### 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

<table>
<thead>
<tr>
<th>Product code:</th>
<th>M3017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Name:</td>
<td>MELPHALAN</td>
</tr>
<tr>
<td>Chemical Name:</td>
<td>Alanine, 3-(p-(bis(2-chloroethyl)amino)phenyl)-, L-</td>
</tr>
</tbody>
</table>
| Synonyms: | Alkeran  
L-3-(p-(Bis(2-chloroethyl)amino)phenyl)alanine  
p-Bis(beta-chloroethyl)aminophenylalanine  
p-N-Bis(2-chloroethyl)amino-L-phenylalanine  
3-(p-(Bis(2-chloroethyl)amino)phenyl)-L-alanine  
4-(Bis(2-chloroethyl)amino)-L-phenylalanine  
p-Di-(2-chloroethyl)amino-L-phenylalanine  
p-N-Di(chloroethyl)aminophenylalanine  
3-p-(Di(2-chloroethyl)amino)-phenyl-L-alanine  
Levofalan  
Melfalan  
L-Sarcolysin  
P-L-Sarcolysin  
L-Sarcolysine  
L-Sarkolysin  
Alanine nitrogen mustard  
L-Phenylalanine, 4-(bis(2-chloroethyl)amino)-  
Phenylalanine mustard  
L-Phenylalanine mustard  
Phenylalanine nitrogen mustard |
| CAS #: | 148-82-3 |
| Formula: | C13-H18-Cl2-N2-O2 |
| RTECS #: | AY3675000 |
| CI#: | Not available |
| Supplier: | Spectrum Chemicals and Laboratory Products, Inc.  
14422 South San Pedro St.  
Gardena, CA 90248  
(310) 516-8000 |
| Emergency Telephone Number: | CHEMTREC: 1-800-424-9300 |
| Contact Person: | Martin LaBenz (West Coast) |
| Contact Person: | Chris Terpak (East Coast) |
2. HAZARDS IDENTIFICATION

OSHA Regulatory Status
This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200)

POTENTIAL HEALTH EFFECTS

Ode: None.
Physical state: Solid.
Appearance: Powder.

Principal Routes of Exposure:
Ingestion. Inhalation.

Acute Potential Health Effects:
Skin Contact:
May cause skin irritation.

Eye Contact:
Contact with eyes may cause irritation.

Inhalation:
May cause irritation of respiratory tract.

Ingestion:
Toxic if swallowed. May be fatal if swallowed. May cause nausea and vomiting. May cause diarrhea. May affect the bone marrow. May affect the blood. May affect the liver. May cause Cholitis. It may affect the kidneys. May cause central nervous system effects.

Chronic Potential Health Effects:

<table>
<thead>
<tr>
<th>Component</th>
<th>Carcinogen Status:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melphalan</td>
<td>Group 1 - Carcinogenic to humans by IARC</td>
</tr>
</tbody>
</table>

Target Organs:

Teratogenic Effects: May cause birth defects (teratogenic effects) based on animal test data
It has not been shown to cause teratogenic effects in humans

Mutagenic Effects: May affect genetic material. Mutations in microorganisms. Experiments with bacteria have shown mutagenic effects. Mutagenic effects in mammalian somatic cells. Experiments with human lymphocytes have shown mutagenic effects.

Aggravated Medical Conditions: Hypersensitivity to material.

See Section 11 for additional Toxicological Information

POTENTIAL ENVIRONMENTAL EFFECTS
No information available

Product code: M3017
Product name: MELPHALAN
3. COMPOSITION/INFORMATION ON INGREDIENTS

<table>
<thead>
<tr>
<th>Components</th>
<th>CAS-No.</th>
<th>Weight %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melphalan</td>
<td>148-82-3</td>
<td>100</td>
</tr>
</tbody>
</table>

4. FIRST AID MEASURES

General Advice: Poison information centres in each State capital city can provide additional assistance for scheduled poisons (13 1126). Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves. First aider needs to protect himself.

Skin Contact: Wash off immediately with soap and plenty of water removing all contaminated clothes and shoes. Get medical attention if irritation develops.

Eye Contact: Flush eye with water for 15 minutes. Get medical attention if irritation occurs. If symptoms persist, call a physician.

Inhalation: Move to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. WARNING! It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled or ingested material is toxic, infectious or corrosive. Do not use mouth-to-mouth resuscitation if victim ingested or inhaled the substance; induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Immediate medical attention is required.

Ingestion: Do not induce vomiting without medical advice. Never give anything by mouth to an unconscious person. Toxic if swallowed. Immediate medical attention is required. Call a physician or Poison Control Centre immediately.

Notes to Physician: Treat symptomatically

5. FIRE-FIGHTING MEASURES

Flammable Properties

Flashpoint (°C/°F): No information available.

Tested according to: Not available

Lower Explosion Limit (%): No information available

Upper Explosion Limit (%): No information available

Autoignition Temperature (°C/°F): Not applicable.

Suitable Extinguishing Media: Dry chemical. Carbon dioxide (CO2). Water spray mist or foam. Alcohol-resistant foam.

Unsuitable Extinguishing Media: No information available.

Hazardous Combustion Products: Carbon monoxide; Carbon dioxide, Nitrogen oxides, Hydrogen chloride

Specific hazards: May be combustible at high temperatures.
Special Protective Equipment for Firefighters: As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

Specific Methods: Water mist may be used to cool closed containers. For larger fires, use water spray or fog. Cool containers with flooding quantities of water until well after fire is out. Dike fire-control water for later disposal; do not scatter the material.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Keep people away from and upwind of spill/leak. Ensure adequate ventilation. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Use personal protective equipment. Avoid contact with skin, eyes and clothing. Avoid dust formation. Remove all sources of ignition.

Environmental Precautions: Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Prevent entry into waterways, sewers, basements or confined areas.

Methods for Cleaning Up: Sweep up and shovel into suitable containers for disposal. Use a suitable vacuum cleaner. Clean contaminated surface thoroughly.

7. HANDLING AND STORAGE

Handling

Technical Measures/Precautions: Provide sufficient air exchange and/or exhaust in work rooms. Avoid dust formation. Keep away from incompatible materials.

Safe Handling Advice: Wear personal protective equipment. Avoid contact with skin, eyes and clothing. Do not ingest. Do not breathe vapours/dust. Avoid dust formation. Keep away from heat and sources of ignition. Handle in accordance with good industrial hygiene and safety practice.

Storage


Incompatible Products: No information available.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering measures to reduce exposure: Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protective Equipment
Eye protection: Safety glasses. Safety glasses with side-shields.

Skin and body protection: Long sleeved clothing. Chemical resistant apron. Gloves.

Respiratory protection: Wear respirator with dust filter.

Hygiene measures: Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product. When using, do not eat, drink or smoke.

National occupational exposure limits

United States
U.S Occupational Exposure Limits: Not determined

<table>
<thead>
<tr>
<th>Components</th>
<th>OSHA</th>
<th>NIOSH</th>
<th>ACGIH</th>
<th>AIHA WHEEL</th>
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</thead>
<tbody>
<tr>
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<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
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</table>

Canada
Canada Occupational Exposure Limits: Not determined

<table>
<thead>
<tr>
<th>Components</th>
<th>Alberta</th>
<th>British Columbia</th>
<th>Ontario</th>
<th>Quebec</th>
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</table>

Australia and Mexico
Occupational Exposure Limits for Australia and Mexico: Not determined

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<thead>
<tr>
<th>Components</th>
<th>Australia</th>
<th>Mexico</th>
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</thead>
<tbody>
<tr>
<td>Melphalan 148-82-3</td>
<td>None</td>
<td>None</td>
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</tbody>
</table>

9. PHYSICAL AND CHEMICAL PROPERTIES
### 9. PHYSICAL AND CHEMICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical state</td>
<td>Solid</td>
<td>Appearance</td>
<td>Powder</td>
</tr>
<tr>
<td>Odor</td>
<td>None</td>
<td>Taste</td>
<td>No information available</td>
</tr>
<tr>
<td>Flash point (°C):</td>
<td>Not applicable</td>
<td>Lower Explosion Limit (%)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Autoignition Temperature (°C/°F):</td>
<td>No information available</td>
<td>Decomposition temperature (°C/°F):</td>
<td>180-183 °C/356-361.4 °F</td>
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<tr>
<td>Melting point/range (°C/°F):</td>
<td>180-183 °C/356-356 °F</td>
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<tr>
<td>Density (g/cm³):</td>
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<td>Bulk density</td>
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<tr>
<td>Vapor density</td>
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<td>Evaporation rate</td>
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<td>Odor threshold (ppm):</td>
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<td>Partition coefficient (n-octanol/water):</td>
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<tr>
<td>Solubility</td>
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<td>Miscibility</td>
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<tr>
<td></td>
<td>Soluble in Propylene glycol</td>
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</tr>
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<td></td>
<td>Slightly soluble in Methanol</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insoluble in Chloroform</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insoluble in Ether</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Practically insoluble in water</td>
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</tr>
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<td>Molecular/Formula weight:</td>
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<tr>
<td>Density (g/cm³):</td>
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<tr>
<td>Bulk density</td>
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<tr>
<td>Evaporation rate</td>
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<td></td>
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<tr>
<td>VOC content (g/L):</td>
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</tr>
<tr>
<td>Miscibility</td>
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</tr>
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<td>Lower Explosion Limit (%)</td>
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<tr>
<td>Molecular weight</td>
<td>305.20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 10. STABILITY AND REACTIVITY

**Stability:** Stable at normal conditions

**Conditions to avoid:** Heat. Avoid dust formation. Dust may form explosive mixture in air. Fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard. Exposure to light.

**Materials to avoid:** No information available

**Hazardous decomposition products:** When heated to decomposition it emits toxic fumes. Carbon monoxide. Carbon dioxide. Nitrogen oxides (NOx). Hydrogen chloride gas.

**Possibility of Hazardous Reactions:** No information available

**Polymerization:** Hazardous polymerisation does not occur

**Corrosivity:** No information available

**Special Remarks on Corrosivity:** No information available

### 11. TOXICOLOGICAL INFORMATION

**Acute Toxicity**

**Component Information**
Melphalan - 148-82-3
LD50/oral/rat = 11.2 mg/kg Oral LD50 Rat
LD50/oral/mouse = No information available
LD50/dermal/rabbit = No information available
LD50/dermal/rat = No information available
LC50/inhalation/rat = No information available
LC50/inhalation/mouse = No information available
Other LD50 or LC50 information = No information available

Product Information
LC50/inhalation/rat = No information available
LC50/inhalation/mouse = No information available
LD50/dermal/rabbit = No information available
LD50/dermal/rat = No information available
LD50/oral/rat = No information available
LD50/oral/mouse = No information available

Local Effects
Skin irritation: May cause skin irritation. Mild skin irritation.
Eye irritation: Contact with eyes may cause irritation. Mild eye irritation.
Inhalation: May cause irritation of respiratory tract.
Ingestion: Toxic if swallowed. Ingestion may cause nausea, vomiting. May cause diarrhea. May cause oral ulceration. May cause irritation to mucous membranes. May cause loss of appetite. May affect the liver (liver function tests are abnormal). May affect the liver and cause jaundice, a yellowing of the skin and/or eyes. May affect urinary system (kidneys). May affect behavior/central nervous system (somnolence, convulsions). It may affect the bone marrow (bone marrow depression). It may affect the blood (changes in white and red blood cell count). It may affect the blood (leukopenia, thrombocytopenia, agranulocytosis, pancytopenia, anemia).

Sensitization: Prolonged or repeated ingestion may cause hypersensitivity and anaphylactic reactions which are characterized by dermatitis, urticaria, pruritus, widespread rash, edema (swelling) of the mouth, face, lips or tongue, tachycardia, bronchospasm, wheezing, chest tightness, dyspnea (shortness of breath or difficulty breathing), difficulty swallowing, hypotension.

Chronic Toxicity
Prolonged or repeated ingestion may cause nausea, vomiting, diarrhea. Prolonged or repeated ingestion may affect metabolism (cause anorexia, weight loss). Prolonged or repeated ingestion may affect the kidneys. Prolonged or repeated ingestion may affect the bone marrow. Prolonged or repeated ingestion may affect the blood (changes in red blood cell count). Prolonged or repeated ingestion may affect the blood (changes in white blood cell count). Prolonged or repeated ingestion may affect the spleen. Prolonged or repeated ingestion may affect the liver. Prolonged or repeated ingestion may cause alopecia. Prolonged or repeated exposure by inhalation or ingestion will have effects similar to those of acute inhalation or ingestion.
Carcinogenic effects:

<table>
<thead>
<tr>
<th>Components</th>
<th>NTP</th>
<th>IARC</th>
<th>OSHA HCS - Carcinogens</th>
<th>ACGIH - Carcinogens</th>
<th>Australia - Prohibited Carcinogenic Substances</th>
<th>Australia - Notifiable Carcinogenic Substances</th>
</tr>
</thead>
</table>

Mutagenic Effects:
May affect genetic material
- Mutations in microorganisms
- Experiments with bacteria have shown mutagenic effects
- Mutagenic effects in mammalian somatic cells
- Experiments with human lymphocytes have shown mutagenic effects

Reproductive Effects:
May cause adverse reproductive effects. There are no adequate and well-controlled studies in humans. Data in humans were insufficient to evaluate the effects on reproduction.

Teratogenic Effects:
May cause birth defects (teratogenic effects) based on animal test data. It has not been shown to cause teratogenic effects in humans.

Target Organs:

12. ECOLOGICAL INFORMATION

ECOTOXICITY

Toxicity to terrestrial and aquatic plants and animals:
No information available

Ecotoxicity effects:
No data available. This product has no known eco-toxicological effects.

Aquatic toxicity:
No information available

Mobility:
No information available

Persistence and degradability:
No information available

Bioaccumulative potential:
An estimated Bioconcentration Factor (BCF) value of 0.24 suggests that melphalan will not bioconcentrate in aquatic organisms.

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products:
Waste must be disposed of in accordance with Federal, State and Local regulation.

Contaminated packaging:
Empty containers should be taken for local recycling, recovery or waste disposal

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Melphalan</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>U150</td>
</tr>
</tbody>
</table>

14. TRANSPORT INFORMATION

DOT
UN-No: UN2811

Product code: M3017
Product name: MELPHALAN
Proper Shipping Name: Toxic solids, organic, n.o.s.
Hazard Class: 6.1
Packing Group: II
Subsidiary Risk: Not applicable
Marine Pollutant: No data available
ERG No: 153
DOT RQ (lbs): No information available
Symbol(s): G

TDG (Canada)
UN-No: UN2811
Proper Shipping Name: Toxic solid, organic, n.o.s.
Hazard Class: 6.1
Packing Group: II
Subsidiary Risk: No information available
Description: No information available

ADR
UN-No: UN2811
Proper Shipping Name: Toxic solid, organic, n.o.s.
Hazard Class: 6.1
Packing Group: II
Subsidiary Risk: No information available
Classification Code: No information available
Description: No information available
CEFIC Tremcard No: No information available

IMO / IMDG
UN-No: UN2811
Proper Shipping Name: Toxic solid, organic, n.o.s.
Hazard Class: 6.1
Subsidiary Risk: No information available
Packing Group: II
Description: No information available
IMDG Page: No information available
Marine Pollutant: No information available
EMS: F-A
MFAG: No information available
Maximum Quantity: No information available

RID
UN-No: UN2811
Proper Shipping Name: Toxic solid, organic, n.o.s.
Hazard Class: 6.1
Packing Group: II
Subsidiary Risk: 6.1
Classification Code: No information available
Description: No information available

ICAO
UN-No: UN2811
Proper Shipping Name: Toxic solid, organic, n.o.s.
Hazard Class: 6.1
Packing Group: II
Subsidiary Risk: No information available
Description: No information available

IATA
UN-No: UN2811

Product code: M3017  Product name: MELPHALAN
Proper Shipping Name: Toxic solid, organic, n.o.s.
Hazard Class: 6.1
Packing Group: II
Subsidiary Risk: No information available
ERG Code: 6L
Description: No information available

15. REGULATORY INFORMATION

International Inventories

<table>
<thead>
<tr>
<th>Components</th>
<th>U.S. TSCA</th>
<th>Philippines (PICCS)</th>
<th>KOREA KECL</th>
<th>Japan ENCS</th>
<th>CHINA</th>
<th>Australia (AICS)</th>
<th>EINECS-No.</th>
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</thead>
<tbody>
<tr>
<td>Melphalan</td>
<td>Not Listed</td>
<td>Not present</td>
<td>Not present</td>
<td>Not present</td>
<td>Not present</td>
<td>Present</td>
<td>205-726-3</td>
</tr>
</tbody>
</table>

U.S. Regulations

*Melphalan*

- Massachusetts RTK: Present
- New Jersey RTK Hazardous Substance List: Present
- New Jersey - Discharge Prevention - List of Hazardous Substances: Present
- Pennsylvania RTK: Environmental hazard
- Special hazardous substance
- Pennsylvania RTK - Environmental Hazard List: Present
- Pennsylvania RTK - Special Hazardous Substances: Present
- RI RTK - Hazardous Substances List: Present
- Minnesota - Hazardous Substance List: Present
- New York Release Reporting - List of Hazardous Substances: 1 lb RQ
- Louisiana Reportable Quantity List for Pollutants: 1 lb final RQ
- 0.454 kg final RQ
- California Directors List of Hazardous Substances: Present


Chemicals Known to the State of California to Cause Cancer:
WARNING: This product contains a chemical known to the State of California to cause cancer. (See table below)

Chemicals Known to the State of California to Cause Reproductive Toxicity:
WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm. (See table below)

<table>
<thead>
<tr>
<th>Components</th>
<th>Carcinogen</th>
<th>Developmental Toxicity</th>
<th>Male Reproductive Toxicity</th>
<th>Female Reproductive Toxicity</th>
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</thead>
<tbody>
<tr>
<td>Melphalan</td>
<td>carcinogen</td>
<td>developmental toxicity</td>
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</table>

CERCLA/SARA

<table>
<thead>
<tr>
<th>Components</th>
<th>CERCLA - Hazardous Substances and their Reportable Quantities</th>
<th>Section 302 Extremely Hazardous Substances and TPQs</th>
<th>Section 302 Extremely Hazardous Substances and RQs</th>
<th>Section 313 - Chemical Category</th>
<th>Section 313 - Reporting de minimis</th>
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</thead>
<tbody>
<tr>
<td>Melphalan</td>
<td>1 lb final RQ</td>
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<td>None</td>
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U.S. TSCA

<table>
<thead>
<tr>
<th>Components</th>
<th>TSCA Section 5(a)2 - Chemicals With Significant New Use Rules (SNURS)</th>
<th>TSCA 8(d) - Health and Safety Reporting</th>
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</thead>
<tbody>
<tr>
<td>Melphalan</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

Canada
WHMIS hazard class:
D1A Very toxic materials
D2A Very toxic materials
D2B Toxic materials

Canada Controlled Products Regulation:
This product has been classified according to the hazard criteria of the CPR (Controlled Products Regulation) and the MSDS contains all of the information required by the CPR.

Inventory

<table>
<thead>
<tr>
<th>Components</th>
<th>Canada (DSL)</th>
<th>Canada (NDSL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melphalan</td>
<td>Present</td>
<td>Not Listed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Components</th>
<th>CEPA Schedule I - Toxic Substances</th>
<th>CEPA - 2010 Greenhouse Gases Subject to Mandatory Reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melphalan</td>
<td>Not listed</td>
<td>Not listed</td>
</tr>
</tbody>
</table>

EU Classification

R-phrase(s)
R28 - Very toxic if swallowed.
R45 - May cause cancer.
R68 - Possible risk of irreversible effects.
R63 - Possible risk of harm to the unborn child.

S-phrase(s)
S45 - In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S36 - Wear suitable protective clothing.
S37 - Wear suitable gloves.

The product is classified in accordance with Annex VI to Directive 67/548/EEC

Indication of danger:
T+ - Very toxic.
T - Toxic

16. OTHER INFORMATION

The MSDS format complies with ANSI Z400.1-2004 standards.

Preparation Date 07-Sep-2011
Reason for revision: Not applicable
Prepared by: Sonia Owen
Literature reference: No information available

Product code: M3017 Product name: MELPHALAN
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