

SID RICHARDSON CARBON CO. MATERIAL SAFETY DATA SHEET

CARBON BLACK

(ISO 11014-1 / ANSI Z 400.1-1998 / 93/112/EC)

First issue: June 17, 1999
Revision date: November 20, 2003

NOTE: Added new grades, Section I only

Herb Harless
Manager EH&S
817-338-8386

1. PRODUCT AND COMPANY IDENTIFICATION

November 2003

Manufacturer/supplier: Sid Richardson Carbon Co.

Company name: Sid Richardson Carbon Co.

Company mailing address: 3560 W. Market St., Suite 420
Akron, OH 44333

Emergency Phone No.: (330) 666-2777 – Day
(800) 767-2227 – Night/Weekend

[for foreign distribution indicate country code, e.g., US (01)]

Optional emergency number(s): CHEMTREC: 1-800-424-9300 (US)
CANUTEC: 613-996-6666 (Canada)

Common Name, Chemical Name or Trade Name: CARBON BLACK:

The following grades and also other grades with similar properties when manufactured by the oil furnace processes used by Sid Richardson Carbon Co. (SRCC):

N110	N134	N231	N326	N343	N358	N660	N774	SR 310	SR 630
N120	N135	N234	N330	N347	N550	N762	SR155	SR 511	SR 730
N121	N220	N299	N339	N351	N650	N772	SR 301	SR 530	

2. COMPOSITION/INFORMATION ON INGREDIENTS

2.1 Component(s):

Carbon Black, amorphous (100%)

Chemical formula:

C

CAS number:

1333-86-4

EINECS number:

215-609-9

2.2 OSHA Regulatory Status:

This material is classified as hazardous under OSHA regulations.

SID RICHARDSON CARBON CO.

MATERIAL SAFETY DATA SHEET

CARBON BLACK

(ISO 11014-1 / ANSI Z 400.1-1998 / 93/112/EC)

3. HAZARDS IDENTIFICATION

June 2003

3.1 Emergency Overview

A black, odorless powder, which can burn or smolder at temperatures greater than 572°F (>300°C). Hazardous products of decomposition can include carbon monoxide, carbon dioxide, and oxides of sulfur. May cause mechanical irritation to the eyes and the respiratory tract especially at concentrations above the occupational exposure limit. Some grades of carbon black are sufficiently electrically non-conductive to allow a buildup of static charge during handling. Take measures to prevent the build up of electrostatic charge.

3.2 Product Classification

EU: Not defined as a dangerous substance or preparation according to Council Directive 67/548/EEC and its various amendments and adaptations
WHMIS: This material is classified as D2A under Canadian Worker Hazardous Materials Information System (WHMIS) criteria

3.3 Routes of Exposure: Inhalation, Eye and Skin

3.4 Potential Health Effects:

Inhalation: Temporary discomfort to upper respiratory tract may occur due to mechanical irritation when exposures are well above the occupational exposure limit. Long-term exposure may result in a small non-clinically significant increase in normal loss in one aspect of lung function (FEV₁).

See Section 11.

Ingestion: No evidence of adverse effects from available data.

Eye: High dust concentrations may cause mechanical irritation to eye.

Skin: May cause mechanical irritation, soiling and drying of skin.

Sensitization: No cases of sensitization in humans have been reported

Chronic: IARC listed; *Group 2B (possibly carcinogenic to humans)*. Not listed as a carcinogen by NTP, ACGIH, OSHA or the European Union.

See Section 11.

There are no known human carcinogenic effects related to the PAH content of carbon blacks. Recent research has shown that the PAH content of carbon blacks is not released from carbon black in biological fluids and thus not available for biological activity.

3.5 Potential Environmental Effects:

No significant environmental hazards are associated with carbon black release to the environment. Carbon black is not soluble in water. See Section 12.

SID RICHARDSON CARBON CO. MATERIAL SAFETY DATA SHEET

CARBON BLACK

(ISO 11014-1 / ANSI Z 400.1-1998 / 93/112/EC)

4. FIRST-AID MEASURES

4.1 First aid procedures:

<u>Inhalation:</u>	Take affected persons out in fresh air, if necessary.
<u>Skin:</u>	Wash skin with mild soap and water. If symptoms develop, seek medical attention.
<u>Eye:</u>	Rinse eyes thoroughly with plenty of water keeping eyelid open. If symptoms develop, seek medical attention.
<u>Ingestion:</u>	Do not induce vomiting. If conscious, rinse mouth with water.

4.2 Note to physicians: Treat symptomatically.

5. FIRE-FIGHTING MEASURES

5.1 Flammable and Explosive Properties:

Flashpoint:	not applicable
Spontaneous Ignition (transport):	>284°F (>140°C)
Explosive Limits (dust):	
Furnace black ¹ :	
Lower :	50 g/m ³
Upper:	not determined
Thermal black ¹ :	
Lower:	375 g/m ³
Upper:	not determined
Maximum Absolute Explosion Pressure ¹	10 bar
Maximum Rate of Pressure Rise ¹	30-100 bar/sec.
Dust Explosion Class ²	ST 1
Ignition Energy ¹	
Furnace black:	>1 kJ
Thermal black:	>20 kJ
Minimum Ignition Temperature ¹	
Method: VDI 2263 (BAM Furnace)	>932°F (>500°C)
Godberg-Greenwald Furnace	>600°F (>315°C)
Minimum Ignition Energy ¹	>10 J
Burn Velocity ² (not classifiable as "Highly Flammable", or "Easily Ignitable")	>45 seconds
Flammability Classification (as defined by OSHA 1910.1200):	not applicable

¹German VDI Guideline 2263, Test Methods for the Determination of the Safety Characteristics of Dusts.

²German VDI Guideline 2263 and EC Directive 84/449

SID RICHARDSON CARBON CO.

MATERIAL SAFETY DATA SHEET

CARBON BLACK

(ISO 11014-1 / ANSI Z 400.1-1998 / 93/112/EC)

5.2 Extinguishing Media:

Use foam, carbon dioxide (CO₂), dry chemical, or water spray. Avoid high-pressure water stream as this may spread burning powder (burning powder will float). A fog spray is recommended if water is used. NOTE: It may not be obvious that carbon black is burning unless the material is stirred and sparks are apparent. Carbon black that has been on fire should be observed closely for at least 48 hours to ensure no smoldering material is present.

5.3 Protection of Firefighters:

Products of combustion include carbon monoxide (CO), carbon dioxide (CO₂), and oxides of sulfur. Wear full protective fire fighting gear including self-contained breathing apparatus (SCBA).

5.4 Static Charge Effects:

Some grades of carbon black are sufficiently electrically non-conductive to allow a build-up of a static charge during handling.

6. ACCIDENTAL RELEASE MEASURES

NOTE: Wet carbon black produces dangerously slippery walking surfaces. Small spills should be vacuumed when possible. Dry sweeping is not recommended. A vacuum equipped with HEPA (high efficiency particulate air) filtration is recommended. If necessary, light water spray will reduce dust for dry sweeping. Large spills may be shoveled into containers. See Section 13. Wear appropriate personal protective equipment and respiratory protection. See Section 8.

Carbon black poses no significant environmental hazards. As a matter of good practice, minimize contamination of sewage water, soil, groundwater, drainage systems, or bodies of water.

7. HANDLING AND STORAGE

7.1 Handling:

Avoid dust exposures above the occupational exposure limit. Wash exposed skin daily. Use local exhaust ventilation to control exposures to below occupational exposure limit. Fine dust may cause electrical shorts and is capable of penetrating electrical equipment unless tightly sealed. If hot work (welding, torch cutting, etc.) is required the immediate work area must be cleared of carbon black product and dust.

7.2 Storage:

Store in dry place away from ignition sources and strong oxidizers. Before entering closed vessels and confined spaces containing carbon black test for adequate oxygen, flammable gases and potential toxic air contaminants (e.g., CO). Follow safe practices when entering confined spaces.

SID RICHARDSON CARBON CO. MATERIAL SAFETY DATA SHEET

CARBON BLACK

(ISO 11014-1 / ANSI Z 400.1-1998 / 93/112/EC)

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Engineering Controls:

Use process enclosures and/or exhaust ventilation to keep airborne dust concentrations below the occupational exposure limit.

8.2 Personal Protective Equipment (PPE):

No special PPE required. Gloves may be used to protect hands from carbon black soiling. Work clothes should not be taken home and should be washed daily.

Skin Protection: Wash hands and other exposed skin with mild soap and use skin cream to prevent skin drying.

Respiratory Protection: An approved air-purifying respirator (APR) may be used where airborne concentrations are expected to exceed occupational exposure limits. Protection provided by APRs is limited. Use a positive-pressure, air supplied respirator if there is any potential for uncontrolled release, exposure levels are not known, or any circumstances where air-purifying respirators may not provide adequate protection. A complete respiratory protection program in accordance with national standards and current best practices must accompany use of any respirator.

The following agencies/organizations approve respirators and/or criteria for respirator programs:

- U.S.: NIOSH approval under 42 CFR 84 required.
OSHA (29 CFR 1910.134, effective 8 Apr.98).
ANSI Z88.2-1992, Respiratory Protection.
- EU: CR592, Guidelines for the Selection and Use of
Respiratory Protection.
- Germany: DIN/EN 143, Respiratory Protective Devices for Dusty
Materials.
- UK: BS 4275, Recommendations for the Selection, Use and
Maintenance of Respiratory Protective Equipment.
HSE Guidance Note HS(G)53 Respiratory Protective
Equipment.

General Hygiene Considerations: Wash hands and face thoroughly with mild soap before eating and drinking. Frequent skin washing may dry skin. Application of a skin lotion is recommended.

Eye protection recommended as a matter of good industrial safety practice.

SID RICHARDSON CARBON CO. MATERIAL SAFETY DATA SHEET

CARBON BLACK

(ISO 11014-1 / ANSI Z 400.1-1998 / 93/112/EC)

8.3 Exposure Guidelines:

<u>Country</u>	<u>Occupational Exposure Limit, mg/m³</u>
Australia	3.0 TWA
United States	
OSHA-PEL	3.5 TWA
ACGIH-TLV	3.5 TWA
NIOSH -REL	3.5 TWA (see Section 11)
Germany	
MAKs	1.5 respirable TWA*
	4.0 inhalable TWA*
TRGS 900	6.0 respirable TWA*
Canada	3.5 TWA
United Kingdom	3.5 TWA
	7.0 STEL, 10 minutes
France	3.5 TWA
Sweden	3.0 TWA
Korea	3.5 TWA

TWA = 8-hour time weighted average. STEL = short-term exposure limit.

PEL = permissible exposure limit. REL = recommended exposure limit.

MAK = maximum concentration values in the workplace

Contact your carbon black supplier for additional information on occupational exposure levels.

*For particulates not otherwise classified (PNOC).

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	powder or pellet
Color:	black
Odor:	odorless
Molecular formula:	C
Molecular weight (as carbon):	12
Melting point/range:	not applicable
Boiling point/range:	not applicable
Vapor pressure :	not applicable
Density: (20°C)	1.7 – 1.9 g/cm ³
Bulk density:	20 – 550 kg/m ³
Solubility:	insoluble in water
pH value:	>7 [50 g/l water, 68°F (20°C)]
Partition coefficient:	not applicable
Viscosity:	not applicable

SID RICHARDSON CARBON CO. MATERIAL SAFETY DATA SHEET

CARBON BLACK

(ISO 11014-1 / ANSI Z 400.1-1998 / 93/112/EC)

10. STABILITY AND REACTIVITY

Stability: stable under normal ambient conditions

Decomposition: >572°F (>300°C)

Conditions to avoid: exposure to high temp. >572°F (>300°C) and open flames.

Materials to avoid: strong oxidizers such as chlorates, bromates, and nitrates.

Hazardous decomposition products: carbon monoxide, carbon dioxide, organic products of decomposition, oxides or sulfur (sulfoxides) form if heated above decomposition temperature.

Hazardous polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

June 2003

11.1 Acute Toxicity:

Acute Oral Toxicity: LD₅₀ (rat), > 8000 mg/kg

Acute Dermal Toxicity: LD₅₀ – not available

Acute Inhalation Toxicity: LC₅₀ – not available

Primary Skin Irritation: (rabbit), non-irritative, index score 0.6/8 (4.0 = severe edema)

Primary Eye Irritation: (rabbit), non-irritative, Draize score 10-17/110 (100 = maximally irritating)

11.2 Subchronic Toxicity:

Rat, inhalation, duration 90 days, NOAEL = 1.0 mg/m³

Target organ: lungs

Effect: inflammation, hyperplasia, fibrosis

11.3 Chronic Toxicity:

Rat, oral, duration 2 years - Effect: no tumors

Mouse, oral, duration 2 years - Effect: no tumors

Mouse, dermal, duration 18 months - Effect: no skin tumors

Rat, inhalation, duration: 2 years - Effect: inflammation, fibrosis, tumors

Target organ: Lungs.

Note: Tumors in the rat lung are considered to be related to the "particle overload phenomenon" rather than to a specific chemical effect of carbon black itself in the lung. These effects in rats have been reported in many studies on other inorganic insoluble particles and appear to be rat specific. Tumors have not been observed in other species (i.e., mouse and hamster) for carbon black or other insoluble particles under similar circumstances and study conditions.

SID RICHARDSON CARBON CO.

MATERIAL SAFETY DATA SHEET

CARBON BLACK

(ISO 11014-1 / ANSI Z 400.1-1998 / 93/112/EC)

11.4 Carcinogenicity:

In 1995 International Agency for Research on Cancer (IARC) concluded, "There is *inadequate evidence* in humans for the carcinogenicity of carbon black." Based on rat inhalation studies, IARC concluded that there is, "*sufficient evidence* in experimental animals for the carcinogenicity of carbon black," resulting in their classifying carbon black as "*possibly carcinogenic to humans (Group 2B)*".

Carbon black is not designated a carcinogen by the U.S. National Toxicology Program (NTP), the U.S. Occupational Safety and Health Administration (OSHA), the American Conference of Governmental Industrial Hygienists (ACGIH) or the European Union (EU).

11.5 Sensitization: No animal data available

11.6 Mutagenic effects:

In an experimental investigation, mutational changes in the *hprt* gene were reported in alveolar epithelial cells in the rat following inhalation exposure to carbon black. This observation is believed to be rat specific and a consequence of "lung overload" which led to chronic inflammation and release of oxygen species. (see Chronic toxicity above). This is thus considered to be a secondary genotoxic effect and thus carbon black itself would not be considered to be mutagenic.

11.7 Reproductive effects: No effects reported in long-term animal studies.

11.8 Epidemiology:

Results of epidemiological studies of carbon black production workers suggest that cumulative exposure to carbon black may result in small decrements in lung function, as measured by FEV₁. A recent U.S. respiratory morbidity study suggested a 27 ml decline in FEV₁ from a 1-mg/m³ exposure over a 40-year period. An older European investigation suggested an exposure to 1 mg/m³ (inhalable fraction) of carbon black over a 40-year working-lifetime would result in a 48ml decline in FEV₁. In contrast, normal age related decline over a similar period of time would be approximately 1200 ml.

The relationship between symptoms and working lifetime exposure to carbon black is less clear. In the U.S. study, 9% of the highest exposure group (in contrast to 5% of the unexposed group) reported symptoms consistent with chronic bronchitis. In the recent U.S. study no links were noted between current exposure levels and decrements in lung function and symptoms.

A study of carbon black workers in the UK showed an elevated incidence of lung cancer but it was not considered to be related to carbon black.

SID RICHARDSON CARBON CO. MATERIAL SAFETY DATA SHEET

CARBON BLACK

(ISO 11014-1 / ANSI Z 400.1-1998 / 93/112/EC)

Results of epidemiological studies of carbon black production workers suggest that cumulative exposure to carbon black may result in small decrements in lung function, as measured by FEV₁. According to a European investigation, exposure to 1 mg/m³ (inhalable fraction) of carbon black over a 40-year lifetime will result in a 48-milliliter (ml) decline in FEV₁. In contrast, normal age related decline over a similar period of time would be approximately 1200 ml. A similar morbidity study in the United States suggested a 27 ml decline in FEV₁ from a 1mg/m³ exposure (inhalable fraction) over a 40 year period.

The relationship between symptoms and exposure to carbon black is less clear. In the U.S. study, 9% of the highest exposure group (in contrast to 5% of the unexposed group) reported symptoms consistent with chronic bronchitis. In the European study, methodological limitations in the administration of the questionnaire limit the drawing of definitive conclusions about symptoms. This study, however, indicated a link between carbon black and small opacities on the chest films, with negligible effects on lung function.

12. ECOLOGICAL DATA

Ecotoxicity:

- Aquatic toxicity: Acute fish toxicity: LC50 (96 h) > 1000mg/l, *Brachydanio rerio* (zebrafish), (OECD Guideline 203).
- Acute water flea toxicity: EC50 (24 h) > 5600 mg/l. *Daphnia magna* (waterflea), (OECD Guideline 202).
- Acute algae toxicity: EC 50 (72 h) >10,000 mg/l NOEC 50 ≥10,000 mg/l (*Scenedesmus subspicatus*), (OECD Guideline 201)
- Behavior in water treatment plants: Activated sludge, EC0 (3 h) >= 800 mg/l. DEV L3 (TTC test)
- Mobility: Not soluble in water.
- Bioaccumulation: Potential bioaccumulation is not expected because of physio-chemical properties of the substance.

13. DISPOSAL CONSIDERATIONS

Product can be burned in suitable incineration plants or disposed of in a suitable landfill in accordance with the regulations of the appropriate federal, provincial, state and local authorities.

EU: See European Waste Catalogue (Council Directive 75/422/EEC).

U.S.: Not a hazardous waste under U.S. RCRA, 40 CFR 261.

Canada: Not a hazardous waste under provincial regulations.

Container/Packaging: Return reusable containers to manufacturer. Paper bags may be incinerated, recycled, or disposed of in an appropriate landfill in

SID RICHARDSON CARBON CO. MATERIAL SAFETY DATA SHEET

CARBON BLACK

(ISO 11014-1 / ANSI Z 400.1-1998 / 93/112/EC)

accordance with national and local laws.

14. TRANSPORT INFORMATION

Carbon black is not classified as a hazardous material by the following country regulations/agencies:

Canadian Transport of Dangerous Goods Regulation
European Transport of Dangerous Goods Regulations
GGVS, GGVE, RID, ADR, IMDG Code, ICAO-TI
United Nations (no UN number)
U.S. Department of Transportation

International transportation identification:

"Carbon black, non-activated, mineral origin"
Not dangerous according to IMDG-Code
Not dangerous according to ICAO-TI

UN Shipping Class: Not classified.

UN Packing Group: Not classified.

U.S. Rail Regulations: Not classified.

15. REGULATORY INFORMATION

June 2003

15.1 European Union (EU):

Label Information

Classification: Not defined as a dangerous substance or preparation according to Council Directive 67/548/EEC and its various amendments and adaptations.

Symbol: None required

Risk and Safety Phrases: S22 - Do not breathe dust

S33 - Take precautionary measures against static discharge

[S33 may not be applicable to all grades of carbon black]

15.2 Germany:

WGK Water Classification: Number: Unknown, Class: Unknown

15.3 Canada:

WHMIS Classification: D2A .

Statement of Equivalence: "This product has been classified in accordance with the hazard criteria of the *Controlled Products Regulations* and the MSDS contains all the information required by the *Controlled Products Regulations*."

Ingredient Disclosure List: Contains carbon black. See Section 2.

SID RICHARDSON CARBON CO.

MATERIAL SAFETY DATA SHEET

CARBON BLACK

(ISO 11014-1 / ANSI Z 400.1-1998 / 93/112/EC)

15.4 United States:

Federal Regulations

Superfund Amendments and Reauthorization Act (SARA) Title III
Section 313 Toxic Substances: Does not contain any
components subject to this section.

Toxic Release Inventory (TRI): Under EPA's Toxics Release Inventory
(TRI) program the reporting threshold for 21 Polycyclic
Aromatic Compounds (PACs) has been lowered to 100
pounds per year manufactured, processed, or otherwise used.
(64 CFR 58666, Oct. 29, 1999) The 100 pounds/yr applies to
the cumulative total of 21 specific PACs. Carbon black may
contain certain of these PACs and the user is advised to
evaluate their own TRI reporting responsibilities.

State Regulations

California Safe Drinking Water and Toxics Enforcement Act of 1986
(Proposition 65):
"Carbon black (airborne, unbound particles of respirable size)" is a
California Proposition 65 listed substance. All three listing qualifiers
(airborne, unbound (not bound within a matrix), and respirable size (10
micrometers or less in diameter)) must be met for this substance to be
considered a Proposition 65 listed substance.

15.5 Inventory Status:

All components either are listed on or exempt from the following inventories:

European Union: European Inventory of Existing Commercial Chemical
Substances (EINECS) No. 215-609-9.

Australia: Australian Inventory of Chemical Substances (AICS)

Canada: Domestic Substances List (DSL)

Japan: Existing and New Chemical Substances (ENCS) No. 5-3328.

Korea: Existing Chemical Substances List (ECL) No. KE-04882

Philippines: Philippine Inventory of Chemicals and Chemical Substances
(PICCS)

China: Inventory of Existing Chemical Substances

United States: Toxic Substances Control Act (TSCA)

SID RICHARDSON CARBON CO. MATERIAL SAFETY DATA SHEET

CARBON BLACK

(ISO 11014-1 / ANSI Z 400.1-1998 / 93/112/EC)

16. OTHER INFORMATION

June 2003

- 16.1** Polycyclic Aromatic Hydrocarbon (PAH) Content. Manufactured carbon blacks generally contain less than 0.1% of solvent extractable polycyclic aromatic hydrocarbons (PAH). Solvent extractable PAH content depends on numerous factors including, but not limited to, the manufacturing process, desired product specifications, and the analytical procedure used to measure and identify solvent extractable materials.

Questions concerning PAH content of carbon black and analytical procedures should be addressed to your carbon black supplier.

- 16.2** National Fire Protection Association (NFPA) Rating:

Health: 1

Flammability: 1

Reactivity: 0

0 = minimal, 1 = slight, 2 = moderate, 3 = serious, 4 = severe

[Note: Chronic effects are not taken into consideration in the NFPA rating]

- 16.3** Hazardous Materials Identification System[®] (HMIS[®]) Rating:

Health: 1*

Flammability: 1

Physical Hazard: 0

0 = minimal, 1 = slight, 2 = moderate, 3 = serious, 4 = severe

HMIS[®] is a registered trademark of the National Paint and Coatings Association

[Note: the Health rating is a "1". The asterisk must be added to represent the chronic hazard (carbon black listed on IARC)]*

- 16.4** Disclaimer:

The data and information presented herein corresponds to the present state of our knowledge and experience and is intended to describe our product with respect to possible occupational safety and health concerns. The user of this product has sole responsibility to determine the suitability of the product for any use and manner of use intended, and for determining the regulations applicable to such use in the relevant jurisdiction. This MSDS is updated on a periodic basis in accordance with applicable health and safety standards.

NOV 12 2002

124-38-9/E-3

SCOTT SPECIALTY GASES

19087772

MATERIAL SAFETY DATA SHEETS

DATE: 9/02/97

SUPPLIER ADDRESS: 6141 EASTON ROAD, BLDG 1
 PO BOX 310
 PLUMSTEADVILLE, PA 18949-0310

EMERGENCY PHONE: (215) 766-8861
 NUMBER

1. CHEMICAL PRODUCT

PRODUCT NAME: CARBON DIOXIDE

SYNONYMS: Carbonic Anhydride, Carbonic Acid Gas

2. COMPOSITION, INFORMATION ON INGREDIENTS

Ingredient Name	Formula	CAS#	Concentration	Exposure Limits (PPM)			
				ACGIH TLV	OSHA PEL	MAC	Other STEL
CARBON DIOXIDE	CO2	124-38-9	99+%	5,000	5,000	5,000	30,000

3. HAZARD IDENTIFICATION

*** EMERGENCY OVERVIEW ***

High pressure liquid and gas.
 Can cause rapid suffocation.
 Can increase respiration and heart rate.
 May cause frostbite.

POTENTIAL HEALTH EFFECTS

ROUTES OF ENTRY: Inhalation

ACUTE EFFECTS: Exposure to carbon dioxide at 1-4% concentrations result in increased respiratory volume. Material acts as a simple asphyxiant by displacing air necessary for life. Symptoms include rapid respiration, muscular incoordination, fatigue, nausea and vomiting and unconsciousness. Liquid may cause frostbite. Pressure drop through valves and piping may cause extreme cold and frostbite on contact.

CHRONIC EFFECTS: None known

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: None known

OTHER EFFECTS OF OVEREXPOSURE: None

CARCINOGENICITY (US Only):

NTP - No
 IARC MONOGRAPHS - No
 OSHA REGULATED - No

4. FIRST AID MEASURES

INHALATION: Immediately remove victim to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.

EYE CONTACT: None

SKIN CONTACT: If frostbite occurs, flush affected areas with lukewarm water. DO NOT USE HOT WATER.

INGESTION: None

IN EVENT OF EXPOSURE, CONSULT A PHYSICIAN

NOTE TO PHYSICIAN: None

5. FIRE FIGHTING MEASURES

FLASH POINT: Nonflammable

AUTOIGNITION TEMPERATURE: N/Ap

FLAMMABLE LIMITS: Nonflammable

LOWER:

UPPER:

EXTINGUISHING MEDIA: Use what is appropriate for surrounding fire.

SPECIAL FIRE FIGHTING INSTRUCTION AND EQUIPMENT: Wear self-contained breathing apparatus and full protective clothing. Keep fire exposed cylinders cool with water spray.

HAZARDOUS COMBUSTION PRODUCTS: Toxic carbon monoxide may be given off during combustion.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Cylinder rupture may occur under fire conditions.

6. ACCIDENTAL RELEASE MEASURES

CLEAN UP PROCEDURES: Shut off source if possible and remove source of heat. Remove leaking cylinder to exhaust hood or safe outdoor area if this can be done safely.

SPECIALIZED EQUIPMENT: None

7. HANDLING AND STORAGE

PRECAUTIONS TO BE TAKEN IN HANDLING: Secure cylinder when using to protect from falling. Use suitable hand truck to move cylinders.

PRECAUTIONS TO BE TAKEN IN STORAGE: Store in well ventilated areas. Keep valve protection cap on cylinders when not in use.

8. EXPOSURE CONTROLS/ PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide adequate general and local exhaust ventilation to maintain concentration below exposure limits.

PERSONAL PROTECTION

EYE/FACE PROTECTION: Safety glasses . A face shield is also recommended when handling cold liquid, solid or vapor.

SKIN PROTECTION: Loose fitting gloves of impermeable material, such as leather, when working with cold liquid, solid or vapor.

RESPIRATORY PROTECTION: Use a self-contained breathing apparatus in case of emergency or non-routine use.

OTHER PROTECTIVE EQUIPMENT: Safety shoes when handling cylinders.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Colorless

ODOR: Odorless

PHYSICAL STATE: Gas

VAPOR PRESSURE: @20 deg.C: 816 psig

VAPOR DENSITY (AIR=1): 1.53

BOILING POINT (C): Sublimes - 109.3

SOLUBILITY IN WATER: v/v @68 deg.F: 87.8

SPECIFIC GRAVITY (H2O=1): 1.56

EVAPORATION RATE: N/Av

ODOR THRESHOLD: N/Av

Continued ...

10. STABILITY AND REACTIVITY

STABILITY: Stable under normal storage conditions.

CONDITIONS TO AVOID: Storage in poorly ventilated areas. Storage near a heat source.

MATERIALS TO AVOID: Carbon dioxide decomposes when heated above 1700 degrees celsius. This weakly acidic material will react with alkaline materials to form carbonates and bicarbonates.

HAZARDOUS POLYMERIZATION: Will not occur.

HAZARDOUS DECOMPOSITION: Toxic carbon monoxide when heated above 1700 deg.C.

11. TOXICOLOGICAL INFORMATION

LETHAL CONCENTRATION (LC50): NONE ESTABLISHED
LETHAL DOSE 50 (LD50): N/Ap
TERATOGENICITY: N/Ap
REPRODUCTIVE EFFECTS: N/Ap
MUTAGENICITY: N/Ap

12. ECOLOGICAL INFORMATION

No adverse ecological effects are expected.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: Dispose of non-refillable cylinders in accordance with federal, state and local regulations. Allow gas to vent slowly to atmosphere in an unconfined area or exhaust hood. If the cylinders are the refillable type, return cylinders to supplier with any valve outlet plugs or caps secured and valve protection caps in place.

14. TRANSPORT INFORMATION

CONCENTRATION: 99+%
DOT DESCRIPTION (US ONLY):
PROPER SHIPPING NAME: Carbon Dioxide
HAZARD CLASS: 2.2 (nonflammable)
IDENTIFICATION NUMBER: UN1013
REPORTABLE QUANTITIES: None

LABELING: NONFLAMMABLE GAS

ADR/RID (EU Only): Class 2, 2a

SPECIAL PRECAUTIONS: Cylinders should be transported in a secure upright position in a well ventilated truck.

15. REGULATORY INFORMATION

OSHA: Process Safety Management: Material is not listed in appendix A of 29 CFR 1910.119 as highly hazardous chemical.

TSCA: Material is listed in TSCA inventory.

SARA: The threshold planning quantity for material is 10,000 lbs.

EU NUMBER: 204-646-9

NUMBER IN ANNEX 1 OF DIR 67/548: Not listed in annex 1.

EU CLASSIFICATION: None

R: As

S: 9,23

16. OTHER INFORMATION

OTHER PRECAUTIONS: Protect containers from physical damage. Do not deface cylinders or labels. Cylinders should be refilled by qualified producers of compressed gas. Shipment of a compressed gas cylinder which has not been filled by the owner or with his written consent is a violation of federal law (49 CFR)

ABBREVIATIONS:
N/Ap - Not Applicable
N/Av - Not Available
SA - Simple Asphyxiant
NE - None Established

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SCOTT SPECIALTY GASES**MATERIAL SAFETY DATA SHEETS**

DATE: 9/02/97

SUPPLIER ADDRESS: 6141 EASTON ROAD
 PO BOX 310
 PLUMSTEADVILLE, PA 18949-0310
 EMERGENCY PHONE: (215) 766-8861
 NUMBER

1. CHEMICAL PRODUCT

PRODUCT NAME: OXYGEN

SYNONYMS: None

2. COMPOSITION, INFORMATION ON INGREDIENTS

Ingredient Name	Formula	CAS#	Concentration	Exposure Limits (PPM)			
				ACGIH TLV	OSHA PEL	MAC	Other STEL
OXYGEN	O ₂	7782-44-7	99%	NE	NE	NE	NE

Note: NE = NONE ESTABLISHED

3. HAZARD IDENTIFICATION

*** EMERGENCY OVERVIEW ***
 High pressure oxidizing gas.
 Vigorously accelerates combustion.

POTENTIAL HEALTH EFFECTS

ROUTES OF ENTRY: Inhalation

ACUTE EFFECTS: Extended exposures to oxygen at higher pressures may be hazardous. A variety of central nervous system effects may result from breathing oxygen greater than 2 atm. Symptoms include dizziness, impaired coordination, visual and hearing disturbances and seizures. Can cause frostbite and burns to skin and eyes.

CHRONIC EFFECTS: Prolonged breathing of very cold atmospheres can cause lung damage. Prolonged exposure to cold areas can result in hypothermia.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: None known

OTHER EFFECTS OF OVEREXPOSURE: None

CARCINOGENICITY (US Only):

NTP - No
 IARC MONOGRAPHS - No
 OSHA REGULATED - No

Continued ...

4. FIRST AID MEASURES

INHALATION: Immediately remove victim to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.

EYE CONTACT: Remove victim from source of contact. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

SKIN CONTACT: Do not apply direct heat. Do not rub frozen area. Flush affected area with tepid water.

INGESTION: None

IN EVENT OF EXPOSURE, CONSULT A PHYSICIAN

NOTE TO PHYSICIAN: None

5. FIRE FIGHTING MEASURES

FLASH POINT: Nonflammable

AUTOIGNITION TEMPERATURE: N/Av

FLAMMABLE LIMITS: Nonflammable

LOWER:

UPPER:

EXTINGUISHING MEDIA: Use extinguish media appropriate for surrounding fire.

SPECIAL FIRE FIGHTING INSTRUCTION AND EQUIPMENT: Wear self-contained breathing apparatus and full protective clothing. Keep fire exposed cylinders cool with water spray. If possible, stop the product flow. Move container from fire area if possible.

HAZARDOUS COMBUSTION PRODUCTS: None

UNUSUAL FIRE AND EXPLOSION HAZARDS: Cylinder rupture may occur under fire conditions. High oxidizing atmosphere increases the likelihood of fires. Oxygen vigorously supports combustion.

6. ACCIDENTAL RELEASE MEASURES

CLEAN UP PROCEDURES: Evacuate and ventilate area. Shut off source if possible and remove source of heat.

SPECIALIZED EQUIPMENT: None

7. HANDLING AND STORAGE

PRECAUTIONS TO BE TAKEN IN HANDLING: Secure cylinder when using to protect from falling. Use suitable hand truck to move cylinders. Use only oxygen cleaned equipment. Avoid oils and greases. Oxygen reacts violently with hydrocarbons particularly at high pressure.

PRECAUTIONS TO BE TAKEN IN STORAGE: Store in well ventilated areas away from combustibles. Keep valve protection cap on cylinders when not in use.

8. EXPOSURE CONTROLS/ PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide adequate general and local exhaust ventilation.

PERSONAL PROTECTION

EYE/FACE PROTECTION: Safety glasses

SKIN PROTECTION: None

RESPIRATORY PROTECTION: In case of leakage, use self-contained breathing apparatus.

OTHER PROTECTIVE EQUIPMENT: Safety shoes when handling cylinders.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Colorless

ODOR: Odorless

PHYSICAL STATE: Gas

VAPOR PRESSURE: N/Av

VAPOR DENSITY (AIR=1): @25 deg.C: 1.105

BOILING POINT (C): -183

SOLUBILITY IN WATER: 4.89 cm³/100 cm³

SPECIFIC GRAVITY (H₂O=1): Gas

EVAPORATION RATE: Gas

ODOR THRESHOLD: None

Continued ...

10. STABILITY AND REACTIVITY

STABILITY: Stable under normal storage conditions.

CONDITIONS TO AVOID: Storage in poorly ventilated areas. Storage near a heat source.

MATERIALS TO AVOID: Reacts violently with phosphine, hydrazine, ethers, alcohol's, hydrogen sulfide, and hydrocarbons.

HAZARDOUS POLYMERIZATION: Will not occur.

HAZARDOUS DECOMPOSITION: None

11. TOXICOLOGICAL INFORMATION

LETHAL CONCENTRATION (LC50): None established

LETHAL DOSE 50 (LD50): N/Ap

TERATOGENICITY: N/Ap

REPRODUCTIVE EFFECTS: N/Ap

MUTAGENICITY: N/ap

12. ECOLOGICAL INFORMATION

No adverse ecological effects are expected.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: Non-returnable cylinders must not be refilled. Dispose of non-refillable cylinders in accordance with federal, state, and local regulations. Allow gas to discharge at a moderate rate. Return cylinders to supplier with any valve outlet plugs or caps secured and valve protection cap in place.

14. TRANSPORT INFORMATION

CONCENTRATION: 99+%

DOT DESCRIPTION (US ONLY):

PROPER SHIPPING NAME: Oxygen, compressed

HAZARD CLASS: 2.2 (nonflammable)

IDENTIFICATION NUMBER: UN1072

REPORTABLE QUANTITIES: None

LABELING: NONFLAMMABLE, OXIDIZING GAS

ADR/RID (EU Only): Class 2, 10

SPECIAL PRECAUTIONS: Cylinders should be transported in a secure upright position in a well ventilated truck.

15. REGULATORY INFORMATION

OSHA: Process Safety Management: Materials are not listed in appendix A of 29 CFR 1910.119 as highly hazardous chemicals.

TSCA: Material is listed in TSCA inventory.

SARA: The threshold planning quantity for material is 10,000 lbs.

EU NUMBER: 231-956-9

NUMBER IN ANNEX 1 OF DIR 67/548: Not listed in annex 1.

EU CLASSIFICATION: N/Av

R: 8A

S: 9,17A

16. OTHER INFORMATION

OTHER PRECAUTIONS: Protect containers from physical damage. Do not deface cylinders or labels. Cylinders should be refilled by qualified producers of compressed gas. Shipment of a compressed gas cylinder which has not been filled by the owner or with his written consent is a violation of federal law (49 CFR)

ABBREVIATIONS:

N/Ap - Not Applicable

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SA - Simple Asphyxiant

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SCOTT SPECIALTY GASES**MATERIAL SAFETY DATA SHEETS**

DATE: 10/14/97

SUPPLIER ADDRESS: 6141 EASTON ROAD
 PO BOX 310
 PLUMSTEADVILLE, PA 18949-0310
 EMERGENCY PHONE: (215) 766-8861
 NUMBER

1. CHEMICAL PRODUCT

PRODUCT NAME: HYDROGEN SULFIDE

SYNONYMS: Dihydrogen sulfide,
hydrosulfuric acid, sulfuretted hydrogen**2. COMPOSITION, INFORMATION ON INGREDIENTS**

Ingredient Name	Formula	CAS#	Concentration	Exposure Limits (PPM)			
				ACGIH TLV	OSHA PEL	MAC	Other STEL
HYDROGEN SULFIDE (c) = ceiling	H ₂ S	7783-06-4	99+%	10	20 (c)	10	15

3. HAZARD IDENTIFICATION

*** EMERGENCY OVERVIEW ***

Poisonous, flammable liquid and gas under pressure.
 May be fatal if inhaled.

Can form explosive mixtures with air.

May cause respiratory tract and central nervous system damage.

Can cause eye irritation.

Gas deadens sense of smell.

Symptoms of exposure may be delayed.

POTENTIAL HEALTH EFFECTS

ROUTES OF ENTRY: Inhalation

ACUTE EFFECTS: Irritation to the eyes, mucous membranes, and upper respiratory tract. May cause pulmonary edema, headache, dizziness, bronchitis, and respiratory paralysis. High concentrations may cause collapse and death.

CHRONIC EFFECTS: May cause conjunctivitis, photophobic, corneal bullae, tearing, pain, and blurred vision.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: Persons with impaired pulmonary function or pre-existing eye problems may be at increased risk from exposure.

OTHER EFFECTS OF OVEREXPOSURE: None

CARCINOGENICITY (US Only):

NTP - No

IARC MONOGRAPHS - No

OSHA REGULATED - No

Continued ...

4. FIRST AID MEASURES

INHALATION: Immediately remove victim to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.

EYE CONTACT: Immediately flush with copious amounts of water for at least 15 minutes.

SKIN CONTACT: Immediately flush with copious amounts of water for at least 15 minutes while removing contaminated clothing.

INGESTION: None

IN EVENT OF EXPOSURE, CONSULT A PHYSICIAN

NOTE TO PHYSICIAN: None

5. FIRE FIGHTING MEASURES

FLASH POINT: -60 deg.C

AUTOIGNITION TEMPERATURE: 260 deg.C

FLAMMABLE LIMITS: Vol.%

LOWER: 4.3

UPPER: 46

EXTINGUISHING MEDIA: Dry chemical or carbon dioxide. The only safe way to extinguish a H₂S fire is to stop the flow of gas.

SPECIAL FIRE FIGHTING INSTRUCTION AND EQUIPMENT: Wear self-contained breathing apparatus and full protective clothing. Keep fire exposed cylinders cool with water spray.

HAZARDOUS COMBUSTION PRODUCTS: None

UNUSUAL FIRE AND EXPLOSION HAZARDS: Cylinder rupture may occur under fire conditions. Vapors may travel a considerable distance to the source of ignition and flash back. Emits toxic fumes under fire conditions. Fight fire from maximum possible distance.

6. ACCIDENTAL RELEASE MEASURES

CLEAN UP PROCEDURES: Evacuate and ventilate area. Remove leaking cylinder to exhaust hood or safe outdoor area. Shut off source if possible and remove source of heat.

SPECIALIZED EQUIPMENT: None

7. HANDLING AND STORAGE

PRECAUTIONS TO BE TAKEN IN HANDLING: Secure cylinder when using to protect from falling. Use suitable hand truck to move cylinders.

PRECAUTIONS TO BE TAKEN IN STORAGE: Store in well ventilated areas. Keep valve protection cap on cylinders when not in use. Store away from heat, flame, and sparks.

8. EXPOSURE CONTROLS/ PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide adequate general and local exhaust ventilation to maintain concentrations below exposure and flammable limits.

PERSONAL PROTECTION

EYE/FACE PROTECTION: Safety glasses

SKIN PROTECTION: None

RESPIRATORY PROTECTION: In case of leakage, use self-contained breathing apparatus.

OTHER PROTECTIVE EQUIPMENT: Safety shoes when handling cylinders.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Colorless
 ODOR: Rotten egg smell.
 PHYSICAL STATE: Gas
 VAPOR PRESSURE: @20 deg.C: 18.5 atm
 VAPOR DENSITY (AIR=1): 1.175
 BOILING POINT (C): -60
 SOLUBILITY IN WATER: Soluble
 SPECIFIC GRAVITY (H₂O=1): Gas
 EVAPORATION RATE: Gas
 ODOR THRESHOLD: 0.06 to 1.0 ppm

Continued ...

10. STABILITY AND REACTIVITY

STABILITY: Stable under normal storage conditions.

CONDITIONS TO AVOID: Storage in poorly ventilated areas. Storage near a heat source.

MATERIALS TO AVOID: Oxidizing materials, rubber, lead, silver, alkali metals, mercury, brass and copper.

HAZARDOUS POLYMERIZATION: Will not occur.

HAZARDOUS DECOMPOSITION: Sulfur oxides.

11. TOXICOLOGICAL INFORMATION

LETHAL CONCENTRATION (LC50): 712 ppm, rat 1 hour.

LETHAL DOSE 50 (LD50): N/Ap

TERATOGENICITY: N/Ap

REPRODUCTIVE EFFECTS: N/Ap

MUTAGENICITY: N/Ap

12. ECOLOGICAL INFORMATION

No adverse ecological effects are expected.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: Dispose of non-refillable cylinders in accordance with federal, state and local regulations. Allow gas to vent slowly to atmosphere in an unconfined area or exhaust hood. If the cylinders are the refillable type, return cylinders to supplier with any valve outlet plugs or caps secured and valve protection caps in place.

14. TRANSPORT INFORMATION

CONCENTRATION: 99+%

DOT DESCRIPTION (US ONLY):

PROPER SHIPPING NAME: Hydrogen sulfide

HAZARD CLASS: 2.3 (poison), Hazard Zone B

IDENTIFICATION NUMBER: UN1053

REPORTABLE QUANTITIES: 100 lb.

LABELING: POISON GAS, FLAMMABLE GAS

ADR/RID (EU Only): Class 2,2TF

SPECIAL PRECAUTIONS: Cylinders should be transported in a secure upright position in a well ventilated truck.

15. REGULATORY INFORMATION

OSHA: Process Safety Management: Material is listed in appendix A of 29 CFR 1910.119 as highly hazardous chemical.

TSCA: Material is listed in TSCA inventory.

SARA: The threshold planning quantity for this material is 500 lb.

EU NUMBER: 231-977-3

NUMBER IN ANNEX 1 OF DIR 67/548: Material is listed in annex 1.

EU CLASSIFICATION: N/Av

R: 13-26

S: 7/9-16-45

16. OTHER INFORMATION

OTHER PRECAUTIONS: Protect containers from physical damage. Do not deface cylinders or labels. Cylinders should be refilled by qualified producers of compressed gas. Shipment of a compressed gas cylinder which has not been filled by the owner or with his written consent is a violation of federal law (49 CFR)

ABBREVIATIONS:

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