



United States Steel Corporation

Cryogenically-Processed Coke Oven Gas Safety Data Sheet (SDS)

USS IHS Number: 78443

Locations: Clairton

Revision: 8/01/2018

Original: 05/14/2012

Section 1 – Identification

1(a) Product Identifier Used on Label: Cryogenically-Processed Coke Oven Gas

1(b) Other Means of Identification: Clairton Coke-Oven Gas, Mon Valley Coke-Oven Gas, Downriver Coke-Oven Gas

1(c) Recommended Use of the Chemical and Restrictions on Use: Fuel gas; none

1(d) Name, Address, and Telephone Number:

United States Steel Corporation Phone number: (412) 433-6840 (8:00 am to 5:00 pm)
600 Grant Street, Room 1662 FAX: (412) 433-5019
Pittsburgh, PA 15219-2800

1(e) Emergency Phone Number: 1-800-262-8200 (CHEMTREC)

Section 2 – Hazard(s) Identification

2(a) Classification of the Chemical: Cryogenically-Processed Coke Oven Gas is hazardous according to the criteria specified in European Directives 67/548/EEC and 1999/45/EC and OSHA 29 CFR 1910.1200 Hazard Communication Standard. The categories of Health Hazards as defined in "GLOBALLY HARMONIZED SYSTEM OF CLASSIFICATION AND LABELLING OF CHEMICALS (GHS), Third revised edition ST/SG/AC.10/30/Rev. 3" United Nations, New York and Geneva, 2009 have been evaluated and are listed below. Refer to Section 3, 8 and 11 for additional information.

2(b) Signal Word, Hazard Statement(s), Symbols and Precautionary Statement(s):

Hazard Symbol	Hazard Classification	Signal Word	Hazard Statement(s)
	Flammable Gases - 1	DANGER	<p>Extremely flammable gas. May cause cancer. May damage fertility or the unborn child. Causes damage to blood forming tissue, heart and central nervous system through prolonged or repeated inhalation exposure. May cause damage to central nervous system, lung, blood forming system and cardiovascular system. May cause genetic defects. May displace oxygen and cause rapid suffocation.</p>
	Germ Cell Mutagenicity - 1B Carcinogenicity - 1A Reproductive Toxicity - 1A Single Target Organ Toxicity (STOT) Repeat Exposure - 1		
	STOT Single Exposure - 2		
No Pictogram	Simple Asphyxiant - Single Category		

Precautionary Statement(s)

Prevention	Response	Storage/Disposal
<p>Keep away from heat/sparks/open flames/hot surfaces. -No smoking Do not breathe gas. Wear protective gloves / protective clothing / eye protection / face protection. Wash thoroughly after handling. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not eat, drink or smoke when using this product.</p>	<p>Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so If exposed, concerned or feel unwell: Get medical advice/attention or call poison center/doctor.</p>	<p>Dispose of contents in accordance with federal, state and local regulations. Store locked up. Store in well-ventilated place.</p>

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Section 2 – Hazard(s) Identification (continued)

2(c) Hazards Not Otherwise Classified: None Known

2(d) Unknown Acute Toxicity Statement (mixture): None Known

Section 3 – Composition/Information on Ingredients

3(a-c) Chemical Name, Common Name (synonyms), CAS Number and Other Identifiers, and Concentration:

Chemical Name	CAS Number	EC Number	% weight
Hydrogen	1333-74-0	215-605-7	40 – 60
Methane	74-82-8	200-812-7	20 – 30
Nitrogen	7727-37-9	231-783-9	3 – 15
Carbon Monoxide	630-08-0	211-128-3	3 – 6
Ethylene	74-85-1	200-815-3	0 – 5
Carbon Dioxide	124-38-9	204-696-9	0 – 5
Oxygen	7782-44-2	231-956-9	0 – 3
Ethane	74-84-0	200-814-8	0 – 2
Benzene	71-43-2	200-753-7	0 – 1
Propylene	115-07-1	204-062-1	0 – 1
Hydrogen Sulfide	7783-06-4	231-977-3	0 – 0.2
Propane	74-98-6	200-827-9	0 – 0.1
Carbonyl Sulfide	463-58-1	207-340-0	0 – 0.02

EC- European Community

CAS- Chemical Abstract Service

Cryogenically-Processed Coke Oven Gas contains small amounts of various constituents in addition to those listed. These small quantities are frequently referred to as “trace” or “residual” constituents that generally originate in the raw materials used. **Cryogenically-Processed Coke Oven Gas** may contain the following trace or residual constituents: toluene, mixed xylenes, naphthalene, methyl mercaptan, ethyl mercaptan, carbon disulfide, sulfur dioxide, and hydrogen cyanide.

Section 4 – First-aid Measures

4(a) Description of Necessary Measures: If exposed concerned or feel unwell: Get medical advice/attention.

- **Inhalation:** If inhaled: Remove person to fresh air and keep comfortable for breathing. Call a poison center or doctor if you feel unwell.
- **Eye Contact:** In case of contact: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing if eye irritation persists: Get medical advice/attention, if needed.
- **Skin Contact:** This material is a gas under normal atmospheric conditions. If exposed or concerned get medical advice/attention, if needed.
- **Ingestion:** This material is a gas under normal atmospheric conditions and ingestion is unlikely.

4(b) Most Important Symptoms/Effects, Acute and Delayed (chronic):

Acute Effects:

- **Inhalation:** When exposed at high concentrations will act as a simple asphyxiant. Simple asphyxiants displace the oxygen in the air and can cause symptoms of oxygen deprivation.
- **Eye:** May cause irritation
- **Skin:** None Expected
- **Ingestion:** This material is a gas under normal atmospheric conditions and ingestion is unlikely.

Delayed (chronic) Effects:

- **Inhalation:** Prolonged or repeated exposures may result in respiratory disorders. Chronic obstructive pulmonary disease may also develop from fibrous obstruction of the smaller airways. Repeated exposure may cause chronic cough, bronchitis, asthma, vocal cord dysfunction, reactive airways disease, and lung fibrosis.
- **Eye:** May cause irritation
- **Skin:** Prolonged or repeated exposures may result in irritation and dermatitis.
- **Ingestion:** Repeated or prolonged ingestion of harmful amounts of this product as distributed is unlikely.

4(c) Immediate Medical Attention and Special Treatment: Treat symptomatically.

Section 5 – Fire-fighting Measures

5(a) Suitable (and unsuitable) Extinguishing Media: Leaking gas fire: Do not extinguish, unless leak can be stopped safely or fire is immediately impacting human life. Eliminate all ignition sources if safe to do so. Extinguish with foam, carbon dioxide, dry powder or water fog, once leak is stopped. Do not use a solid stream of water as it may scatter and spread the fire.

5(b) Specific Hazards Arising from the Chemical: Irritating vapors/gas may form in fire. Tactical considerations must be made regarding gas fed fires and if it is safe to fully extinguish visible flame before shut off of the gas is accomplished. Unburned gas may result and seek a source of ignition.

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Section 5 – Fire-fighting Measures (continued)

5(c) Special Protective Equipment and Precautions for Fire-fighters Self-contained NIOSH approved respiratory protection and full protective clothing should be worn when fumes and/or smoke from fire are present. Firefighters should wear full face-piece self-contained breathing apparatus and chemical protective clothing with thermal protection. Direct water stream will scatter and spread flames and, therefore, should not be used. Evacuate area. Remove pressurized gas cylinders from the immediate vicinity. Cool containers exposed to flames with water until well after the fire is out. Close the valve if no risk is involved. Do not extinguish a leaking gas fire unless leak can be stopped. If leak cannot be stopped and no danger to surrounding area allow the fire to burn out. Fight fire from a protected location. Prevent buildup of vapors or gases to explosive concentrations.

Section 6 - Accidental Release Measures

6(a) Personal Precautions, Protective Equipment and Emergency Procedures: Leaking gas fire: Evacuate area. Do not extinguish unless leak can be stopped safely. Contact Gas Services to perform testing before entering the area.

6(b) Methods and Materials for Containment and Clean Up: Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Collect material in appropriate, labeled containers for recovery or disposal in accordance with federal, state, and local regulations. Follow applicable OSHA regulations (29 CFR 1910.120) and all other pertinent state and federal requirements.

Section 7 - Handling and Storage

7(a) Precautions for Safe Handling: Keep away from heat/sparks/open flames/hot surfaces. No smoking. Eliminate all ignition sources if safe to do so. Practice good housekeeping.

7(b) Conditions for Safe Storage, including Any Incompatibilities: Store in well-ventilated place. If feasible, store locked up. Store in well-ventilated place.

Section 8 - Exposure Controls / Personal Protection

8(a) Occupational Exposure Limits (OELs): Hot or Cold Rolled Steel Sheet/Strip and Hot Rolled Skelp as sold/shipped in its physical form does not present an inhalation, ingestion or contact hazard, nor would any of the following exposure data apply. However, operations such as high temperature (burning, welding, sawing, brazing, machining and grinding) may produce fumes and/or particulates. The following exposure limits are offered as reference, for an experience industrial hygienist to review.

Ingredients	8(a) OSHA PEL ¹	ACGIH TLV ²	NIOSH REL ³	IDLH ⁴
Hydrogen	NE	Simple Asphyxiant	NE	NE
Methane	NE	NE	NE	NE
Nitrogen	NE	NE	NE	NE
Carbon Monoxide	50 ppm	25 ppm	35 ppm "C" 200 ppm	1,200 ppm
Ethylene	NE	200 ppm	NE	NE
Carbon Dioxide	5000 ppm	5000 ppm "STEL" 30,000 ppm	5000 ppm "STEL" 30,000 ppm	40,000 ppm
Oxygen	NE	NE	NE	NE
Ethane	NE	NE	NE	NE
Benzene	1.0 ppm "STEL" 5.0 ppm	0.5 ppm, skin "STEL" 2.5 ppm	0.1 ppm "STEL" 1.0 ppm	500 ppm, Ca
Propylene	NE	500 ppm	NE	NE
Hydrogen Sulfide	"C" 20 ppm "PEAK" 50 ppm (10-min)	1.0 ppm "STEL" 5.0 ppm	"C" 10 ppm (10-min)	100 ppm
Propane	1000 ppm	NE	1000 ppm	2,100 ppm
Carbonyl Sulfide	NE	5.0 ppm	NE	NE

NE - None Established

1. OSHA PELs (Permissible Exposure Limits) are 8-hour TWA (time-weighted average) concentrations unless otherwise noted. A ("C") designation denotes a ceiling limit, which should not be exceeded during any part of the working exposure unless otherwise noted. A Short Term Exposure Limit (STEL) is defined as a 15-minute exposure, which should not be exceeded at any time during a workday. An Action level (AL) is used by OSHA and NIOSH to express a health or physical hazard. They indicate the level of a harmful or toxic substance/activity, which requires medical surveillance, increased industrial hygiene monitoring, or biological monitoring. Action Levels are generally set at one half of the PEL but the actual level may vary from standard to standard. The intent is to identify a level at which the vast majority of randomly sampled exposures will be below the PEL.
2. Threshold Limit Values (TLV) established by the American Conference of Governmental Industrial Hygienists (ACGIH) are 8-hour TWA concentrations unless otherwise noted. ACGIH TLVs are for guideline purposes only and as such are not legal, regulatory limits for compliance purposes. DSEN – May cause dermal sensitization. This notation is used to indicate the potential for dermal sensitization resulting from the interaction of an absorbed agent and ultraviolet light (i.e. photosensitization). RSEN – May cause respiratory sensitization.
3. The National Institute for Occupational Safety and Health Recommended Exposure Limits (NIOSH-REL)- Compendium of Policy and Statements. NIOSH, Cincinnati, OH (1992). NIOSH is the federal agency designated to conduct research relative to occupational safety and health. As is the case with ACGIH TLVs, NIOSH RELs are for guideline purposes only and as such are not legal, regulatory limits for compliance purposes.
4. The "immediately dangerous to life or health air concentration values (IDLHs)" are used by NIOSH as part of the respirator selection criteria and were first developed in the mid-1970's by NIOSH. The Documentation for Immediately Dangerous to Life or Health Concentrations (IDLHs) is a compilation of the rationale and sources of information used by NIOSH during the original determination of 387 IDLHs and their subsequent review and revision in 1994. Ca is designated as carcinogen.

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Section 8 - Exposure Controls / Personal Protection (continued)

8(b) Appropriate Engineering Controls: Local exhaust ventilation should be used to control the emission of air contaminants. General dilution ventilation may assist with the reduction of air contaminant concentrations. Emergency eye wash stations and deluge safety showers should be available in the work area.

8(c) Individual Protection Measures:

- **Respiratory Protection:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, use only a NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. Concentration in air of the various contaminants determines the extent of respiratory protection needed. Use a positive-pressure-demand, full-face, supplied air respirator or SCBA for concentrations above 50 times the exposure limit. If exposure is above the IDLH for any of the constituents, or there is a possibility of an uncontrolled release or exposure levels are unknown, then use a positive-demand, full-face, supplied air respirator with escape bottle or SCBA.

Warning! Air-purifying respirators both negative-pressure and powered-air do not protect workers in oxygen-deficient atmospheres.

- **Eyes:** Wear appropriate eye protection to prevent eye contact.
- **Skin:** Wear appropriate personal protective clothing to prevent skin contact. This may include fire retardant clothing.
- **Other Protective Equipment:** An eyewash fountain and deluge shower should be readily available in the work area.

Section 9 - Physical and Chemical Properties





<p>9(a) Appearance (physical state, color, etc.): Colorless gas</p> <p>9(b) Odor: Sulfur odor</p> <p>9(c) Odor Threshold: ND</p> <p>9(d) pH: ND</p> <p>9(e) Melting Point/Freezing Point: -434.45°F (Hydrogen)</p> <p>9(f) Initial Boiling Point and Boiling Range: -423.17°F (Hydrogen)</p> <p>9(g) Flash Point: 752°F (Hydrogen)</p> <p>9(h) Evaporation Rate: NA</p> <p>9(i) Flammability (solid, gas): Flammable</p> <p><small>NA - Not Applicable</small></p> <p><small>ND - Not Determined for product as a whole</small></p>	<p>9(j) Upper/lower Flammability or Explosive Limits: 34% / 4.4%</p> <p>9(k) Vapor Pressure: ND</p> <p>9(l) Vapor Density (Air = 1): 0.35 – 0.46</p> <p>9(m) Relative Density: ND</p> <p>9(n) Solubility(ies): ND</p> <p>9(o) Partition Coefficient n-octanol/water: NA</p> <p>9(p) Auto-ignition Temperature: ND</p> <p>9(q) Decomposition Temperature: ND</p> <p>9(r) Viscosity: NA</p>
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Section 10 - Stability and Reactivity

- 10(a) Reactivity:** Not Determined (ND) for product as a whole.
- 10(b) Chemical Stability:** Cryogenically-Processed Coke Oven Gas is stable under normal storage and handling conditions.
- 10(c) Possibility of Hazardous Reaction:** None Known
- 10(d) Conditions to Avoid:** Static discharge, sparks, open flames and other ignition sources.
- 10(e) Incompatible Materials:** Oxidizing agents, halogens.
- 10(f) Hazardous Decomposition Products:** Can produce carbon dioxide and carbon monoxide.

Section 11 - Toxicological Information

11(a-e) Information on Toxicological Effects: The following toxicity data has been determined for Cryogenically-Processed Coke Oven Gas by using the information available for its components applied to the guidance on the preparation of an SDS under the GHS requirements of OSHA and the EU CPL:

Hazard Classification	Hazard Category		Hazard Symbols	Signal Word	Hazard Statement
	EU	OSHA			
Germ Cell Mutagenicity (covers Categories 1A, 1B and 2)	1B	1B ^f		Danger	May cause genetic defects
Carcinogenicity (covers Categories 1A, 1B and 2)	1A	1A ^g		Danger	May cause cancer
Toxic to Reproduction (covers Categories 1A, 1B and 2)	1A	1A ^h		Danger	May damage fertility or the unborn child.
Specific Target Organ Systemic Toxicity (STOST) Following Single Exposure (covers Categories 1-3)	2	2 ⁱ		Warning	May causes damage to blood if inhaled, May cause respiratory irritation drowsiness or dizziness


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Section 11 - Toxicological Information (continued)

11(a-e) Information on Toxicological Effects (continued):

Hazard Classification	Hazard Category		Hazard Symbols	Signal Word	Hazard Statement
	EU	OSHA			
STOST Following Repeated Exposure (covers Categories 1 and 2)	1	1 ^j		Danger	Causes damage to blood forming tissues, heart and central nervous system through prolonged or repeated exposure
Simple Asphyxiant (Single Category)	NA	Single category	No Pictogram	Warning	May displace oxygen and cause rapid suffocation.

* Not Applicable

Toxicological data listed below are presented regardless to classification criteria. Individual hazard classification categories where the toxicological information has met or exceeded a classification criteria threshold are listed above.

a. No LC₅₀ or LD₅₀ has been established for **Cryogenically-Processed Coke Oven Gas** as a mixture. The following data has been determined for the components:

- **Benzene:** LC₅₀= 30,000 mg/m³ (Inhalation/ Rat/7hr); LC₅₀= 10,000 ppm (Inhalation/Rat/7hr); LD₅₀= 3.8 g/kg (Oral/Rat)
- **Carbon Monoxide** = LC₅₀ = 1807 ppm (rat) and 2440 ppm (mouse). Simple asphyxiation (oxygen displacement)
- **Ethylene:** LC₅₀ >57000 ppm/4hr
- **Hydrogen Sulfide:** LC₅₀ = 712 ppm rat/4 hr
- **Carbon Dioxide:** Rat LC₅₀ = 30000 – 50,000 ppm

b. No Skin (Dermal) Irritation data available for **Cryogenically-Processed Coke Oven Gas** as a mixture. The following Skin (Dermal) Irritation information was found for the components:

- **Benzene** - Mild to moderate in rabbits

c. No Eye Irritation data available for **Cryogenically-Processed Coke Oven Gas** as a mixture. The following Eye Irritation information was found for the components:

- **Benzene** - Moderate to severe irritant; may cause corneal injury
- **Hydrogen Sulfide** -20 – 50 ppm (human)

d. No Skin (Dermal)/Respiratory Sensitization data available for **Cryogenically-Processed Coke Oven Gas** as a mixture or its individual components.

e. No Aspiration Hazard data available for **Cryogenically-Processed Coke Oven Gas** as a mixture or its individual components.

f. No Germ Cell Mutagenicity data available for **Cryogenically-Processed Coke Oven Gas** as a mixture. The following Mutagenicity and Genotoxicity information was found for the components:

- **Benzene**- Chronic overexposure can cause chromosomal aberrations in animals and humans. Also, may induce sister-chromatid exchange (SCE), and micronuclei both *in vivo* and *in vitro*. Benzene overexposure has been shown to induce aneuploidy in dividing cells. Classified as a potential germ cell mutagen.
- g. Carcinogenicity: IARC, NTP, and OSHA do not list **Cryogenically-Processed Coke Oven Gas** as carcinogens. The following Carcinogenicity information was found for the components:

- **Benzene:** OSHA, carcinogen; IARC-1, carcinogen to humans; ACGIH TLV-A1, confirmed human carcinogen; NTP-K, known to be a carcinogen; NIOSH-Ca, potential occupational carcinogen; EPA-A, human carcinogen (by inhalation route of entry), EPA-K, cannot be determined, not classifiable as to human carcinogenicity.

- **Hydrogen Sulfide:** EPA-I, data are inadequate for an assessment of human carcinogenic potential.

- **Ethylene:** IARC-3, unclassifiable as to carcinogenicity in humans; ACGIH TLV-A4, not classifiable as a human carcinogen.

h. No Toxic to Reproduction data available for **Cryogenically-Processed Coke Oven Gas** as a mixture. The following Toxic to Reproductive information was found for the components:

- **Carbon Monoxide**- Embryofetal toxicity at maternally toxic dose levels.
- **Carbon Dioxide** - Increase in cardiac and skeletal defects in rats or rabbits exposed to 6 - 13% CO₂ at different times during gestation; effects on male fertility index
- **Hydrogen Sulfide** - Postnatal neurological alterations from prenatal exposure of 20 or 50 ppm (rats)

i. No Specific Target Organ Toxicity (STOT) following a Single Exposure data available for **Cryogenically-Processed Coke Oven Gas** as a mixture. The following STOT following a Single Exposure data was found for the components:

- **Hydrogen, Methane, Ethane, Nitrogen gas** - May cause dizziness, headache, nausea and unconsciousness, and suffocation.
- **Carbon Monoxide** - Central Nervous System effects: Headaches; tachypnea; nausea; weakness, dizziness, confusion, hallucinations; cyanosis; depressed ST segment of the ECG; angina; syncope; unconsciousness; death. Blood effects: carboxyhemoglobin formation.
- **Ethylene** - Central Nervous System effects: Excessive exposures may cause headache, drowsiness, dizziness, loss of coordination, and extreme exposure may cause unconsciousness and death.
- **Carbon Dioxide** - Lung effects: reduced inhalation and damage (rats). Cardiovascular effects: Decreased blood pressure (dogs) Central Nervous System effects: Headache, drowsiness, dizziness, stinging of the nose and throat, excitation rapid breathing and heart rate, excess salivation, vomiting, and unconsciousness (human).
- **Oxygen** - At high exposure levels: Lung: Transient decrease in pulmonary function Central Nervous System effects: Nausea, vomiting, dizziness or vertigo, muscle twitching, vision changes, and loss of consciousness and generalized seizures.

Section 11 - Toxicological Information (continued)

11(a-e) Information on Toxicological Effects (continued):

- i. No Specific Target Organ Toxicity (STOT) following a Single Exposure (continued):
- **Propylene** - Central Nervous System effects: light anesthesia in at 40% (rats); may cause dizziness, headache, nausea and unconsciousness, and suffocation (humans).
 - **Benzene** – Mild to moderate respiratory tract irritation expected with breathing vapors.
 - **Hydrogen Sulfide** - Lung: In high concentrations (1000 to 3000 ppm) hydrogen sulfide was lethal to dogs. At 3000 ppm, respiration ceased after a few breaths; death occurred within 15 to 20 minutes at 1000 ppm. Central Nervous System effects: In humans: inhalation of 500 ppm/30 min produces headache, dizziness, excitement, staggering, and gastro-enteric disorders, bronchitis or bronchial pneumonia; above 600 ppm can be fatal within 30 minutes through respiratory paralyses.
- j. No Specific Target Organ Toxicity (STOT) following Repeated Exposure data was available for **Cryogenically-Processed Coke Oven Gas** as a whole. The following STOT following Repeated Exposure data was found for the components:
- **Benzene**-induced blood dyscrasias in humans were characterized by erythrocytic anisocytosis and poikilocytosis, anemia, decreased hemoglobin, and reduced hematocrit. In addition, benzene is a human carcinogen
 - **Carbon Monoxide**- Carboxyhemoglobin; increased hematocrit; cardiovascular effects; cardiac hypertrophy; ECG alterations; neurotoxicity.
 - **Propylene** - Chronic exposure to mice and rats at 5000 ppm (7 h/day for 5 days/week for 120 weeks was not toxic)

The above toxicity information was determined from available scientific sources to illustrate the prevailing posture of the scientific community. The scientific resources includes: The American Conference of Governmental Industrial Hygienist (ACGIH) Documentation of the Threshold Limit Values (TLVs) and Biological Exposure Indices (BELs) with Other Worldwide Occupational Exposure Values 2018, The International Agency for Research on Cancer (IARC), The National Toxicology Program (NTP) updated documentation, the World Health Organization (WHO) and other available resources, the International Uniform Chemical Information Database (IUCLID), European Union Risk Assessment Report (EU-RAR), Concise International Chemical Assessment Documents (CICAD), European Union Scientific Committee for Occupational Exposure Limits (EU-SCOEL), Agency for Toxic Substances and Disease Registry (ATSDR), Hazardous Substance Data Bank (HSDB), and International Programme on Chemical Safety (IPCS).

The following health hazard information is provided regardless to classification criteria and is based on the individual component(s) and potential resultant components from further processing:

Acute Effects by component:

- **Hydrogen, Methane, Ethylene, Ethane and Nitrogen**: Simple asphyxiant
- **Carbon Monoxide**: Carbon monoxide reacts with hemoglobin to form carboxyhemoglobin. This form of hemoglobin has a reduced affinity to bind oxygen.
- **Carbon Dioxide**: Carbon dioxide has had lethal effects observed when atmospheric concentrations are increased above normal levels.
- **Benzene**: Excessive exposures may cause irritation to eyes, skin, nose, throat, lungs, and respiratory tract. Central nervous system effects may occur due to excessive exposures. Excessive exposures may result in headaches, nausea, sleep disturbances, excitability, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.
- **Hydrogen Sulfide**: Causes serious eye irritation. Fatal if inhaled. Causes damage to the cardiovascular system, central nervous system and respiratory system.

Delayed (chronic) Effects by Component:

- **Hydrogen, Methane, Ethylene, Ethane, Nitrogen and Carbon Dioxide**: Not Reported/Not Classified
- **Carbon Monoxide**: Human Fetal Death has resulted from exposure of CO to mothers bearing children. Causes damage to blood and central nervous system through prolonged or repeated exposure if inhaled.
- **Benzene**: IARC Group I- Human Cancer Hazard. Early signs and symptoms of chronic overexposure include effects on CNS and the GI tract (headache, loss of appetite, drowsiness, nervousness, and pallor) but the major manifestation of toxicity is aplastic anemia. Bone marrow depression may occur resulting in leucopenia, anemia, or thrombocytopenia (leukemogenic action). With continued over exposure the disease states may progress to pancytopenia resulting from bone marrow aplasia. Evidence has linked benzene in the etiology of leukemia.

Section 12 - Ecological Information

12(a) Ecotoxicity (aquatic & terrestrial): No Data Available for **Cryogenically-Processed Coke Oven Gas** as a whole. However, individual components have been found to be toxic to the environment:

- **Ethylene**: EC₅₀ (Daphnia magna) = 53.402 mg/L
- **Carbon Dioxide**: Harmful to some species of aquatic life in concentrations less than 20 mg/L
- **Benzene**: LC₅₀ Lepomis macrochirus (bluegill sunfish) 20 mg/l/24 to 48 hr /Conditions of bioassay not specified/; LC50 Salmo trutta (brown trout yearlings) 12 mg/l/1 hr (static bioassay)
- **Hydrogen Sulfide**: LC_{50/96 h} = <2 – 7 µg/L fresh water fish

12(b) Persistence & Degradability: Vapor-phase benzene is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 13 days for benzene.

12(c) Bioaccumulative Potential: No Data Available

12(d) Mobility (in soil): No Data Available for **Cryogenically-Processed Coke Oven Gas** as a whole. However, benzene has been estimated to be moderately to highly mobile in soil. Evaporation is expected to be the primary loss mechanism from water. Benzene is not expected to adsorb to sediment and suspended solids in water. Volatilization half-lives for a model river and model lake have been estimated to be 1 hr and 3.5 days for benzene.

12(e) Other Adverse Effects: None Known

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Section 12 - Ecological Information (continued)

Additional Information:

Hazard Category: Acute 1, Chronic 2

Signal Word: Warning

Hazard Symbol:



Hazard Statement: Toxic to aquatic life with long lasting effects

Section 13 - Disposal Considerations

Disposal: Waste code D001: Waste Flammable material with a flash point <140°F. This material and its container must be disposed of as hazardous waste. Under RCRA, it is the responsibility of the user of the product to determine, at the time of disposal, whether the product meets RCRA criteria for hazardous waste.

Container Cleaning and Disposal: Dispose of contents in accordance with federal, state and local regulations. Observe safe handling precautions. EWC: 16-05-04 (gases in pressure containers (including halons) containing dangerous substances; hazardous waste).

Please note this information is for Cryogenically-Processed Coke Oven Gas in its original form. Any alterations can void this information.

Section 14 - Transport Information

14 (a-g) Transportation Information:

US Department of Transportation (DOT) under 49 CFR 172.101 regulates **Cryogenically-Processed Coke Oven Gas** as a hazardous material. All federal, state, and local laws and regulations that apply to the transport of this type of material must be adhered to.

<p>Shipping Name: Compressed gas, flammable, n.o.s. (Coke Oven Gas)</p> <p>Shipping Symbols: G</p> <p>Hazard Class: 2.1</p> <p>UN No: UN1954</p> <p>Packing Group: NA</p> <p>DOT/IMO Label: 2.1</p> <p>Special Provisions (172.102): NA</p>	<p>Packaging Authorizations</p> <p>a) Exceptions: 306</p> <p>b) Bulk: 302, 305</p> <p>c) Non-bulk: 314, 315</p>	<p>Quantity Limitations</p> <p>a) Passenger, Aircraft, or Railcar: Forbidden</p> <p>b) Cargo Aircraft Only: 150 kg</p> <p>Vessel Stowage Requirements</p> <p>a) Vessel Stowage: D</p> <p>b) Other: 40</p> <p>DOT Reportable Quantities: Note over 2500 lb shipment would exceed the threshold for Benzene and make it an RQ for Benzene</p>
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International Maritime Dangerous Goods (IMDG) and the Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID) classification, packaging and shipping requirements follow the US DOT Hazardous Materials Regulation.

Regulations Concerning the International Carriage of Dangerous Goods by Road (ADR) regulates **Cryogenically-Processed Coke Oven Gas** as a hazardous material.

<p>Shipping Name: Compressed gas, flammable, n.o.s. (Coke Oven Gas)</p> <p>Class / Classification Code: 2 / 1F</p> <p>UN No.: UN1954</p> <p>Packing Group: NA</p> <p>ADR Label: 2.1</p> <p>Special Provisions: 274, 660, 662</p> <p>Limited/Excepted Quantities: 0 / E0</p>	<p>Packaging</p> <p>a) Packing Instructions: P200</p> <p>b) Special Packing Provisions: NA</p> <p>c) Mixed Packing Provisions: MP9</p>	<p>Portable Tanks & Bulk Containers</p> <p>a) Instructions: (M)</p> <p>b) Special Provisions: NA</p>
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International Air Transport Association (IATA) regulates **Cryogenically-Processed Coke Oven Gas** as a hazardous material.

<p>Shipping Name: Compressed gas, flammable, n.o.s. (Coke Oven Gas)</p> <p>Class/Division: 2.1</p> <p>Hazard Label (s): Flammable Gas</p> <p>UN No.: 1954</p> <p>Packing Group: NA</p> <p>Excepted Quantities (EQ): E0</p>	<p>Passenger & Cargo Aircraft</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Limited Quantity (EQ)</td> <td style="width: 50%;"></td> </tr> <tr> <td>Pkg Inst: Forbidden</td> <td>Pkg Inst: Forbidden</td> </tr> <tr> <td>Max Net Qty/Pkg: Forbidden</td> <td>Max Net Qty/Pkg: Forbidden</td> </tr> </table>	Limited Quantity (EQ)		Pkg Inst: Forbidden	Pkg Inst: Forbidden	Max Net Qty/Pkg: Forbidden	Max Net Qty/Pkg: Forbidden	<p>Cargo Aircraft Only:</p> <p>Pkg Inst: 200</p> <p>Max Net Qty/Pkg: 150 kg</p>	<p>Special Provisions: A1</p> <p>ERG Code: 10L</p>
Limited Quantity (EQ)									
Pkg Inst: Forbidden	Pkg Inst: Forbidden								
Max Net Qty/Pkg: Forbidden	Max Net Qty/Pkg: Forbidden								

Pkg Inst – Packing Instructions

Max Net Qty/Pkg – Maximum Net Quantity per Package

ERG – Emergency Response Drill Code

Transport Dangerous Goods (TDG) Classification: **Cryogenically-Processed Coke Oven Gas** has a TDG Classification as Compressed gas, flammable, n.o.s., Class 2.1, UN1954

Cryogenically-Processed Coke Oven Gas

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Section 15 - Regulatory Information


Regulatory Information: The following listing of regulations relating to a U. S. Steel product may not be complete and should not be solely relied upon for all regulatory compliance responsibilities. This product and/or its constituents are subject to the following regulations:

SARA Potential Hazard Categories: Immediate Acute Health Hazard; Delayed Chronic Health Hazard

Section 313 Supplier Notification: The product, **Cryogenically-Processed Coke Oven Gas** contains the following toxic chemicals subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR part 372:

CAS #	Chemical Name	Percent by Weight
71-43-2	Benzene	2
74-85-1	Ethylene	5
74-98-6	Propylene	1
7783-06-4	Hydrogen Sulfide	0.2
463-58-1	Carbonyl Sulfide	0.02

State Regulations: The product, **Cryogenically-Processed Coke Oven Gas** as a whole is not listed in any state regulations. However, individual components of the product are listed in various state regulations:

California Prop. 65:  This product can expose you to chemicals including benzene which is known to the State of California to cause cancer, and benzene and carbon monoxide which is known to the State of California to cause developmental toxicity. For more information go to www.P65Warnings.ca.gov.

Other Regulations:

WHMIS Classification (Canadian): The product, **Cryogenically-Processed Coke Oven Gas** is not listed as a whole. However individual components are listed.

Ingredients	WHMIS Classification
Hydrogen	Flammable gases – Category 1 (flammable limit – concentration range = 4-75%); Gases under pressure – Compressed gas *; Simple asphyxiants – Category 1 (Gas that is liable to cause asphyxiation by the displacement of air)
Methane	Flammable gases – Category 1 (lower flammable limit = 5.0%); Gases under pressure – Compressed gas *; Simple asphyxiants – Category 1
Nitrogen	Gasses under pressure - Compressed gas; Simple asphyxiants – Category 1
Carbon Monoxide	Flammable gases – Category 1 (flammable limit – concentration range = 12-75%); Gases under pressure – Compressed gas; Acute toxicity – inhalation – Category 3; Specific target organ toxicity – single exposure – Category 1 Reproductive toxicity – Category 1A (adverse effects on the development of the offspring)
Ethylene	Flammable gases – Category 1 (lower flammable limit = 2.7%); Gases under pressure – Liquified gas; Germ cell mutagenicity – Category 2; Simple Asphyxiants – Category 1
Carbon Dioxide	Compressed Gas (critical temperature = 31.1°C) disclosure at 1.0%
Oxygen	Oxidizing gases – Category 1 (Gas listed in ISO 10156:2010 standard); Gases under pressure – Compressed gas *
Benzene	Flammable liquids - Category 2 (Flash point = -11 °C closed cup (non- reported method) and boiling point = 80 °C); Skin corrosion/irritation - Category 2; Serious eye damage/eye irritation - Category 2; Germ cell mutagenicity - Category 1B; Carcinogenicity - Category 1A; Specific target organ toxicity - repeated exposure - Category 1; Specific target organ toxicity - single exposure (narcotic effects) - Category 3 - Narcotic effect; Aspiration hazard - Category 1 (Liquid hydrocarbon with a kinematic viscosity of 0.74 mm2/s at 20 °C)
Propylene	Flammable gases – Category 1 (lower flammable limit = 2.0%); Gases under pressure – Liquified gas; Simple Asphyxiants – Category 1
Hydrogen Sulfide	Flammable gases – Category 1 (flammable limit – concentration range = 4-46%); Gases under pressure– Liquified gas; Acute toxicity – inhalation – Category 2; Serious eye damage/eye irritation - Category 2; Specific target organ toxicity - single exposure (respiratory tract irritation) - Category 3 - Respiratory tract irritation; Specific target organ toxicity - single exposure (narcotic effects) - Category 3 - Narcotic effect
Propane	Flammable gases – Category 1 (lower flammable limit = 2.1%); Gases under pressure – Liquified gas
Carbonyl Sulfide	Flammable gases – Category 1 (lower flammable limit = 12%); Gases under pressure – Liquified gas; Acute toxicity – inhalation – Category 3

* Compressed gas listed in: UN Recommendations on the TDG-Model Regulations Vol II

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the SDS contains all the information required by the Controlled Products Regulations.

Section 16 - Other Information

Prepared By: United States Steel Corporation

Revision History:

5/14/2012 – Original

8/01/2018 – Update WHMIS 2015 and multiple sections

Expiration Date: NA

Cryogenically-Processed Coke Oven Gas

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Section 16 - Other Information (continued)

Additional Information:

Hazardous Material Identification System (HMIS) Classification

Health Hazard	1
Fire Hazard	4
Physical Hazard	0

HEALTH = 1, Denotes possible chronic hazard if airborne dusts or fumes are generated Irritation or minor reversible injury possible.
 FIRE = 4, Flammable gases, or very volatile flammable liquids with flash points below 73 °F, and boiling points below 100 F. Materials may ignite spontaneously with air. (Class IA).
 PHYSICAL HAZARD = 0, Materials that are normally stable, even under fire conditions, and will not react with water, polymerize, decompose, condense, or self-react. Non-explosives.

National Fire Protection Association (NFPA)



HEALTH = 1, Exposure could cause irritation but only minor residual injury even if no treatment is given.
 FIRE = 4, Will rapidly or completely vaporize at normal pressure and temperature, or is readily dispersed in air and will burn readily.
 INSTABILITY = 0, Normally stable, even under fire exposure conditions, and are not reactive with water.

ABBREVIATIONS/ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists	NIF	No Information Found
BEIs	Biological Exposure Indices	NIOSH	National Institute for Occupational Safety and Health
CAS	Chemical Abstracts Service	NTP	National Toxicology Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	ORC	Organization Resources Counselors
CFR	Code of Federal Regulations	OSHA	Occupational Safety and Health Administration
CNS	Central Nervous System	PEL	Permissible Exposure Limit
GI, GIT	Gastro-Intestinal, Gastro-Intestinal Tract	PNOR	Particulate Not Otherwise Regulated
HMIS	Hazardous Materials Identification System	PNOC	Particulate Not Otherwise Classified
IARC	International Agency for Research on Cancer	PPE	Personal Protective Equipment
LC50	Median Lethal Concentration	ppm	parts per million
LD50	Median Lethal Dose	RCRA	Resource Conservation and Recovery Act
LD_{Lo}	Lowest Dose to have killed animals or humans	RTECS	Registry of Toxic Effects of Chemical Substances
LEL	Lower Explosive Limit	SARA	Superfund Amendment and Reauthorization Act
LOEL	Lowest Observed Effect Level	SCBA	Self-contained Breathing Apparatus
LOAEC	Lowest Observable Adverse Effect Concentration	SDS	Safety Data Sheet
µg/m³	microgram per cubic meter of air	STEL	Short-term Exposure Limit
mg/m³	milligram per cubic meter of air	TLV	Threshold Limit Value
mppcf	million particles per cubic foot	TWA	Time-weighted Average
MSHA	Mine Safety and Health Administration	UEL	Upper Explosive Limit
NFPA	National Fire Protection Association		

Disclaimer: This information is taken from sources or based upon data believed to be reliable. However, United States Steel Corporation makes no warranty as to the absolute correctness or sufficiency of any of the foregoing or that additional or other measures may not be required under particular conditions.