (how much), the duration (how long), the route or pathway by which you are exposed (breathing, eating, drinking, or skin contact), the other chemicals to which you are exposed, and your individual characteristics such as age, sex, nutritional status, family traits, life style, and state of health.

1.1 WHAT ARE HYDRAZINES?

Hydrazines are chemical compounds that contain two nitrogen atoms joined by a single covalent bond. Three examples of hydrazines are

- hydrazine - also known as diamine, diamide, anhydrous hydrazine, and hydrazine base

- 1,1-dimethylhydrazine - also known as unsymmetrical dimethylhydrazine, dimazine, and by other names

- 1,2-dimethylhydrazine - also known as symmetrical dimethylhydrazine, hydrazomethane, and by other names

This document uses the term “hydrazines” to refer to hydrazine, l,l-dimethylhydrazine, and 1,2-dimethylhydrazine, collectively. These hydrazines are somewhat similar in chemical structure and reactivity. However, there are some clear differences in their production, uses, and adverse health effects. There are many other hydrazine compounds; however, these three hydrazines are discussed together in this document because they are of interest to the U.S. Department of Defense.

Hydrazines are manufactured from chemicals such as ammonia, dimethylamine, hydrogen peroxide, or sodium hypochlorite. A small amount of hydrazine occurs naturally in some plants. The amounts of hydrazine and l,l-dimethylhydrazine produced in the United States in the mid-1960s to mid-1980s have been reported to range from 15 million to 38 million pounds and from 9,900 to 99,000 pounds per year, respectively. 1,2-Dimethylhydrazine is a research chemical and the quantities produced are likely to be much less. We don’t know how much hydrazines is currently produced.

In their pure form, hydrazines are clear, colorless liquids, These liquids can evaporate in air. Hydrazines smell somewhat like ammonia. Most people can smell hydrazine or 1,1 -dimethylhydrazine when present at concentrations greater than 2-8 parts hydrazines per million parts of air (ppm). Hydrazines are highly reactive and easily catch fire.

Hydrazine has been used as fuel for many rockets and spacecraft, including the space shuttle. Hydrazine is used to treat boiler water to reduce corrosion, to reduce other chemicals, and to bring about or speed up chemical reactions. It is also used as a medicine and to make other medicines, farm chemicals, and plastic foams. 1,1-Dimethylhydrazine has been used as a rocket propellant and to make other chemicals. Other uses are also possible.
1,2 Dimethylhydrazine has no commercial uses but is used in labs to study colon cancer in experimental animals.

For more information about the chemical properties and uses of hydrazines, see Chapters 3 and 4.

1.2 WHAT HAPPENS TO HYDRAZINES WHEN THEY ENTER THE ENVIRONMENT?

Hydrazines can be released to the environment from places that make, process, or use these chemicals. One of the primary ways hydrazine and 1,1-dimethylhydrazine enter the environment is from their use as rocket fuels. Accidental spills and leaks from storage and waste sites may add to environmental levels of hydrazines. Because 1,2-dimethylhydrazine is not used commercially and is produced only in small amounts, large releases to the environment are not expected.

Most of the hydrazines are released directly to the air where they are quickly destroyed by reactive molecules (small parts or bits) normally in air. Most of the hydrazines in air are gone within a few minutes or hours.

Smaller amounts of hydrazines are also released directly to surface water and soil: Lab studies show that some of the hydrazines released to soil and water can evaporate into the air. Hydrazines can also dissolve in water or bind to soil. The extent to which these processes occur depends on soil and water conditions. Hydrazines can move with water through soil as it flows underground. This is particularly true in sandy soils. In water and soil, some

microorganisms (tiny plants or animals) can break down hydrazines to form less toxic compounds. Most of the hydrazines in soil and water are gone within a few weeks.

Hydrazines may become concentrated in some fish living in contaminated water. However, most animals quickly digest and excrete hydrazines so high levels of these compounds are not expected to remain in their bodies.

For more information on what happens to hydrazines in the environment, see Chapters 4 and 5.

1.3 HOW MIGHT I BE EXPOSED TO HYDRAZINES?

You may be exposed to significant amounts of hydrazines if you work in a place that makes, processes, or uses hydrazines, especially if you do not use proper protective equipment. People who live near these places, or near accidental spills or hazardous waste sites contaminated with hydrazines, may also be exposed. However, since hydrazines stay in air, water, and soil only briefly, most people are not exposed to them from these sources.

Small amounts of hydrazine and 1,1-dimethylhydrazine have been found in tobacco products. Therefore, people who chew tobacco, smoke cigarettes, or are exposed to cigarette smoke indirectly may be exposed to small amounts of these chemicals.

In the past, some people may have been exposed to 1,1-dimethylhydrazine in fruits sprayed with Alar, a growth enhancer. 1,1-Dimethylhydrazine is sometimes found where Alar is made or used. Because Alar is no longer used on food plants in the United States, people are no longer exposed to it from this source. However, Alar is still used on some nonfood plants. Therefore, some greenhouse workers who use Alar may be exposed to small amounts of 1, l-dimethylhydrazine.

Since 1,2-dimethylhydrazine is not used commercially, most people are not exposed to this chemical. It is used as a research chemical to produce colon cancer in lab animals. Therefore, lab workers who use 1,2-dimethylhydrazine for this purpose may be exposed to small amounts.

For more information about how you can be exposed to hydrazines, see Chapter 5.

1.4 HOW CAN HYDRAZINES ENTER AND LEAVE MY BODY?

Very little is known about how hydrazines enter and leave your body. Based on limited studies in animals, hydrazines are probably rapidly absorbed into your blood if you swallow them or if you get them on your skin. Based on their chemical and physical properties, hydrazines are also likely to be well absorbed if you breathe them into your lungs. Once they are in your blood, hydrazines are probably carried to all tissues of your body. Animal studies suggest that soon after you are exposed, the levels of hydrazines in your blood and tissues will fall rapidly. This is because your body changes hydrazines into other compounds called metabolites. Some of these metabolites (or compounds) can react with important molecules in your body and may harm you. Animal studies show that most metabolites and unchanged hydrazines leave your body in urine within 1 day. A small amount can also be found in the air you breathe out.

For more information about how hydrazines can enter and leave your body, see Chapter 2.

1.5 HOW CAN HYDRAZINES AFFECT MY HEALTH?

A small number of case studies of acute exposure in people suggest that your lungs, liver, kidney, and central nervous system may be injured if you breathe in hydrazine or 1,1-dimethylhydrazine or get them on your skin. Similar effects have been observed in animals.
Animal studies indicate that effects on the liver usually consist of fatty changes, but other effects have also been noted. Some animals developed convulsions, tremors, seizures, or

other effects on the nervous system after breathing hydrazines. Serious effects on the reproductive system were sometimes observed in animals. These effects included decreased sizes of the ovaries and testes and decreased sperm production. Some of these effects were seen in animals exposed to concentrations as low as 0.05-l ppm hydrazine or l,l-dimethylhydrazine in air for several months or more. Note that these concentrations are below those at which most people begin to smell hydrazines (2-8 ppm).

A few studies in people show that hydrazine and l,l-dimethylhydrazine affect your nervous system. If you swallow hydrazines, you may experience an upset stomach, vomiting, uncontrolled shaking, lethargy (sluggishness), coma, and neuritis (an inflammation of your nerves). These effects usually occur soon after exposure, but some may be delayed. Hydrazine has been used in the past to treat cancer patients. These effects occurred in some patients that swallowed 0.2-0.7 milligrams hydrazine per kilogram of their body weight per day (mg/kg/day) for 1 month or more. Vitamin B, has been given to people exposed to these chemicals to reduce nervous system effects. Effects on the nervous system have also been seen in animals exposed to hydrazine and l,l-dimethylhydrazine, but not to 1,2-dimethylhydrazine.

If you are exposed to hydrazines, you may have an increased cancer risk. The cancer-causing effects of hydrazines have not been well studied in people. However, many studies show that hydrazines can cause cancer in some animals after exposure to doses of 0.06-19 mg/kg/day through the mouth or exposure to concentrations of 0.05-5 ppm in the air. Tumors have been seen in many organs of animals exposed in this way but were found most often in the lungs, blood vessels, or colon. Some of the cancers caused by l,l-dimethylhydrazine may have been due to the presence of dimethylnitrosamine (a powerful carcinogen) as an impurity of this chemical. It is of particular concern that 1,2-dimethylhydrazine has caused colon cancer in lab animals following a single exposure.

Although it is hard to apply information from animal cancer studies directly to people, several government agencies have considered all the cancer evidence and developed the following conclusions:

- The Department of Health and Human Services (DHHS) has determined that hydrazine and 1,1-dimethylhydrazine may reasonably be anticipated to be carcinogens (cause cancer).

- The International Agency for Research on Cancer (IARC) has determined that hydrazine, 1,1 -dimethylhydrazine, and 1,2-dimethylhydrazine are possibly carcinogenic to humans (possibly cause cancer in humans).

- EPA has determined that hydrazine, l,l-dimethylhydrazine, and 1,2-dimethylhydrazine are probable human carcinogens (probably cause cancer in people).

- The American Conference of Governmental Industrial Hygienists (ACGIH) currently lists hydrazine and l,l-dimethylhydrazine as suspected human carcinogens, but has recently recommended that the listing of hydrazine be changed to that of animal carcinogen, not likely to cause cancer to people under normal exposure conditions.

For more information about how hydrazines can affect your health, see Chapter 2.

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

If you are exposed to hydrazines, you can be tested for the presence of these chemicals or their metabolites in your blood, urine, or feces. These tests must be done soon after you are exposed (usually within 1 day). Exposure to some cancer drugs or other chemicals can produce hydrazines or their metabolites in your body. These tests cannot be used to tell how much you were exposed to or if you are going to be ill. These tests are not usually done in a

doctor's office but in special labs for testing. Because these tests require the use of expensive equipment and skilled technicians, their availability may be limited in some regions.

For more information about tests for exposure to hydrazines, see Chapters 2 and 6.

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

Several government regulatory agencies have taken action to protect people from excess exposure to hydrazines. EPA considers hydrazine and 1,1 -dimethylhydrazine to be hazardous air pollutants. The Occupational Safety and Health Administration (OSHA) limits the amount of hydrazine and l,l-dimethylhydrazine to 0.1 and 0.5 ppm, respectively, in workplace air for an S-hour workday and notes the potential for skin absorption in unprotected individuals. The National Institute of Occupational Safety and Health (NIOSH) recommends that the levels of hydrazine and l,l-dimethylhydrazine in workplace air not exceed 0.03 and 0.06 ppm, respectively, for a 2-hour period. The Food and Drug Administration (FDA) has ruled that hydrazine cannot be added to water for steam that will contact food. The EPA restricts the amount of hydrazines that may be released to the environment during burning or by disposal in landfills.

For more information regarding the regulations and guidelines for hydrazines, see Chapter 7.

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

1. PUBLIC HEALTH STATEMENT

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop E-29
Atlanta, Georgia 30333
(404) 639-6000

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.