



# United States Steel Corporation

## RAW COKE OVEN GAS

### Safety Data Sheet (SDS)

USS IHS Number: IHS 82501

(Replaces USS Code Number's: IHS 34, IHS 24841, IHS 24842)

Locations: Gary Works, Granite City Works, Hamilton Works, Lake Erie Works, Mon Valley Works, U. S. Steel Kosice

Original: 12/16/2010

Revision: 12/31/2020

### Section 1 – Identification

1(a) Product Identifier used on Label: Raw Coke Oven Gas (COG)

1(b) Other Means of Identification: Sour Coke Oven Gas (COG)

1(c) Recommended use of the chemical and restrictions on use: Fuel gas or intermediate by-product; Combustion restrictions vary by plant location

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: Raw COG is considered a hazardous material according to the criteria specified in REACH [REGULATION (EC) No 1907/2006] and CLP [REGULATION (EC) No 1272/2008] 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. 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 Gasses	WARNING	Extremely flammable gas May displace oxygen and cause rapid suffocation. May cause genetic defects. May cause cancer. May damage fertility or the unborn child. Toxic if inhaled. Causes skin irritation. Causes serious eye irritation. Causes central nervous system depression, respiratory irritation drowsiness or dizziness and damage to lungs, liver and blood cells. Causes damage to the heart through prolonged or repeated exposures. Causes damage to blood forming tissues and central nervous system through prolonged or repeated exposure.
	Acute Toxicity-Inhalation - 3		
	Germ Cell Mutagenicity - 1B Carcinogenicity -1A Reproductive Toxicity - 1A Single Target Organ Toxicity (STOT) Following Single Exposure - 1 STOT Repeated Exposure - 1		
	Skin Irritation - 2 Eye Irritation - 2A		
None	Simple Asphyxiant - Single Category		

Precautionary Statement(s):

Prevention	Response	Storage/Disposal

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Keep away from heat/sparks/open flames/hot surfaces – No smoking. Leaking gas fire: Do not extinguish, unless leak can be stopped safely.	If exposed, concerned or feel unwell: Get medical advice/attention.	Store locked up. Dispose of contents in accordance with federal, state and local regulations.
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### Section 2 – Hazard(s) Identification (continued)

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

**Precautionary Statement(s) (continued):**

Prevention	Response	Storage/Disposal
Eliminate all ignition sources if safe to do so. Store in well-ventilated place. Keep container tightly closed. Do not breathe gas. Use only outdoors or in a well-ventilated area. 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.	If in eyes: 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 on skin: Take off contaminated clothing and wash it before reuse. Wash with plenty of water. If skin irritation occurs: get medical advice/attention.  If inhaled: Remove person to fresh air and keep comfortable for breathing. Call a poison center or doctor.	

**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	% Volume
Hydrogen	1333-74-0	215-605-7	52-59
Methane	74-82-8	200-812-7	26-33
Nitrogen	7727-37-9	231-783-9	1.9-5.7
Carbon Monoxide	630-08-0	211-128-3	4.5-7.0
Ethylene	74-85-1	200-815-3	2.0-2.8
Carbon Dioxide	124-38-9	204-696-9	1.4-2.1
Hydrogen Sulfide	7783-06-4	231-977-3	0.4-1.2
Hydrogen Cyanide	74-90-8	200-821-6	0-1.2
Ethane	74-84-0	200-814-8	0.7 – 1.1
Ammonia	7664-41-7	231-635-3	0-1.1
Benzene	71-43-2	200-753-7	0 – 1.0
Carbon Disulfide	75-15-0	200-843-6	0-0.3
Toluene	108-88-3	203-625-9	0.1-0.2

EC- European Community

CAS- Chemical Abstract Service

### 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.
- **Eye Contact:** If in eyes: 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.
- **Skin Contact:** This material is a gas under normal atmospheric conditions. If on skin: Take off contaminated clothing and wash it before reuse. Rinse skin with water/shower.
- **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:** Breathing mist and vapors may cause irritation to the respiratory tract. Carbon monoxide gas and Hydrogen sulfide is fatal if inhaled. 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.

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- **Skin:** May cause irritation.
- **Ingestion:** This material is a gas under normal atmospheric conditions and ingestion is unlikely.

### Section 4 – First-aid Measures (continued)

**4(b) Most Important Symptoms/Effects, Acute and Delayed (Chronic) (continued):**

**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.

**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:** If leakage cannot be stopped, evacuate area. 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.

### Section 8 - Exposure Controls / Personal Protection

**8(a) Occupational Exposure Limits (OELs):** The following exposure limits are offered as reference, for an experience industrial hygienist to review.

Ingredients	OSHA PEL <sup>1</sup>	ACGIH TLV <sup>2</sup>	NIOSH REL <sup>3</sup>	IDLH <sup>4</sup>
Hydrogen	NE	NE (Simple Asphyxiant)	NE	NE
Methane	NE	NE (Asphyxiant)	NE	NE
Nitrogen	NE	Simple Asphyxiant	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
Hydrogen Sulfide	"C" 20 ppm "Peak" 50 ppm (10 minutes)	1.0 ppm "STEL" 5.0 ppm	"C" 10 ppm (10 minutes)	100 ppm
Hydrogen Cyanide	10 ppm, skin	4.7 ppm (as CN), skin	4.7 ppm, skin	50 ppm
Ethane	NE	NE (Asphyxiant)	NE	NE

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Oxygen	NE	NE	NE	NE
Ammonia	50 ppm	25 ppm "STEL" 35 ppm	25 ppm "STEL" 35 ppm	300 ppm

### Section 8 - Exposure Controls / Personal Protection (continued)

**8(a) Occupational Exposure Limits (OELs) (continued):**

Ingredients	OSHA PEL <sup>1</sup>	ACGIH TLV <sup>2</sup>	NIOSH REL <sup>3</sup>	IDLH <sup>4</sup>
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
Carbon Disulfide	20 ppm "C" 30 ppm "P" 100 ppm (30-min per 8-hr shift)	1.0 ppm	1.0 ppm "STEL" 10 ppm	500 ppm
Toluene	200 ppm "C" 300 ppm "Peak" 500 ppm (10 min)	50 ppm	100 ppm "STEL" 150 ppm	500 ppm

NE - None Established

\* Simple Asphyxiant may not be assigned a TLV because the limiting factor is the available oxygen without other significant physiologic effects.

\*\* Exposure limits based on 29 CFR 1910.1028, however refer to 29 CFR 1910.1000, Table Z-2 for exclusions.

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-1970s 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.

**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><b>9(a) Appearance (physical state, color, etc.):</b> yellowish brown gas</p> <p><b>9(b) Odor:</b> Organic-odor</p> <p><b>9(c) Odor Threshold:</b> NA</p> <p><b>9(d) pH:</b> NA</p> <p><b>9(e) Melting Point/Freezing Point:</b> NA</p> <p><b>9(f) Initial Boiling Point and Boiling Range:</b> NA</p> <p><b>9(g) Flash Point:</b> NA</p> <p><b>9(h) Evaporation Rate:</b> NA</p> <p><b>9(i) Flammability (solid, gas):</b> Flammable gas</p>	<p><b>9(j) Upper/Lower Flammability or Explosive Limits:</b> 75% / 4%</p> <p><b>9(k) Vapor Pressure:</b> NA</p> <p><b>9(l) Vapor Density (Air = 1):</b> 0.39</p> <p><b>9(m) Relative Density:</b> 0.589 SG</p> <p><b>9(n) Solubility(ies):</b> Partial</p> <p><b>9(o) Partition Coefficient n-octanol/water:</b> NA</p> <p><b>9(p) uto-ignition Temperature:</b> ND</p> <p><b>9(q) Decomposition Temperature:</b> ND</p> <p><b>9(r) Viscosity:</b> ND</p>
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NA - Not Applicable  
 ND - Not Determined for product as a whole

## Section 10 - Stability and Reactivity

**10(a) Reactivity:** May react suddenly with air, oxygen, halogens and with fine dispersed metal dust.

**10(b) Chemical Stability:** Stable under normal storage and handling conditions.

## Section 10 - Stability and Reactivity (continued)

**10(c) Possibility of Hazardous Reaction:** No Data Found









**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 **Raw COG** 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			
<b>Acute Toxicity Hazard</b> (covers Categories 1-4)	3	3 <sup>a</sup>		<b>Danger</b>	Toxic if inhaled.
<b>Skin Irritation</b> (covers Categories 1A, 1B, and 2)	2	2 <sup>b</sup>		<b>Warning</b>	Causes skin irritation.
<b>Eye Damage/Irritation</b> (covers Categories 1, 2A and 2B)	2	2A <sup>c</sup>		<b>Warning</b>	Causes serious eye irritation.
<b>Germ Cell Mutagenicity</b> (covers Categories 1A, 1B and 2)	1B	1B <sup>f</sup>		<b>Danger</b>	May cause genetic defects.
<b>Carcinogenicity</b> (covers Categories 1A, 1B and 2)	1A	1A <sup>g</sup>		<b>Danger</b>	May cause cancer.
<b>Toxic Reproduction</b> (covers Categories 1A, 1B and 2)	1A	1A <sup>h</sup>		<b>Danger</b>	May damage fertility or the unborn child.
<b>Specific Target Organ Toxicity (STOT) Following Single Exposure</b> (covers Categories 1-3)	1	1 <sup>i</sup>		<b>Danger</b>	Causes central nervous system depression, respiratory irritation drowsiness or dizziness and damage to lungs, liver and blood cells
<b>STOT following Repeated Exposure</b> (covers Categories 1 and 2)	1	1 <sup>j</sup>		<b>Danger</b>	Causes damage to lungs. Causes damage to blood and blood forming system through prolonged or repeated exposure
<b>Simple Asphyxiant</b> (Single Category)	NA*	Single Category	No Pictogram	<b>Warning</b>	May displace oxygen and cause rapid suffocation

\* NR Not Rated - Available data does not meet criteria for classification.

The 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 LC<sub>50</sub> or LD<sub>50</sub> has been established for **Raw COG**. The following data has been determined for the components:

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>• Carbon Monoxide: Rat LD<sub>50</sub> = 1300 ppm (REACH)<br/>Mouse LC<sub>50</sub> = 2444 ppm</li> <li>• Ethylene: LC<sub>50</sub> &gt;57000 ppm/4hr</li> <li>• Hydrogen Sulfide: Rat LC<sub>50</sub> = 444 ppm (REACH)</li> <li>• Ammonia: Rat LC<sub>50</sub> = 13,770 mg/m<sup>3</sup> (REACH)<br/>Rat LC<sub>50</sub> = 2,000 ppm (IUCLID)</li> <li>• Hydrogen Cyanide: Rat LC<sub>50</sub> &lt; 68 mg/m<sup>3</sup> Rat LC<sub>50</sub> = 144 mg/m<sup>3</sup> (REACH)</li> </ul> | <ul style="list-style-type: none"> <li>• Carbon Dioxide: Rat LC<sub>50</sub> = 30,000 – 50,000 ppm</li> <li>• Benzene: Rat LD<sub>50</sub> 3.8 (2.9-4.8) and 5.6 (4.0-7.8) ml/kg young and old resp. Rabbit LD<sub>50</sub>: &gt; 9.4 ml/kg (abraded skin)</li> <li>• Carbon disulfide: Rat LC<sub>50</sub> = 10.35 mg/L (REACH)<br/>Mouse 2 hr LC<sub>50</sub> = 10 mg/L (IUCLID)</li> <li>• Toluene: Rat LD<sub>50</sub> (rat) &gt; 5000 mg/kg (REACH)<br/>Rabbit LD<sub>50</sub> &gt; 5000 mg/kg (REACH)<br/>Rat LC<sub>50</sub> &gt; 20 mg/L (REACH) LD<sub>50</sub> (rat) i.p. =1332 mg/kg (IUCLID)</li> </ul> |
|--|---|

b. No Skin Irritation data available for **Raw COG** as a mixture. The following Skin Irritation information was found for the components:

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- **Benzene:** Mild to moderate in rabbits
  - **Toluene:** Toluene is irritating to rabbit skin (REACH and IUCLID)
  - **Carbon Disulfide:** Highly irritating in rabbits, Human irritation.
  - **Ammonia:** Ammonia is irritating to rabbit skin (REACH and IUCLID)
- c. No Eye Irritation data available for **Raw COG** as a mixture. The following Eye Irritation information was found for the components:
- **Benzene:** Moderate to severe irritant; may cause corneal injury.
  - **Toluene:** Slight irritation (REACH and IUCLID) Severe Eye Irritant in humans (NLM HSD)
  - **Carbon Disulfide:** Highly irritating in Rabbits
  - **Hydrogen Sulfide:** 20 – 50 ppm (human)

### Section 11 - Toxicological Information (continued)

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

- d. No Skin (Dermal)/Respiratory Sensitization data available for **Raw COG** as a mixture or its individual components.
- e. No Aspiration Hazard data available for **Raw COG** as a mixture or its individual components.
- f. No Germ Cell Mutagenicity data available for **Raw COG** as a mixture. The following Germ Cell Mutagenicity 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 **Raw COG** as a carcinogen. The following Carcinogenicity information was found for the components:
- **Hydrogen Sulfide:** EPA-CaI, Data are inadequate for an assessment of human carcinogenic potential
  - **Hydrogen Cyanide:** EPA-II, inadequate information to assess carcinogenic potential
  - **Ethylene:** IARC-3, unclassifiable as to carcinogenicity in humans; ACGIH TLV-A4, not classifiable as a human carcinogen
  - **Carbon Disulfide:** ACGIH TLV-A4, not classifiable as a human carcinogen
  - **Benzene:** IARC-1, carcinogen to humans; ACGIH TLV-A1, confirmed human carcinogen; NIOSH-Ca, potential occupational carcinogen; NTP-K, known to be a carcinogen; EPA-A, human carcinogen (by inhalation route of entry), EPA-K, cannot be determined, not classifiable as to human carcinogenicity; OSHA-Ca, carcinogen
  - **Toluene:** IARC-3, unclassifiable as to carcinogenicity in humans; ACGIH TLV-A4, not classifiable as a human carcinogen; EPA-II, inadequate information to assess carcinogenic potential
- h. No Toxic Reproduction data available for **Raw COG** as a mixture. The following Carcinogenicity information was found for the components:
- **Carbon Monoxide:** Reproductive Categories on EU are adopted for GHS because Human Fetal Death has resulted from exposure of CO to mothers bearing children.
  - **Hydrogen Sulfide** - Postnatal neurological alterations from prenatal exposure of 20 or 50 ppm (rats).
  - **Carbon disulfide:** Results of studies suggest a direct effect on Testes with dose related decrease in plasma testosterone.
  - **Toluene:** Low incidence of malformations at doses causing maternal toxicity.
- i. No Specific Target Organ Toxicity (STOT) following a Single Exposure data available for **Raw COG** as a mixture. The following STOST following Single Exposure information 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).
  - **Hydrogen Cyanide:** Inhibits ATP production in Mitochondria of all cells.
  - **Hydrogen Sulfide:** Lung: In high concentrations (1,000 to 3,000 ppm) hydrogen sulfide was lethal to dogs. At 3000 ppm, respiration ceased after a few breaths; death occurred within 15 to 20 minutes at 1,000 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
  - **Benzene:** Mild to moderate respiratory tract irritation expected with breathing vapors.
  - **Carbon disulfide:** Mood changes, dizziness
  - **Toluene:** Headache, dizziness and impaired performance

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j. No Specific Target Organ Toxicity (STOT) following Repeated Exposure data was available for **Raw COG** as a whole. The following STOT following Repeated Exposure data was found for the components:

- **Carbon Monoxide:** Damage to Heart by inhalation (REACH), Rat 72 wk Inhalation LOAEL = 200 ppm cardiac hypertrophy (REACH), Rat 13 wk inhalation NOEL = 135 ppm **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
- **Hydrogen Cyanide:** Rat 90 day drinking water NOAEL 12.5 mg/kg No effects in studies. Rat 13-week drinking water study NOAEL 80 mg/kg based on BW effects at higher dose. Rat dietary study 1 yr LOEL 40 mg/kg based on thyroid weight. Rat dietary 56 days NOAEL >40 mg/kg
- **Carbon Disulfide:** Neurotoxicity, chronic effects on heart, liver, kidney, Ocular changes and skin (OSHA)
- **Toluene:** Ataxia, hypothermia, Leucocyte decrease in female rats and increase liver and kidney weights.

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 (BEIs) with Other Worldwide Occupational Exposure Values 2020, 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 (IUCID), 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).

### Section 11 - Toxicological Information (continued)

The following health hazard information is provided regardless to classification criteria and is based on the individual component(s):

#### 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.
- **HYDROGEN SULFIDE:** Causes serious eye irritation. Fatal if inhaled. Causes damage to the cardiovascular system, central nervous system and respiratory system.
- **HYDROGEN CYANIDE:** Acute oral and inhalation data show that when administered at a single bolus dose, HCN is extremely toxic at less than 5 mg/kg. Inhibits ATP production in Mitochondria of all cells.
- **AMMONIA:** Breathing mist and vapors can cause severe chemical burns and can be extremely destructive to mucous membranes, and upper respiratory tract. Causes chemical burns to the eyes and skin.
- **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.
- **CARBON DISULFIDE:** Excessive quantities of carbon disulfide may be fatal if ingested or inhaled. Serious health hazard, affecting the central nervous system. Carbon disulfide is readily absorbed through the skin. Sufficient material may be absorbed through the skin to be fatal. Excessive exposures may cause reproductive damage, including impairing fertility. Skin irritant.
- **TOLUENE:** Excessive exposures may cause irritation to eyes, nose, throat, lungs, and respiratory tract. Central nervous system effects may occur. Excessive exposures may result in headaches, nausea dizziness, loss of balance and coordination, unconsciousness, and coma as well as respiratory failure and/or death.

#### Delayed (chronic) Effects by Component:

- **HYDROGEN, METHANE, ETHYLENE, ETHANE, CARBON DIOXIDE and NITROGEN:** 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.
- **AMMONIA:** 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. A permanent decrement in pulmonary function has been noted to occur.
- **BENZENE:** 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.
- **CARBON DISULFIDE:** Chronic overexposure to carbon disulfide has resulted primarily in neurological and cardiovascular effects, gastrointestinal and immune insufficiency problems as well as possible risk of impaired fertility and harm to the unborn child have also been reported.
- **TOLUENE:** Chronic overexposure has been associated with headache, lassitude, and nausea, loss of coordination, memory loss, and loss of appetite along with enlargement of the liver, a moderate decrease in red blood cells, and reduction in white blood cells, as well as palpitations, weakness, and impaired reaction time may occur. The neurological effects of chronic overexposure to high levels of toluene gradually progress to an irreversible state. Besides effects on behavior and intelligence, degeneration of the optic nerve and nerve deafness has also been reported. Dermatitis from repeated contact with the skin may also occur. Overexposure to toluene may cause risk of harm to the unborn child.

### Section 12 - Ecological Information

**12(a) Ecotoxicity (aquatic & terrestrial):** No data available for the product, **Raw COG** as a whole. However, individual components have been found to be toxic to the environment:

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- **Ethylene:** EC<sub>50</sub> *Daphnia magna* = 53.402 mg/L
- **Hydrogen Sulfide:** LC<sub>50</sub>/96 h (fresh water fish) = <2 – 7 µg/L; LC<sub>50</sub> *Rhombus maeoticus* > 2.4 mg/L; LC<sub>50</sub> *Carassium auratus* = 0.09 mg/L; LC<sub>50</sub> *Catostomus commersoni* = 0.019 mg/L
- **Carbon disulfide:** LC<sub>50</sub> *Western mosquitofish*: 135,000/96H
- **Ammonia:** LC<sub>50</sub> *Oncorhynchus mykiss* = 11 – 48 mg/L; LC<sub>50</sub> *Lepomis cyanellus*=0.5 mg/L; LC<sub>50</sub> *Daphnia magna* =101 mg/L
- **Benzene:** LC<sub>50</sub> *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)
- **Toluene:** LC50 *Pimephales promelas* (fathead minnow) =34.27 mg/l 96 hr (95% Confidence Limits= 22.83-45.86 mg/l) /Conditions of bioassay not specified; LC50 *Daphnia magna*, (water flea) 313 mg/l 48 hr /Conditions of bioassay not specified.

**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):** 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

### 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 Raw COG 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 **Raw COG** 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><b>Shipping Name:</b> UN1954, Compressed gas, flammable, 2.1  <b>Shipping Symbols:</b> NA  <b>Hazard Class:</b> 2.1  <b>UN No:</b> UN1954  <b>Packing Group:</b> NA  <b>DOT/ IMO Label:</b> 2.1  <b>Special Provisions (172.102):</b> NA</p>	<p><b>Packaging Authorizations</b>  <b>a) Exceptions:</b> 306  <b>b) Bulk:</b> 302, 305  <b>c) Non-bulk:</b> 314, 315</p>	<p><b>Quantity Limitations</b>  <b>a) Passenger, Aircraft, or Railcar:</b> Forbidden  <b>b) Cargo Aircraft Only:</b> 150 kg  <b>Vessel Stowage Requirements</b>  <b>a) Vessel Stowage:</b> D  <b>b) Other:</b> 40  <b>DOT Reportable Quantities:</b> Note over 850 lb shipment would exceed the threshold for benzene, hydrogen cyanide and require it to be marked with an RQ for benzene and hydrogen cyanide.</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 **Raw COG** as a hazardous material.

<p><b>Shipping Name:</b> UN1954, Compressed gas, flammable, 2.1  <b>Classification Code:</b> 1F  <b>UN No.:</b> UN1954  <b>Packing Group:</b> NA  <b>ADR Label:</b> 2.1  <b>Special Provisions:</b> 274  <b>Limited Quantities:</b> LQ0, E0</p>	<p><b>Packaging</b>  <b>a) Packing Instructions:</b> P200  <b>b) Special Packing Provisions:</b> NA  <b>c) Mixed Packing Provisions:</b> MP9</p>	<p><b>Portable Tanks &amp; Bulk Containers</b>  <b>a) Instructions:</b> (M)  <b>b) Special Provisions:</b> NA</p>
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**International Air Transport Association (IATA)** regulates **Raw COG** as a hazardous material.

<b>Shipping Name:</b> UN1954, Compressed gas, flammable, 2.1 <b>Class/Division:</b> 2.1 <b>Hazard Label (s):</b> Flammable Gas <b>UN No.:</b> 1954 <b>Packing Group:</b> NA <b>Excepted Quantities (EQ):</b> E0	<b>Passenger &amp; Cargo Aircraft</b>		<b>Cargo Aircraft Only:</b> <b>Pkg Inst:</b> 200  <b>Max Net Qty/Pkg:</b> 150 kg	<b>Special Provisions:</b> A1  <b>ERG Code:</b> 10L
	<b>Limited Quantity (EQ)</b>			
	<b>Pkg Inst:</b> Forbidden	<b>Pkg Inst:</b> Forbidden		
	<b>Max Net Qty/Pkg:</b> Forbidden	<b>Max Net Qty/Pkg:</b> Forbidden		

Pkg Inst – Packing Instructions

Max Net Qty/Pkg – Maximum Net Quantity per Package

ERG – Emergency Response Drill Code

**Raw COG** has a **Transport Dangerous Goods (TDG)** classification as **Compressed gas, flammable, n.o.s.**

### 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 15 - Regulatory Information (continued)

**Section 313 Supplier Notification:** This product, **Raw COG** 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	Max Percent by Weight
74-85-1	Ethylene	2.8
7783-06-4	Hydrogen Sulfide	1.2
74-90-8	Hydrogen Cyanide	1.2
7664-41-7	Ammonia	1.1
71-43-2	Benzene	1.0
75-15-0	Carbon disulfide	0.3
108-88-3	Toluene	0.2

**State Regulations:** The product, **Raw COG** 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:



The product, **Raw COG** can expose you to benzene which is known to the State of California to cause cancer and reproductive toxicity, carbon monoxide and toluene which are known to the State of California to cause reproductive toxicity. For more information go to [www.P65Warnings.ca.gov](http://www.P65Warnings.ca.gov).

**Other Regulations:**

**WHMIS Classification (Canadian):** The product, **Raw COG** 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 % (71%)]; 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 (Gas that is liable to cause asphyxiation by the displacement of air)
Nitrogen	Gases under pressure - Compressed gas; Simple asphyxiants - Category 1
Carbon Monoxide	Flammable gases – Category 2 (Flammable limit - concentration range = 12 - 75 %); Gases under pressure - Compressed gas; Acute toxicity - inhalation - Category 3; Reproductive toxicity - Category 1A (Adverse effects on the development of the offspring); Specific target organ toxicity - single exposure - Category 1
Hydrogen Sulfide	Flammable gases – Category 1 [Flammable limit - concentration range = 4% (4-46%), Lower flammable limit = 4%]; Gases under pressure - Liquefied 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
Hydrogen Cyanide	Flammable liquids - Category 1 [Flash point = -17.8 °C closed cup (non reported method) and boiling point = 25.7 °C]; Acute toxicity - oral - Category 1; Acute toxicity - dermal - Category 1; Acute toxicity - inhalation - Category 1; Serious eye damage/eye irritation - Category 2; Physical hazards not otherwise classified (exploding bomb) - Category 1

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Ammonia	Flammable gases – Category 1 [Flammable limit - concentration range = 12% (15-28); Gases under pressure - Liquified gas; Acute toxicity - inhalation - Category 3; Skin corrosion/irritation - Category 1 (Forms a corrosive substance upon contact with water: ammonium hydroxide); Serious eye damage/eye irritation - Category 1
Ethylene	Flammable gases – Category 1 (Lower flammable limit = 2.7%); Gases under pressure – Liquified gas; Germ cell mutagenicity – Category 2; Simple asphyxiants – Category 1
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; Aspiration hazard - Category 1 (Liquid hydrocarbon with a kinematic viscosity of 0.74 mm <sup>2</sup> /s at 20°C)
Carbon Disulphide	Flammable liquids – Category 2 [Flash point = 30° closed cup (non reported method) and boiling point = --46XX]; Acute toxicity - inhalation - Category 4; Specific target organ toxicity - repeated exposure - Category 1; Reproductive toxicity - Category 1B (Toxic to reproductive function, Toxic to the development); Specific target organ toxicity - single exposure (narcotic effects) - Category 3 - Narcotic effect;
Toluene	Flammable liquids - Category 2 (Flash point = 4,4°C Setaflash closed cup and boiling point = 111°C); Skin corrosion/irritation - Category 2; Specific target organ toxicity - repeated exposure - Category 2; Reproductive toxicity - Category 2 (Toxic to the development - Adverse effects on the development of the offspring); Specific target organ toxicity - single exposure (narcotic effects) - Category 3 - Narcotic effect; Aspiration hazard - Category 1 (Liquid hydrocarbon with a kinematic viscosity of 0,676 mm <sup>2</sup> /s at 20°C)

\* 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:**

12/31/2020 – Update to sections 2, 8, 11, 15  
08/15/2017 – Update WHMIS 2015  
7/7/2014 - Revision

**Expiration Date:** 12/31/2023

2/10/2013 - Update to OSHA HAZ COM 2012

**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:**

<b>ACGIH</b>	American Conference of Governmental Industrial Hygienists
<b>BEIs</b>	Biological Exposure Indices
<b>CAS</b>	Chemical Abstracts Service
<b>CERCLA</b>	Comprehensive Environmental Response, Compensation, and Liability Act
<b>CFR</b>	Code of Federal Regulations
<b>CNS</b>	Central Nervous System
<b>GI, GIT</b>	Gastro-Intestinal, Gastro-Intestinal Tract
<b>HMIS</b>	Hazardous Materials Identification System
<b>IARC</b>	International Agency for Research on Cancer
<b>LC50</b>	Median Lethal Concentration
<b>LD50</b>	Median Lethal Dose
<b>LD<sub>Lo</sub></b>	Lowest Dose to have killed animals or humans
<b>LEL</b>	Lower Explosive Limit
<b>µg/m<sup>3</sup></b>	microgram per cubic meter of air
<b>mg/m<sup>3</sup></b>	milligram per cubic meter of air
<b>mppcf</b>	million particles per cubic foot
<b>SDS</b>	Safety Data Sheet
<b>MSHA</b>	Mine Safety and Health Administration

<b>NIF</b>	No Information Found
<b>NIOSH</b>	National Institute for Occupational Safety and Health
<b>NTP</b>	National Toxicology Program
<b>ORC</b>	Organization Resources Counselors
<b>OSHA</b>	Occupational Safety and Health Administration
<b>PEL</b>	Permissible Exposure Limit
<b>PNOR</b>	Particulate Not Otherwise Regulated
<b>PNOC</b>	Particulate Not Otherwise Classified
<b>PPE</b>	Personal Protective Equipment
<b>ppm</b>	parts per million
<b>RCRA</b>	Resource Conservation and Recovery Act
<b>RTECS</b>	Registry of Toxic Effects of Chemical Substances
<b>SARA</b>	Superfund Amendment and Reauthorization Act
<b>SCBA</b>	Self-contained Breathing Apparatus
<b>STEL</b>	Short-term Exposure Limit
<b>TLV</b>	Threshold Limit Value
<b>TWA</b>	Time-weighted Average
<b>UEL</b>	Upper Explosive Limit

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NFPA	National Fire Protection Association		
<p><b>Disclaimer:</b> 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.</p>			