# MATERIAL SAFETY DATA SHEET

*Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS Standards and EU Standards*

## SECTION 1. PRODUCT IDENTIFICATION

**PRODUCT NAME: KRYPTON-85 balance inert gas (argon, helium, neon, nitrogen, xenon, and/or krypton)**
**PROPER DOT SHIPPING NAME:** Radioactive material, Type A package
**UN IDENTIFICATION NUMBER:** UN 2915
**PRODUCT USE:** Various Industrial
**MANUFACTURER:**

**ADDRESS:** **SPECTRA GASES, INC.**
3434 Route 22 West
Branchburg, NJ 08876, U.S.A.
**PHONE:** 908/252-9300
**FAX:** 908/252-0811
**WEB SITE:** www.spectra-gases.com

**SPECTRA GASES EMERGENCY CONTACT:** 800/932-0624 8:30 AM–7:00 PM (EST)
**24 HOUR EMERGENCY CONTACT, CHEMTREC:** 800/424-9300, 703/527-3887

## SECTION 2. COMPOSITION and INFORMATION ON INGREDIENTS

Please reference applicable international standards and regulations regarding the use of Krypton-85. In the U.S. the use of Krypton-85 is governed by the rules and regulations of the United States Nuclear Regulatory Commission or an Agreement State where that State has obtained statutory authority to regulate the use of radioactive materials. As such, its use is subject to NRC/Agreement State rules and regulations, the standard conditions imposed by your radioactive material's license, and your facility's radiation protection/health physics program internal rules and procedures.

The Federal OSHA Hazard Communication Standard provides an exemption for material that produces ionizing and non-ionizing radiation. However, Spectra Gasses, Inc has produced this Material Safety Data sheet to provide users of this product an understanding of the properties and hazards associated with this product.

**EU LABELING/CLASSIFICATION:** The following classification is self-classification, based on European Union Council Directives 67/548/EEC and 1999/45/EC: Carcinogenic Category 3 [Xn]
**EU Risk Phrases:** [R: 40] Limited evidence of a carcinogenic effect.

| | Chemical Synonyms | Chemical Formula | CAS # | EINECS # | % Composition |
|---|---|---|---|---|---|
| Krypton-85 | Not Applicable | $^{85}Kr$ | 13983-27-2 | Not Established | <10 TBq/package |
| Argon | None | Ar | 7440-37-1 | 231-147-0 | 0-99% |
| Helium | None | He | 7440-59-7 | 231-168-5 | 0-99% |
| Krypton | None | Kr | 7439-90-9 | 231-098-5 | 0-99% |
| Nitrogen | None | $N_2$ | 7727-37-9 | 231-783-9 | 0-99% |
| Neon | None | Ne | 7440-01-9 | 231-110-9 | 0-99% |
| Xenon | None | Xn | 7440-63-3 | 231-172-7 | 0-99% |

## SECTION 3. HAZARD IDENTIFICATION

**EMERGENCY OVERVIEW:** **Product Description:** This product is an inert gas mix containing the radioactive isotope Krypton-85. It is a colorless, odorless gas, shipped under pressure. **Health Hazards:** Krypton 85, a component of this mix, is a radioactive isotope and may cause associated health effects upon inhalation or by radiation exposure through the skin. This inert gas mix can cause the displacement of oxygen and create an asphyxiation hazard. **Flammability Hazards:** This gas is not flammable. **Reactivity Hazards:** This gas is not reactive. **Environmental Hazards:** Release of this product to the environment is not expected to cause environmental harm. **Emergency Response Considerations:** Emergency responders must wear the proper personal protective equipment suitable for the situation to which they are responding. **WARNING**—If rescue personnel need to enter an area suspected of contamination, they should be equipped with Self-Contained Breathing Apparatus (SCBA) and appropriate personal protective equipment.

**HMIS RATINGS:** HEALTH HAZARD: = 0; FLAMMABILITY HAZARD: = 0; PHYSICAL HAZARD: = 2

In addition to hazard classifications noted above, this gas poses a hazard due to its radioactivity.

## SECTION 3. HAZARD IDENTIFICATION (cont'd)

**RADIOACTIVITY HAZARDS: WARNING!** Krypton-85 is a radioactive isotope. Though Krypton-85 occurs naturally and a small amount of this isotope is normally present in the atmosphere, exposure to significant quantities may be harmful. Krypton-85 generates beta particles and gamma rays and poses an external radiation hazard. Upon inhalation of Krypton-85 gas, this isotope can be incorporated into the body's cells and emit radiation energy to surrounding tissues. Exposure to this product should be kept to levels as low as reasonably achievable. Refer to applicable standards and regulations for workplace limits on radiation exposure. In the U.S., reference NRC Radiation Safety Regulations 10 CFR Subpart C, Section 20.1201 for occupational dose limits for adults.

**ROUTES OF ENTRY, SYMPTOMS OF ACUTE EXPOSURE: WARNING**—If rescue personnel need to enter an area in which a release of Krypton-85 has occurred, they should be equipped with Self-Contained Breathing Apparatus (SCBA) and appropriate personal protective equipment. High concentration of this gas will create an oxygen-deficient atmosphere, creating the risk of asphyxiation. The symptoms described below are pertinent to hazards associated with this material as an inert gas.

**EYE CONTACT:** Release of a high-pressure gas may result in airborne objects.

**INGESTION:** Ingestion of this gas is not a likely route of industrial exposure.

**INHALATION:** High concentrations of this gas can cause an oxygen-deficient environment. The health effects associated with various levels of oxygen deficiency are described as follows:

| CONCENTRATION of OXYGEN | EXPOSURE SYMPTOM |
|---|---|
| 20.9% Oxygen: | Normal oxygen concentration in air. |
| 15–19% Oxygen: | Decreased ability to perform tasks. May impair coordination and may induce early symptoms in persons with heart, lung, or circulatory problems. |
| 12–15% Oxygen: | Breathing increases, especially in exertion. Pulse up. Impaired coordination, perception, and judgment. |
| 10–12% Oxygen: | Breathing further increases in rate and depth, poor coordination and judgment, lips slightly blue. |
| Less than 10%Oxygen: | Mental failure, inability to perform various movements, loss of consciousness without warning, convulsions, death. |

**WARNING: Exposure to atmospheres containing 8–10% or less oxygen will bring about unconsciousness without warning and so quickly that individuals cannot help or protect themselves. Lack of sufficient oxygen may cause serious injury or death.**

**SKIN CONTACT:** Not applicable.

**OTHER HEALTH EFFECTS:** Contact with rapidly expanding gases (which are released from under high pressure) may cause frostbite. Symptoms of frostbite include change in skin color to white or grayish-yellow. The pain caused by frostbite can quickly subside, masking the injury. In addition, the sudden release of a pressurized gas (such as may occur in the event of a valve failure) may present a severe hazard of mechanical injury.

**ROUTES OF ENTRY, SYMPTOMS OF CHRONIC EXPOSURE:**

**ROUTE OF ENTRY:** External radiation hazard, inhalation.

**TARGET ORGANS:** All

**SYMPTOMS:** Exposure to low levels of radioactivity may increase likelihood of cancer and exposure should be should be kept to levels as low as reasonably achievable.

**MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:** None are anticipated.

**CARCINOGENICITY:** Because it is a radioactive isotope, Kr-85 is considered a potential carcinogen. Krypton (an inert gas) is not listed as a carcinogen or as a potential carcinogen on EPA, NIOSH, GERMAN MAK, OSHA, NTP, IARC, or CAL/OSHA Carcinogen lists.

## SECTION 4. FIRST AID MEASURES

**PERSONS ACCIDENTALLY EXPOSED TO THIS COMPOUND MUST RECEIVE PROMPT MEDICAL ATTENTION!**

Contact your radiation safety office or your agreement State or Regional NRC office for information. Users outside of the US,must comply with all applicable regulations.

**EYE CONTACT**: If mechanical injury occurs, cover eye with bandage and seek appropriate medical attention. Contact the radiation safety office immediately.

**INGESTION:** Ingestion is an unlikely route of exposure for this gas.

**INHALATION**: Remove victim(s) to fresh air, as quickly as possible. If symptoms of oxygen deprivation are observed, trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary.

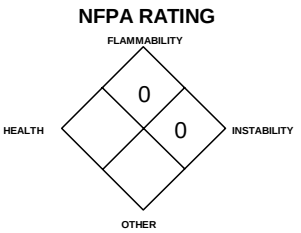
**SKIN CONTACT:** In case of frostbite, place the frostbitten part in warm water. DO NOT USE HOT WATER. If warm water is not available, or is impractical to use, wrap the affected parts gently in blankets. Alternatively, if the fingers or hands are frostbitten, place the affected area in the armpit. Encourage victim to gently exercise the affected part while being warmed. Seek immediate medical attention.

**NOTES TO PHYSICIANS**: Administer oxygen, if necessary, and treat symptoms. It is recommended that workers are monitored for radiation exposure.

## SECTION 5. FIRE FIGHTING MEASURES

**FLASH POINT:** Not Applicable
**AUTOIGNITION:** Not Applicable
**FLAMMABLE RANGE:** Not Applicable

**NFPA RATINGS:**
HEALTH: = 0 FLAMMABILITY: = 0
INSTABILITY: = 0 SPECIAL: None




In addition to hazard classifications noted above, this gas poses a hazard due to its radioactivity.

**EXTINGUISHING MEDIA:** This is a non-flammable, inert gas; use fire-extinguishing media appropriate for the surrounding materials.

**SPECIAL FIRE-FIGHTING PROCEDURES:** Non-flammable, inert gas. Use extinguishing media appropriate for surrounding fire.

**UNUSUAL FIRE AND EXPLOSION HAZARDS:** This gas is radioactive. Firefighters should wear adequate personal protective equipment when fighting fires involving Krypton-85. This gas does not burn; however, containers, when involved in fire, may rupture or burst in the heat of the fire. Most cylinders have a pressure release device, which will vent contents if the cylinder is exposed to high temperatures.

**EXPLOSION SENSITIVITY TO MECHANICAL IMPACT:** Not sensitive.

**EXPLOSION SENSITIVITY TO STATIC DISCHARGE:** Not sensitive.

**HAZARDOUS COMBUSTION PRODUCTS:** None known.

## SECTION 6. ACCIDENTAL RELEASE MEASURES

**STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:** In the event of a leak of this product, operator should close the gas source if possible to do so safely. Evacuate area until room has been vented and a determination has been made that room is safe to re-enter. Geiger-Mueller Detector can be used to determine that all the radioactive material has dissipated. (Elimination of radioactive hazard also ensures that this gas mix is not adversely affecting oxygen levels. If desired an oxygen monitor can be used to confirm adequate oxygen level (>19.5%). ]
Only trained personnel, wearing Self-Contained Breathing Apparatus (SCBA) and appropriate protective clothing should re-enter a contaminated area.
Persons responding to a release of a pressurized gas should be aware of the severe hazard of mechanical injury in the event of valve failure or other event causing a rapid release of cylinder contents.
If leak is in user's gas handling equipment or system, close cylinder valve, and safely vent high pressure before attempting repairs.
If leak is from the cylinder, cylinder valve or the valve pressure relief device (PRD), contact your supplier.

## SECTION 7. HANDLING AND STORAGE

**It is expected that this product will be handled by customers with appropriate experience and training. Specific handling and storage procedures should be provided as part of your company radiation safety plan.**

**STORAGE:** Cylinders should be stored upright (with valve protection caps or plugs in place) and firmly secured to prevent falling or being knocked over. Cylinders should be stored in dry, well-ventilated areas. Protect from salt or other corrosive materials. Storage should be away from heavily traveled areas, walkways, elevators, platform edges or other objects or situations that could damage the cylinder wall. Do not store in a manner that will block emergency exits, fire extinguishers or other safety equipment. Do not allow storage temperature to exceed 125°F (52°C). Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time. Store empty cylinders away from full cylinders. Consideration should be taken to install leak detection and alarm equipment for storage areas. **NOTE:** Use only DOT or ASME code cylinders designed for compressed gas storage. Cylinders must not be recharged except by or with the consent of owner.

**HANDLING: THIS COMPOUND IS A RADIOISOTOPE. ALL WORK PRACTICES MUST BE DESIGNED TO ELIMINATE OR REDUCE HUMAN EXPOSURE TO THE LOWEST LEVEL POSSIBLE.** Employees must be trained to properly use this product. Areas in which this product is used must have appropriate radiation warning signs. Personnel monitoring may be required. Use of this material requires training of personnel in the safe handling of radioactive materials. Refer to your company radiation safety plan for safety recommendations. Refer to the regulations of Nuclear Regulatory Commission (10 CFR Part 20) for specific radiation protection standards.
Cylinder valves should be inspected regularly for physical damage or corrosion (apparent by discoloration or rust). Care should be taken to inspect the following valve locations for corrosion: neck (where valve inserts into cylinder); bonnet nut (where handle attaches to valve body). Close valve after each use and when empty. The failure of a valve can result in violent release of the pressurized gas, creating a severe mechanical injury hazard.
Do not drag, roll, slide or drop cylinder. Use a suitable hand truck designed for cylinder movement. Never attempt to lift a cylinder by its cap. Secure cylinders at all times while in use. Use a pressure regulator to safely discharge product from cylinder. Use a check valve to prevent reverse flow into cylinder. Once cylinder has been connected to properly purged process, open cylinder valve slowly and carefully. If user experiences any difficulty operating cylinder valve, discontinue use and contact supplier. Never insert an object (e.g., wrench, screwdriver, etc.) into valve cap openings; doing so may damage valve, causing a leak to occur. Use an adjustable strap-wrench to remove overly tight or rusted caps.

## SECTION 7. HANDLING AND STORAGE (cont'd)

Do not heat cylinders by any means to increase the discharge rate of product from the cylinder. Never apply flame or localized heat directly to any part of the cylinder. Cylinders should not be artificially cooled as certain types of steel undergo property changes when cryogenically cooled, thus making the cylinder unstable.

**SPECIAL PRECAUTIONS:** All work operations should be monitored in such a way that emergency personnel can be immediately contacted in the event of a release. Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, Inc. (telephone 703-412-0900) pamphlet CGA P-1, *Safe Handling of Compressed Gases in Containers.* Local regulations may require specific equipment for storage and use.

## SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

**VENTILATION AND ENGINEERING CONTROLS**: Forced ventilation systems for the general work area should be provided. If appropriate, install automatic monitoring equipment to detect the level of oxygen. It is recommended that this product be used within a closed system.

**EXPOSURE LIMITS:**

| Chemical Name | CAS # | OSHA PELs ppm | ACGIH TLVs ppm | NIOSH RELs ppm | NIOSH IDLH ppm | DFG MAKs ppm | AIHA WEELs ppm |
|---|---|---|---|---|---|---|---|
| Krypton | 7439-09-9 | Refer to the local standards and regulations for specific exposure guidelines to the Krypton-85 Isotope. In the US, refer to Nuclear Regulatory Commission Standards. | | | | | |
| Argon | 7440-37-1 | Simple Asphyxiant | | | | | |
| Helium | 7440-59-7 | Simple Asphyxiant | | | | | |
| Krypton | 7439-90-9 | Simple Asphyxiant | | | | | |
| Neon | 7440-01-9 | Simple Asphyxiant | | | | | |
| Nitrogen | 7727-37-9 | Simple Asphyxiant | | | | | |
| Xenon | 7440-63-3 | Simple Asphyxiant | | | | | |

**NE = Not Established**

*The following information on appropriate Personal Protective Equipment is provided to assist employers in complying with OSHA regulations found in 29 CFR Subpart I (beginning at 1910.132) or equivalent standard of Canada, or standards of EU member states (including EN 149 for respiratory PPE, and EN 166 for face/eye protection). Please reference applicable regulations and standards for relevant details.*

**RESPIRATORY PROTECTION:** Maintain oxygen levels above 19.5% in the workplace. Use supplied air respiratory protection if oxygen level is below 19.5%, or during emergency response to a release of this product. If respiratory protection is required, follow the requirements of the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134) and under 10 CFR §20.1703, or equivalent U.S. State standards, standards of Canada, the European Standard EN149, and EU member states.

**EYE PROTECTION:** Use approved safety goggles or safety glasses, when cylinders are not closed and capped. Be aware that particles or objects propelled by high pressure gas can fly significant distances. Eyewear should be as described in OSHA 29 CFR 1910.133 or by the European Standard EN166.

**SKIN PROTECTION:** Work (such as leather) gloves are recommended when handling cylinders of this gas. Wear gloves appropriate to the specific operation for which this gas mixture is used. If necessary, refer to U.S. OSHA 29 CFR 1910.138, and the European Standard DIN EN 374, or appropriate Standards of Canada.

**OTHER PROTECTIVE EQUIPMENT:** Use body protection appropriate for task. Safety shoes are recommended when handling cylinders. Information on general protective measures can be found in U.S. OSHA 29 CFR 1910.136.

## SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

| | **Krypton-85** |
|---|---|
| **Molecular Weight** | 85 |
| **Gas Density @ 21.1°C (70°F)** | 0.2172 lb/ft$^3$ (3.479 kg/m$^3$) |
| **Boiling Point @ 1 atm** | -153.4°C (-244.0°F) |
| **Freezing/Melting Point @ 1 atm** | -157°C (-251°F) |
| **Specific Gravity (air = 1) @ 21.1°C (70°F)** | 2.899 |
| **Solubility in Water vol/vol at 0°C (32°F) and 1 atm** | 0.0594 |
| **Specific Volume @ 21.1°C (70°F** | 4.604 ft$^3$/lb (0.287 m$^3$/kg) |
| **Critical Pressure** | 798.0 psia (5502 kPa abs) |
| **Odor Threshold** | odorless |

## SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES (cont'd)

The following information is for inert components that may be part of this mixture:

| | Argon | Helium | Krypton | Neon | Xenon |
|---|---|---|---|---|---|
| **Molecular Weight** | 39.95 | 4.00 | 83.80 | 20.183 | 131.3 |
| **Gas Density @ 21.1ºC (70ºF)** | 0.103 lb/ft$^3$ (1.650 kg/m$^3$) | 0.0103 lb/ft$^3$ (0.165 kg/m$^3$) | 0.2172 lb/ft$^3$ (3.479 kg/m$^3$) | 0.05215 lb/ft$^3$ (1.83536 kg/m$^3$) | 0.3416 lbs ft$^3$ (5.472 kg/m$^3$) |
| **Boiling Point @ 1 atm** | -185.9°C (-302.6°F) | -268.9°C (-452.1°F) | -153.4°C (-244.0°F) | -246.0°C (-410.9°F) | -108.2°C (-162.6°F) |
| **Freezing/Melting Point @ 1 atm** | -189.2°C (-308.6°F) | None | -157°C (-251°F) | -248.7°C (-415.6°F) | -168°F (-111°C) |
| **Specific Gravity (air = 1) @ 21.1°C (70°F)** | 1.38 | 1.38 | 2.899 | 0.696 | 4.560 |
| **Solubility in Water vol/vol at 0ºC (32°F) and 1 atm** | 0.056 | 0.0094 | 0.0594 | 0.0105 | 0.108 |
| **Specific Volume @ 21.1ºC (70ºF** | 9.71 ft$^3$/lb (0.606 m$^3$/kg) | 97.09 ft$^3$/lb (6.061 m$^3$/kg) | 4.604 ft$^3$/lb (0.287 m$^3$/kg) | 19.18 ft$^3$/lb (1.197 m$^3$/kg) | 2.927 ft$^3$/lb (0.183 m$^3$/kg) |
| **Critical Pressure** | 711.5 psia (4905 kPa abs) | 33.0 psia (227 kPa abs) | 798.0 psia (5502 kPa abs) | 384.9 psia (2654 kPa abs) | 847.0 psia (5840 kPa abs) |
| **Odor Threshold** | odorless | odorless | odorless | odorless | odorless |

**APPEARANCE, ODOR AND STATE:** Colorless, odorless gas.

**WARNING PROPERTIES FOR THIS GAS:** There are no warning properties in the event of a release. In terms of leak detection, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation. A Geiger-Mueller Detector should be used to detect the presence of Krypton-85.

**CHARACTERISTIC ENERGY LEVELS OF KRYPTON-85:** Gamma: 0.52MeV Beta: 0.67MeV

**HALF-LIFE of KRYPTON-85 ISOTOPE:** 11 years

## SECTION 10. STABILITY AND REACTIVITY

**CHEMICAL STABILITY:** Stable.
**CONDITIONS TO AVOID:** Cylinders should not be exposed to temperatures in excess of 125°F (52°C).
**MATERIALS WITH WHICH GAS IS INCOMPATIBLE:** None. Krypton-85 is an inert gas.
**REACTIVITY:**

**A) HAZARDOUS DECOMPOSITION PRODUCTS:** None.
**B) HAZARDOUS POLYMERIZATION:** Will not occur.

## SECTION 11. TOXICOLOGICAL INFORMATION

**TOXICITY DATA:** There are no toxicology data for Krypton-85. Krypton-85 is a simple asphyxiant, which acts to displace oxygen in the environment. Because Kr-85 is a radioactive isotope it is considered a potential carcinogen. Exposure to this isotope should be eliminated or reduced to as low as possible to reduce any cancer risk posed by this product. The remaining components of this mix are inert and have no toxicity data.

**IRRITANCY OF PRODUCT:** Not applicable.

**SENSITIZATION OF PRODUCT:** This gas mixture is not known to be a sensitizer.

**REPRODUCTIVE TOXICITY INFORMATION**: Refer to company NRC license or permit regarding declared pregnancy policy.

Mutagenicity: Krypton-85 is not reported to cause mutagenic effects in humans.
Embryotoxicity: Krypton-85 is not reported to cause embryotoxic effects in humans.
Teratogenicity: Krypton-85 is not reported to cause teratogenic effects in humans.
Reproductive Toxicity: Krypton-85 is not reported to cause adverse reproductive effects in humans.

*A mutagen is a chemical that causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An embryotoxin is a chemical that causes damage to a developing embryo (i.e., within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical that causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance that interferes in any way with the reproductive process.*

**BIOLOGICAL EXPOSURE INDICES (BEIs):** Currently, Biological Exposure Indices (BEIs) have not been determined for Krypton-85.

## SECTION 12. ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.

**ENVIRONMENTAL STABILITY:** Krypton-85 occurs naturally in the atmosphere. Krypton-85 will decay over time (the half-life is 11 years). The gas mixture will be dissipated rapidly in well-ventilated areas.

**EFFECT OF MATERIAL ON PLANTS or ANIMALS:** Immediate adverse effect on plants would be related to oxygen-deficient environments or frost from rapidly expanding gases, unless exposure occurs in a confined space.

**EFFECT OF CHEMICAL ON AQUATIC LIFE:** There is currently no evidence of adverse effects from exposure to this gas mixture on aquatic life.

**MOBILITY:** This gas mixture is inert and does not present a hazard of mobility.

## SECTION 12. ECOLOGICAL INFORMATION (cont'd)

**PERSISTENCE:** This gas mixture presents no hazard of persistence.

**HALF-LIFE of KRYPTON-85 ISOTOPE:** 11 years

**POTENTIAL TO BIOACCUMULATE:** This gas mixture will not bioaccumulate.

**OZONE-DEPLETION POTENTIAL:** This inert gas mixture does not contain any Class I or Class II ozone depleting chemical (40 CFR Part 82).

## SECTION 13. DISPOSAL CONSIDERATIONS

**UNUSED PRODUCT / EMPTY CONTAINER:** Do not dispose of residual product. Return used product in cylinders to: Spectra Gases, Inc., 320 Mt. Pleasant Ave., Newark, NJ 07104. Cylinders to be shipped "empty" must be done so in accordance with all DOT requirements including those found under 49 CFR 173.428.

**DISPOSAL INFORMATION:** Refer to the applicable regulations. The following references may apply: the U.S. Nuclear Regulatory Commission or the State radiological control agency for proper waste disposal (10 CFR Part 20, Sections 300-305), regulations of Canada and its Provinces, or regulations of EU member states.

## SECTION 14. TRANSPORT INFORMATION

**U.S. SHIPPING INFORMATION:**

One packaging requirement of note: [

- Except for LSA material, a Type A package may not contain greater quantity than A2 for "normal form" Class 7 material. (DOT regulations 49 CFR 173.431) Gas in a cylinder is "normal form". A2 for Kr 85 = 10Tbq (approx. 270 Ci)

**U.S. DOT PROPER SHIPPING NAME:** Radioactive material, Type A package
**HAZARD CLASS NUMBER and DESCRIPTION:** 7 (Radioactive material)
**UN IDENTIFICATION NUMBER:** UN 2915
**U.S. DOT SHIPPING LABEL(S) REQUIRED:** 7 (I,II, or III) and 2.2

Class 7 label options are dependant on Transport Index (determined by maximum radiation level 1 meter from package surface) (DOT regulation 49 CRF 172.403)

| Transport Index * *(TI= 100 x mSv/h at 1 meter)* | Maximum Radiation Level at any point on the external surface | Label Category |
|---|---|---|
| 0 | ≤ 0.005 mSv/h (0.5 mrem/h) | WHITE-I |
| 0< TI ≤ 1 | 0.005 mSv/h < radiation level ≤ 0.5 mSv/h (50 mrem/h) | YELLOW-II |
| 1< TI ≤ 10 | 0.5 mSv/h < radiation level ≤ 2 mSv/h (200 mrem/h) | YELLOW-III |
| more than 10 | 2 mSv/h < radiation level ≤ 2 mSv/h (200 mrem/h) | YELLOW-III (must be shipped via "exclusive use" provisions) |

*If the measured TI is not greater than 0.05, the value may be considered to be zero

**PLACARD (When required*):** 7 (Radioactive Yellow III only)

* see 49 CFR 172.504 – placarding is required for Yellow III labeled material and "exclusive use" shipments.

**SPECIAL SHIPPING INFORMATION:** Cylinders should be transported in a secure position. Ensure cylinder valve is properly closed, valve outlet cap has been reinstalled, and valve protection cap is secured before shipping cylinder. Ensure that tamper seal is intact.

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

**NAERG (NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK) #:** 163

**IATA SHIPPING INFORMATION:**
**UN IDENTIFICATION NUMBER:** UN 2915
**PROPER SHIPPING NAME:** Radioactive material, Type A package
**HAZARD CLASS NUMBER and DESCRIPTION:** 7 (Radioactive material)
**IATA DOT SHIPPING LABEL(S) REQUIRED:** 7 ( I, II or III as determined by Table 10.5.D), and 2.2
**PACKING INSTRUCTION:** IATA "*Dangerous Goods Regulations*", Section 10.5
**PLACARD (required if in large container*):** 7 see 49th ed. of the IATA Dangerous Goods Regulations, section 10.7.7.5

**SPECIAL SHIPPING INFORMATION:** Cylinders should be transported in a secure position. Ensure cylinder valve is properly closed, valve outlet cap has been reinstalled, and valve protection cap is secured before shipping cylinder. Ensure that tamper seal is intact.
This material must be shipped "Cargo Aircraft Only" for shipments to, from or within the United States since it is industrial-use-only product. [40 CFR 172.23(b)(11)&49 CFR 172.204(c)(4) ]
**CAUTION:** Compressed gas cylinders shall not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with the owner's written consent is a violation of Federal law (USDOT 49 CFR 173.301).
**EMERGENCY RESPONSE:** Drill Code 7L (from "*Emergency Response Guidance for Aircraft Incidents involving Dangerous Goods*" (ICAO Doc. 9481–AN/928)) or NAERG (North American Emergency Response Guidebook) #163
**LOCAL REGULATORY REQUIREMENTS:** Check local regulatory requirements for state-specific hazardous materials transportation requirements.

## SECTION 15. REGULATORY INFORMATION

**U.S. FEDERAL REGULATIONS:**
**EPA - ENVIRONMENTAL PROTECTION AGENCY:**
**CERCLA:** Comprehensive Environmental Response, Compensation, and Liability Act of 1990 (40 CFR Parts 117 and 302)
Reportable Quantity (RQ): 1000 curies
**SARA TITLE III:** Superfund Amendment and Reauthorization Act
**SECTIONS 302/304:** Emergency Planning and Notification (40 CFR Part 355)
Extremely Hazardous Substances: Krypton is not listed.
Threshold Planning Quantity (TPQ): Not Applicable
Reportable Quantity (RQ): Not Applicable
**SECTIONS 311/312:** Hazardous Chemical Reporting (40 CFR Part 370)

## SECTION 15. REGULATORY INFORMATION (cont'd)

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

**SECTION 313:** Toxic Chemical Release Reporting (40 CFR 372)
Releases of Krypton do not require reporting under Section 313.
**CLEAN AIR ACT:**
**SECTION 112 (r):** Risk Management Programs for Chemical Accidental Release (40 CFR Part 68)
Threshold Planning Quantity (TPQ): Not Applicable
**TSCA:** Toxic Substances Control Act
Because Krypton-85 is a byproduct material (as such terms are defined in the Atomic Energy Act of 1954 [42 U.S.C. 2011 et seq.], it is not considered a "chemical substance" as defined in 15 U.S.C. 53.2602.
**OSHA - OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:**
**29 CFR Part 1910.119:** Process Safety Management of Highly Hazardous Chemicals.
Threshold Planning Quantity (TPQ): Not Applicable
**OTHER U.S. FEDERAL REGULATIONS:** Requirements under Nuclear Regulatory Commission (10 CFR Part 20) for specific radiation protection standards must be followed. Some of the regulations pertinent to the handling of this material include: 10 CFR 20.101 (Dose Standards for Individuals in Restricted Areas); 10 CFR 20.202 (Personnel Monitoring) and 10 CFR 20.203 (Caution Signs, Labels, Signals, and Controls). The requirements of 10 CFR Part 30 (Rules of General Applicability to Domestic Licensing of Byproduct Material) and 10 CFR Part 71 (Packaging and Transportation of Radioactive Material) may also be applicable.

**U.S. STATE REGULATORY INFORMATION**:
**CALIFORNIA PROPOSITION 65**: Krypton-85 is listed on the California Proposition 65 lists as a radionuclide.

**CANADIAN FEDERAL REGULATIONS:**

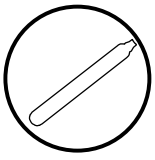
**CANADIAN DSL INVENTORY STATUS:** Krypton-85 is regulated by Canadian Nuclear Safety Commission.

**OTHER CANADIAN REGULATIONS:** Krypton-85 is categorized as a Controlled Product, Hazard Class A, as per the Controlled Product Regulations. Krypton is not on the CEPA Priorities Substances Lists.

**CANADIAN WHMIS SYMBOLS:** **Class A:** Compressed Gas

**EUROPEAN UNION REGULATIONS:**

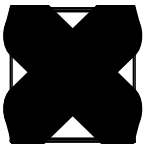
**EU LABELING AND CLASSIFICATION:** The European Union Council Directives 67/548/EEC and following classification is self-classification, based on 1999/45/EC: Carcinogenic Category 3 [Xn]



**EU CLASSIFICATION:** Carcinogenic Category 3 [Xn]
**EU RISK PHRASES:** [R: 40] Limited evidence of a carcinogenic effect.

**EU SAFETY PHRASES:** [S: 7] Keep container tightly closed. [S: 9] Keep container in a well-ventilated place. [S: 23] Do not breathe gas. [S: 35] This material and its container must be disposed of in a safe way. [S: 36/37] Wear suitable protective clothing and gloves. [S: 53] Avoid exposure—Obtain special instructions before use.

**EUROPEAN UNION ANNEX II HAZARD SYMBOL:**



## SECTION 16. OTHER INFORMATION

Information contained in this Material Safety Data Sheet is provided to our customers so they may comply with 29 CFR 1910.1200, Hazard Communication Standard, the Canadian WHMIS Standard, and the requirements of the European Union Directives. The intent of this Material Safety Data Sheet is to provide end users of this product with the health and physical hazards associated with possible exposure to this product. All statements, technical data and recommendations are based on readily available texts and data that Spectra Gases, Inc., believes to be reliable and accurate. Spectra Gases, Inc., makes no warranties, guarantees or representations of any kind with respect to this product or this data. It is the responsibility of the user to obtain and use the most recent version of this MSDS.

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Rev: 5/2/07 Sec. 13 cyl return to Newark
Rev. 1/31/08 new MSDS #1163B Sec. 1, 13, 14 DOT Type A package
Rev. 5/7/08: Sec 14: Correction - added Class 2.2 subsidiary hazard label. Added IATA to section 14. Added other clarification , sec 14.