MATERIAL SAFETY DATA SHEET

SECTION 1. PRODUCT IDENTIFICATION

PRODUCT NAME: **Hydrogen Sulfide**
CHEMICAL NAME: Hydrogen sulfide **FORMULA:** H_2S
SYNONYMS: Sulfuretted Hydrogen; Hydrogen Sulphide; Hydrosulfuric Acid; Sulfur Hydride; Sewer Gas

MANUFACTURER: **Air Products and Chemicals, Inc.**
7201 Hamilton Boulevard
Allentown, PA 18195-1501

PRODUCT INFORMATION: (800) 752-1597

MSDS NUMBER: 1010 **REVISION:** 6
REVIEW DATE: December 1999 **REVISION DATE:** December 1999

SECTION 2. COMPOSITION / INFORMATION ON INGREDIENTS

Hydrogen Sulfide is sold as pure product (> 99%).

CAS NUMBER: 7783-06-4
EXPOSURE LIMITS:
OSHA: PEL = 20 ppm (Ceiling) **ACGIH:** TWA = 10 ppm STEL = 15 ppm **NIOSH:** REL = 10 ppm Ceiling (10 minutes) IDLH = 100 ppm

SECTION 3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW

Hydrogen Sulfide is a toxic, flammable, colorless, liquefied compressed gas packaged in cylinders under its own vapor pressure of 248.9 psig at 70 °F. It poses an immediate fire and explosion hazard when mixed with air at concentrations exceeding 4.0%. The gas is heavier than air, and may spread long distances. Distant ignition and flashback are possible. Hydrogen Sulfide has a distinct “rotten-egg” smell. However, odor is not an effective warning of the presence of Hydrogen Sulfide. Continuous inhalation of low concentrations may cause olfactory fatigue. Exposure to Hydrogen Sulfide concentrations greater than 500 ppm can result in unconsciousness, coma, and death. Contact with the liquid (or rapidly expanding gases) may cause frostbite. Self-contained breathing apparatus (SCBA) required for rescue workers.

EMERGENCY TELEPHONE NUMBERS

(800) 523-9374 **Continental U.S., Canada, and Puerto Rico**
(610) 481-7711 **Other locations**

ACUTE POTENTIAL HEALTH EFFECTS:

ROUTES OF EXPOSURE:

EYE CONTACT: Inflammation and irritation of the eyes can occur at very low airborne concentrations (less than 10 ppm). Symptoms may include tearing, burning, pain when looking at light (photophobia), and blurred vision. Exposed individuals may see rings around bright lights. Most symptoms disappear when exposure ceases. In addition, contact with liquid (or rapidly expanding gas) may cause irritation and frostbite.

INGESTION: Ingestion of Hydrogen Sulfide is not a likely route of industrial exposure.

INHALATION: Inhalation of Hydrogen Sulfide can cause deadening of sense of smell, dizziness, headache, nausea and respiratory tract irritation. Exposure to Hydrogen Sulfide concentrations greater than 500 ppm can result in respiratory arrest, coma, unconsciousness and death. Continuous inhalation of low concentrations may cause olfactory fatigue, so that the odor is no longer an effective warning of the presence of Hydrogen Sulfide. Severe exposures which do not result in death may cause long-term symptoms such as memory loss, paralysis of facial muscles, or nerve tissue damage.
SKIN CONTACT: May cause irritation. Contact with liquid (or rapidly expanding gas) may cause irritation and frostbite.

POTENTIAL HEALTH EFFECTS OF REPEATED EXPOSURE:

ROUTE OF ENTRY: Inhalation, skin contact
SYMPTOMS: Chronic health effects caused by repeated low-level exposure to Hydrogen Sulfide have not been established. Repeated low level skin exposure may cause dermatitis.

TARGET ORGANS: Eyes, skin, respiratory and central nervous systems.
MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: Acute or chronic respiratory conditions, neurological or eye disorders may be aggravated by over-exposure to Hydrogen Sulfide.
CARCINOGENICITY: This product is not listed as a carcinogen or potential carcinogen by NTP, IARC, or OSHA.

SECTION 4. FIRST AID MEASURES

EYE CONTACT: Flush eyes with plenty of lukewarm water for several minutes. Seek medical attention immediately.
INGESTION: Ingestion is an unlikely route of exposure for Hydrogen Sulfide.
INHALATION: Remove person to fresh air. If not breathing, administer artificial respiration. If breathing is difficult, administer oxygen. Obtain prompt medical attention.
SKIN CONTACT: If liquid Hydrogen Sulfide comes in contact with skin, or if irritation of the skin develops after exposure to gas, immediately begin decontamination with running water. Remove contaminated clothing and flush with plenty of lukewarm water for several minutes. Seek immediate medical attention.
NOTES TO PHYSICIANS: Administer oxygen, if necessary and treat symptoms. Be observant for initial signs of pulmonary edema.

SECTION 5. FIRE FIGHTING MEASURES

FLASH POINT:	**AUTOIGNITION:**	**FLAMMABLE RANGE:**
Not applicable	500 °F (260 °C)	(LEL): 4.0% (UEL): 44.0%

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical, water.
SPECIAL FIRE-FIGHTING PROCEDURES: Evacuate all personnel from area. If possible, without risk, shut off source of gas, then fight fire according to types of materials burning. Extinguish fire only if gas flow can be stopped. This will avoid possible accumulation and reignition of a flammable gas mixture. Keep adjacent cylinders cool by spraying with large amounts of water until the fire burns itself out. Self-contained breathing apparatus (SCBA) required.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Most cylinders are designed to vent contents when exposed to elevated temperatures. Pressure in a cylinder can build-up due to heat and it may rupture if pressure relief devices should fail to function. An extreme explosion hazard exists in areas in which the gas has been released but the material has not yet ignited. The gas is heavier than air, and may spread long distances. Distant ignition and flashback are possible.

HAZARDOUS COMBUSTION PRODUCTS: Oxides of sulfur

SECTION 6. ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: Evacuate immediate area. Eliminate any possible sources of ignition, and provide maximum explosion-proof ventilation. Shut off source of leak, if possible. Isolate any leaking cylinder. If leak is from container, pressure relief device or its valve, contact

your supplier. If leak is in user's system, close cylinder valve, safely vent pressure and purge with inert gas before attempting repairs. Monitoring should be done for the levels of Hydrogen Sulfide. The concentration of Hydrogen sulfide must be below levels listed in Section 2 (Composition / Information on Ingredients) and the atmosphere must have at least 19.5% oxygen before personnel can be allowed in the area without self-contained breathing apparatus (SCBA). Combustible vapor levels must be below 0.40%, which is 10% of the LEL of Hydrogen Sulfide, prior to entry.

SECTION 7. HANDLING AND STORAGE

STORAGE: Store cylinders in a well-ventilated, secure area, protected from the weather. Secured cylinders should be stored up-right with valve outlet seals and valve protection caps in place. There should be no sources of ignition. All electrical equipment should be explosion-proof in the storage areas. Storage areas must meet National Electrical Codes for Class 1 hazardous areas. Flammable storage areas must be separated from oxygen and other oxidizers by a minimum distance of 20 ft. or by a barrier of non-combustible material at least 5 ft. high, having a fire resistance rating of at least 1/2 hour. Post "No Smoking or Open Flames" signs in the storage and use areas. Hydrogen Sulfide detectors should be installed in or near areas where Hydrogen Sulfide is being used or stored. Do not allow storage temperature to exceed 125 °F (52 °C). Storage should be away from heavily traveled areas and emergency exits. Full and empty cylinders should be segregated. Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time. Local codes may have special requirements for toxic gas storage.

HANDLING: Do not drag, roll, slide or drop cylinder. Use a suitable hand truck designed for cylinder movement. Never attempt to lift a cylinder by its cap. Secure cylinders at all times while in use. Use a pressure reducing regulator to safely discharge gas from cylinder. Use a check valve to prevent reverse flow into cylinder. Never apply flame or localized heat directly to any part of the cylinder. Do not allow any part of the cylinder to exceed 125 °F (52 °C). Once cylinder has been connected to properly purged and inerted process, open cylinder valve slowly and carefully. If user experiences any difficulty operating cylinder valve, discontinue use and contact supplier. Never insert an object (e.g., wrench, screwdriver, etc.) into valve cap openings. Doing so may damage valve, causing a leak to occur. Use an adjustable strap-wrench to remove over-tight or rusted caps. All piped systems and associated equipment must be grounded. Electrical equipment should be non-sparking or explosion-proof. If appropriate, install automatic monitoring equipment to detect the level of oxygen and the presence of potentially explosive air-gas mixtures.

SPECIAL PRECAUTIONS: Be aware of any signs of dizziness or fatigue; exposures to fatal concentrations of Hydrogen Sulfide could occur without any significant warning symptoms. All work operations should be monitored in such a way that emergency personnel can be immediately contacted in the event of a release. All work practices should minimize the release of Hydrogen Sulfide.

Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, Inc. (telephone 703-412-0900) pamphlet CGA P-1, *Safe Handling of Compressed Gases in Containers.* Local regulations may require specific equipment for storage and use.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS:

VENTILATION: Because of the hazards associated with Hydrogen Sulfide, control measures such as ventilated enclosures may be necessary. Provide explosion-proof ventilation sufficient to ensure Hydrogen Sulfide does not reach exposure limits listed in Section 2. (Composition / Information on Ingredients). Local exhaust ventilation is preferred.

RESPIRATORY PROTECTION:

Emergency Use: Self-contained breathing apparatus (SCBA) or positive pressure air line with full-face mask and escape pack should be used in areas where the Hydrogen Sulfide concentration is below 0.40%, which is 10% of the LEL of Hydrogen Sulfide, and exceeds permissible exposure limits. High concentrations may be within the flammable range and must not be entered.

EYE PROTECTION: Safety glasses for handling cylinders. Chemical goggles with full faceshield for connecting or disconnecting cylinders.

SKIN PROTECTION: Butyl rubber, chlorinated polyethylene, neoprene, nitrile, or polyvinyl rubber gloves. Fire-resistant gloves and clothing in emergency situations. Leather gloves for handling cylinders.
OTHER PROTECTIVE EQUIPMENT: Safety shoes are recommended when handling cylinders. Static-resistant clothing is recommended. Safety shower and eye wash station should be readily available.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE, ODOR AND STATE: Colorless gas with odor of "rotten eggs" .
MOLECULAR WEIGHT: 34.08
BOILING POINT (1 atm): -76.4 °F (-60.2 °C)
SPECIFIC GRAVITY (also called vapor density) (air = 1): 1.17
SPECIFIC GRAVITY (of liquid) (At 59 °F (15 °C)): 0.79
FREEZING/MELTING POINT: -122 °F (-85.6 °C)
VAPOR PRESSURE (At 70 °F (21.1 °C): 248.9 psig
GAS DENSITY (At 68 °F (20 °C) and 1 atm): 0.089 lb/ft^3
SOLUBILITY IN WATER (At 68 °F (20 °C): 0.0317 lb/gal

SECTION 10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable
CONDITIONS TO AVOID: Cylinders should not be exposed to temperatures in excess of 125 °F (52 °C).
INCOMPATIBILITY (Materials to Avoid): Oxidizing agents, organic peroxides, alkaline materials, metals (i.e. copper, lead), and metal oxides. Hydrogen Sulfide reacts with most metals to form metal sulfides.
REACTIVITY:

A) HAZARDOUS DECOMPOSITION PRODUCTS: Hydrogen and sulfur
B) HAZARDOUS POLYMERIZATION: Will not occur

SECTION 11. TOXICOLOGICAL INFORMATION

LC_{50} (Inhalation): 587 ppm (rat, 2 hour); 444 - 501 ppm (rat, 4 hour); 335 ppm (rat, 6 hour)
LD_{50}, (Oral): Not available
LD_{50} (Dermal): Not available
SKIN CORROSIVITY: Hydrogen Sulfide is irritating to the skin.
ADDITIONAL NOTES: Rats and mice that were exposed for 90 days to Hydrogen Sulfide at a concentration of 80 ppm had significantly decreased body weights compared to controls. Rats exposed to 80 ppm had depressed brain weights compared to controls. The only histological finding was inflammation of the nasal mucosa.
Hydrogen Sulfide was not mutagenic in a bacterial (S. typhimurium) assay.

SECTION 12. ECOLOGICAL INFORMATION

AQUATIC TOXICITY: Currently, the following aquatic toxicity data are available for Hydrogen Sulfide:

TLm (Asellussp) 96 hours = 0.111 mg/L
TLm (Cranfgonyx sp) 96 hours =1.07 mg/L
TLm (Gammarrus) 96 hours = 0.84 mg/L
LC_{50} (fly inhalation) 960 minutes = 380 mg/m^3
LC_{50} (fly inhalation) 7 minutes = 1500 mg/m^3
TLm (Lepomis macrochirus, bluegill sunfish) 96 hours = 0.0478 mg/L
TLm (*Lepomis macrochirus*, bluegill sunfish) 96 hours = 0.0448 mg/L at 21-22 °C
TLm (*Pimephlaes promelas*, fathead minnow) 96 hours = 0.0071-0.55 mg/L
TLm (*Salvenilis foninalis*, brook trout) 96 hours = 0.0216-0.038 mg/L at 8-12.5 °C

MOBILITY: Hydrogen Sulfide will not be mobile in soil.
PERSISTENCE AND BIODEGRADABILITY: Persistence: Converts to elemental sulfur upon standing in water. Biodegradation: Microorganisms in soil and water are involved in oxidation-reduction reactions that oxidize hydrogen sulfide to elemental sulfur. Members of the genera Beggiatoa, Thioploca, and Thiotrix function in transition zones between aerobic and anaerobic conditions where both molecular oxygen and hydrogen sulfide are found. Also, some photosynthetic bacteria oxidize hydrogen sulfide to elemental sulfur. Members of the families Chlorobiaceae and

Chromatiaceae (purple sulfur bacteria) are obligate aerobes and are phototropic, and are found in waters with high H_2S concentrations. The interactions of these organisms form part of the global sulfur cycle.

POTENTIAL TO BIOACCUMULATE: Hydrogen Sulfide does not have bioaccumulation or food chain contamination potential.

REMARKS: Hydrogen Sulfide is not a Class I or Class II ozone depleting chemical (40 CFR Part 82).

SECTION 13. DISPOSAL CONSIDERATIONS

UNUSED PRODUCT / EMPTY CONTAINER: Return container and unused product to supplier. Do not attempt to dispose of residual or unused quantities.

DISPOSAL INFORMATION: Shall be done in accordance with Federal, State and local regulations. Wastes containing this material may be classified by EPA as a hazardous waste by characteristic (such as Ignitability, Corrosivity, Toxicity, Reactivity). Waste streams must be characterized by the user to meet Federal, State and local requirements.

SECTION 14. TRANSPORT INFORMATION

DOT SHIPPING NAME: Hydrogen Sulfide
Poison - Inhalation Hazard, Zone B

HAZARD CLASS: 2.3

IDENTIFICATION NUMBER: UN1053

SHIPPING LABEL(s): Poison gas, Flammable gas

PLACARD (All quantities): Poison Gas

ADDITIONAL MARKING: Hydrogen Sulfide is also a hazardous substance regulated by the EPA. When shipping quantities of 100 lbs. or more in one cylinder, add the prefix "RQ" to the DOT shipping name on the documentation and clearly mark "RQ" on the cylinder near the label.

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure upright position in a well-ventilated truck. Never transport in passenger compartment of a vehicle. Ensure cylinder valve is properly closed, valve outlet cap has been reinstalled, and valve protection cap is secured before shipping cylinder.

CAUTION: Compressed gas cylinders shall not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with the owner's written consent is a violation of Federal law (49 CFR 173.301).

NAERG (NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK) #: 117

SECTION 15. REGULATORY INFORMATION

U.S. FEDERAL REGULATIONS:

EPA - ENVIRONMENTAL PROTECTION AGENCY:

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act of 1990 (40 CFR Parts 117 and 302)

Reportable Quantity (RQ): 100 lbs (45.4 kgs)

SARA TITLE III: Superfund Amendment and Reauthorization Act

SECTIONS 302/304: Emergency Planning and Notification (40 CFR Part 355)

Extremely Hazardous Substances: Hydrogen Sulfide is listed.
Threshold Planning Quantity (TPQ): 500 lbs (227 kgs)
Reportable Quantity (RQ): 100 lbs (45.4 kgs)

SECTIONS 311/312: Hazardous Chemical Reporting (40 CFR Part 370)

IMMEDIATE HEALTH: Yes
DELAYED HEALTH: No
PRESSURE: Yes
REACTIVITY: Yes
FIRE: Yes

SECTION 313: Toxic Chemical Release Reporting (40 CFR 372)

This product does not require reporting under Section 313.

CLEAN AIR ACT:

SECTION 112 (r): Risk Management Programs for Chemical Accidental Release (40 CFR Part 68)

Hydrogen Sulfide is listed as a regulated substance.
Threshold Quantity (TQ): 10,000 lbs (4,535 kg)

TSCA: Toxic Substances Control Act

Hydrogen Sulfide is listed on the TSCA Inventory.

OSHA - OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

29 CFR Part 1910.119: Process Safety Management of Highly Hazardous Chemicals.

Hydrogen Sulfide is listed as a highly hazardous substance.
Threshold Quantity (TQ): 1500 lbs (681 kgs)

STATE REGULATIONS:

CALIFORNIA:

Accidental Release Prevention Program: Threshold Quantity (TQ): 500 lbs (227 kgs)

Proposition 65: Hydrogen Sulfide is not a listed substance which the State of California requires warning under this statute.

NEW JERSEY:

Toxic Catastrophe Prevention Act: Registration Quantity (RQ): 500 lbs (227 kgs)

SECTION 16. OTHER INFORMATION

NFPA RATINGS:		**HMIS RATINGS:**	
HEALTH:	= 4	HEALTH:	= 2
FLAMMABILITY:	= 4	FLAMMABILITY:	= 4
REACTIVITY:	= 0	REACTIVITY:	= 0
SPECIAL:	None		