1 Identification of substance:

Product details:

Product name: Hydrazine
Stock number: 32728

Manufacturer/Supplier:
Alfa Aesar, A Johnson Matthey Company
Johnson Matthey Catalog Company, Inc.
30 Bond Street
Ward Hill, MA 01835-8099
Emergency Phone: (978) 521-6300
CHEMTREC: (800) 424-9300
Web Site: www.alfa.com

Information Department: Health, Safety and Environmental Department

Emergency information:
During normal hours the Health, Safety and Environmental Department. After normal hours call
Chemtrec at (800) 424-9300.

2 Composition/Data on components:

Chemical characterization:

Description: (CAS#) hydrazine (CAS# 302-01-2); 100%
Identification number(s):
EINECS Number: 206-114-9
Index number: 007-008-00-3

3 Hazards identification

Hazard description:

T Toxic
N Dangerous for the environment

Information pertaining to particular dangers for man and environment
R 45 May cause cancer.
R 10 Flammable.
R 23/24/25 Also toxic by inhalation, in contact with skin and if swallowed.
R 34 Causes burns.
R 43 May cause sensitization by skin contact.
R 50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment

Classification system

HMIS ratings (scale 0-4)
(Hazardous Materials Identification System)

<table>
<thead>
<tr>
<th>HEALTH</th>
<th>FIRE</th>
<th>REACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

GHS label elements

Danger

3.1/2 - Fatal if swallowed.
3.1/2 - Fatal in contact with skin.
3.1/2 - Fatal if inhaled.
3.4/1 - May cause an allergic skin reaction.

Danger

3.6/1A - May cause cancer.

Danger

3.2/1A - Causes severe skin burns and eye damage.
Material Safety Data Sheet
acc. to OSHA and ANSI

Printing date 05/11/2009 Reviewed on 05/11/2009

Product name: Hydrazine

(Contd. of page 1)

Warning

2.6/3 - Flammable liquid and vapour.

Warning

4.1/1 - Very toxic to aquatic life with long lasting effects.

Prevention:
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
Keep container tightly closed.
Ground/bond container and receiving equipment.
Use explosion-proof electrical/ventilating/lighting/equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Do not breathe dust/fume/gas/mist/vapours/spray.
Avoid breathing dust/fume/gas/mist/vapours/spray.
Do not get in eyes, on skin, or on clothing.
Wash thoroughly after handling.
Do not eat, drink or smoke when using this product.
Use only outdoors or in a well-ventilated area.
Contaminated work clothing should not be allowed out of the workplace.
Avoid release to the environment.
Wear protective gloves/protective clothing/eye protection/face protection.
Use personal protective equipment as required.
Wear respiratory protection.

Response:
IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician.
IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
IF ON SKIN: Gently wash with plenty of soap and water.
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
IF exposed or concerned: Get medical advice/attention.
Specific treatment is urgent (see label).
Specific treatment (see label).
Specific measures (see label).
Rinse mouth.
If skin irritation or rash occurs: Get medical advice/attention.
Remove/Take off immediately all contaminated clothing.
Wash contaminated clothing before reuse.
In case of fire: Use for extinction: CO2, powder or water spray.
Collect spillage.

Storage:
Store in a well-ventilated place. Keep container tightly closed.
Store in a well-ventilated place. Keep cool.
Store locked up.

Disposal:
Dispose of contents/container in accordance with local/regional/national/international regulations.

(Contd. on page 3)
5 Fire fighting measures

Suitable extinguishing agents:
Carbon dioxide, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.

Protective equipment:
Wear self-contained respirator.
Wear fully protective impervious suit.

After eye contact
Rinse opened eye for several minutes under running water. Then consult a doctor.

After swallowing
Do not induce vomiting; immediately call for medical help.
Seek immediate medical advice.

5 Accidental release measures

Person-related safety precautions:
Wear protective equipment. Keep unprotected persons away.
Ensure adequate ventilation
Keep away from ignition sources

Measures for environmental protection:
Prevent material to be released to the environment without proper governmental permits.

Measures for cleaning/collecting:
Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
Use neutralizing agent.
Dispose contaminated material as waste according to item 13.
Ensure adequate ventilation.
Keep away from ignition sources.

Additional information:
See Section 7 for information on safe handling
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

7 Handling and storage

Handling
Information for safe handling:
Handle under protective gas.
Keep container tightly sealed.
Store in cool, dry place in tightly closed containers.
Ensure good ventilation at the workplace.
Open and handle container with care.

Information about protection against explosions and fires:
Keep ignition sources away.
Protect against electrostatic charges.
Fumes can combine with air to form an explosive mixture.

Storage
Requirements to be met by storerooms and receptacles:
No special requirements.

Information about storage in one common storage facility:
Store away from metals.
Do not store together with oxidizing and acidic materials.
Store away from halogens.

Further information about storage conditions:
Store under inert gas.
Keep container tightly sealed.
Store in cool, dry conditions in well sealed containers.

8 Exposure controls and personal protection

Additional information about design of technical systems:
Properly operating chemical fume hood designed for hazardous chemicals and having an average face velocity of at least 100 feet per minute.

Components with limit values that require monitoring at the workplace:

<table>
<thead>
<tr>
<th>Component</th>
<th>Limit Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrazine</td>
<td>ppm</td>
</tr>
<tr>
<td>ACGIH TLV</td>
<td>0.01</td>
</tr>
<tr>
<td>Denmark TWA</td>
<td>0.1 (skin)</td>
</tr>
<tr>
<td>Finland TWA</td>
<td>0.1, 0.3-STEL (skin)</td>
</tr>
<tr>
<td>France TWA</td>
<td>0.1</td>
</tr>
</tbody>
</table>
Material Safety Data Sheet
acc. to OSHA and ANSI

Product name: Hydrazine

Drugs
Ireland TWA 0.1 (skin)
Netherlands TWA 0.1 (skin)
Russia TWA 0.1 (skin)
Sweden TWA 0.1, 0.3-STEL (skin)
Switzerland TWA 0.1 (skin)
United Kingdom TWA 0.02, 0.1-STEL
USA PEL 1 (skin)

Additional information: No data

Personal protective equipment
General protective and hygienic measures
The usual precautionary measures for handling chemicals should be followed.
Keep away from foodstuffs, beverages and feed.
Remove all soiled and contaminated clothing immediately.
Wash hands before breaks and at the end of work.
Store protective clothing separately.
Avoid contact with the eyes and skin.

Breathing equipment: Use suitable respirator when high concentrations are present.
Protection of hands: Impervious gloves
Eye protection:
Safety glasses
Tightly sealed goggles
Full face protection

Body protection: Protective work clothing.

9 Physical and chemical properties:

General Information
Form: Liquid
Color: Colorless
Odor: Ammonia-like

Change in condition
Melting point/Melting range: 1.4°C (35°F)
Boiling point/Boiling range: 113.5°C (236°F)
Sublimation temperature / start: Not determined

Flash point: 38°C (100°F)
Ignition temperature: 270°C (518°F)
Decomposition temperature: Not determined

Explosion limits:
Lower: 4.7 Vol %
Upper: 100 Vol %

Vapor pressure at 20°C (68°F): 13 hPa (10 mm Hg)
Density at 20°C (68°F): 1.011 g/cm³

Solubility in / Miscibility with
Water at 20°C (68°F): 1000 g/l

10 Stability and reactivity

Thermal decomposition / conditions to be avoided:
Decomposition will not occur if used and stored according to specifications.

Materials to be avoided:
Oxidizing agents
Oxygen
Metal powders
Organic materials

Dangerous reactions
Forms explosive gas mixture with air
Reacts with various metals
Explosive reaction with oxidizing agents such as calcium chlorate and or peroxides
Reacts with acids

Dangerous products of decomposition: Nitrogen oxides

(Contd. on page 5)
11 Toxicological information

Acute toxicity:

<table>
<thead>
<tr>
<th>LD/LC50 values that are relevant for classification:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oral</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Dermal</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Inhalative</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Primary irritant effect:
on the skin:
Corrosive effect on skin and mucous membranes.
Irritant to skin and mucous membranes.
on the eye:
Strong corrosive effect.
Irritating effect.
Sensitization: Sensitization possible through skin contact.
Other information (about experimental toxicology):
Mutagenic effects have been observed on tests with bacteria.
Subacute to chronic toxicity:
Hydrazine and its derivatives may be corrosive and skin sensitizers. They are experimental carcinogens of the lungs, nervous system, liver, kidney, breast and skin. Mutagenic data has been reported. Ingestion may cause gastrointestinal and central nervous system damage.
Contact with the eyes can cause permanent injury or blindness. Inhalation can lead to lung, liver, kidney and blood injury. Exposure may also cause cyanosis, dizziness, nausea, vomiting, diarrhea and convulsions.
Additional toxicological information:
Danger through skin absorption.
Swallowing will lead to a strong corrosive effect on mouth and throat and to the danger of perforation of esophagus and stomach.
To the best of our knowledge the acute and chronic toxicity of this substance is not fully known.
EPA-B2: Probable human carcinogen, sufficient evidence from animal studies; inadequate evidence or no data from epidemiologic studies.
IARC-2B: Possibly carcinogenic to humans: limited evidence in humans in the absence of sufficient evidence in experimental animals.
NTP-2: Reasonably anticipated to be a carcinogen: limited evidence from studies in humans or sufficient evidence from studies in experimental animals.
ACGIH A3: Animal carcinogen: Agent is carcinogenic in experimental animals at a relatively high dose, by route(s) of administration, at site(s), of histologic type(s), or by mechanism(s) not considered relevant to worker exposure. Available epidemiologic studies do not confirm an increased risk of cancer in exposed humans. Available evidence suggests that the agent is not likely to cause cancer in humans except under uncommon or unlikely routes or levels of exposure.
The Registry of Toxic Effects of Chemical Substances (RTECS) contains tumorigenic and/or carcinogenic and/or neoplastic data for components in this product.

12 Ecological information:

Ecotoxicological effects:
Remark: Very toxic for fish
General notes:
Do not allow product to reach ground water, water course or sewage system, even in small quantities.
Danger to drinking water if even extremely small quantities leak into the ground.
Also poisonous for fish and plankton in water bodies.
Do not allow material to be released to the environment without proper governmental permits.
Very toxic for aquatic organisms

13 Disposal considerations

Product:
Recommendation Consult state, local or national regulations to ensure proper disposal.
Uncleaned packagings:
Recommendation: Disposal must be made according to official regulations.
Recommended cleansing agent: Water, if necessary with cleansing agents.
14 Transport information

DOT regulations:

Hazard class: 8
Identification number: UN2029
Packing group: I
Hazardous substance: 1 lbs, 0.454 kg
Proper shipping name (technical name): HYDRAZINE, ANHYDROUS
Label: 8 + 3 + 6.1

Land transport ADR/RID (cross-border)

ADR/RID class: 8 (CFT) Corrosive substances
Danger code (Kemler): -
UN-Number: 2029
Packaging group: I
Description of goods: 2029 HYDRAZINE, ANHYDROUS

Maritime transport IMDG:

IMDG Class: 8
UN Number: 2029
Label: 8 + 3 + 6.1
Packaging group: I
EMS Number: P-E,S-C
Proper shipping name: HYDRAZINE, ANHYDROUS

Air transport ICAO-TI and IATA-DGR:

ICAO/IATA Class: 8
UN/ID Number: 2029
Label: 8 + 3 + 6.1
Packaging group: I
Proper shipping name: HYDRAZINE, ANHYDROUS

UN "Model Regulation": UN2029, HYDRAZINE, ANHYDROUS, 8 (3+6.1), I
Environmental hazards: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID

15 Regulations

Product related hazard informations:
Hazard symbols:
T Toxic
N Dangerous for the environment

Risk phrases:
45 May cause cancer.
10 Flammable.
23/24/25 Also toxic by inhalation, in contact with skin and if swallowed.
34 Causes burns.
43 May cause sensitization by skin contact.
50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment

Safety phrases:
53 Avoid exposure - obtain special instructions before use.
Drastic reaction. In case of accident or if you feel unwell, seek medical advice immediately.

60 This material and its container must be disposed of as hazardous waste.

61 Avoid release to the environment. Refer to special instructions/Safety data sheets.

National regulations:
All components of this product are listed in the U.S. Environmental Protection Agency Toxic Substances Control Act Chemical substance Inventory.
This product contains a chemical known to the state of California to cause cancer or reproductive toxicity.

All components of this product are listed on the Canadian Domestic Substances List (DSL).

Information about limitation of use:
For use only by technically qualified individuals.
This product is subject to the reporting requirements of section 313 of the Emergency Planning and Community Right to Know Act of 1986 and 40CFR372.

16 Other information:
Employers should use this information only as a supplement to other information gathered by them, and should make independent judgement of suitability of this information to ensure proper use and protect the health and safety of employees. This information is furnished without warranty, and any use of the product not in conformance with this Material Safety Data Sheet, or in combination with any other product or process, is the responsibility of the user.

Department issuing MSDS: Health, Safety and Environmental Department.

Contact: Zachariah Holt

Abbreviations and acronyms:
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
RID: Règlement international concernant le transport des marchandises dangereuses par chemin de fer (Regulations Concerning the International Transport of Dangerous Goods by Rail)
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
IATA-DGR: Dangerous Goods Regulations by the "International Air Transport Association" (IATA)
ICAO-TI: Technical Instructions by the "International Civil Aviation Organization" (ICAO)
GHS: Globally Harmonized System of Classification and Labelling of Chemicals
EINECS: European Inventory of Existing Commercial Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
HMIS: Hazardous Materials Identification System (USA)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent