Material Safety Data Sheet

Ovonic® Solid Hydrogen Storage Canisters **MSDS No. TXO 200,006**

July 16, 2004 – Revised May11, 2009

Section 1 - Chemical Product and Company Identification

Product/Chemical Name: Hydrogen Storage Canister
Chemical Formula: Hydrogen in a metal hydride storage system
Model Numbers: 85G250B, 85G555B, 85G694B, 25G250B, 25G555B, 25G694B, 10G250B, 10G555B, 10G694B, 7G250B, 7G555B, & 7G694B
General Use: Fuel Gas
Manufacturer: Ovonic Hydrogen Systems LLC., 2983 Waterview Drive, Rochester Hills, MI 48309
Phone (248) 293-8772, FAX (248) 299-4520 (8:00 a.m. – 5:00 p.m. Mon. – Fri.)

HMIS	
H	0
F	4
R	0
PPE†	
†Sec. 8	

24 Hour Emergency phone number (CHEMTREC): (800) 424-9300 *

**Call emergency number only for spills, leaks, exposure, or transportation accidents involving this product. For routine information, contact supplier.*

Section 2 - Composition / Information on Ingredients in Aluminum Canister

Ingredient Name	CAS Number
Cylinder	
Aluminum	7429-90-5
Contents of Cylinder	
Hydrogen	1333-74-0
Chromium	7440-47-3
Iron	7439-89-6
Manganese	7439-96-5
Vanadium	7440-62-2
Titanium	7440-32-6
Zirconium	7440-67-7
Aluminum	7429-90-5
Tin	7440-31-5

	OSHA PEL		ACGIH TLV
Ingredient	**TWA**	**STEL**	**TWA**
Aluminum	5 mg/m^3	none established	10 mg/m^3
Hydrogen	none established	none established	Simple asphyxiant
Chromium	1 mg/m^3	none established	0.5 mg/m^3
Iron	none established	none established	1 mg/m^3
Manganese	5 mg/m^3 (fume)	none established	0.2 mg/m^3
Vanadium	none established	none established	none established
Titanium	none established	none established	none established
Zirconium	5 mg/m^3	10 mg/m^3	5 mg/m^3
Tin	0.1 mg/m^3	0.2 mg/m^3	0.1 mg/m^3

Section 3a - Physical and Chemical Properties of Hydrogen Gas

Appearance and Odor: Colorless and Odorless
Gas Density: 0.00521 lb/ft^3 (0.08342 kg/m^3)
Specific Gravity (H_2O=1, at 4 °C): 0.06960
Molecular Weight: 2.016
LFL: 4% (hydrogen)
UFL: 75% (hydrogen)
Water Solubility: Reactive
Boiling Point: -423.0 F (-252.8 C)
Melting Point: -434.55 (-259.2 C)
% Volatile: 100
Auto ignition Temperature: 932°F (500 °C)

Section 3b - Physical and Chemical Properties of Hydridable Metal Alloy

Appearance and Odor: Silver / gray metallic color
Gas Density: 0.00521 lb/ft^3 (0.08342 kg/m^3)
Specific Gravity (H_2O=1, at 4 °C): 0.06960
Molecular Weight: 2.016
LFL: 4% (hydrogen)
UFL: 75% (hydrogen)
Water Solubility: Reactive
Boiling Point: -423.0 F (-252.8 C)
Melting Point: -434.55 (-259.2 C)
% Volatile: 100
Auto ignition Temperature: Self heating and igniting on contact with air or other oxidizer

Section 4 - Fire-Fighting Measures

Flammability Classification: If contents are released, hydrogen gas and hydridable metal alloy powder are extremely flammable and may self-ignite.

Extinguishing Media: Water if canister is intact. Cool canister if it is hot. If cylinder has ruptured releasing metal powder, smother with sand or METL-X fire extinguishing powder, if necessary. Otherwise allow to burn out while protecting surrounding area.

Unusual Fire or Explosion Hazards: Canister may be under pressure and may release some hydrogen gas or rupture under extreme heat from fire conditions. Hydrogen is a flammable gas and the flame is nearly invisible. The canister is equipped with a pressure relief device. Escaping gas may ignite spontaneously. If venting occurs, do not extinguish flame because hydrogen gas can form explosive mixtures with air and oxidizing agents.

Hazardous Combustion Products: Irritating fumes and/or toxic gases.

Fire-Fighting Instructions: Contents of canister are extremely flammable and may self-ignite if exposed to air. Contents burn rapidly, releasing dense, white, irritating fumes. Use of water on internal contents may cause its dispersal with fire spreading through dispersed material. Material may re-ignite after fire is extinguished. Eliminate ignition sources. Immediately deluge intact canister with water from a safe distance until cool, then move them away from fire area if this can be done without risk. Withdraw immediately in case of hissing sound from venting safety devices or discoloration of canister. Do not extinguish flames emitted from canister; allow to burn out while protecting the surrounding area.

Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 5a - Stability and Reactivity of Hydrogen Gas

Stability: Hydrogen is stable at room temperature in closed containers under normal storage and handling conditions. In air hydrogen gas is flammable and may attain explosive mixtures.
Polymerization: Hazardous polymerization cannot occur.
Chemical Incompatibilities: Hydrogen is extremely flammable and may attain explosive mixtures with oxidizers (including air)
Conditions to Avoid: Extreme heat
Hazardous Decomposition Products: none.

Section 5b - Stability and Reactivity of Hydridable Metal Alloy

Stability: Granular or compacted granular material is self-heating and pyrophoric.
Polymerization: Hazardous polymerization cannot occur.
Chemical Incompatibilities: 1. Granular or compacted granular media reacts with oxidizers (including air).
Conditions to Avoid: 1. Oxidative atmosphere
2. Flammable materials in the immediate area.
Hazardous Decomposition Products: Thermal oxidative decomposition of product can produce irritating fumes and/or toxic gases.

Section 6 - Health Hazard Information

Potential Health Effects

*Under normal conditions, it is not expected that any of the contents of the product will be released. In the event of a **hydrogen gas release**, the following health effects may occur:*

Primary Entry Routes: Inhalation
Target Organs: Lungs and upper respiratory tract
Acute Effects
Inhalation: Asphyxiant. Effects are due to lack of oxygen. Moderate concentrations may cause headache, drowsiness, dizziness, excitation, excess salivation, vomiting, an odd-sounding high pitched voice, and unconsciousness.
Eye: No harm expected in the absence of superheating.
Skin: Burns possible if canister contents ignite, if released hydrogen gas ignites or if solid contents of canister contact the body.

Carcinogenicity: IARC, NTP, and OSHA do not list product as a carcinogen.
Medical Conditions Aggravated by Long-Term Exposure: 1. The toxicology and the physical and chemical properties of hydrogen suggest that overexposure is unlikely to aggravate existing medical conditions. 2. Long term exposure to canister contents cannot occur since it oxidizes to metal oxides rapidly on exposure to air.
Chronic Effects: No harm expected.

Emergency and First Aid Procedures

Inhalation: Move victim to fresh air. Call 911 or emergency medical service. Apply artificial respiration if victim is not breathing. If breathing is difficult, qualified personnel may give oxygen.
Eye Contact: Flush eyes thoroughly with water for at least 15 minutes. Seek medical attention immediately.
Skin Contact: Wash with soap and water. If irritation persists, seek medical attention.
Ingestion: An unlikely route of exposure for a gas.
Special Precautions/Procedures/Note to Physician: There is no specific antidote. Treatment of overexposure should be directed at the control of symptoms and the clinical condition of the patient.

Section 7 - Spill, Leak, and Disposal Procedures

Spill /Leak Procedures: Released hydrogen gas and metal hydride powder are extremely flammable. Immediately evacuate area. Release of metal hydride powder will cause ignition of flammable materials.
Spills: In the event of a powder spill, cover with dry earth, dry sand, or METL-X powder.
Containment: Do not release into sewers or waterways.
Cleanup: Do not use compressed air or a vacuum cleaner to clean up powder. Powder dispersed in air with an ignition source can cause an explosion or deflagration. The container contents are a self-heating and self-igniting material and should be handled appropriately for that material.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Do not incinerate or throw away in garbage. Contact your supplier for detailed recommendations for disposal of canister. Follow applicable Federal, state, and local regulations.

EPA Regulations:
RCRA Hazardous Waste Number (40 CFR 261.21): D001
CERCLA Hazardous Substance (40 CFR 302.4): Chromium, Manganese
CERCLA Reportable Quantity (RQ): Not listed
SARA Toxic Chemical (40 CFR 372.65): Aluminum, Chromium, and Manganese
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed
OSHA Regulations:
Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-2, Z-3): Aluminum, Chromium, Manganese, Tin, and Zirconium
State Regulations: In California and Pennsylvania, check with your state regulatory agency for any special regulations.

Note: The Hydrogen Storage Systems do not exceed any regulatory limits.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Such controls or protection is not required for normal handling or use.
Ventilation: Use canister in a ventilated area.
Administrative Controls: Such controls or protection is not required for normal handling or use.
Respiratory Protection: Such controls or protection is not required for normal handling or use. If responding to a spill or leak, use SCBA with a full facepiece operated in pressure-demand or positive-pressure mode. Follow OSHA respirator regulations (29 CFR 1910.134).
Protective Clothing/Equipment: Such controls or protection is not required for normal handling and use. However, in the event of a spill or leak, wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.
Safety Stations: Such controls or protection is not required for normal handling or use. However, make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.
Contaminated Equipment: Such controls or protection is not required for normal handling or use. In the event of responding to a spill or leak, separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.
Comments: Such controls or protection is not required for normal handling and use. In the event of responding to a spill or leak, practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Special Precautions and Comments

Handling Precautions: Protect canister from damage. Canister may be heavier than anticipated. Do not drop canister. Damage can occur. Do not tamper with valve opening. Do not expose to heat or flame, and prolonged exposure to sunlight. Do not disassemble or puncture.
Storage Requirements: Store and use with adequate ventilation. Keep away from extreme heat or flame, and prolonged exposure to sunlight.
Canister Recertification
The canister must be re-certified or removed from service five years after its manufacture date.

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Hydrogen in a metal hydride storage system
Hazard Class of Container: 2.1
ID No.: UN3468
Packing Group: N/A
Label: Flammable Gas
Special Provisions: A current copy of CA2008050020 must be carried aboard each motor vehicle, vessel, or aircraft used in transportation.

Packaging Authorizations
a) Exceptions: none
b) Non-bulk Packaging: (173.214) CA2008050020
c) Bulk Packaging: none

Quantity Limitations
a) Passenger Aircraft : Forbidden
b) Cargo Aircraft Only: 100kg gross
c) Motor Vehicle or Rail Freight: none

Vessel Stowage Requirements
a) Vessel Stowage: Deck
b) Other: NA

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Revision notes:
11/4/05 – remove Texaco, update model numbers
4/10/06 – revise fire-fighting measures, change headers/title to match users manual
5/11/09 – update to reference competent authority approval CA2008050020 rather than DOT-SP13280, remove 20G---B models, add 10G---B and 25G---B models