S A F E T Y  D A T A  S H E E T

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Xenon Xe-133 Gas

Version 4.0 11/4/2015

Product Uses
Xenon-133 gas is a radiopharmaceutical that is used to evaluate pulmonary function and cerebral blood flow, and for imaging the lungs. It is administered by inhalation from closed respirator systems and spirometers. Xenon-133 gas is a readily diffusible gas which is neither utilized nor produced by the body. Most of the Xenon-133 gas that enters the circulation from a single breath is returned to the lungs and exhaled after a single pass through the peripheral circulation. It is essentially an inert gas. Overexposure manifests as asphyxiation.

COMPANY IDENTIFICATION: Lantheus Medical Imaging
331 Treble Cove Road
Billerica, MA 01862
United States of America
1-800-299-3431

EMERGENCY PHONE: CHEMTREC 1-800-424-9300.
For International Transportation Emergencies Call CHEMTREC @ 1-703-527-3887.
Collect Calls are accepted

SECTION 2: HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

Appearance Colorless Gas

Signal Word Danger!

Hazard Statements Radioactive.

Precautionary Measures Avoid ingestion, inhalation, skin and eye contact. Care should be taken to minimize radiation exposure. Appropriate radiation shielding should be used. Keep material in a lead container. Avoid direct handling by using remote manipulation tools. Wash hands after handling to minimize exposure. Pregnant or nursing women should avoid exposure.
Potential Health Effects

Eyes
Exposure to ionizing radiation may produce adverse effects.

Skin
Exposure to ionizing radiation may produce adverse effects.

Ingestion
Exposure to ionizing radiation may produce adverse effects.

Inhalation
Exposure to ionizing radiation may produce adverse effects.

Target Organs
Lung; bone; fatty tissue

Signs and Symptoms
Acute: diarrhea, nausea, vomiting, abdominal pain, thirst, fever, difficulty sleeping, tremors, delirium, confusion, convulsions, coma, death.
Chronic: Radioactive material: may cause cancer, adverse reproductive effects, embryo/fetal toxicity, hair loss, rash, skin effects, nail changes, pain, weakness,

Environmental Effects
Refer to Section 12

SECTION 3: COMPOSITION INFORMATION ON INGREDIENTS

Substance  Xenon-133 Gas

Common Name/Synonym:  Xenon gas, Xenon-133, Xe-133 Gas

Hazardous Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Concentration</th>
<th>CAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xe-133 Gas</td>
<td>&lt;0.1%</td>
<td>14932-42-4</td>
</tr>
</tbody>
</table>

Mixture Concentration

<table>
<thead>
<tr>
<th>Component</th>
<th>Concentration</th>
<th>CAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Dioxide</td>
<td>5%</td>
<td>124-38-9</td>
</tr>
<tr>
<td>Xenon</td>
<td>95%</td>
<td>7440-63-3</td>
</tr>
</tbody>
</table>

SECTION 4: FIRST AID MEASURES

Eye contact  Not Applicable

Skin contact  Not Applicable

Inhalation  Move to fresh air. Obtain medical attention.

Ingestion  Not Applicable
Note to Physicians  
Xenon-133 gas is a radiopharmaceutical that is used to evaluate pulmonary function and cerebral blood flow, and for imaging the lungs. It is administered by inhalation from closed respirator systems and spirometers. Xenon-133 gas is a readily diffusible gas which is neither utilized nor produced by the body. Most of the Xenon-133 gas that enters the circulation from a single breath is returned to the lungs and exhaled after a single pass through the peripheral circulation. It is essentially an inert gas. Overexposure manifests as asphyxiation.

Medical Surveillance  
A pre-placement physical examination and history for employees with potential exposure to this compound is recommended. Baseline testing would include: EKG, a blood test for liver function. Based on opportunity for exposure and duration of exposure a periodic follow-up examination may be considered. This exam should be overseen by a physician thoroughly knowledgeable about both the toxicity of this compound and the extent of workplace exposure. It is recommended that the content be similar to the pre-placement exam. Employees, who are pregnant, are breast-feeding, or who are concerned with other reproductive issues should be encouraged to consult with the occupational health physician monitoring worker's health.

SECTION 5: FIRE-FIGHTING MEASURES

Flammable Properties  
Material is a non-flammable gas.

Extinguishing Media  
Suitable extinguishing media: Dry chemical, Water spray, Foam

Protection of Firefighters  
Specific hazards: Radioactive.
Protective equipment: Use personal protective equipment. In the event of fire, wear self-contained breathing apparatus. Hazardous Combustion Products: None

SECTION 6: ACCIDENTAL RELEASE MEASURES

Personal Precautions  
Evacuate affected rooms. Contact the company Radiation Safety Officer. Care should be taken to minimize radiation exposure. Handle as radioactive gas release. Refer to protective measures listed in sections 7 and 8. Use personal protective equipment. Depending on the nature of the spill (quantity and extent of release) a self-contained breathing apparatus may be needed.

Environmental Precautions  
Prevent release to the environment.
Containment Methods
Seal leaking containers.

Cleanup Methods
Allow released gas to clear from the affected area through the building ventilation.

SECTION 7: HANDLING AND STORAGE

Handling Precautions
Avoid exposure. Contact the company/institution Radiation Safety Officer. Care should be taken to minimize radiation exposure. Handling time should be kept to a minimum. Appropriate radiation shielding should be used. Use of syringe shields and tongs are recommended. Keep material in a lead container. Avoid direct handling by using remote manipulation tools. Obtain appropriate governmental licenses to possess and handle radioactive material. Keep away from heat and sources of ignition. For a complete discussion of Handling and Storage information, please consult the full prescribing information.

Storage Conditions
Store at controlled room temperature of 15 - 30°C. Storage and disposal of product should be controlled in a manner compliant with applicable governmental regulations pertaining to radionuclides. Store and handle in a designated area. Keep away from heat, sparks and flames.

Container Requirements
Store in sturdy containers appropriate to maintain the integrity of this material for its intended use.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

<table>
<thead>
<tr>
<th>Exposure Limit(s)</th>
<th>NCR</th>
<th>ICRP/ACGIH</th>
<th>OSHA</th>
<th>NIOSH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radionuclides</td>
<td>5 rem Whole Body (annual)</td>
<td>20 mSv Effective Dose (annual)</td>
<td>2.0 mCi Annual Limit (NRC - 10 CFR 20)</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>15 rem Lens of eye Annual</td>
<td>150 mSv (lens of eye) annual equivalent dose</td>
<td>0.000001 μCi/ml Derived Air (annual)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50 rem skin of whole body</td>
<td>500 mSv (skin) annual equivalent dose</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50 rem Extremities (annual)</td>
<td>500 mSv (hands &amp; feet) annual equivalent dose</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5 rem Embryo/fetus</td>
<td>0.5 mv Equivalent Dose annual equivalent dose</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Term of pregnancy 2 mSv Embryo/Fetus (abdomen of pregnant woman over course of pregnancy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>150 mSv Effective dose (lens of eye)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Annual Equivalent Dose 500mSv (skin)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Annual Equivalent Dose</td>
<td></td>
</tr>
</tbody>
</table>
**Exposure Limit(s)**

<table>
<thead>
<tr>
<th></th>
<th>NCR</th>
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</thead>
<tbody>
<tr>
<td>Xenon</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Exposure Control Banding**

- Not Available

**Lantheus MI Exposure Guidelines Summary**

- Not Available

**Recommended Industrial Hygiene Monitoring Methods**

Contact the Lantheus Medical Imaging Radiation Protection Office at 978-671-8672 or 978-671-8673

**Engineering Controls and Ventilation**

Use process enclosures, containment technology, or other engineering controls to keep airborne levels below recommended exposure limit.

**Respiratory Protection**

Use and selection of respiratory protection is based upon engineering controls in use and potential for aerosol generation. When engineering controls are not sufficient control exposure, wear an approved respirator.

**Eye Protection**

Chemical safety goggles and face shields are recommended. Note: Choice of eye protection may be influenced by the type of respirator which is selected.

**Hand Protection**

Impervious nitrile, rubber and latex gloves are recommended. Please note that employees who are allergic to natural rubber latex should use nitrile gloves.

**Skin and Body Protection**

Wear a disposable coverall, polyethylene apron and sleeves, and shoe covers.

**Hygiene**

Wash hands and face before breaks and immediately after handling the product.

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**SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES**

### Appearance

<table>
<thead>
<tr>
<th>Physical State</th>
<th>Gas</th>
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</thead>
<tbody>
<tr>
<td>Color</td>
<td>Colorless</td>
</tr>
<tr>
<td>Odor</td>
<td>Odorless</td>
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Physical and Chemical Properties

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<th>Property</th>
<th>Description</th>
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<tbody>
<tr>
<td>Molecular Weight</td>
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<tr>
<td>Solubility</td>
<td>Soluble</td>
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<tr>
<td>Flashpoint</td>
<td>NA</td>
</tr>
<tr>
<td>Density</td>
<td>Not Available</td>
</tr>
<tr>
<td>pH</td>
<td>NA</td>
</tr>
<tr>
<td>Boiling Point</td>
<td>NA</td>
</tr>
<tr>
<td>Melting Point</td>
<td>NA</td>
</tr>
<tr>
<td>Vapor Density</td>
<td>Not Available</td>
</tr>
<tr>
<td>Vapor Pressure</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

SECTION 10: STABILITY AND REACTIVITY

Chemical Stability Stable under recommended storage conditions.

Conditions to Avoid Heat, sparks, flame

Incompatible Products Not Available

Hazardous Decomposition Products Not Available

Hazardous Reactions Hazardous polymerization does not occur.

SECTION 11: TOXICOLOGICAL INFORMATION

Routes of Entry Inhalation

Eye Irritation Not expected

Skin Irritation Not expected

Respiratory Irritation Not expected

Sensitization Not expected

Acute Toxicity Xenon/Carbon dioxide: asphyxiation if oxygen displaced. Carbon dioxide: In high concentrations causes rapid circulatory insufficiency.

Carcinogenicity Ionizing radiation: exposure known to increase risk of cancer. Xenon/carbon dioxide: not listed by IARC, NTP, OSHA, ACGIH
Reproductive Toxicity  Ionizing radiation: exposure known to increase risk of reproductive and developmental effects.

Developmental Toxicity  Ionizing radiation: exposure known to increase risk of reproductive and developmental effects.

Target Organs  Carbon dioxide: cardiovascular system.

Symptoms  Carbon dioxide: headache, nausea and vomiting, which may lead to unconsciousness.

Section 12 ECOLOGICAL INFORMATION

Environmental Fate:  Not available. Hazardous component, Xe-133 will undergo radiological decay to Cs-133, a non-radioactive isotope of Cesium.

Environmental Toxicity:  Ecotoxicological Information (Aquatic)  Not Available

Ecotoxicological Information (Terrestrial)  Not Available

SECTION 13: Disposal Considerations

Advice on Disposal And Packaging  Segregate and label radioactive waste. Disposal should be in accordance with applicable regional, national, and local laws and regulations. Local regulations may be more stringent than regional or national requirements. After use follow local procedures for radioactive waste.

Other Information  This information presented below only applies to the material as supplied.

SECTION 14: TRANSPORT INFORMATION

US DOT Transportation Classification for All Modes  The classification for transportation of radioactive materials will depend on the specific activity level of the material, type of isotope, as well as the quantity shipped. Specific site procedures should be followed for shipping radioactive materials or seek advise from your site radiation safety officer.
SECTION 15: REGULATORY INFORMATION

United States of America
OSHA Hazard Classification
No OSHA Hazards. Note: This regulation does not address radiation hazards.

CERCLA/SARA RQ
Not Listed

313 Toxic Release Inventory
No components listed on the SARA 313 inventory.

Listed Chemicals/Compounds

TSCA Inventory
Not listed. Food, drug and cosmetic products are exempt from TSCA.

International

Canada

WHMIS
Finished medicinal products are exempt from classification and labeling requirements under the Canadian Hazardous Products Act and Controlled Products Regulations. Note: This regulation does not address hazards related to radioactivity.

DSL/NDSL
Not listed

Europe

EINECS/ELINCS Number
Xenon: 231-172-7, Carbon Dioxide: 204-696-9

Other Information
Medicinal product are exempt from classification and labeling requirements under EU Preparations Directive 1999/45/EC.

Mexico
Health classification - Minimal hazard -0 - Substances that do not pose a hazard under emergency conditions other than that of ordinary combustible materials. Note: This regulation does not address hazards related to radioactivity.

SECTION 16: OTHER INFORMATION

MSDS preparation information

Prepared by
Environment, Health and Safety 1-978-671-8673

Prepared on
11/4/2015
The information contained in this MSDS is believed to be accurate and represents the best information reasonably available at the time of preparation. However, we make no warranty, express or implied, with respect to such information, and we assume no liability from its use.