8331-A Silver Conductive Epoxy Adhesive

MG Chemicals UK Limited

SECTION 1 IDENTIFICATION OF THE SUBSTANCE / MIXTURE AND OF THE COMPANY / UNDERTAKING

1.1. Product Identifier

Product name: 8331-A
Other means of identification: Silver Conductive Epoxy Adhesive

1.2. Relevant identified uses of the substance or mixture and uses advised against

Relevant identified uses: Silver filled electrically conductive adhesive for repairing traces on circuit boards, cold soldering, and bonding
Uses advised against: Not Applicable

1.3. Details of the supplier of the safety data sheet

Registered company name: MG Chemicals UK Limited
Address: Heame House, 23 Bilston Street, Sedgely Dudley DY3 1JA United Kingdom
9347 - 193 Street Surrey V4N 4E7 British Columbia Canada
Telephone: +44(41) 1663 362888
Fax: Not Available
Website: Not Available
Email: sales@mgchemicals.com

1.4. Emergency telephone number

Association / Organisation: CHEMTREC
Emergency telephone numbers: +44(41) 670-6200418
Other emergency telephone numbers: +1(41) 703-527-3887

SECTION 2 HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture

Classification according to regulation (EC) No 1272/2008 [CLP] [1]
H315 - Skin Corrosion/Irritation Category 2, H319 - Eye Irritation Category 2, H317 - Skin Sensitizer Category 1, H410 - Chronic Aquatic Hazard Category 1


2.2. Label elements

Hazard pictogram(s):

SIGNAL WORD: WARNING

Hazard statement(s)

H315 - Causes skin irritation.
H319 - Causes serious eye irritation.
H317 - May cause an allergic skin reaction.
H410 - Very toxic to aquatic life with long lasting effects.

Supplementary statement(s)

Not Applicable

Precautionary statement(s) Prevention

Continued...
Precautionary statement(s) Response

P302+P352 IF ON SKIN: Wash with plenty of water and soap.
P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P333+P313 If skin irritation or rash occurs: Get medical advice/attention.
P337+P313 If eye irritation persists: Get medical advice/attention.
P362+P364 Take off contaminated clothing and wash it before reuse.
P391 Collect spillage.

Precautionary statement(s) Storage
Not Applicable

Precautionary statement(s) Disposal

P501 Dispose of contents/container in accordance with local regulations.

2.3. Other hazards
Inhalation may produce health damage*. Cumulative effects may result following exposure*. May produce discomfort of the respiratory system*. Limited evidence of a carcinogenic effect*. Possible respiratory sensitizer*. REACH - Art.57-59: The mixture does not contain Substances of Very High Concern (SVHC) at the SDS print date.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

3.1. Substances
See 'Composition on ingredients' in Section 3.2

3.2. Mixtures

<table>
<thead>
<tr>
<th>CAS No</th>
<th>Index No</th>
<th>Name</th>
<th>Classification according to regulation (EC) No 1272/2008 [CLP]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.7440-22-4</td>
<td>2.231-131-3</td>
<td>silver</td>
<td>EUH210[1]</td>
</tr>
<tr>
<td>1.2866-14-4</td>
<td>2.231-131-3</td>
<td>bisphenol F glycidyl ether/</td>
<td>Skin Corrosion/Irritation Category 2, Eye Irritation Category 2, Chronic Aquatic Hazard Category 2, Skin Sensitizer Category 1: H315, H319, H411, H317, EUH205, EUH019 [1]</td>
</tr>
<tr>
<td>Not Available</td>
<td>Not Available</td>
<td>formaldehyde capopolymer</td>
<td></td>
</tr>
</tbody>
</table>


SECTION 4 FIRST AID MEASURES

4.1. Description of first aid measures

**Eye Contact**
If this product comes in contact with the eyes:
- Wash out immediately with fresh running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Seek medical attention without delay; if pain persists or recurs seek medical attention.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
- **DO NOT attempt to remove particles attached to or embedded in eye**.
- Lay victim down, on stretcher if available and pad BOTH eyes, make sure dressing does not press on the injured eye by placing thick pads under dressing, above and below the eye.
- Seek urgent medical assistance, or transport to hospital.

**Skin Contact**
If skin contact occurs:
- Immediately remove all contaminated clothing, including footwear.
- Flush skin and hair with running water (and soap if available).
- Seek medical attention in event of irritation.

**Inhalation**
If fumes, aerosols or combustion products are inhaled remove from contaminated area.
- Other measures are usually unnecessary.
### Ingestion

- Immediately give a glass of water.
- First aid is not generally required. If in doubt, contact a Poisons Information Centre or a doctor.

### 4.2 Most important symptoms and effects, both acute and delayed

See Section 11

### 4.3. Indication of any immediate medical attention and special treatment needed

Treat symptomatically.

53ag

Copper, magnesium, aluminium, antimony, iron, manganese, nickel, zinc (and their compounds) in welding, brazing, galvanising or smelting operations all give rise to thermally produced particulates of smaller dimension than may be produced if the metals are divided mechanically. Where insufficient ventilation or respiratory protection is available these particulates may produce 'metal fume fever' in workers from an acute or long term exposure.

- Onset occurs in 4-6 hours generally on the evening following exposure. Tolerance develops in workers but may be lost over the weekend. (Monday Morning Fever)
- Pulmonary function tests may indicate reduced lung volumes, small airway obstruction and decreased carbon monoxide diffusing capacity but these abnormalities resolve after several months.
- Although mildly elevated urinary levels of heavy metal may occur they do not correlate with clinical effects.
- The general approach to treatment is recognition of the disease, supportive care and prevention of exposure.
- Seriously symptomatic patients should receive chest x-rays, have arterial blood gases determined and be observed for the development of tracheobronchitis and pulmonary edema.

[Ellenhorn and Barceloux: Medical Toxicology]

### SECTION 5 FIREFIGHTING MEASURES

#### 5.1. Extinguishing media

- **DO NOT** use halogenated fire extinguishing agents.

**DO NOT USE WATER, CO2 OR FOAM.**

- Use DRY sand, graphite powder, dry sodium chloride based extinguishers, G-1 or Met L-X to smother fire.
- Confining or smothering material is preferable to applying water as chemical reaction may produce flammable and explosive hydrogen gas.
- Chemical reaction with CO2 may produce flammable and explosive methane.
- If impossible to extinguish, withdraw, protect surroundings and allow fire to burn itself out.

#### 5.2. Special hazards arising from the substrate or mixture

<table>
<thead>
<tr>
<th>Fire Incompatibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reacts with acids producing flammable / explosive hydrogen (H2) gas</td>
</tr>
<tr>
<td>Avoid contamination with oxidising agents i.e. nitrates, oxidising acids, chlorine bleaches, pool chlorine etc. as ignition may result</td>
</tr>
</tbody>
</table>

#### 5.3. Advice for firefighters

**Fire Fighting**

- **DO NOT** disturb burning dust. Explosion may result if dust is stirred into a cloud, by providing oxygen to a large surface of hot metal.
- **DO NOT** use water or foam as generation of explosive hydrogen may result.

With the exception of the metals that burn in contact with air or water (for example, sodium), masses of combustible metals do not represent unusual fire risks because they have the ability to conduct heat away from hot spots so efficiently that the heat of combustion cannot be maintained - this means that it will require a lot of heat to ignite a mass of combustible metal. Generally, metal fire risks exist when sawdust, machine shavings and other metal ‘fines’ are present. Metal powders, while generally regarded as non-combustible:

- **May** burn when metal is finely divided and energy input is high.
- **May** react explosively with water.
- **May** be ignited by friction, heat, sparks or flame.
- **May** REIGNITE after fire is extinguished.
- Will burn with intense heat.

**Fire/Explosion Hazard**

- Metal dust fires are slow moving but intense and difficult to extinguish.
- Containers may explode on heating.
- Dusts or fumes may form explosive mixtures with air.
- Gases generated in fire may be poisonous, corrosive or irritating.
- Hot or burning metals may react violently upon contact with other materials, such as oxidising agents and extinguishing agents used on fires involving ordinary combustibles or flammable liquids.
- Temperatures produced by burning metals can be higher than temperatures generated by burning flammable liquids.
- Some metals can continue to burn in carbon dioxide, nitrogen, water, or steam atmospheres in which ordinary combustibles or flammable liquids would be incapable of burning.
- Combustion products include: carbon monoxide (CO), carbon dioxide (CO2), aldehydes, other pyrolysis products typical of burning organic material.

### SECTION 6 ACCIDENTAL RELEASE MEASURES

#### 6.1. Personal precautions, protective equipment and emergency procedures

See section 8

#### 6.2. Environmental precautions
6.3. Methods and material for containment and cleaning up

### Minor Spills

Environmental hazard - contain spillage.
- Clean up all spills immediately.
- Avoid contact with skin and eyes.
- Wear impervious gloves and safety glasses.
- Use dry clean-up procedures and avoid generating dust.
- Vacuum up (consider explosion-proof machines designed to be grounded during storage and use).
- Do NOT use air hoses for cleaning.
- Place spilled material in clean, dry, sealable, labelled container.

### Major Spills

Environmental hazard - contain spillage.
- If molten:
  - Contain the flow using dry sand or salt flux as a dam.
  - All tooling (e.g., shovels or hand tools) and containers which come in contact with molten metal must be preheated or specially coated, rust free and approved for such use.
  - Allow the spill to cool before remelting scrap.
- Moderate hazard.
  - **CAUTION:** Advise personnel in area.
  - Alert Emergency Services and tell them location and nature of hazard.
  - Control personal contact by wearing protective clothing.
  - Prevent, by any means available, spillage from entering drains or water courses.
  - **IF DRY:** Use dry clean-up procedures and avoid generating dust. Collect residues and place in sealed plastic bags or other containers for disposal. **IF WET:** Vacuum/shovel up and place in labelled containers for disposal.
  - **ALWAYS:** Wash area down with large amounts of water and prevent runoff into drains.

6.4. Reference to other sections

Personal Protective Equipment advice is contained in Section 8 of the SDS.

SECTION 7 HANDLING AND STORAGE

7.1. Precautions for safe handling

For molten metals:
- Molten metal and water can be an explosive combination. The risk is greatest when there is sufficient molten metal to entrap or seal off water. Water and other forms of contamination on or contained in scrap or remelt ingot in melting operations. While the products may have minimal surface roughness and internal voids, there remains the possibility of moisture contamination or entrainment. If confined, even a few drops can lead to violent explosions.
  - All tooling, containers, molds and ladles, which come in contact with molten metal must be preheated or specially coated, rust free and approved for such use.
  - Any surfaces that may contact molten metal (e.g. concrete) should be specially coated
  - Drops of molten metal in water (e.g. from plasma arc cutting), while not normally an explosion hazard, can generate enough flammable hydrogen gas to present an explosion hazard. Vigorous circulation of the water and removal of the particles minimise the hazard.

During melting operations, the following minimum guidelines should be observed:
- Preheat and dry large objects adequately before charging in to a furnace containing molten metal. This is typically done by the use of a drying oven or homogenising furnace. The dry cycle should bring the metal temperature of the coldest item of the batch to 200 degree C (400 deg F) and then hold at that temperature for 6 hours.
- Inspect all materials prior to furnace charging and completely remove surface contamination such as water, ice, snow, deposits of grease and oil or other surface contamination resulting from weather exposure, shipment, or storage.
  - Store materials in dry, heated areas with any cracks or cavities pointed downwards.
  - Preheat and dry large objects adequately before charging in to a furnace containing molten metal. This is typically done by the use of a drying oven or homogenising furnace. The dry cycle should bring the metal temperature of the coldest item of the batch to 200 degree C (400 deg F) and then hold at that temperature for 6 hours.
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  - Drops of molten metal in water (e.g. from plasma arc cutting), while not normally an explosion hazard, can generate enough flammable hydrogen gas to present an explosion hazard. Vigorous circulation of the water and removal of the particles minimise the hazard.

**Safe handling**

- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
- Prevent concentration in hollows and sumps.
- **DO NOT** enter confined spaces until atmosphere has been checked.
- **DO NOT** allow material to contact humans, exposed food or food utensils.
- Avoid contact with incompatible materials.
- When handling, **DO NOT** eat, drink or smoke.
- Keep containers securely sealed when not in use.
- Avoid physical damage to containers.
- Always wash hands with soap and water after handling.
- Work clothes should be laundered separately. Launder contaminated clothing before re-use.
- Use good occupational work practice.
- Observe manufacturer's storage and handling recommendations contained within this SDS.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
- Organic powders when finely divided over a range of concentrations regardless of particulate size or shape and suspended in air or some other oxidizing medium may form explosive dust-air mixtures and result in a fire or dust explosion (including secondary explosions)
- Minimise airborne dust and eliminate all ignition sources. Keep away from heat, hot surfaces, sparks, and flame.
- Establish good housekeeping practices.
- Remove dust accumulations on a regular basis by vacuuming or gentle sweeping to avoid creating dust clouds.
- Use continuous suction at points of dust generation to capture and minimise the accumulation of dusts. Particular attention should be given to overhead and hidden horizontal surfaces to minimise the probability of a 'secondary' explosion. According to NFPA Standard 654, dust layers 1/32 in. (0.8 mm) thick can be sufficient to warrant immediate cleaning of the area.
- Do not use air hoses for cleaning.
- Minimise dry sweeping to avoid generation of dust clouds. Vacuum dust-accumulating surfaces and remove to a chemical disposal area. Vacuums with explosion-proof motors should be used.
- Control sources of static electricity. Dusts or their packages may accumulate static charges, and static discharge can be a source of ignition.
- **DO NOT** allow material to contact humans, exposed food or food utensils.
- Avoid chemical contact with incompatible materials.
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- When handling, **DO NOT** eat, drink or smoke.
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### 7.2. Conditions for safe storage, including any incompatibilities

<table>
<thead>
<tr>
<th>Suitable container</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lined metal can, lined metal pail can.</td>
</tr>
<tr>
<td>Plastic pail.</td>
</tr>
<tr>
<td>Polyliner drum.</td>
</tr>
<tr>
<td>Packaging as recommended by manufacturer.</td>
</tr>
<tr>
<td>Check all containers are clearly labelled and free from leaks.</td>
</tr>
<tr>
<td>Bulk bags: Reinforced bags required for dense materials.</td>
</tr>
<tr>
<td>Glass container is suitable for laboratory quantities.</td>
</tr>
<tr>
<td>CARE: Packing of high density product in light weight metal or plastic packages may result in container collapse with product release</td>
</tr>
<tr>
<td>Heavy gauge metal packages / Heavy gauge metal drums</td>
</tr>
</tbody>
</table>

**Storage incompatibility**

- May form unstable peroxides on storage in air, light, sunlight, UV light or other ionising radiation, trace metals - inhibitor should be maintained at adequate levels
- May polymerise in contact with heat, organic and inorganic free radical producing initiators
- May polymerise with evolution of heat in contact with oxidisers, strong acids, bases and amines
- May react violently with strong oxidisers, peroxides, peroxides, acyl halides, alkalis, ammonium persulfate, bromine dioxide
- May attack some forms of plastics, coatings, and rubber

**Metals exhibit varying degrees of activity. Reaction is reduced in the massive form (sheet, rod, or drop), compared with finely divided forms. The less active metals will not burn in air but:**

- Can react exothermically with oxidising acids to form noxious gases.
- Catalyse polymerisation and other reactions, particularly when finely divided
- React with halogenated hydrocarbons (for example, copper dissolves when heated in carbon tetrachloride), sometimes forming explosive compounds.

- Finely divided metal powders develop pyrophoricity when a critical specific surface area is exceeded; this is ascribed to high heat of oxide formation on exposure to air.
- Safe handling is possible in relatively low concentrations of oxygen in an inert gas.
- Several pyrophoric metals, stored in glass bottles, have ignited when the container is broken on impact. Storage of these materials moist and in metal containers is recommended.
- The reaction residues from various metal synthesis (involving vacuum evaporation and co-deposition with a ligand) are often pyrophoric.

### 7.3. Specific end use(s)

See section 1.2

### SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

#### 8.1. Control parameters

| DERIVED NO EFFECT LEVEL (DNEL) |
### Occupational Exposure Limits (OEL)

<table>
<thead>
<tr>
<th>Source</th>
<th>Ingredient</th>
<th>Material name</th>
<th>TWA</th>
<th>STEL</th>
<th>Peak</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK Workplace Exposure Limits (WELs)</td>
<td>silver</td>
<td>Silver, metallic</td>
<td>0.1 mg/m³</td>
<td>Not Available</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

### Predicted No Effect Level (PNEC)

Not Available

### Material Data

The adopted TLV-TWA for silver dust and fumes is 0.1 mg/m³ and for the more toxic soluble silver compounds the adopted value is 0.01 mg/m³. Cases of argyria (a slate to blue-grey discoloration of epithelial tissues) have been recorded when workers were exposed to silver nitrate at concentrations of 0.1 mg/m³ (as silver). Exposure to very high concentrations of silver fume has caused diffuse pulmonary fibrosis. Percutaneous absorption of silver compounds is reported to have resulted in allergy. Based on a 25% retention upon inhalation and a 10 m³/day respiratory volume, exposure to 0.1 mg/m³ (TWA) would result in total deposition of no more than 1.5 gms in 25 years.

### Exposure Controls

8.2. Exposure controls

Metal dusts must be collected at the source of generation as they are potentially explosive.

- Avoid ignition sources.
- Good housekeeping practices must be maintained.
- Dust accumulation on the floor, ledges and beams can present a risk of ignition, flame propagation and secondary explosions.
- Do not use compressed air to remove settled materials from floors, beams or equipment.
- Vacuum cleaners, of flame-proof design, should be used to minimise dust accumulation.
- Use non-sparking handling equipment, tools and natural bristle brushes. Cover and resell partially empty containers. Provide grounding and bonding where necessary to prevent accumulation of static charges during metal dust handling and transfer operations.
- Do not allow chips, fines or dusts to contact water, particularly in enclosed areas.
- Metal spraying and blasting should, where possible, be conducted in separate rooms. This minimises the risk of supplying oxygen, in the form of metal oxides, to potentially reactive finely divided metals such as aluminium, zinc, magnesium or titanium.
- Work-shops designed for metal spraying should possess smooth walls and a minimum of obstructions, such as ledges, on which dust accumulation is possible.
- Wet scrubbers are preferable to dry dust collectors.
- Bag or filter-type collectors should be sited outside the workrooms and be fitted with explosion relief doors.
- Cyclones should be protected against entry of moisture as reactive metal dusts are capable of spontaneous combustion in humid or partially wetted states.
- Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0.5 metre/sec.
- Local ventilation and vacuum systems must be designed to handle explosive dusts. Dry vacuum and electrostatic precipitators must not be used, unless specifically approved for use with flammable/ explosive dusts.

Air contaminants generated in the workplace possess varying ‘escape’ velocities which, in turn, determine the ‘capture velocities’ of fresh circulating air required to effectively remove the contaminant.

<table>
<thead>
<tr>
<th>Type of Contaminant:</th>
<th>Air Speed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>welding, brazing fumes (released at relatively low velocity into moderately still air)</td>
<td>0.5-1.0 m/s (100-200 f/min.)</td>
</tr>
</tbody>
</table>

Within each range the appropriate value depends on:

<table>
<thead>
<tr>
<th>Lower end of the range</th>
<th>Upper end of the range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Room air currents minimal or favourable to capture</td>
<td>1: Disturbing room air currents</td>
</tr>
<tr>
<td>2: Contaminants of low toxicity or of nuisance value only.</td>
<td>2: Contaminants of high toxicity</td>
</tr>
<tr>
<td>3: Intermittent, low production.</td>
<td>3: High production, heavy use</td>
</tr>
<tr>
<td>4: Large hood or large air mass in motion</td>
<td>4: Small hood-local control only</td>
</tr>
</tbody>
</table>

Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 1-2.5 m/s (200-500 f/min.) for extraction of gases discharged 2 meters distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used.
Skin protection

See Hand protection below

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Eye and face protection

- Safety glasses with side shields.
- Chemical goggles.
- Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate imants. A written policy document, describing the wearing
  of lenses or restriction on use, should be created for each workplace task. This should include a review of lens absorption and adsorption for the
  class of chemicals in use and an account of injury experience. Medical and first-aid personnel should be trained in their removal and suitable equipment
  should be readily available. In the event of chemical exposure, begin eye irritation immediately and remove contact lens as soon as practicable. Lens
  should be removed at the first signs of eye redness or irritation - lens should be removed in a clean environment only after workers have washed hands
  thoroughly. [CDC NIOSH Current Intelligence Bulletin 69] [AS/NZS 1336 or national equivalent]

Skin cleansing cream.
- Barrier cream.
- P.V.C. apron.
- Overalls.
- Polyvinyl chloride.
- Fluorocaoutchouc.
- Butyl rubber.
- Nitrile rubber.
- Nitrile Butyl Rubber (NBR) from excellent to fair.
- Neoprene from excellent to fair.
- Polyvinyl (PVC) from excellent to poor.

The performance, based on breakthrough times, of:
- Ethyl Vinyl Alcohol (EVAL laminate) is generally excellent.
- Butyl Rubber ranges from excellent to good.
- Nitrile Butyl Rubber (NBR) from excellent to fair.
- Neoprene from excellent to fair.
- Polyvinyl (PVC) from excellent to poor.

As defined in ASTM F-739-96 in any application, gloves are rated as:
- Excellent: Breakthrough time > 480 min
- Good: Breakthrough time > 20 min
- Fair: Breakthrough time < 20 min
- Poor: Breakthrough time < 20 min
- Thinner gloves (down to 0.1 mm or less) may be required where a high degree of manual dexterity is needed. However, these gloves are
  only likely to give short duration protection and would normally be just for single use applications, then disposed of. Thicker gloves (up to 3 mm or more) may be required where there is a mechanical (as well as a chemical) risk i.e. where there is
  abrasion or puncture potential

Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturiser is recommended.

Select gloves tested to a relevant standard (e.g. Europe EN 374, US F739, AS/NZS 2161.1 or national equivalent).
- When prolonged or frequently repeated contact may occur, a glove with a protection class of 5 or higher (breakthrough time greater than
  240 minutes according to EN 374, AS/NZS 2161.10.1 or national equivalent) is recommended.
- When only brief contact is expected, a glove with a protection class of 3 or higher (breakthrough time greater than 60 minutes according
  to EN 374, AS/NZS 2161.10.1 or national equivalent) is recommended.
- Some glove polymer types are less affected by movement and this should be taken into account when considering gloves for long-term
  use.

Contaminated gloves should be replaced.

As defined in ASTM F-739-96 the material may produce skin sensitisation in predisposed individuals. Care must be taken, when removing gloves and other protective equipment, to
avoid all possible skin contact.

Gloves may be contaminated, thus shoes, belts and watch-bands should be removed and destroyed. The selection of suitable gloves does not only depend on the material, but also on further marks of quality which vary from manufacturer to manufacturer. Where the chemical is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be
checked prior to the application.

The exact break through time for substances has to be obtained from the manufacturer of the protective gloves and has to be observed when making a final choice.

Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturiser is recommended.

Suitability and durability of glove type is dependent on usage. Important factors in the selection of gloves include:
- frequency and duration of contact,
- chemical resistance of glove material,
- glove thickness and
- dexterity

Glove selection should also be based on consideration of the task requirements and knowledge of breakthrough times.

It should be emphasised that glove thickness is not necessarily a good predictor of glove resistance to a specific chemical, as the permeation efficiency of
the glove will be dependent on the exact composition of the glove material. Therefore, glove selection should also be based on consideration of the task
requirements and knowledge of breakthrough times.

Glove material may vary depending on the glove manufacturer, the glove type and the glove model. Therefore, the manufacturers' technical data
should always be taken into account to ensure selection of the most appropriate glove for the task.

Note: Depending on the activity being conducted, gloves of varying thickness may be required for specific tasks. For example:
- Thinner gloves (down to 0.1 mm or less) may be required where a high degree of manual dexterity is needed. However, these gloves are
  only likely to give short duration protection and would normally be just for single use applications, then disposed of. Thicker gloves (up to 3 mm or more) may be required where there is a mechanical (as well as a chemical) risk i.e. where there is
  abrasion or puncture potential

Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturiser is recommended.

Protective gloves eg. Leather gloves or gloves with leather facing

When handling liquid grade epoxy resins wear chemically protective gloves, boots and aprons.

The performance, based on breakthrough times of:
- Ethyl Vinyl Alcohol (EVAL laminate) is generally excellent.
- Butyl Rubber ranges from excellent to good.
- Nitrile Butyl Rubber (NBR) from excellent to fair.
- Neoprene from excellent to fair.
- Polyvinyl (PVC) from excellent to poor.

As defined in ASTM F-739-96
- Excellent breakthrough time > 480 min
- Good breakthrough time > 20 min
- Fair breakthrough time < 20 min
- Poor breakthrough time < 20 min

Gloves must be tested against each resin system prior to making a selection of the most suitable type. Systems include both the resin and any hardener, individually and collectively:
- DO NOT use cotton or leather (which absorb and concentrate the resin), natural rubber (latex), medical or polyethylene gloves (which absorb the resin).
- DO NOT use barrier creams containing emulsified fats and oils as these may absorb the resin; silicone-based barrier creams should be reviewed prior to use.

Replacement time should be considered when selecting the most appropriate glove. It may be more effective to select a glove with lower chemical
resistance but which is replaced frequently than to select a more resistant glove which is reused many times.

Experience indicates that the following polymers are suitable as glove materials for protection against undissolved, dry solids, where abrasive particles are
not present.
- polychloroprene.
- nitrile rubber.
- butyl rubber.
- fluoroelastomer.
- polyvinyl chloride.

Gloves should be examined for wear and/ or degradation constantly.

Hands/feet protection

- Protective gloves eg. Leather gloves or gloves with leather facing
- Overalls.
- P.V.C. apron.
- Barrier cream.
- Skin cleansing cream.
- Eye wash unit.

Body protection

See Other protection below
Respiratory protection


<table>
<thead>
<tr>
<th>Required Minimum Protection Factor</th>
<th>Half-Face Respirator</th>
<th>Full-Face Respirator</th>
<th>Powered Air Respirator</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 10 x ES</td>
<td>A P1</td>
<td>-</td>
<td>A PAPR-P1</td>
</tr>
<tr>
<td>up to 50 x ES</td>
<td>Air-line*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>up to 100 x ES</td>
<td>Air-line**</td>
<td>A P2</td>
<td>A PAPR-P2</td>
</tr>
<tr>
<td>100+ x ES</td>
<td>-</td>
<td>A P3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* - Negative pressure demand  ** - Continuous flow

A (All classes) = Organic vapours, B AUS or B1 = Acid gasses, B2 Acid gas or hydrogen cyanide(HCN), B3 Acid gas or hydrogen cyanide(HCN), E = Sulfur dioxide(SO2), G = Agricultural chemicals, K = Ammonia(NH3), Hg = Mercury, NO = Oxides of nitrogen, MB = Methyl bromide, AX = Low boiling point organic compounds(below 65 degC)

- Respirators may be necessary when engineering and administrative controls do not adequately prevent exposures.
- The decision to use respiratory protection should be based on professional judgment that takes into account toxicity information, exposure measurement data, and frequency and likelihood of the worker’s exposure - ensure users are not subject to high thermal loads which may result in heat stress or distress due to personal protective equipment (powered, positive flow, full face apparatus may be an option).
- Published occupational exposure limits, where they exist, will assist in determining the adequacy of the selected respiratory protection. These may be government mandated or vendor recommended.
- Certified respirators will be useful for protecting workers from inhalation of particulates when properly selected and fit tested as part of a complete respiratory protection program.
- Use approved positive flow mask if significant quantities of dust becomes airborne.
- Try to avoid creating dust conditions.

8.2.3. Environmental exposure controls

See section 12

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

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<thead>
<tr>
<th>Property</th>
<th>Value</th>
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<td>Viscosity (cSt)</td>
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<td>Flammability</td>
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<td>Oxidising properties</td>
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<td>Upper Explosive Limit (%)</td>
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<td>Lower Explosive Limit (%)</td>
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</table>

9.2. Other information

Not Available

SECTION 10 STABILITY AND REACTIVITY

10.1. Reactivity

See section 7.2

10.2. Chemical stability

- Unstable in the presence of incompatible materials.
- Product is considered stable.
- Hazardous polymerisation will not occur.

10.3. Possibility of hazardous reactions

See section 7.2

10.4. Conditions to avoid

See section 7.2

10.5. Incompatible materials

See section 7.2

10.6. Hazardous decomposition products

See section 5.3

SECTION 11 TOXICOLOGICAL INFORMATION
In vitro or chromosomal aberrations in animal models. The glycidyl ethers were generally mutagenic to bacteria and mammalian cells in vitro. The material has NOT been classified by EC Directives or other classification systems as ‘harmful by ingestion’. This is because of the lack of corroborating animal or human evidence. The material may still be damaging to the health of the individual, following ingestion, especially where pre-existing organ (e.g. liver, kidney) damage is evident. Present definitions of harmful or toxic substances are generally based on doses producing mortality rather than those producing morbidity (disease, ill-health). Gastrointestinal tract discomfort may produce nausea and vomiting. In an occupational setting however, ingestion of insignificant quantities is not thought to be cause for concern.

Information on toxicological effects

**Inhaled**
Inhalation of freshly formed metal oxide particles sized below 1.5 microns and generally between 0.02 to 0.05 microns may result in ‘metal fume fever’. Symptoms may be delayed and occur 6-12 hours after exposure. The material has been shown to induce transient respiratory irritation, conjunctivitis, dryness of the mucous membranes of the nasal cavities, and eye irritation in several studies.

**Ingestion**
Continued...

Evidence exists, or experimental practice predicts, that the material either produces inflammation of the skin in a substantial number of individuals following direct contact, and/or produces significant inflammation when applied to the healthy intact skin of animals, for up to four hours, such inflammation being present twenty-four hours or more after the end of the exposure period. Skin irritation may also be present after prolonged or repeated exposure; this may result in a form of contact dermatitis (nonallergic). The dermatitis is often characterised by skin redness (erythema) and swelling (oedema) which may persist for several days or weeks after removal of the irritant. At the microscopic level there may be intercellular oedema of the spongy layer of the skin (spongiosis) and intraepidermal oedema of the epidermis. The material may accentuate any pre-existing dermatitis condition

Skin contact is not thought to have harmful health effects (as classified under EC Directives), the material may still produce health damage following entry through wounds, lesions or abrasions.

**Skin Contact**
Evidence exists, or experimental practice predicts, that the material may cause eye irritation in a substantial number of individuals and/or may produce significant ocular lesions which are present twenty-four hours or more after instillation into the eye(s) of experimental animals. Repeated or prolonged eye contact may cause inflammation characterised by temporary redness (similar to windburn) of the conjunctiva (conjunctivitis); temporary impairment of vision and/or other transient eye damage/ulceration may occur.

**Eye**
Practical experience shows that skin contact with the material is capable either of inducing a sensitisation reaction in a substantial number of individuals, and/or of producing a positive response in experimental animals. All glycidy ethers show genotoxic potential due to their alkylating properties. Those glycidy ethers that have been investigated in long term studies exhibit more or less marked carcinogenic potential. Alkylating agents may damage the stem cell which acts as the precursor to components of the blood. Loss of the stem cell may result in pancytopenia (a reduction in the number of red and white blood cells and platelets) with a latency period corresponding to the lifetime of the individual blood cells. Granulocytopenia (a reduction in granular leukocytes) develops within days and thrombocytopenia (a disorder involving platelets), within 1-2 weeks, whilst loss of erythrocytes (red blood cells) need months to become clinically manifest. Aplastic anaemia develops due to complete destruction of the stem cells. Glycidy ethers have been shown to cause allergic contact dermatitis in humans. Glycidy ethers generally cause skin sensitisation in experimental animals. Necrosis of the mucous membranes was induced in mice exposed to allyl glycidyl ether. A study of workers with mixed exposures was inconclusive with regard to the effects of specific glycidy ethers. Phenyl glycidyl ether, but not n-butyl glycidyl ether, induced morphological transformation in mammalian cells in vitro. n-Butyly glycidyl ether induced micronuclei in mice in vivo following intraperitoneal but not oral administration. Phenyl glycidyl ether did not induce micronuclei or chromosomal aberrations in vivo or chromosomal aberrations in animal cells in vitro. Alkyl C12 or C14 glycidyl ether did not induce DNA damage in cultured human cells or mutation in cultured animal cells. Alkyl glycidyl ether induced mutation in Drosophila. The glycidy ethers were generally mutagenic to bacteria.

On the basis, primarily, of animal studies, concern has been expressed that the material may produce carcinogenic or mutagenic effects; in respect of the available information, however, there presently exists inadequate data for making a satisfactory assessment. Bisphenol F, Bisphenol A, fluorine-containing bisphenol A (Bisphenol AF), and other diphenylalkanes were found to be oestrogenic in a bioassay with MCF7 human breast cancer cells in culture. Bisphenol F (4'-dihydroxydiphenylmethane) has been reported to exhibit oestrogen agonistic properties in the uterotrophic assay. Bisphenol F (BPF) is present in the environment and as a contaminant of food. Humans may, therefore, be exposed to BP. BPF has been shown to have genotoxic and endocrine-disruptor properties in a human hepatoma cell line (HePG2), which is a model system for studies of xenobiotic toxicity. BP was largely metabolised by the HepG2 cell line. BP was oxidised to the lactone and glucuronide by human hepatocytes, but with differences between individuals. The metabolism of BP in both HepG2 cells and human hepatocytes suggests the existence of a detoxification pathway.

**Chronic**
Bisphenol F was orally administered at doses 0, 20, 100 and 500 mg/kg per day for at least 28 days, but no clear endocrine-mediated changes were detected, and it was concluded to have no endocrine-mediated effects in young adult rats. On the other hand, the main effect of bisphenol F was concluded to be liver toxicity based on clinical biochemical parameters and liver weight, but without histopathological changes. The no-observed-effect level for bisphenol F is concluded to be under 20 mg/kg per day since decreased body weight accompanied by decreased serum total cholesterol, glucose, and albumin values were observed in the female rats given 20 mg/kg per day or higher doses of bisphenol F.

Bisphenol A exhibits hormone-like properties that raise concern about its suitability in consumer products and food containers. Bisphenol A is thought to be an endocrine disruptor which can mimic oestrogen and may lead to negative health effects. More specifically, bisphenol A closely mimics the structure and function of the hormone oestradiol with the ability to bind to and activate the same oestrogen receptor as the natural hormone. Early developmental stages appear to be the period of greatest sensitivity to its effects and some studies have linked prenatal exposure to later physical and neurological difficulties. Regulatory bodies have determined safety levels for humans, but those safety levels are being questioned or are under review.

A 2009 study on Chinese workers in bisphenol A factories found that workers were four times more likely to report erectile dysfunction, reduced sexual desire and overall dissatisfaction with their sex life than workers with no heightened bisphenol A exposure. Bisphenol A workers were also seven times more likely to have sexual difficulties. They were also more likely to report reduced sexual function within one year of beginning employment at the factory, and the higher the exposure, the more likely they were to have sexual difficulties.

Bisphenol A in weak concentrations is sufficient to produce a negative reaction on the human testicle. The researchers found that a concentration equal to 2 µg/ml of bisphenol A in the culture medium, a concentration equal to the average concentration generally found in the blood, urine and amniotic fluid of the population, was sufficient to produce the effects. The researchers believe that exposure of pregnant women to bisphenol A may be one of the causes of congenital malformations of the hypospadias and cryptorchidism types the frequency of which has doubled overall since the 70's. They also suggested that ‘it is also possible that bisphenol A contributes to a reduction in the production of sperm and the increase in the incidence of testicular cancer in adults that have been observed in recent decades’.

One review has concluded that obesity may be increased as a function of bisphenol A exposure, which ‘...merits concern among scientists and public health officials’

One study demonstrated that adverse neurological effects occur in non-human primates regularly exposed to bisphenol A at levels equal to the United States Environmental Protection Agency's (EPA) maximum safe dose of 50 ug/kg/day. This research found a connection between bisphenol A and interference with brain cell connections vital to memory, learning, and mood.

A further review concluded that bisphenol A has been shown to bind to thyroid hormone receptor and perhaps have selective effects on its functions. Carcinogenicity studies have shown increases in leukaemia and testicular interstitial cell tumours in male rats. However, these studies have not been considered as convincing evidence of a potential cancer risk because of the doubtful statistical significance of the small differences in incidences from controls. Another in vitro study has concluded that bisphenol A is able to induce neoplastic transformation in human breast epithelial cells, whilst a further study concluded that maternal oral exposure to low concentrations of bisphenol A, during lactation, increases mammary carcinogenesis in a rodent model.
In vitro studies have suggested that bisphenol A can promote the growth of neuroblastoma cells and potentially promotes invasion and metastasis of neuroblastoma cells. Newborn rats exposed to a low-dose of bisphenol A (10 µg/kg) showed increased prostate cancer susceptibility when adults. At least one study has suggested that bisphenol A suppresses DNA methylation which is involved in epigenetic changes.

Bisphenol A is the isopropyl adduct of 4,4'-dihydroxydiphenyl oxide (DHDPO). A series of DHDPO analogues have been investigated as potential oestrogen receptor-anti-tumour drug carriers in the development of a class of therapeutic drugs called ‘cytostatic hormones’. Oestrogenic activity is induced with 1 to 100 mg/kg body weight in animal models. Bisphenol A sealants are frequently used in dentistry for treatment of dental pits and fissures. Samples of saliva collected from dental patients during a 1-hour period following application contain the monomer. A bisphenol-A sealant has been shown to be oestrogenic in vitro; such sealants may represent an additional source of xenoestrogens in humans and may be the cause of additional concerns in children. Concerns have been raised about the possible developmental effects on the foetus/embryo or neonate resulting from the leaching of bisphenol A from epoxy linings in metal cans which come in contact with food-stuffs.

Many drugs, including naproxen, salicylic acid, carbamazepine and mefenamic acid can, in vitro, significantly inhibit bisphenol A glucuronidation (detoxification).

### 8331 A Silver Conductive Epoxy Adhesive: Moderate Cure / High Conductivity

**TOXICITY**
- Not Available

**IRRITATION**
- Not Available

### 8331 A Silver Conductive Epoxy Adhesive: Moderate Cure / High Conductivity

**TOXICITY**
- Oral (rat) LD50: >2000 mg/kg

**IRRITATION**
- Eyes * (·) (·) Slight irritant

### Bisphenol F glycidyl ether/ formaldehyde copolymer

**TOXICITY**
- Dermal (rat) LD50: 4000 mg/kg

**IRRITATION**
- Skin * (·) (·) Slight irritant

**Legend:**
1. Value obtained from Europe ECHA Registered Substances - Acute toxicity 2: Value obtained from manufacturer’s SDS. Unless otherwise specified data extracted from RTECS - Register of Toxic Effect of chemical Substances

### 8331 A Silver Conductive Epoxy Adhesive: Moderate Cure / High Conductivity

The chemical structure of hydroxylated diphenylalkanes or bisphenols consists of two phenolic rings joined together through a bridging carbon. This class of endocrine disruptors that mimic oestrogens is widely used in industry, particularly in plastics.

Bisphenol A (BPA) and some related compounds exhibit oestrogenicity in human breast cancer cell line MCF-7, but there were remarkable differences in activity. Several derivatives of BPA exhibited significant thyroid hormonal activity towards rat pituitary cell line GH3, which releases growth hormone in a thyroid hormone-dependent manner. However, BPA and some other bisphenol compounds did not show such activity. Results suggest that the 4-hydroxy group of the A-phenyl ring and the B-phenyl ring of BPA derivatives are required for these hormonal activities, and substitutions at the 3,5-positions of the phenyl rings and the bridging alkyl moiety markedly influence the activities.

Bisphenols promoted cell proliferation and increased the synthesis and secretion of cell type-specific proteins. When ranked by proliferative potency, the longer the alkyl substituent at the bridging carbon, the lower the concentration needed for maximal cell yield; the most active compound contained two propyl chains at the bridging carbon. Bisphenols with two hydroxyl groups in the para position and an angular configuration are suitable for appropriate estrogen binding to the acceptor site of the oestrogen receptor.

### 8331 Part A Silver Conductive Epoxy Adhesive: Moderate Cure / High Conductivity

The following information refers to contact allergens as a group and may not be specific to this product. Contact allergies quickly manifest themselves as contact eczema, more rarely as urticaria or Quincke’s oedema. The pathogenesis of contact eczema involves a cell-mediated (T lymphocytes) immune reaction of the delayed type. Other allergic skin reactions, e.g. contact urticaria, involve antibody-mediated immune reactions. The significance of the contact allergen is not simply determined by its sensitisation potential: the distribution of the substance and the opportunities for contact with it are equally important. A weakly sensitising substance which is widely distributed can be a more important allergen than one with stronger sensitising potential with which few individuals come into contact. From a clinical point of view, substances are noteworthy if they produce an allergic test reaction in more than 1% of the persons tested.

### Acute Toxicity
- Skin Irritation/Corrosion
- Serious Eye Damage/Irritation
- Respiratory or Skin sensitisation
- Mutagenicity

### Carcinogenicity
- Reproductivity

### STOT - Single Exposure
- STOT - Repeated Exposure

**Legend:**
- Data available but does not fill the criteria for classification
- Data available to make classification
- Data Not Available to make classification

**SECTION 12 ECOLOGICAL INFORMATION**

12.1. Toxicity
8331-A Silver Conductive Epoxy Adhesive

**8331 Part A Silver Conductive Epoxy Adhesive: Moderate Cure / High Conductivity**

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**silver**

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<td>96</td>
<td>Fish</td>
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<td>EC50</td>
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<td>Crustacea</td>
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<td>Algae or other aquatic plants</td>
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<td>72</td>
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</table>

**biphenol F glycidyl ether/ formaldehyde copolymer**

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<th>SPECIES</th>
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**Legend:** Extracted from 1. IUCLID Toxicity Data 2. Europe ECHA Registered Substances - Ecotoxicological Information - Aquatic Toxicity 3. EPIWIN Suite V3.12 (Qsar) - Aquatic Toxicity Data (Estimated) 4. US EPA, Ecotox database - Aquatic Toxicity Data 5. ECTOC Aquatic Hazard Assessment Data 6. NITE (Japan) - Bioconcentration Data 7. METI (Japan) - Bioconcentration Data 8. Vendor Data

Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. Do NOT allow product to come in contact with surface waters or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment washwaters. With metal resulting from use of the product must be disposed of on site or at approved waste sites. Metal-containing inorganic substances generally have negligible vapour pressure and are not expected to partition to air. Once released to surface waters and moist soils their fate depends on solubility and dissociation in water. Environmental processes (such as oxidation and the presence of acids or bases) may transform insoluble metals to more soluble ionic forms. Microbiological processes may also transform insoluble metals to more soluble forms. Such ionic species may bind to dissolved ligands or sorb to solid particles in aquatic or aqueous media. A significant proportion of dissolved sorbed metals will end up in sediments through the settling of suspended particles. The remaining metal ions can then be taken up by aquatic organisms. When released to dry soil most metals will exhibit limited mobility and remain in the upper layer; some will teach locally into ground water and/or surface water ecosystems when soaked by rain or melt ice. Environmental processes may also be important in changing solubilities. Even though many metals show few toxic effects at physiological pHs, new environmental may be induced or magnified effects. A metal ion is considered infinitely persistent because it cannot degrade further. The current state of science does not allow for an unambiguous interpretation of various measures of bioaccumulation. The counter-ion may also create health and environmental concerns once isolated from the metal. Under normal physiological conditions the counter-ion may be essentially insoluble and may not be bioavailable. Environmental processes may enhance bioavailability. Significant environmental findings are limited. Oxiranes (including glycidyl ethers and alkyloxides, and epoxides) exhibit common characteristics with respect to environmental fate and ecotoxicology. One such oxirane is ethyloxirane and data presented here may be taken as representative.

1.2 butene oxide (ethylxylene): Environmental fate: Ethyloxirane is highly soluble in water and has a very low soil-adsorption coefficient, which suggests that if released to water, adsorption of ethyloxirane to sediment and suspended solids is not expected. Volatilisation of ethyloxirane from water surfaces would be expected based on the moderate estimated Henry's Law constant. If ethyloxirane is released to soil, it is expected to have low adsorption and thus very high mobility. Volatilisation from moist soil and dry soil surfaces is expected, based on its vapour pressure. It is expected that ethyloxirane exists solely as a vapour in ambient atmosphere, based on its very high vapour pressure. Ethyloxirane may also be removed from the atmosphere by wet deposition processes, considering its relatively high water solubility.

Persistence: The half-life in air is about 5.6 days from the reaction of ethyloxirane with photochemically produced hydroxyl radicals which indicates that this chemical meets the persistence criterion in air (half-life = 2 days)*.

Ethyloxirane, on the other hand, is hydrolyzable, with a half-life of 6.5 days, and biodegradable up to 100% degradation and is not expected to persist in water. A further model-predicted biodegradation half-life of 15 days in water was observed and used to predict this half-life in this chemical in soil and sediment by applying Boethling's extrapolation factors (11/2 water: 11/2 soil: 1/2sediment = 1: 1: 4) (Boethling 1995). According to these values, it can be concluded that ethyloxirane does not meet the persistence criteria in water and soil (half-lives > 182 days) and sediments (half-life > 365 days). Experimental and modelled log Kow values of 0.68 and 0.86, respectively, indicate that the potential for bioaccumulation of ethyloxirane in organisms is likely to be low. Modelled bioaccumulation -factor (BAF) and bioconcentration -factor (BCF) values of 1 to 17 L/kg indicate that ethyloxirane does not meet the bioaccumulation criteria (BCF/BAF = 5000)*

Ecotoxicity: Experimental ecotoxicological data for ethyloxirane (OECD 2001) indicate low to moderate toxicity to aquatic organisms. For fish and water flea, acute LC50/EC50 values vary within a narrow range of 70-215 mg/L, for algae, toxicity values exceed 500 mg/L, while for bacteria they are close to 5000 mg/L.

* Persistence and Bioaccumulation Regulations (Canada 2000).

Environmental toxicity is a function of the n-octanol/water partition coefficient (log Pow, log Kow). Phenols with log Pow >7.4 are expected to exhibit low toxicity to aquatic organisms. However, the toxicity of phenols with a lower log Pow is variable, ranging from low toxicity (LC50 values >100 mg/L) to highly toxic (LC50 values <1 mg/L) dependent on log Pow, molecular weight and substitutions on the aromatic ring. Dinitrophenols are more toxic than predicted from QSAR estimates. Hazard information for these groups is not generally available.

Environmental fate: Silver is a rare but naturally occurring metal, often found deposited as a mineral ore in association with other elements. Emissions from smelting operations, manufacture and disposal of certain photographic and electrical supplies, coal combustion, and cloud seeding are some of the anthropogenic sources of silver in the biosphere. The global biogeochemical movements of silver are characterized by releases to the atmosphere, water, land, and natural and anthropogenic sorbents, long-range transport of fine particles in the atmosphere, wet and dry deposition, and sorption to soils and sediments.

In general, accumulation of silver by terrestrial plants from soils is low, even if the soil is amended with silver-containing sewage sludge or the plants are grown on tailings from silver mines, where silver accumulates mainly in the root systems. The ability to accumulate dissolved silver varies widely between species. Some reported bioconcentration factors for marine organisms (calculated as milligrams of silver per litre of medium) are 210 in diatoms, 240 in brown algae, 330 in mussels, 2300 in scallops, and 18 700 in oysters, whereas bioconcentration factors for freshwater organisms have been reported to range from negligible in bluegills (Lepomis macrochirus) to 60 in daphnids; these values represent uptake of bioavailable silver in laboratory experiments. Laboratory studies with the less toxic silver compounds, such as silver sulfide and silver chloride, reveal that accumulation of silver does not necessarily lead to adverse effects. At concentrations normally encountered in the environment, food-chain biomagnification of silver in aquatic systems is unlikely. Elevated silver concentrations in biota occur in the vicinities of sewage outfalls, electroplating plants, mine waste sites, and silver iodide-seeded areas. Maximum concentrations recorded in field collections, in milligrams total silver per kilogram dry weight (tissue), were 1.5 in marine mammals (liver) (except Alaskan beluga whales Delphinapterus leucas, which had concentrations 2 orders of magnitude higher than those of other marine mammals), 6 in fish (bone), 14 in plants (whole), 30 in annelid worms (whole), 44 in birds (liver), 110 in mushrooms (whole), 185 in bivalve mussels (soft parts), and 320 in gastropods (whole).

Ecotoxicity: In general, silver ion was less toxic to freshwater aquatic organisms under conditions of low dissolved silver ion concentration and increasing water pH, hardness, sulfides, and dissolved and particulate organic loadings; under static test conditions, with flow-through regimes; and when animals were adequately nourished instead of being starved. Silver ions are very toxic to microorganisms. However, there is generally no strong inhibitory effect on microbial activity in sewage treatment plants because of reduced bioavailability due to rapid complexation and adsorption. Free silver ion was lethal to representative species of sensitive aquatic plants, invertebrates, and teleosts at nominal water concentrations of 1-5 ug/litre. Adverse effects occur on development of trout at concentrations as low as 0.17 ug/litre and on phytoplankton species composition and succession at 0.3-0.6 ug/litre.
A knowledge of the speciation of silver and its consequent bioavailability is crucial to understanding the potential risk of the metal. Measurement of free ionic silver is the only direct method that can be used to assess the likely effects of the metal on organisms. Speciation models can be used to assess the likely proportion of the total silver measured that is bioavailable to organisms. Unlike some other metals, background freshwater concentrations in pristine and most urban areas are well below concentrations causing toxic effects. Levels in most industrialized areas border on the effect concentration, assuming that conditions favour bioavailability. On the basis of available toxicity test results, it is unlikely that bioavailable free silver ions would ever be at sufficiently high concentrations to cause toxicity in marine environments. No data were found on effects of silver on wild birds or mammals. Silver was harmful to poultry (tested as silver nitrate) at concentrations as low as 100 mg total silver/litre in drinking-water or 200 mg total silver/kg in diets. Sensitive laboratory mammals were adversely affected at total silver concentrations (added as silver nitrate) as low as 250 ug/litre in drinking-water (brain histopathology), 6 mg/kg in diet (high accumulations in kidneys and liver), or 13.9 mg/kg body weight (lethality). Silver and Silver Compounds; Concise International Chemical Assessment Document (CICAD) 44 IPCS InChem (WHO)

'The transport of silver through estuarine and coastal marine systems is dependent on biological uptake and incorporation. Uptake by phytoplankton is rapid, in proportion to silver concentration and inversely proportional to salinity. In contrast to studies performed with other toxic metals, silver availability appears to be controlled by both the free silver ion concentration and the concentration of other silver complexes. Silver incorporated by phytoplankton is not lost as salinity increase; as a result silver associated with cellular material is largely retained within the estuary. Phytoplankton exhibit a variable sensitivity to silver. Sensitive species exhibit a marked delay in the onset of growth in response to silver at low concentrations, even though maximum growth rates are similar to controls. A delay in the onset of growth reduces the ability of a population to respond to short-term favourable conditions and to succeed within the community.'

James G. Saunders and George R Abbe: Aquatic Toxicology and Environmental Fate; ASTM STP 1007, 1989, pp 5-18

12.2. Persistence and degradability

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Persistence: Water/Soil</th>
<th>Persistence: Air</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Data available for all ingredients</td>
<td>No Data available for all ingredients</td>
</tr>
</tbody>
</table>

12.3. Bioaccumulative potential

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Bioaccumulation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Data available for all ingredients</td>
</tr>
</tbody>
</table>

12.4. Mobility in soil

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Data available for all ingredients</td>
</tr>
</tbody>
</table>

12.5. Results of PBT and vPvB assessment

<table>
<thead>
<tr>
<th>Relevant available data</th>
<th>B</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

12.6. Other adverse effects

No data available

SECTION 13 DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

<table>
<thead>
<tr>
<th>Product / Packaging disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containers may still present a chemical hazard/danger when empty.</td>
</tr>
<tr>
<td>Return to supplier for reuse/recycling if possible.</td>
</tr>
<tr>
<td>Otherwise:</td>
</tr>
<tr>
<td>If container can not be cleaned sufficiently well to ensure that residuals do not remain or if the container cannot be used to store the same product, then puncture containers, to prevent re-use, and bury at an authorised landfill.</td>
</tr>
<tr>
<td>Where possible retain label warnings and SDS and observe all notices pertaining to the product.</td>
</tr>
<tr>
<td>DO NOT allow wash water from cleaning or process equipment to enter drains.</td>
</tr>
<tr>
<td>It may be necessary to collect all wash water for treatment before disposal.</td>
</tr>
<tr>
<td>In all cases disposal to sewer may be subject to local laws and regulations and these should be considered first.</td>
</tr>
<tr>
<td>Where in doubt contact the responsible authority.</td>
</tr>
</tbody>
</table>

Waste treatment options Not Available

Sewage disposal options Not Available

SECTION 14 TRANSPORT INFORMATION

Labels Required

Limited Quantity: (For 8331-14G, 8331-50ML, 8331-200ML kits ship as per Part B)

Land transport (ADR)

<table>
<thead>
<tr>
<th>14.1. UN number</th>
<th>3077</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2. UN proper shipping name</td>
<td>ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (contains silver and bisphenol f glycidyl ether/ formaldehyde copolymer)</td>
</tr>
<tr>
<td>14.3. Transport hazard class(es)</td>
<td></td>
</tr>
<tr>
<td>Class</td>
<td>9</td>
</tr>
<tr>
<td>Subrisk</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>
### Air transport (ICAO-IATA / DGR)

<table>
<thead>
<tr>
<th>14.1. UN number</th>
<th>3077</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2. UN proper shipping name</td>
<td>Environmentally hazardous substance, solid, n.o.s. * (contains silver and bisphenol f glycidyl ether/ formaldehyde copolymer)</td>
</tr>
<tr>
<td>14.3. Transport hazard class(es)</td>
<td></td>
</tr>
<tr>
<td>ICAO/IATA Class</td>
<td>9</td>
</tr>
<tr>
<td>ICAO / IATA Subrisk</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>ERG Code</td>
<td>9L</td>
</tr>
<tr>
<td>14.4. Packing group</td>
<td>III</td>
</tr>
<tr>
<td>14.5. Environmental hazard</td>
<td>Environmentally hazardous</td>
</tr>
<tr>
<td>14.6. Special precautions for user</td>
<td></td>
</tr>
<tr>
<td>Special provisions</td>
<td>A97 A158 A179 A197</td>
</tr>
<tr>
<td>Cargo Only Packing Instructions</td>
<td>966</td>
</tr>
<tr>
<td>Cargo Only Maximum Qty / Pack</td>
<td>400 kg</td>
</tr>
<tr>
<td>Passenger and Cargo Packing Instructions</td>
<td>956</td>
</tr>
<tr>
<td>Passenger and Cargo Maximum Qty / Pack</td>
<td>400 kg</td>
</tr>
<tr>
<td>Passenger and Cargo Limited Quantity Packing Instructions</td>
<td>Y966</td>
</tr>
<tr>
<td>Passenger and Cargo Limited Maximum Qty / Pack</td>
<td>30 kg G</td>
</tr>
</tbody>
</table>

### Sea transport (IMDG-Code / GGVSee)

<table>
<thead>
<tr>
<th>14.1. UN number</th>
<th>3077</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2. UN proper shipping name</td>
<td>ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (contains silver and bisphenol f glycidyl ether/ formaldehyde copolymer)</td>
</tr>
<tr>
<td>14.3. Transport hazard class(es)</td>
<td></td>
</tr>
<tr>
<td>IMDG Class</td>
<td>9</td>
</tr>
<tr>
<td>IMDG Subrisk</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>14.4. Packing group</td>
<td>III</td>
</tr>
<tr>
<td>14.5. Environmental hazard</td>
<td>Marine Pollutant</td>
</tr>
<tr>
<td>14.6. Special precautions for user</td>
<td></td>
</tr>
<tr>
<td>EMS Number</td>
<td>F-A , S-F</td>
</tr>
<tr>
<td>Special provisions</td>
<td>274 335 966 967 969</td>
</tr>
<tr>
<td>Limited Quantities</td>
<td>5 kg</td>
</tr>
</tbody>
</table>

### Inland waterways transport (ADN)

<table>
<thead>
<tr>
<th>14.1. UN number</th>
<th>3077</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2. UN proper shipping name</td>
<td>ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (contains silver and bisphenol f glycidyl ether/ formaldehyde copolymer)</td>
</tr>
<tr>
<td>14.3. Transport hazard class(es)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>14.4. Packing group</td>
<td>III</td>
</tr>
<tr>
<td>14.5. Environmental hazard</td>
<td>Environmentally hazardous</td>
</tr>
<tr>
<td>14.6. Special precautions for user</td>
<td></td>
</tr>
<tr>
<td>Classification code</td>
<td>M7</td>
</tr>
<tr>
<td>Special provisions</td>
<td>274; 335; 375; 601</td>
</tr>
<tr>
<td>Limited quantity</td>
<td>5 kg</td>
</tr>
<tr>
<td>Equipment required</td>
<td>PP, A***</td>
</tr>
<tr>
<td>Fire cones number</td>
<td>0</td>
</tr>
</tbody>
</table>

### 14.7. Transport in bulk according to Annex II of MARPOL and the IBC code

Not Applicable

### SECTION 15 REGULATORY INFORMATION

15.1. Safety, health and environmental regulations / legislation specific for the substance or mixture

SILVER(7440-22-4) IS FOUND ON THE FOLLOWING REGULATORY LISTS
**EU European Chemicals Agency (ECHA) Community Rolling Action Plan (CoRAP) List of Substances**

European Customs Inventory of Chemical Substances ECICS (English)

**UK Workplace Exposure Limits (WELs)**

**BISPHENOL F GLYCIDYL ETHER/ FORMALDEHYDE COPOLYMER (28064-14-4) IS FOUND ON THE FOLLOWING REGULATORY LISTS**

Not Applicable

This safety data sheet is in compliance with the following EU legislation and its adaptations - as far as applicable - : Directives 98/24/EC, 92/85/EEC, 94/33/EC, 2008/98/EC, 2010/75/EU; Commission Regulation (EU) 2015/830; Regulation (EC) No 1272/2008 as updated through ATPs.

### 15.2. Chemical safety assessment

No Chemical Safety Assessment has been carried out for this substance/mixture by the supplier.

#### National Inventory Status

<table>
<thead>
<tr>
<th>National Inventory</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia - AICS</td>
<td>Y</td>
</tr>
<tr>
<td>Canada - DSL</td>
<td>Y</td>
</tr>
<tr>
<td>Canada - NDSL</td>
<td>N (bisphenol F glycidyl ether/ formaldehyde copolymer; silver)</td>
</tr>
<tr>
<td>China - IECSC</td>
<td>Y</td>
</tr>
<tr>
<td>Europe - EINECS / ELINCS / NLP</td>
<td>N (bisphenol F glycidyl ether/ formaldehyde copolymer)</td>
</tr>
<tr>
<td>Japan - ENCS</td>
<td>N (silver)</td>
</tr>
<tr>
<td>Korea - KECI</td>
<td>Y</td>
</tr>
<tr>
<td>New Zealand - NZIoC</td>
<td>Y</td>
</tr>
<tr>
<td>Philippines - PICCS</td>
<td>Y</td>
</tr>
<tr>
<td>USA - TSCA</td>
<td>Y</td>
</tr>
</tbody>
</table>

**Legend:**

Y = All ingredients are on the inventory  
N = Not determined or one or more ingredients are not on the inventory and are not exempt from listing (see specific ingredients in brackets)

### SECTION 16 OTHER INFORMATION

| Revision Date | 11/10/2018 |
| Initial Date | 05/10/2016 |

**Full text Risk and Hazard codes**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H411</td>
<td>Toxic to aquatic life with long lasting effects.</td>
</tr>
</tbody>
</table>

**Other information**

**Ingredients with multiple cas numbers**

<table>
<thead>
<tr>
<th>Name</th>
<th>CAS No</th>
</tr>
</thead>
<tbody>
<tr>
<td>bisphenol F glycidyl ether/ formaldehyde copolymer</td>
<td>28064-14-4, 42616-71-7, 59029-73-1, 94422-39-6</td>
</tr>
</tbody>
</table>

Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references. The SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered. For detailed advice on Personal Protective Equipment, refer to the following EU CEN Standards:  
EN 166 Personal eye protection  
EN 340 Protective clothing  
EN 374 Protective gloves against chemicals and micro-organisms  
EN 13682 Footwear protecting against chemicals  
EN 133 Respiratory protective devices

**Definitions and abbreviations**

PC – TWA: Permissible Concentration-Time Weighted Average  
PC – STEL: Permissible Concentration-Short Term Exposure Limit  
IARC: International Agency for Research on Cancer  
ACGIH: American Conference of Governmental Industrial Hygienists  
STEL: Short Term Exposure Limit  
TEEL: Temporary Emergency Exposure Limit  
IDLH: Immediately Dangerous to Life or Health Concentrations  
OSF: Odour Safety Factor  
NOAEL: No Observed Adverse Effect Level  
LOAEL: Lowest Observed Adverse Effect Level  
TLV: Threshold Limit Value  
LOD: Limit Of Detection  
OTV: Odour Threshold Value  
BCF: BioConcentration Factors  
BEI: Biological Exposure Index  

**Reason for Change**

A-1.00 - Format changes to section 1, 2, 14, 15, and 16 as well as starting a new versioning system.
SECTION 1 IDENTIFICATION OF THE SUBSTANCE / MIXTURE AND OF THE COMPANY / UNDERTAKING

1.1. Product Identifier

<table>
<thead>
<tr>
<th>Product name</th>
<th>8331-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other means of identification</td>
<td>Silver Conductive Epoxy Adhesive</td>
</tr>
</tbody>
</table>

1.2. Relevant identified uses of the substance or mixture and uses advised against

| Relevant identified uses | Silver filled electrically conductive adhesive for repairing traces on circuit boards, cold soldering, and bonding |
| Uses advised against     | Not Applicable |

1.3. Details of the supplier of the safety data sheet

| Registered company name | MG Chemicals UK Limited |
| Address                 | Heame House, 23 Bilston Street, Sedgeley Dudley DY3 1JA United Kingdom |
| Telephone               | +44 (1663) 362888 |
| Fax                     | Not Available |
| Website                 | Not Available |
| Email                   | sales@mgchemicals.com |

| Registered company name | MG Chemicals (Head office) |
| Address                 | 9347 - 193 Street Surrey V4N 4E7 British Columbia Canada |
| Telephone               | +1 (800) 201-8822 |
| Fax                     | +1 (800) 708-9888 |
| Website                 | www.mgchemicals.com |
| Email                   | info@mgchemicals.com |

1.4. Emergency telephone number

| Association / Organisation | CHEMTREC |
| Emergency telephone numbers | +44 (670) 6200418 |
| Other emergency telephone numbers | +1 (703) 527-3887 |

SECTION 2 HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture

| Classification according to regulation (EC) No 1272/2008 [CLP] [1] |
| H302 - Acute Toxicity (Oral) Category 4, H314 - Skin Corrosion/Irritation Category 1C, H317 - Skin Sensitizer Category 1, H361 - Reproductive Toxicity Category 2, H410 - Chronic Aquatic Hazard Category 1 |


2.2. Label elements

<table>
<thead>
<tr>
<th>Hazard pictogram(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Danger Symbol]</td>
</tr>
<tr>
<td>SIGNAL WORD</td>
</tr>
</tbody>
</table>

Hazard statement(s)

<table>
<thead>
<tr>
<th>Hazard statement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H302</td>
<td>Harmful if swallowed.</td>
</tr>
<tr>
<td>H314</td>
<td>Causes severe skin burns and eye damage.</td>
</tr>
<tr>
<td>H317</td>
<td>May cause an allergic skin reaction.</td>
</tr>
<tr>
<td>H361</td>
<td>Suspected of damaging fertility or the unborn child.</td>
</tr>
<tr>
<td>H410</td>
<td>Very toxic to aquatic life with long lasting effects.</td>
</tr>
</tbody>
</table>

Supplementary statement(s)

Not Applicable
Precautionary statement(s) Prevention

P201 Obtain special instructions before use.
P260 Do not breathe dust/fume/gas/mist/vapours/spray.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P270 Do not eat, drink or smoke when using this product.
P273 Avoid release to the environment.
P272 Contaminated work clothing should not be allowed out of the workplace.

Precautionary statement(s) Response

P301+P330+P331 IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303+P361+P353 IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower].
P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P306+P313 IF exposed or concerned: Get medical advice/attention.
P310 Immediately call a POISON CENTER/doctor/physician/first aider.
P302+P352 IF ON SKIN: Wash with plenty of water and soap.
P363 Wash contaminated clothing before reuse.
P333+P313 IF skin irritation or rash occurs: Get medical advice/attention.
P362+P364 Take off contaminated clothing and wash it before reuse.
P391 Collect spillage.
P301+P312 IF SWALLOWED: Call a POISON CENTER/doctor/physician/first aider/ if you feel unwell.
P304+P340 IF INHALED: Remove person to fresh air and keep comfortable for breathing.

Precautionary statement(s) Storage

P405 Store locked up.

Precautionary statement(s) Disposal

P501 Dispose of contents/container in accordance with local regulations.

2.3. Other hazards
Inhalation may produce health damage*.
Cumulative effects may result following exposure*.
May produce discomfort of the respiratory system*.
Limited evidence of a carcinogenic effect*.
Possible respiratory sensitizer*.

4-nonylphenol, branched Listed in the European Chemicals Agency (ECHA) Candidate List of Substances of Very High Concern for Authorisation
bisphenol A Listed in the European Chemicals Agency (ECHA) Candidate List of Substances of Very High Concern for Authorisation
bisphenol A Listed in the Europe Regulation (EC) No 1907/2006 - Annex XVII (Label should state: ‘Restricted to professional users.’)

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

3.1. Substances
See ‘Composition on ingredients’ in Section 3.2

3.2. Mixtures

<table>
<thead>
<tr>
<th>1.CAS No</th>
<th>2.EC No</th>
<th>3.Index No</th>
<th>4.REACH No</th>
<th>% [weight]</th>
<th>Name</th>
<th>Classification according to regulation (EC) No 1272/2008 [CLP]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.7440-22-4</td>
<td>2.231-131-3</td>
<td>Not Available</td>
<td>4.01-2119556669-21-XXXX</td>
<td>67</td>
<td>silver</td>
<td>EUH610 [1]</td>
</tr>
<tr>
<td>1.84852-15-3</td>
<td>2.284-325-5</td>
<td>3.601-053-00-8</td>
<td>4.01-2119510715-45-XXXX</td>
<td>22</td>
<td>4-nonylphenol, branched</td>
<td>Reproductive Toxicity Category 2, Acute Toxicity (Oral) Category 4, Chronic Aquatic Hazard Category 1, Acute Aquatic Hazard Category 1, Skin Corrosion/Irritation Category 1B; H361fd, H302, H410, H314 [2]</td>
</tr>
<tr>
<td>1.140-31-8</td>
<td>2.205-411-0</td>
<td>3.612-105-00-4</td>
<td>4.01-2119471486-39-XXXX</td>
<td>7</td>
<td>N-aminoethylpiperazine</td>
<td>Acute Toxicity (Dermal) Category 4, Acute Toxicity (Oral) Category 4, Chronic Aquatic Hazard Category 3, Skin Sensitizer Category 1, Skin Corrosion/Irritation Category 1B; H312, H302, H412, H317, H314 [2]</td>
</tr>
</tbody>
</table>

Continued...
### SECTION 4 FIRST AID MEASURES

#### 4.1. Description of first aid measures

<table>
<thead>
<tr>
<th>Eye Contact</th>
<th>Skin Contact</th>
<th>Inhalation</th>
<th>Ingestion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eye Contact</strong></td>
<td><strong>Skin Contact</strong></td>
<td><strong>Inhalation</strong></td>
<td><strong>Ingestion</strong></td>
</tr>
<tr>
<td>If this product comes in contact with the eyes:</td>
<td>If skin or hair contact occurs:</td>
<td>If fumes or combustion products are inhaled from contaminated area:</td>
<td>If swallowed do NOT induce vomiting:</td>
</tr>
<tr>
<td>- Immediately hold eyelids apart and flush the eye continuously with running water.</td>
<td>- Immediately flush body and clothes with large amounts of water.</td>
<td>- Lay patient down. Keep warm and rested.</td>
<td>- If swallowed do NOT induce vomiting.</td>
</tr>
<tr>
<td>- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.</td>
<td>- Quickly remove all contaminated clothing, including footwear.</td>
<td>- Inhalation of vapours or aerosols (mists, fumes) may cause lung oedema.</td>
<td>- If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.</td>
</tr>
<tr>
<td>- Continue flushing until advised to stop by the Poisons Information Centre or a doctor, or for at least 15 minutes.</td>
<td>- Wash skin and hair with running water. Continue flushing with water until advised to stop by the Poisons Information Centre.</td>
<td>- Corrosive substances may cause lung damage (e.g. lung oedema, fluid in the lungs).</td>
<td>- Observe the patient carefully.</td>
</tr>
<tr>
<td>- Transport to hospital or doctor without delay.</td>
<td>- Transport to hospital, or doctor.</td>
<td>- As this reaction may be delayed up to 24 hours after exposure, affected individuals need complete rest (preferably in semi-recumbent posture) and must be kept under medical observation even if no symptoms are (yet) manifested.</td>
<td>- Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious.</td>
</tr>
<tr>
<td>- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.</td>
<td>- Continue flushing until advised to stop by the Poisons Information Centre or a doctor, or for at least 15 minutes.</td>
<td>- Before any such manifestation, the administration of a spray containing a dexamethasone derivative or beclomethasone derivative may be considered.</td>
<td>- Give water to rinse out mouth, then provide liquid slowly and as much as casualty can comfortably drink.</td>
</tr>
<tr>
<td>- DO NOT attempt to remove particles attached to or embedded in eye.</td>
<td>- Lay victim down, on stretcher if available and pad BOTH eyes, make sure dressing does not press on the injured eye by placing thick pads under dressing, above and below the eye.</td>
<td>- Transport to hospital or doctor without delay.</td>
<td>- Transport to hospital or doctor without delay.</td>
</tr>
<tr>
<td>- Seek urgent medical assistance, or transport to hospital.</td>
<td></td>
<td>- For advice, contact a Poisons Information Centre or a doctor at once.</td>
<td>- If swallowed do NOT induce vomiting.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Urgent hospital treatment is likely to be needed.</td>
</tr>
</tbody>
</table>

#### 4.2 Most important symptoms and effects, both acute and delayed

**See Section 11**

#### 4.3. Indication of any immediate medical attention and special treatment needed

Copper, magnesium, aluminium, antimony, iron, manganese, nickel, zinc (and their compounds) in welding, brazing, galvanising or smelting operations all give rise to thermally produced particulates of smaller dimension than may be produced if the metals are divided mechanically. Where insufficient ventilation or respiratory protection is available these particulates may produce "metal fume fever" from workers as an acute or short-term exposure.  

- **Onset occurs in 4-6 hours generally on the evening following exposure.** Tolerance develops in workers but may be lost over the weekend. ([Monday Morning Fever](http://example.com))  
- **Pulmonary function tests may indicate reduced lung volumes, small airway obstruction and decreased carbon monoxide diffusing capacity but these abnormalities resolve after several months.**  
- **Although mildly elevated urinary levels of heavy metal may occur they do not correlate with clinical effects.**  
- **The general approach to treatment is recognition of the disease, supportive care and prevention of exposure.**  
- **Seriously symptomatic patients should receive chest x-rays, have arterial blood gases determined and be observed for the development of tracheobronchitis and pulmonary edema.**  

[[Ellenhorn and Barceloux: Medical Toxicology](http://example.com)](53ag)  
**For acute or short-term repeated exposures to highly alkaline materials:**  
- **Respiratory stress is uncommon but present occasionally because of soft tissue edema.**  
- **Unless endotracheal intubation can be accomplished under direct vision, cricothyroidotomy or tracheotomy may be necessary.**  
- **Oxygen is given as indicated.**  
- **The presence of shock suggests perforation and mandates an intravenous line and fluid administration.**  
- **Damage due to alkaline corrosives occurs by liquefaction necrosis whereby the saponification of fats and solubilisation of proteins allow deep penetration into the tissue.**  
- **Alkalis continue to cause damage after exposure.**  

**INGESTION:**  
- **Milk and water are the preferred diluents**
No more than 2 glasses of water should be given to an adult.
- Neutalising agents should never be given since exothermic heat reaction may compound injury.
- * Activated charcoal does not absorb alkali.
- * Gastric lavage should not be used.

Supportive care involves the following:
- Withhold oral feedings initially.
- If enoscopy confirms transmural injury start steroids for 24 hours.
- Carefully evaluate amount of tissue necrosis before assessing the need for surgical intervention.
- Patients should be instructed to seek medical attention whenever they develop difficulty in swallowing (dysphagia).

**SKIN AND EYE:**
- Injury should be irrigated for 20-30 minutes.

Eye injuries require saline. [Ellenhorn & Barceloux: Medical Toxicology]

For acute or short term repeated exposures to phenols/ cresols:
- Phenol is absorbed rapidly through lungs and skin. [Massive skin contact may result in collapse and death]*
- Ingestion may result in ulceration of upper respiratory tract; perforation of oesophagus and/or stomach, with attendant complications, may occur. Oesophageal stricture may occur.*
- An initial excitatory phase may present. Convulsions may appear as long as 18 hours after ingestion. Hypotension and ventricular tachycardia that require vasopressor and antiarrhythmic therapy, respectively, can occur.
- Respiratory arrest, ventricular dysrythmias, seizures and metabolic acidosis may complicate severe phenol exposures so the initial attention should be directed towards stabilisation of breathing and circulation with ventilation, intubation, intravenous lines, fluids and cardiac monitoring as indicated.
- [{Vegetable oils retard absorption; do NOT use paraffin oils or alcohols. Gastric lavage, with endotracheal intubation, should be repeated until phenol odour is no longer detectable; follow with vegetable oil. A saline cathartic should then be given.}] ALTERNATIVELY: Activated charcoal (1g/kg) may be given. A cathartic should be given after oral activated charcoal.
- Severe poisoning may require slow intravenous injection of methylcellulose blue to treat methaemoglobinaemia.
- [Renal failure may require haemodialysis.]
- Most absorbed phenol is biotransformed by the liver to ethereal and glucuronide sulfates and is eliminated almost completely after 24 hours. [Ellenhorn and Barceloux: Medical Toxicology]
- [Union Carbide]*

**SECTION 5 FIREFIGHTING MEASURES**

### 5.1. Extinguishing media

Metal dust fires need to be smothered with sand, inert dry powders.
- **DO NOT USE WATER, CO2 OR FOAM.**
- Use DRY sand, graphite powder, dry sodium chloride based extinguishers, G-1 or Met L-X to smother fire.
- Confining or smothering material is preferable to applying water as chemical reaction may produce flammable and explosive hydrogen gas.
- Chemical reaction with CO2 may produce flammable and explosive methane.
- If impossible to extinguish, withdraw, protect surroundings and allow fire to burn itself out.
- **DO NOT use halogenated fire extinguishing agents.**

### 5.2. Special hazards arising from the substrate or mixture

<table>
<thead>
<tr>
<th>Fire Incompatibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reacts with acids producing flammable / explosive hydrogen (H2) gas</td>
</tr>
<tr>
<td>Avoid contamination with oxidising agents i.e. nitrates, oxidising acids, chlorine bleaches, pool chlorine etc. as ignition may result</td>
</tr>
</tbody>
</table>

### 5.3. Advice for firefighters

<table>
<thead>
<tr>
<th>Fire Fighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alert Fire Brigade and tell them location and nature of hazard.</td>
</tr>
<tr>
<td>Wear full body protective clothing with breathing apparatus.</td>
</tr>
<tr>
<td>Prevent, by any means available, spilage from entering drains or water course.</td>
</tr>
<tr>
<td>Use fire fighting procedures suitable for surrounding area.</td>
</tr>
<tr>
<td>Do not approach containers suspected to be hot.</td>
</tr>
<tr>
<td>Cool fire exposed containers with water spray from a protected location.</td>
</tr>
<tr>
<td>If safe to do so, remove containers from path of fire.</td>
</tr>
<tr>
<td>Equipment should be thoroughly decontaminated after use.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fire/Explosion Hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO NOT disturb burning dust. Explosion may result if dust is stirred into a cloud, by providing oxygen to a large surface of hot metal. DO NOT use water or foam as generation of explosive hydrogen may result.</td>
</tr>
<tr>
<td>With the exception of the metals that burn in contact with air or water (for example, sodium), masses of combustible metals do not represent unusual fire risks because they have the ability to conduct heat away from hot spots so efficiently that the heat of combustion cannot be maintained - this means that it will require a lot of heat to ignite a mass of combustible metal. Generally, metal fire risks exist when sawdust, machine shavings and other metal ‘lines’ are present. Metal powders, while generally regarded as non-combustible:</td>
</tr>
<tr>
<td>May burn when metal is finely divided and energy input is high.</td>
</tr>
<tr>
<td>May react explosively with water.</td>
</tr>
<tr>
<td>May be ignited by friction, heat, sparks or flame.</td>
</tr>
<tr>
<td>May REIGNITE after fire is extinguished.</td>
</tr>
<tr>
<td>Will burn with intense heat.</td>
</tr>
</tbody>
</table>

**Note:**
- Metal dust fires are slow moving but intense and difficult to extinguish.
- Containers may explode on heating.
- Dusts or fumes may form explosive mixtures with air.
- Gases generated in fire may be poisonous, corrosive or irritating.
- Hot or burning metals may react violently upon contact with other materials, such as oxidising agents and extinguishing agents used on fires involving ordinary combustibles or flammable liquids.
- Temperatures produced by burning metals can be higher than temperatures generated by burning flammable liquids.
7.1. Precautions for safe handling

Some metals can continue to burn in carbon dioxide, nitrogen, water, or steam atmospheres in which ordinary combustibles or flammable liquids would be incapable of burning. Combustible. Will burn if ignited. Combustion products include: carbon monoxide (CO), carbon dioxide (CO2), other pyrolysis products typical of burning organic material. May emit corrosive fumes.

SECTION 6 ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures

See section 8

6.2. Environmental precautions

See section 12

6.3. Methods and material for containment and cleaning up

<table>
<thead>
<tr>
<th>Minor Spills</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Remove all ignition sources.</td>
</tr>
<tr>
<td>- Clean up all spills immediately.</td>
</tr>
<tr>
<td>- Avoid contact with skin and eyes.</td>
</tr>
<tr>
<td>- Control personal contact with the substance, by using protective equipment.</td>
</tr>
<tr>
<td>- Use dry clean up procedures and avoid generating dust.</td>
</tr>
<tr>
<td>- Place in a suitable, labelled container for waste disposal.</td>
</tr>
<tr>
<td>- Drains for storage or use areas should have retention basins for pH adjustments and dilution of spills before discharge or disposal of material.</td>
</tr>
<tr>
<td>- Check regularly for spills and leaks.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Major Spills</th>
</tr>
</thead>
<tbody>
<tr>
<td>- If molten:</td>
</tr>
<tr>
<td>- Collect recoverable product into labelled containers for recycling.</td>
</tr>
<tr>
<td>- Neutralise/decontaminate residue (see Section 13 for specific agent).</td>
</tr>
<tr>
<td>- Wash area and prevent runoff into drains.</td>
</tr>
<tr>
<td>- After clean up operations, decontaminate and launder all protective clothing and equipment before storing and re-using.</td>
</tr>
</tbody>
</table>

6.4. Reference to other sections

Personal Protective Equipment advice is contained in Section 8 of the SDS.

SECTION 7 HANDLING AND STORAGE

7.1. Precautions for safe handling

For molten metals:
- Molten metal and water can be an explosive combination. The risk is greatest when there is sufficient molten metal to entrap or seal off water. Water and other forms of contamination on or contained in scrap or remelting ingot are known to have caused explosions in melting operations. While the products may have minimal surface roughness and internal voids, there remains the possibility of moisture contamination or entrainment. If confined, even a few drops can lead to violent explosions.
- All tooling, containers, molds and ladles, which come in contact with molten metal must be preheated or specially coated, rust free and approved for such use.
- Any surfaces that may contact molten metal (e.g. concrete) should be specially coated
- All tooling, containers, molds and ladles, which come in contact with molten metal must be preheated or specially coated, rust free and approved for such use.
- Drops of molten metal in water (e.g. from plasma arc cutting), while not normally an explosion hazard, can generate enough flammable hydrogen gas to present an explosion hazard. Vigorous circulation of the water and removal of the particles minimise the hazard.

During melting operations, the following minimum guidelines should be observed:
- Preheat and dry large objects adequately before charging in to a furnace containing molten metal. This is typically done by the use of a drying oven or homogenising furnace. The dry cycle should bring the metal temperature of the coldest item of the batch to 200 degree C (400 deg F) and then hold at that temperature for 6 hours.
- All tooling, containers, molds and ladles, which come in contact with molten metal must be preheated or specially coated, rust free and approved for such use.
- Avoid physical damage to containers.
- Avoid smoking, naked lights or ignition sources.
- Avoid contact with incompatible materials.
- When handling, DO NOT eat, drink or smoke.
- Keep containers securely sealed when not in use.
- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
- WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material.
- Store materials in dry, heated areas with any cracks or cavities pointed downwards.
- Preheat and dry large objects adequately before charging in to a furnace containing molten metal. This is typically done by the use of a drying oven or homogenising furnace. The dry cycle should bring the metal temperature of the coldest item of the batch to 200 degree C (400 deg F) and then hold at that temperature for 6 hours.
- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
- WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material.
- Avoid smoking, naked lights or ignition sources.
- Avoid contact with incompatible materials.
- When handling, DO NOT eat, drink or smoke.
- Keep containers securely sealed when not in use.
- Avoid physical damage to containers.
- Always wash hands with soap and water after handling.
- Work clothes should be laundered separately. Launder contaminated clothing before re-use.
- Use good occupational work practice.

Continued...
7.2. Conditions for safe storage, including any incompatibilities

**Suitable container**
- Glass container is suitable for laboratory quantities
- CARE: Packing of high density product in light weight metal or plastic packages may result in container collapse with product release
- Heavy gauge metal packages / Heavy gauge metal drums
- Lined metal can, lined metal pail / can.
- Plastic pail.
- Polyliner drum.
- Packaging as recommended by manufacturer.
- Check all containers are clearly labelled and free from leaks.
- For low viscosity materials
  - Drums and jerricans must be of the non-removable head type.
  - Where a can is to be used as an inner package, the can must have a screwed enclosure.
  - Where a can is to be used as an inner package, the can must have a screwed enclosure.
- For materials with a viscosity of at least 2680 cSt. (23 deg. C) and solids (between 15 C deg. and 40 deg C.):  
  - Removable head packaging.
  - Cans with friction closures and
  - low pressure tubes and cartridges
- May be used.
- Where combination packages are used, and the inner packages are of glass, porcelain or stoneware, there must be sufficient inert cushioning material in contact with inner and outer packages unless the outer packaging is a close fitting moulded plastic box and the substances are not incompatible with the plastic.

**Storage incompatibility**
- **WARNING:** Avoid or control reaction with peroxides. All transition metal peroxides should be considered as potentially explosive. For example transition metal complexes of alkyl, hydroperoxides may decompose explosively.
- The pi-complexes formed between chromium(0), vanadium(0) and other transition metals (haloarene-metal complexes) and mono- or polfluorobenzenes show extreme sensitivity to heat and are explosive.
- Avoid reaction with borohydrides or cyanoborohydrides
- Silver and its compounds and salts may also form explosive compounds in the presence of acetylene and nitromethane.
- Reacts with mild steel, galvanised steel / zinc producing hydrogen gas which may form an explosive mixture with air.
- Many metals may incandesce, react violently, ignite or react explosively upon addition of concentrated nitric acid.
- N-aminoethyipiperazine:
  - is a strong base in aqueous solutions
  - is incompatible with strong oxidisers, organic anhydrides, acrylates, alcohols, aldehydes, alkylene oxides, substituted allyls, cellulose nitrate, cresols, caprolactam solution, epichlorohydrin, ethylene dichloride, isocyanates, ketones, glycols, nitrates, organic halides, phenols, vinyl acetate
  - decomposes exothermically with maleic anhydride
  - may increase the explosive sensitivity of nitromethane
  - attacks aluminium, copper, magnesium, nickel, zinc, or their alloys, and stabilised steel
  - Phenols are incompatible with strong reducing substances such as hydrides, nitriles, alkali metals, and sulphides.
  - Avoid use of aluminium, copper and brass alloys in storage and process equipment.
  - Heat is generated by the acid-base reaction between phenols and bases.
  - Phenols are sulfonated very rapidly (for example, by concentrated sulfuric acid at room temperature), these reactions generate heat.
  - Phenols are nitrated very rapidly, even by dilute nitric acid.
  - Nitrated phenols often explode when heated. Many of them form metal salts that tend toward detonation by rather mild shock.
  - Avoid strong acids, bases.
  - Avoid contact with copper, aluminum and their alloys.
- Metals exhibit varying degrees of activity. Reaction is reduced in the massive form (sheet, rod, or drop), compared with finely divided forms. The less active metals will not burn in air but:
  - can react exothermically with oxidising acids to form noxious gases.
  - catalyse polymerisation and other reactions, particularly when finely divided
  - react with halogenated hydrocarbons (for example, copper dissolves when heated in carbon tetrachloride), sometimes forming explosive compounds.
  - Finely divided metal powders develop pyrophorcity when a critical specific surface area is exceeded; this is ascribed to high heat of oxide formation on exposure to air.
  - Safe handling is possible in relatively low concentrations of oxygen in an inert gas.
  - Several pyrophoric metals, stored in glass bottles have ignited when the container is broken on impact. Storage of these materials moist and in metal containers is recommended.
  - The reaction residues from various metal syntheses (involving vacuum evaporation and co-deposition with a ligand) are often pyrophoric.
- Factors influencing the pyrophoricity of metals are particle size, presence of moisture, nature of the surface of the particle, heat of formation of the oxide, or nitride, mass, hydrogen content, stress, purity and presence of oxide, among others.
- Many metals in elemental form react exothermically with compounds having active hydrogen atoms (such as acids and water) to form flammable hydrogen gas and caustic products.
- Elemental metals may react with azo/diazo compounds to form explosive products.
- Some elemental metals form explosive products with halogenated hydrocarbons.

7.3. Specific end use(s)

See section 1.2
8.1. Control parameters

**DERIVED NO EFFECT LEVEL (DNEL)**
Not Available

**PREDICTED NO EFFECT LEVEL (PNEC)**
Not Available

**OCCUPATIONAL EXPOSURE LIMITS (OEL)**

### INGREDIENT DATA

<table>
<thead>
<tr>
<th>Source</th>
<th>Ingredient</th>
<th>Material name</th>
<th>TWA</th>
<th>STEL</th>
<th>Peak</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK Workplace Exposure Limits (WELs)</td>
<td>silver</td>
<td>Silver, metallic</td>
<td>0.1 mg/m³</td>
<td>Not Available</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
<tr>
<td>UK Workplace Exposure Limits (WELs)</td>
<td>diethylenetriamine</td>
<td>2,2'-iminodi(ethylamine)</td>
<td>1 ppm / 4.3 mg/m³</td>
<td>Not Available</td>
<td>Not Available</td>
<td>Sk</td>
</tr>
<tr>
<td>EU Consolidated List of Indicative Occupational Exposure Limit Values (IOELVs)</td>
<td>bisphenol A</td>
<td>Bisphenol A (inhaltable dust)</td>
<td>10 mg/m³</td>
<td>Not Available</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
<tr>
<td>EU Consolidated List of Indicative Occupational Exposure Limit Values (IOELVs)</td>
<td>bisphenol A</td>
<td>Bisphenol A; 4,4'-isopropylidenediphenol</td>
<td>2 mg/m³</td>
<td>Not Available</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
<tr>
<td>UK Workplace Exposure Limits (WELs)</td>
<td>bisphenol A</td>
<td>Bisphenol A</td>
<td>2 mg/m³</td>
<td>Not Available</td>
<td>Not Available</td>
<td>Not Available</td>
</tr>
</tbody>
</table>

### EMERGENCY LIMITS

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Material name</th>
<th>TEEL-1</th>
<th>TEEL-2</th>
<th>TEEL-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>silver</td>
<td>Silver</td>
<td>0.3 mg/m³</td>
<td>170 mg/m³</td>
<td>990 mg/m³</td>
</tr>
<tr>
<td>4-nonylphenol, branched</td>
<td>Nonyl phenol, 4- (branched)</td>
<td>0.2 mg/m³</td>
<td>2.3 mg/m³</td>
<td>260 mg/m³</td>
</tr>
<tr>
<td>N-aminoethylpiperazine</td>
<td>Aminoethylpiperazine, N-</td>
<td>6.4 mg/m³</td>
<td>71 mg/m³</td>
<td>420 mg/m³</td>
</tr>
<tr>
<td>diethylenetriamine</td>
<td>Diethylenetriamine</td>
<td>3 ppm</td>
<td>8.5 ppm</td>
<td>51 ppm</td>
</tr>
<tr>
<td>bisphenol A</td>
<td>Bisphenol A; (4,4'-isopropylidenediphenol)</td>
<td>15 mg/m³</td>
<td>110 mg/m³</td>
<td>650 mg/m³</td>
</tr>
</tbody>
</table>

### MATERIAL DATA

The adopted TLV-TWA for silver dust and fumes is 0.1 mg/m³ and for the more toxic soluble silver compounds the adopted value is 0.01 mg/m³. Cases of argyria (a slate to blue-grey discolouration of epithelial tissues) have been recorded when workers were exposed to silver nitrate at concentrations of 0.1 mg/m³ (as silver). Exposure to very high concentrations of silver fume has caused diffuse pulmonary fibrosis. Percutaneous absorption of silver compounds is reported to have resulted in allergy. Based on a 25% retention upon inhalation and a 10 m³/day respiratory volume, exposure to 0.1 mg/m³ (TWA) would result in total deposition of no more than 1.5 gms in 25 years.

8.2. Exposure controls

#### 8.2.1. Appropriate engineering controls

- Metal dusts must be collected at the source of generation as they are potentially explosive.
  - Avoid ignition sources.
  - Good housekeeping practices must be maintained.
  - Dust accumulation on the floor, ledges and beams can present a risk of ignition, flame propagation and secondary explosions.
  - Do not use compressed air to remove settled materials from floors, beams or equipment.
  - Vacuum cleaners, of flame-proof design, should be used to minimise dust accumulation.
  - Use non-sparking handling equipment, tools and natural bristle brushes. Cover and reseal partially empty containers. Provide grounding and bonding where necessary to prevent accumulation of static charges during metal dust handling and transfer operations.
  - Do not allow chips, fines or dusts to contact water, particularly in enclosed areas.
  - Metal spraying and blasting should, where possible, be conducted in separate rooms. This minimises the risk of supplying oxygen, in the form of metal oxides, to potentially reactive finely divided metals such as aluminium, zinc, magnesium or titanium.
  - Work-shops designed for metal spraying should possess smooth walls and a minimum of obstructions, such as ledges, on which dust accumulation is possible.
  - Wet scrubbers are preferable to dry dust collectors.
  - Bag or filter-type collectors should be sited outside the workrooms and be fitted with explosion relief doors.
  - Cyclones should be protected against entry of moisture as reactive metal dusts are capable of spontaneous combustion in humid or partially wetted states.
  - Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0.5 metre/sec.
  - Local ventilation and vacuum systems must be designed to handle explosive dusts. Dry vacuum and electrostatic precipitators must not be used, unless specifically approved for use with flammable explosive dusts.

Air contaminants generated in the workplace possess varying ‘escape’ velocities which, in turn, determine the ‘capture velocities’ of fresh circulating air required to effectively remove the contaminant.

<table>
<thead>
<tr>
<th>Type of Contaminant</th>
<th>Air Speed</th>
</tr>
</thead>
</table>

Continued...
8.2.3. Environmental exposure controls

See section 12

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Recommended material(s)

GLOVE SELECTION INDEX

Glove selection is based on a modified presentation of the 'Forsberg Clothing Performance Index'.

The effect(s) of the following substance(s) are taken into account in the computer-generated selection:

8331 Part B Silver Conductive Epoxy Adhesive: Moderate Cure / High Conductivity

<table>
<thead>
<tr>
<th>Material</th>
<th>CPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUTYL</td>
<td>A</td>
</tr>
<tr>
<td>NEOPRENE</td>
<td>C</td>
</tr>
<tr>
<td>PVC</td>
<td>C</td>
</tr>
<tr>
<td>VITON</td>
<td>C</td>
</tr>
</tbody>
</table>

* CPI - Chemwatch Performance Index
A: Best Selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to Dangerous Choice for other than short term immersion

NOTE: As a series of factors will influence the actual performance of the glove, a final selection must be based on detailed observation.

A(All classes) = Organic vapours, B AUS or B1 = Acid gasses, B2 = Acid gas or hydrogen cyanide(HCN), B3 = Acid gas or hydrogen cyanide(HCN), E = Sulfur dioxide(SO2), G = Agricultural chemicals, K = Ammonia(NH3), Hg = Mercury, NO = Oxides of nitrogen, MB = Methyl bromide, AX = Low boiling point organic compounds(below 65 degC)

<table>
<thead>
<tr>
<th>Required Minimum</th>
<th>Half-Face</th>
<th>Full-Face</th>
<th>Powered Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection Factor</td>
<td>Respirator</td>
<td>Respirator</td>
<td>Respirator</td>
</tr>
<tr>
<td>up to 10 x ES</td>
<td>Air-line*</td>
<td>A P1</td>
<td>A PAPR-P1</td>
</tr>
<tr>
<td>up to 50 x ES</td>
<td>Air-line**</td>
<td>A P2</td>
<td>A PAPR-P2</td>
</tr>
<tr>
<td>up to 100 x ES</td>
<td>A P3</td>
<td>A P3</td>
<td>A PAPR-P3</td>
</tr>
<tr>
<td>100+ x ES</td>
<td>Air-line*</td>
<td>A PAPR-P3</td>
<td></td>
</tr>
</tbody>
</table>

* - Negative pressure demand  ** - Continuous flow

Respiratory protection


Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 1-2.5 m/s (200-500 f/min.) for extraction of gases discharged 2 meters distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used.
9.1. Information on basic physical and chemical properties

<table>
<thead>
<tr>
<th>Appearance</th>
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</thead>
<tbody>
<tr>
<td>Physical state</td>
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</tr>
<tr>
<td>Odour</td>
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</tr>
<tr>
<td>Odour threshold</td>
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</tr>
<tr>
<td>Melting point / freezing point (°C)</td>
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</tr>
<tr>
<td>Initial boiling point and boiling range (°C)</td>
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<tr>
<td>Evaporation rate</td>
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<tr>
<td>Flammability</td>
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</tr>
<tr>
<td>Upper Explosive Limit (%)</td>
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</tr>
<tr>
<td>Lower Explosive Limit (%)</td>
<td>Not Available</td>
</tr>
<tr>
<td>Vapour pressure (kPa)</td>
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<tr>
<td>Solubility in water (g/L)</td>
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<tr>
<td>Vapour density (Air = 1)</td>
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</table>

9.2. Other information
Not Available

SECTION 10 STABILITY AND REACTIVITY

10.1. Reactivity
See section 7.2

10.2. Chemical stability
- Unstable in the presence of incompatible materials.
- Product is considered stable.
- Hazardous polymerisation will not occur.

10.3. Possibility of hazardous reactions
See section 7.2

10.4. Conditions to avoid
See section 7.2

10.5. Incompatible materials
See section 7.2

10.6. Hazardous decomposition products
See section 5.3

SECTION 11 TOXICOLOGICAL INFORMATION

11.1. Information on toxicological effects

Inhaled
- Evidence shows, or practical experience predicts, that the material produces irritation of the respiratory system, in a substantial number of individuals, following inhalation. In contrast to most organs, the lung is able to respond to a chemical insult by first removing or neutralising the irritant and then repairing the damage. The repair process, which initially evolved to protect mammalian lungs from foreign matter and antigens, may however, produce further lung damage resulting in the impairment of gas exchange, the primary function of the lungs. Respiratory tract irritation often results in an inflammatory response involving the recruitment and activation of many cell types, mainly derived from the vascular system. Inhalation of alkaline corrosives may produce irritation of the respiratory tract with coughing, choking, pain and mucous membrane damage. Pulmonary oedema may develop in more severe cases; this may be immediate or in most cases following a latent period of 5-72 hours. Symptoms may include a tightness in the chest, dyspnoea, frothy sputum, cyanosis and dizziness. Findings may include hypotension, a weak and rapid pulse and moist rales. Not normally a hazard due to non-volatile nature of product

- Inhalation of freshly formed metal oxide particles sized below 1.5 microns and generally between 0.02 to 0.05 microns may result in 'metal fume fever'. Symptoms may be delayed for up to 12 hours and begin with the sudden onset of thirst, and a sweet, metallic or foul taste in the mouth. Other symptoms include upper respiratory tract irritation accompanied by coughing and a dryness of the mucous membranes, lassitude and a generalised feeling of malaise. Mild to severe headache, nausea, occasional vomiting, fever or chills, exaggerated mental activity, profuse sweating, diarrhoea, excessive urination and prostration may also occur. Tolerance to the fumes develops rapidly but is quickly lost. All symptoms usually subside within 24-36 hours following removal from exposure.

Ingestion
- Accidental ingestion of the material may be harmful; animal experiments indicate that ingestion of less than 150 gram may be fatal or may produce serious damage to the health of the individual.
- Ingestion of alkaline corrosives may produce immediate pain, and circumoral burns. Mucous membrane corrosive damage is characterised by a white appearance and soapy feel; this may then become brown, oedematous and ulcerated. Profuse salivation with an inability to swallow or speak may also result. Even where there is limited or no evidence of chemical burns, both the oesophagus and stomach may experience a burning pain; vomiting and diarrhoea may follow. The vomitus may be thick and may be slimy (mucous) and may eventually contain blood and shreds of mucosa. Epiglottal oedema may result in respiratory distress and asphyxia. Marked hypotension is symptomatic of shock; a weak and rapid pulse, shallow respiration and clammy skin may also be evident. Circulatory collapse may occur and, if unchecked, may produce renal failure. Severe exposures may result in oesophageal or gastric perforation accompanied by mediastinitis, substernal pain, peritonitis, abdominal rigidity and fever. Although oesophageal, gastric or pyloric stricture may be evident initially, these may occur after weeks or even months and years. Death may be quick and results from asphyxia, circulatory collapse or aspiration of even minute amounts. Death may also be delayed as a result of perforation, pneumonia or the effects of stricture formation.

Skin Contact
- The material can produce severe chemical burns following direct contact with the skin.
Skin contact is not thought to produce harmful health effects (as classified under EC Directives using animal models). Systemic harm, however, has been identified following exposure of animals by at least one other route and the material may still produce health damage following entry through wounds, lesions or abrasions. Good hygiene practice requires that exposure be kept to a minimum and that suitable gloves be used in an occupational setting. Skin contact with alkaline corrosives may produce severe pain and burns; brownish stains may develop. The corroded area may be soft, gelatinous and necrotic; tissue destruction may be deep.

Open cuts, abraded or irritated skin should not be exposed to this material. Entry into the blood-stream through, for example, cuts, abrasions, puncture wounds or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

**Eye**

Long-term exposure to respiratory irritants may result in disease of the airways involving difficult breathing and related systemic problems. Practical experience shows that skin contact with the material is capable either of inducing a sensitisation reaction in a substantial number of individuals, and/or of producing a positive response in experimental animals. Exposure to the material may cause chronic irritation generally on the basis that results in animal studies provide sufficient evidence to cause a strong suspicion of impaired fertility in the absence of toxic effects, or evidence of impaired fertility occurring at around the same dose levels as other toxic effects, but which are not a secondary non-specific consequence of other toxic effects. Limited evidence suggests that repeated or long-term occupational exposure may produce cumulative health effects involving organs or biochemical systems.

The respiratory tract may also be a site of local argyria (following chronic inhalation exposures) with a mild chronic bronchitis being the only obvious symptom. Metalic dusts generated by the industrial process give rise to a number of potential health problems. The larger particles, above 5 micron, are nose and throat irritants. Smaller particles however, may cause lung deterioration. Particles of less than 1.5 micron can be trapped in the lungs and, dependent on the nature of the particle, may give rise to further serious health consequences.

Metals are widely distributed in the environment and are not biodegradable. Biologically, many metals are essential to living systems and are involved in a variety of cellular, physiological, and structural functions. They often are cofactors of enzymes, and play a role in transcriptional control, muscle contraction, nerve transmission, blood clotting, and oxygen transport and delivery. Although all metals are potentially toxic at some level, some are highly toxic at relatively low levels. Moreover, in some cases the same metal can be essential at low levels and toxic at higher levels, or it may be toxic via one route of entry but not another. Toxic effects of some metals are associated with disruption of functions of essential metals. Metals may have a range of effects, including cancer, neurotoxicity, immunotoxicity, cardiotoxicity, reproductive toxicity, teratogenicity, and genotoxicity. Biological half lives of metals vary greatly, from hours to years. Furthermore, the half life of a given metal varies in different tissues. Lead has a half life of 14 days in soft tissues and 20 years in bone.

In considering how to evaluate the toxicity of metals of potential concern, a number of aspects of metal toxicity should be kept in mind: Different species vary in their responses to different metals; in some cases, humans are more sensitive than rodents. Thus, there is a need for broad-based testing of metals:

- The route of exposure may affect the dose and site where the metal concentrates, and thus the observed toxic effects;
- Metal-metal interactions can reduce or enhance toxicity; biotransformation can reduce or enhance toxicity;
- It is difficult to predict the toxicity of one metal based on the adverse effects of another; in trying to evaluate the toxicity of one particular metal compound, predictions based on similar compounds of the same metal may be valid.

<table>
<thead>
<tr>
<th>6331 Part B Silver Conductive Epoxy Adhesive: Moderate Cure / High Conductivity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOXICITY</strong></td>
</tr>
<tr>
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<th><strong>silver</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>TOXICITY</strong></td>
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<tr>
<td>Oral (rat) LD50:  $\geq$2000 mg/kg$^2$</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>4-nonylphenol, branched</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>TOXICITY</strong></td>
</tr>
<tr>
<td>Dermal (rabbit) LD50: $\geq$2000 mg/kg$^2$</td>
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<tr>
<td>Oral (rat) LD50: $\geq$560 mg/kg$^2$</td>
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<table>
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<tr>
<td><strong>TOXICITY</strong></td>
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<td>Dermal (rabbit) LD50: 880 mg/kg$^2$</td>
</tr>
<tr>
<td>Oral (rat) LD50: 2410 mg/kg$^2$</td>
</tr>
<tr>
<td>Skin (rabbit): 5 mg/24h - SEVERE</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>bispheon A diglycidyl ether diethylene triamine reaction products</strong></th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>diethylene triamine</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>TOXICITY</strong></td>
</tr>
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<td>Oral (rat) LD50: $\geq$819-1430 mg/kg$^2$</td>
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</table>
**Bisphenol A**

<table>
<thead>
<tr>
<th>TOXICITY</th>
<th>IRRITATION</th>
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</thead>
<tbody>
<tr>
<td>Dermal (rabbit) LD50: 3000 mg/kg</td>
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</tr>
<tr>
<td>Inhalation (rat) LC50: &gt;0.255 mg/l</td>
<td>Skin (rabbit): 250 mg open - mild</td>
</tr>
<tr>
<td>Oral (rat) LD50: 1200 mg/kg</td>
<td>Skin (rabbit): 500 mg/24h - mild</td>
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</tbody>
</table>

**Legend:**
1. Value obtained from Europe ECHA Registered Substances - Acute toxicity 2. *Value obtained from manufacturer’s SDS. Unless otherwise specified data extracted from RTECS - Register of Toxic Effect of chemical Substances

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**N-AMINOETHYLPIPERAZINE**

Gastrointestinal changes, liver changes, effects on newborn recorded.

For piperazine:
- Exposure to piperazine and its salts has clearly been demonstrated to cause asthma in occupational settings. No NOAEL can be estimated for respiratory sensitisation (asthma).
- Although the LD50 levels indicate a relatively low level of oral acute toxicity (LD50 1-5 g/kg bw), signs of neurotoxicity may appear in humans after exposure to lower doses. Based on exposure levels of up to 3.4 mg/kg/day piperazine base and a LOAEL of 110 mg/kg, there is no concern for acute toxicity.
- In pigs, piperazine is readily absorbed from the gastrointestinal tract, and the major part of the resorbed compound is excreted as unchanged piperazine during the first 48 hours. The principal route of excretion of piperazine and its metabolites is via urine, with a minor fraction recovered from faeces (16%).
- Exposure to piperazine and its salts has been demonstrated to cause allergic dermatitis as well as respiratory sensitisation in humans. As shown by the LLNA, piperazine has a sensitising potential in animals. Although piperazine is clearly sensitising, no NOAEL can be set for this effect from the present database.

A NOAEL of 25 mg/kg/day of piperazine for liver toxicity in the beagle dog has been achieved after repeated exposure. A LOAEL of 30 mg/kg/day of piperazine for neurotoxicity is proposed based on documentation of (rare cases) of neurotoxicity from human clinical practice. Neurotoxicity also appears in other species (e.g., rabbits, dogs, cats, tigers, and horses), but not in rodents.

For reproductive effects of piperazine, there is a NOAEL of 125 mg/kg/day for effects on fertility, i.e., reduced pregnancy index, decreased number of implantation sites, and decreased litter sizes in rats. The teratogenic properties have been investigated in rats and rabbits in adequate studies. In rabbit, such effects may be elicited at a dose level that is also toxic to the dam. The LOAEL is 94 mg/kg/day, and the NOAEL 42 mg/kg/day piperazine base (maternal and embryotoxic). In the rat study, there were decreases in weight gain, body weight, and offspring at the top dose (2,100 mg/kg/day piperazine base), but there were no signs of any malformations.

The genotoxic properties have been investigated both in vitro (in the Ames test, in a nonstandard study on Saccharomyces cerevisiae and in Chinese hamster ovary cells) and in vivo, in a micronucleus assay on mice, all with negative results. There are no solid indications of a carcinogenic effect of piperazine, neither in animals, nor from the investigation on humans. In view of the lack of genotoxic action, it appears unlikely that piperazine poses a carcinogenic risk. There seems to be an additional cancer risk due to the formation of N-mononitrosopiperazine (NPZ) from piperazine. It is possible to calculate a hypothetical additional cancer risk posed by NPZ after exposure to piperazine, but the calculation would depend on several assumptions. We conclude that there seems to be an additional cancer risk due to the formation of NPZ from piperazine, and although it is difficult to estimate, it is probably small. The material may produce moderate eye irritation leading to inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

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**Bisphenol A Diglycidyl Ether**

For alkyl polyamines:
- The alkyl polyamines cluster consists of organic compounds containing two terminal primary amine groups and at least one secondary amine group. Typically these substances are derivatives of ethylenediamine, propylenediamine or hexanediamine. The molecular weight range for the entire cluster is relatively narrow, ranging from 103 to 232.
- Acute toxicity of the alkyl polyamines cluster is low to moderate via oral exposure and a moderate to high via dermal exposure. Cluster members have been shown to be eye irritants, skin irritants, and skin sensitisers in experimental animals. Repeated exposure in rats via the oral route indicates a range of toxicity from low to high hazard. Most cluster members have given positive results in tests for potential genotoxicity.
- Limited carcinogenicity studies on several members of the cluster showed no evidence of carcinogenicity. Unlike aromatic amines, aliphatic amines are not expected to be potential carcinogens because they are not expected to undergo metabolic activation, nor would activated intermediates be stable enough to reach target macromolecules.

The genotoxic properties have been investigated both in vitro (in the Ames test, in a nonstandard study on Saccharomyces cerevisiae and in Chinese hamster ovary cells) and in vivo, in a micronucleus assay on mice, all with negative results. There are no solid indications of a carcinogenic effect of piperazine, neither in animals, nor from the investigation on humans. In view of the lack of genotoxic action, it appears unlikely that piperazine poses a carcinogenic risk. There seems to be an additional cancer risk due to the formation of N-mononitrosopiperazine (NPZ) from piperazine. It is possible to calculate a hypothetical additional cancer risk posed by NPZ after exposure to piperazine, but the calculation would depend on several assumptions. We conclude that there seems to be an additional cancer risk due to the formation of NPZ from piperazine, and although it is difficult to estimate, it is probably small. The material may produce moderate eye irritation leading to inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

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**Bisphenol A**

Following oral administration absorption of BPA is rapid and extensive while dermal absorption is limited. Extensive first pass metabolism occurs following absorption from the gastrointestinal tract with glucuronide conjugation being the major metabolic pathway. Bisphenol A is of low acute toxicity (rodent oral LD50 values from 3300-4100 mg/kg, a rabbit oral LD50 value 2200 mg/kg and a rat acute inhalation 6-hour LC50 value >170 mg/m³). Bisphenol A is not a skin irritant, however, it is severely irritating to the eyes. BPA was negative in gene mutation and clastogenicity assays in cultured mammalian cells, as well as in a micronucleus test for clastogenicity in vivo; therefore, BPA is considered not to present a genotoxic concern for human health. BPA results in minimal effects on the liver and kidney (LOAEL from chronic exposure in the diet was 50 mg/kg/day). For reproductive toxicity, data from a three-generation study in the rat, BPA was not a selective reproductive toxicant at doses ranging from 0.001 to 500 mg/kg/day. BPA is not a developmental toxicant in rats or mice.

Inconsistent findings are reported in the 'low dose' literature for bisphenol A. The inherent challenge of conducting these types of studies may be exacerbated with bisphenol A because the endpoints of concern are endocrine-mediated and potentially impacted by factors that include phytoestrogen.
content of the animal feed, extent of bisphenol A exposure from caging or water bottles, and the alleged sensitivity of the animal model to oestrogens. High-dose studies are less susceptible to these types of influences because the toxicologic response should be more robust and less variable. Several large, robust, well-designed studies with multiple dose groups using several strains of rats and mice have been conducted and none of these detected any adverse reproductive effects. However, for the low dose groups, some, albeit slight, increases in the incidence of maternal deaths or offspring deaths persisted via the lactation period. Further, none of these studies detected changes in prostate weight, age at puberty (rat), pathology or tumors in any tissue, or reproductive tract malformations. Every chemical that produces low dose cellular and molecular alterations of endocrine function also produces a cascade of effects increasing in severity resulting in clearly adverse alterations at higher doses, albeit the effects can be different from those seen at low doses. With these endocrine disruptors, but not BPA, the low dose effects are often causally linked to the high-dose adverse effects on an anatomical or functional level. This is true for androgens like testosterone and trenbolone, estrogens like DES, 17-beta-estradiol and ethinyl estradiol, xenoestrogens like methoxychlor and genistein, and antiandrogens like vinclozolin, for example. However, the failure of BPA to produce reproductive adverse effects via a relevant route of exposure, coupled with the lack of robustness of the many of the low dose studies (sample size, dose range, statistical analyses and experimental design, GLP) and the inability to reproduce many of these effects in any adverse effect strains the credibility of some of these study results. The lack of reproducibility of the low dose effects, the absence of toxicity in those low dose-affected tissues at high-doses, and the uncertain adversity of the reported effects lead to the conclusion that there is ‘minimal’ concern for reproductive effects. In contrast, the literature on bisphenol A effects on neural and behavioral responses is more consistent with respect to the number of ‘positive’ studies although it should be noted that the high-dose studies that proved to be the most useful for evaluating reproductive effects did not adequately assess neural and behavioral responses. In addition, even though different investigators assessed different neural and behavioral endpoints, an expert Panel concluded that the overall findings suggest that bisphenol A may be associated with neural changes in the brain and behavioral alterations related to sexual dimorphism in rodents. For this reason, the Panel expressed ‘some’ concern for these effects even though it is not clear the reported effects constitute an adverse toxicological response. In summary: For pregnant women and fetuses, the Expert Panel has different levels of concern for the different developmental endpoints that may be susceptible to bisphenol A disruption, as follows:
- For neural and behavioral effects, the Expert Panel has some concern;
- For prostate effects, the Expert Panel has minimal concern;
- For the potential effect of accelerated puberty, the Expert Panel has minimal concern; and
- For birth defects and malformations, the Expert Panel has negligible concern.
For infants and children, the Expert Panel has the following levels of concern for biological processes that might be altered by Bisphenol A, as follows:
- Some concern for neural and behavioral effects; and
- Minimal concern for the effect of accelerated puberty.
For adults, the Expert Panel has negligible concern for adverse reproductive effects following exposures in the general population to Bisphenol A. For highly exposed subgroups, the level of concern is not increased, such as occupationally exposed populations. From a clinical point of view, substances are noteworthy if they produce an NTP-CERHR Monograph on the Potential Human Reproductive and Developmental Effects of Bisphenol A National Toxicology Program US Department of Health and Human Services September 2008 NTP Publication No 08-5994 The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is highly exposed subgroups, such as occupationally exposed populations, the level of concern is elevated to minimal.

8331 Part B Silver Conductive Epoxy Adhesive: Moderate Cure / High Conductivity & 4-NONYLPHENOL, BRANCHED & N-AMINOETHYLPIPERAZINE & BISPHENOL A DIGLYCIDYL ETHER DIETHYLENETRIAMINE REACTION PRODUCTS & DIETHYLENETRIAMINE & BISPHENOL A

As a result of chemical reaction, the material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is highly susceptible to these types of influences because the toxicologic response should be more robust and less variable. Several large, robust, well-designed studies with multiple dose groups using several strains of rats and mice have been conducted and none of these detected any adverse reproductive effects. However, for the low dose groups, some, albeit slight, increases in the incidence of maternal deaths or offspring deaths persisted via the lactation period. Further, none of these studies detected changes in prostate weight, age at puberty (rat), pathology or tumors in any tissue, or reproductive tract malformations. Every chemical that produces low dose cellular and molecular alterations of endocrine function also produces a cascade of effects increasing in severity resulting in clearly adverse alterations at higher doses, albeit the effects can be different from those seen at low doses. With these endocrine disruptors, but not BPA, the low dose effects are often causally linked to the high-dose adverse effects on an anatomical or functional level. This is true for androgens like testosterone and trenbolone, estrogens like DES, 17-beta-estradiol and ethinyl estradiol, xenoestrogens like methoxychlor and genistein, and antiandrogens like vinclozolin, for example. However, the failure of BPA to produce reproductive adverse effects via a relevant route of exposure, coupled with the lack of robustness of the many of the low dose studies (sample size, dose range, statistical analyses and experimental design, GLP) and the inability to reproduce many of these effects in any adverse effect strains the credibility of some of these study results. The lack of reproducibility of the low dose effects, the absence of toxicity in those low dose-affected tissues at high-doses, and the uncertain adversity of the reported effects lead to the conclusion that there is ‘minimal’ concern for reproductive effects. In contrast, the literature on bisphenol A effects on neural and behavioral responses is more consistent with respect to the number of ‘positive’ studies although it should be noted that the high-dose studies that proved to be the most useful for evaluating reproductive effects did not adequately assess neural and behavioral responses. In addition, even though different investigators assessed different neural and behavioral endpoints, an expert Panel concluded that the overall findings suggest that bisphenol A may be associated with neural changes in the brain and behavioral alterations related to sexual dimorphism in rodents. For this reason, the Panel expressed ‘some’ concern for these effects even though it is not clear the reported effects constitute an adverse toxicological response. In summary: For pregnant women and fetuses, the Expert Panel has different levels of concern for the different developmental endpoints that may be susceptible to bisphenol A disruption, as follows:
- For neural and behavioral effects, the Expert Panel has some concern;
- For prostate effects, the Expert Panel has minimal concern;
- For the potential effect of accelerated puberty, the Expert Panel has minimal concern; and
- For birth defects and malformations, the Expert Panel has negligible concern.
For infants and children, the Expert Panel has the following levels of concern for biological processes that might be altered by Bisphenol A, as follows:
- Some concern for neural and behavioral effects; and
- Minimal concern for the effect of accelerated puberty.
For adults, the Expert Panel has negligible concern for adverse reproductive effects following exposures in the general population to Bisphenol A. For highly exposed subgroups, the level of concern is not increased, such as occupationally exposed populations. From a clinical point of view, substances are noteworthy if they produce an allergic test reaction in more than 1% of the persons tested.

8331 Part B Silver Conductive Epoxy Adhesive: Moderate Cure / High Conductivity & 4-NONYLPHENOL, BRANCHED & N-AMINOETHYLPIPERAZINE & BISPHENOL A DIGLYCIDYL ETHER DIETHYLENETRIAMINE REACTION PRODUCTS & DIETHYLENETRIAMINE & BISPHENOL A

The chemical structure of hydroxylated diphénylalkanes or bisphenol consists of two phenolic rings joined together through a bridging carbon. This class of endocrine disruptors that mimic oestrogens is widely used in industry, particularly in plastics.
Bisphenol A (BPA) and some related compounds exhibit oestrogenic activity in human breast cancer cell line MCF-7, but there were remarkable differences in activity. Several derivatives of BPA exhibited significant thyroid hormonal activity towards rat pituitary cell line GH3, which releases growth hormone in a thyroid hormone-dependent manner. However, BPA and several other derivatives did not show such activity. Results suggest that the 4-hydroxyl group of the A-phenyl ring and the B-phenyl ring of BPA derivatives are required for these hormonal activities, and substituents at the 3,5-positions of the phenyl rings and the bridging alkyl moiety markedly influence the activity. Bisphenols promoted cell proliferation and increased the synthesis and secretion of cell type-specific proteins. When ranked by proliferative potency, the longer the alky substituent at the bridging carbon, the lower the concentration needed for maximal cell yield; the most active compound contained two propyl chains at the bridging carbon. Bisphenols with two hydroxyl groups in the para position and an angular configuration are suitable for appropriate hydrogen bonding to the acceptor site of the oestrogen receptor.

8331 Part B Silver Conductive Epoxy Adhesive: Moderate Cure / High Conductivity & 4-NONYLPHENOL, BRANCHED & DIETHYLENETRIAMINE

Handling ethyleneamine products is complicated by their tendency to react with other chemicals, such as carbon dioxide in the air, which results in the formation of solid carbonates. Because of their ability to produce chemical burns, skin rashes, and asthma-like symptoms, ethyleneamines also require substantial care in handling. Higher molecular weight ethyleneamines are often handled at elevated temperatures further increasing the possibility of vapor exposure to these compounds.
Because of the fragility of eye tissue, almost any eye contact with any ethyleneamine may cause irreparable damage, even blindness. A single, short exposure to ethyleneamine, may cause severe skin burns, while a single, prolonged exposure may result in the material being absorbed through the skin in harmful amounts. Exposures have caused allergic skin reactions in some individuals. Single dose oral toxicity of ethyleneamines is low. The oral LD50 for rats is in the range of 1000 to 4500 mg/kg for the ethyleneamines.
In general, the low molecular weight ethyleneamines have been positive in the Ames assay, increase sister chromatid exchange in Chinese hamster ovary (CHO) cells, and are positive for unscheduled DNA synthesis although they are negative in the mouse micronucleus assay. It is believed that the positive results are based on its ability to chelate copper.

4-NONYLPHENOL, BRANCHED & DIETHYLENETRIAMINE

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Continued...
The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterised by skin redness (erythema) thickening of the epidermis. Histologically there may be intercellular oedema of the spongy layer (spongiosis) and intracellular oedema of the epidermis. Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.

### Acute Toxicity

<table>
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<th>Endpoint</th>
<th>Test Duration (HR)</th>
<th>Species</th>
<th>Value</th>
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<td>Crustacea</td>
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### Carcinogenicity

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<thead>
<tr>
<th>Endpoint</th>
<th>Test Duration (HR)</th>
<th>Species</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC50</td>
<td>96</td>
<td>Fish</td>
<td>0.017mg/L</td>
<td>2</td>
</tr>
<tr>
<td>EC50</td>
<td>48</td>
<td>Crustacea</td>
<td>0.0644mg/L</td>
<td>2</td>
</tr>
<tr>
<td>EC50</td>
<td>96</td>
<td>Algae or other aquatic plants</td>
<td>0.027mg/L</td>
<td>2</td>
</tr>
<tr>
<td>BCF</td>
<td>24</td>
<td>Fish</td>
<td>0.193mg/L</td>
<td>4</td>
</tr>
<tr>
<td>EC10</td>
<td>96</td>
<td>Algae or other aquatic plants</td>
<td>0.012mg/L</td>
<td>4</td>
</tr>
<tr>
<td>NOEC</td>
<td>2688</td>
<td>Fish</td>
<td>&gt;=0.00127mg/L</td>
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</table>

### Reproductivity

<table>
<thead>
<tr>
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<th>Test Duration (HR)</th>
<th>Species</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC50</td>
<td>96</td>
<td>Fish</td>
<td>2-190mg/L</td>
<td>4</td>
</tr>
<tr>
<td>EC50</td>
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<td>Crustacea</td>
<td>32mg/L</td>
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</tr>
<tr>
<td>EC50</td>
<td>72</td>
<td>Algae or other aquatic plants</td>
<td>495mg/L</td>
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</tr>
<tr>
<td>BCF</td>
<td>24</td>
<td>Fish</td>
<td>=2mg/L</td>
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</tr>
<tr>
<td>NOEC</td>
<td>48</td>
<td>Crustacea</td>
<td>18mg/L</td>
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</table>

### Respiratory or Skin sensitisation

<table>
<thead>
<tr>
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<th>Value</th>
<th>Source</th>
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</thead>
<tbody>
<tr>
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<td>Fish</td>
<td>101.4mg/L</td>
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</tr>
<tr>
<td>EC50</td>
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</tr>
<tr>
<td>EC50</td>
<td>96</td>
<td>Algae or other aquatic plants</td>
<td>345.6mg/L</td>
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</tr>
<tr>
<td>BCF</td>
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</tr>
<tr>
<td>NOEC</td>
<td>504</td>
<td>Crustacea</td>
<td>=5.6mg/L</td>
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### Mutagenicity

<table>
<thead>
<tr>
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</thead>
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<td>Fish</td>
<td>=3.9mg/L</td>
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<td>Crustacea</td>
<td>=3.9mg/L</td>
<td>1</td>
</tr>
<tr>
<td>EC50</td>
<td>96</td>
<td>Algae or other aquatic plants</td>
<td>=1mg/L</td>
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<tr>
<td>BCF</td>
<td>288</td>
<td>Fish</td>
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<tr>
<td>NOEC</td>
<td>Not Available</td>
<td>Fish</td>
<td>0.001-0.179mg/L</td>
<td>2</td>
</tr>
</tbody>
</table>

### Legend:

- Data available but does not fill the criteria for classification
- Data available to make classification
- Data Not Available to make classification
Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. Do NOT allow product to come in contact with surface waters or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment wash waters. Wastes resulting from use of the product must be disposed of on site or at approved waste sites. Metal-containing inorganic substances generally have negligible vapour pressure and are not expected to partition to air. Once released to surface waters and moist soils their fate depends on solubility and dissolution in water. Environmental processes (such as oxidation and the presence of acids or bases) may transform insoluble metals to more soluble ionic forms. Microbiological processes may also transform insoluble metals to more soluble forms. Such ionic species may bind to dissolved ligands or sorb to solid particles in aquatic or aqueous media. A significant proportion of dissolved/corrosed metals will end up in sediments by the settling of suspended particles. The remaining metal ions can then be taken up by aquatic microorganisms. When released to dry soil most metals will exhibit limited mobility and remain in the upper layer; some will leach locally into ground water and/ or surface water ecosystems when soaked by rain or melt ice. Environmental processes may also be important in changing solubilities. Even though many metals show few toxic effects at physiological pHs, transformation may introduce new or magnified effects. A metal ion is considered indefinitely persistent because it cannot degrade further. The state of science does not allow for an unambiguous interpretation of various measures of bioaccumulation. The counter-ion may also create health and environmental concerns once isolated from the metal. Under normal physiological conditions the counter-ion may be essentially insoluble and may not be bioavailable. Environmental processes may enhance bioavailability.

For bisphenol A and related bisphenols:

**Environmental fate:**

- **Biodegradability:** (28 d) 89% - Easily biodegradable
- **Bioconcentration factor (BCF):** 7.8 mg/l

Bisphenol A, its derivatives and analogues, can be released from polymers, resins and certain substances by metabolic products. Substance does not meet the criteria for PBT or vPvB according to Regulation (EC) No 1907/2006, Annex XIII. As an environmental contaminant, bisphenol A interferes with nitrogen fixation at the roots of leguminous plants associated with the bacterial symbiont Sinorhizobium meliloti. Despite a half-life in the soil of only 1-10 days, its ubiquity makes it an important pollutant. According to Environment Canada, initial assessment shows that at low levels, bisphenol A can harm fish and organisms over time. Studies also indicate that it can currently be found in municipal wastewater. However, a study conducted in the United States found that 91-99% of bisphenol A may be removed from water during treatment at municipal water treatment plants.

**Ecotoxicity:**

- Fish LC50 (96 h): 4.6 mg/l (freshwater fish); 11 mg/l (saltwater fish); NOEC 0.016 mg/l (freshwater fish; 144 d); 0.064 mg/l (saltwater fish 164 d)
- Fresh water invertebrates EC50 (48 h): 10.2 mg/l; NOEC 0.025 mg/l - 328 d
- Marine water invertebrate EC50 (96 h): 1.1 mg/l; NOEC 0.017 mg/l (28 d)
- Fish toxicity: LC50 (96 h) 7.7 mg/l
- Marine water alga EC50 (7 d): 20 mg/l; NOEC 7.8 mg/l

In general, studies have shown that bisphenol A can affect growth, reproduction and development in aquatic organisms. Among freshwater fish species, fish appear to be the most sensitive species. Evidence of endocrine-related effects in fish, aquatic invertebrates, amphibians and reptiles has been reported at environmentally relevant exposure levels lower than those required for acute toxicity. There is a widespread variation in reported values for endocrine-related effects, but many fall in the range of 1 µg/l to 1 mg/l.

A 2009 review of the biological impacts of plasticisers on wildlife published by the Royal Society with a focus on anemids (both aquatic and terrestrial), molluscs, crustaceans, insects, fish and amphibians concluded that bisphenol A has been shown to affect reproduction in all studied animal groups, to impair development in crustaceans and amphibians and to induce genetic aberrations. A large 2010 study of two rivers in Canada found that areas contaminated with hormone-like compounds including bisphenol A showed females made up 85% of the population of a certain fish, while females made up only 55% per cent in uncontaminated areas.

Although abundant data are available on the toxic properties of bisphenol A (2,2-bis (4-hydroxydiphenyl)propane (BPA) A variety of BPs were examined for their acute toxicity against Daphnia magna, mutagenicity, and oestrogenic activity using the Daphnix (Creasel Ltd.), the unu test system, and the yeast two-hybrid system, respectively, in comparison with BPA. BPA was moderately toxic to D. magna (48 h; EC50 was 10 mg/l) according to the current U.S. EPA acute toxicity evaluation standard, and it was weakly oestrogenic with 5 orders of magnitude lower activity than that of the natural estrogen 17-beta-estradiol in the yeast screen, while no mutagenicity was observed. All seven BPs tested here showed moderate to slight acute toxicity, no mutagenicity, and weak oestrogenicity as well as BPA. Some of the BPs showed considerably higher oestrogenic activity than BPA, and others exhibited much lower activity. Bisphenol S (bis(4-hydroxydiphenyl)sulphone) and bis(4-hydroxyphenyl)methane) showed oestrogenic activity.

Biodegradation is a major mechanism for eliminating various environmental pollutants. Studies on the biodegradation of bisphenols have mainly focused on bisphenol A. A number of BPA-degrading bacteria have been isolated from enrichments of sludge from wastewater treatment plants. The first step in the biodegradation of BPA is the hydroxylation of the carbon atom of a methyl group or the quaternary carbon atom in the BPA molecule. Judging from these features of the biodegradation mechanisms, it is possible that the same mechanism used for BPA is used to biodegrade all bisphenols that have at least one methyl or methylene group bonded at the carbon atom between the two phenol groups. However, bisphenol F (bis(4-hydroxyphenyl)methane; BPF), which has no substituent at the bridging carbon, is unlikely to be metabolised by such a mechanism. Nevertheless BPF is readily degraded by river water microorganisms under aerobic conditions. From this evidence, it was clear that a specific mechanism for biodegradation of BPF does exist in the natural ecosystem.

Algae can enhance the photodegradation of bisphenols. The photodegradation rate of BPF increased with increasing algae concentration. Humic acid and Fe3+ ions also enhanced the photodegradation of BPF. The effect of pH value on the BPF photodegradation was also important.

For ethyleneamines:

Adsorption of the ethyleneamines correlates closely with both the cation exchange capacity (CEC) and organic content of the soil. Soils with increased CEC and organic content exhibited higher affinities for these amines. This dependence on cation exchange capacity and organic content is most likely due to the strong electrostatic interaction between the positively charged amine and the negatively charged soil surface.

For silver and its compounds:

**Environmental fate:**

Silver is a rare but naturally occurring metal, often found deposited as a mineral ore in association with other elements. Emissions from smelting operations, manufacture and disposal of certain photographic and electrical supplies, coal combustion, and cloud seeding are some of the anthropogenic sources of silver in the biosphere. The global biogeochemical movements of silver are characterized by releases to the atmosphere, water, and land by natural and anthropogenic sources, long range transport of fine particles in the atmosphere, wet and dry deposition, and sorption to soils and sediments. In general, accumulation of silver by terrestrial plants from soils is low, even if the soil is amended with silver-containing sewage sludge or the plants are grown on tailings from silver mines, where silver acculates mainly in the root systems. The ability to accumulate dissolved silver varies widely between species. Some reported biocumulation factors for marine organisms (calculated as milligrams of silver per kilogram fresh weight organism divided by milligrams of silver per litre of medium) are 210 in diatoms, 240 in brown algae, 330 in mussels, 2300 in scallops, and 18 700 in oysters, whereas biocumulation factors for freshwater organisms have been reported to range from negligible in bluegills (Lepomis macrochirus) to 60 in daphnids; these values represent uptake of bioavailable silver in laboratory experiments. Laboratory studies with the less toxic silver compounds, such as silver sulfide and silver chloride, reveal that accumulation of silver does not necessarily lead to adverse effects. At lower environmental concentrations, silver ions can be bioavailable.

A knowledge of the speciation of silver and its consequent bioavailability is crucial to understanding the potential risk of the metal. Measurement of free ionic silver is the only direct method that can

Legend:

- Extracted from 1. IUCLID Toxicity Data 2. Europe ECHA Registered Substances - Ecotoxicological Information - Aquatic Toxicity 3. EPWIN Suite V3.12 (QSR) - Aquatic Toxicity Data (Estimated) 4. US EPA, Ecotox database - Aquatic Toxicity Data 5. ECETOC Aquatic Hazard Assessment Data 6. NITE (Japan) - Bioconcentration Data 7. METI (Japan) - Bioconcentration Data 8. Vendor Data
be used to assess the likely effects of the metal on organisms. Speciation models can be used to assess the likely proportion of the total silver measured that is bioavailable to organisms. Unlike some other metals, background freshwater concentrations in pristine and most urban areas are well below concentrations causing toxic effects. Levels in most industrialized areas border on the effect concentration, assuming that conditions favour bioavailability. On the basis of available toxicity test results, it is unlikely that bioavailable free silver ions would ever be at sufficiently high concentrations to cause toxicity in marine environments.

No data were found on effects of silver on wild birds or mammals. Silver was harmful to poulty (tested as silver nitrate) at concentrations as low as 100 mg total silver/litre in drinking-water or 200 mg total silver/kg in diets. Sensitive laboratory mammals were adversely affected at total silver concentrations (added as silver nitrate) as low as 250 µg/litre in drinking-water (brain histopathology), 6 mg/kg in diet (high accumulations in kidneys and liver), or 13.9 mg/kg body weight (lethally).

Silver and Silver Compounds; Concise International Chemical Assessment Document (CICAD) 44 IPCS InChem (WHO)

The transport of silver through estuarine and coastal marine systems is dependent on biological uptake and incorporation. Uptake by phytoplankton is rapid, in proportion to silver concentration and inversely proportional to salinity. In contrast to studies performed with other toxic metals, silver availability appears to be controlled by both the free silver ion concentration and the concentration of other silver complexes. Silver incorporated by phytoplankton is not lost as salinity increase; as a result silver associated with cellular material is largely retained within the estuary. Phytoplankton exhibit a variable sensitivity to silver. Sensitive species exhibit a marked delay in the onset of growth in response to silver at low concentrations, even though maximum growth rates are similar to controls. A delay in the onset of growth reduces the ability of a population to respond to short-term favourable conditions and to succeed within the community.

James G. Saunders and George R. Alber: Aquatic Toxicology and Environmental Fate; ASTM STP 1007, 1989, pp 5-18

for alkylphenols and their ethoxylates, or propoxylates:

Environmental fate: Alkylphenols are ubiquitous in the environment after the introduction, generally as wastes, of their alkoxylated forms (ethoxylates and propoxylates, for example); these are extensively used throughout industry and in the home.

Alkylphenol ethoxylates are widely used surfactants in domestic and industrial products, which are commonly found in wastewater discharges and in sewage treatment plant (STP) effluents. Degradation of APES in wastewater treatment plants or in the environment generates more persistent shorter-chain APEs and alkylphenol (APs) such as nonylphenol (NP), octylphenol (OP) and AP mono- to triethoxylates (NPE1, NPE2 and NPE3). There is concern that APE metabolites (NP, OP, NPE1-3) can mimic natural hormones and that the levels present in the environment may be sufficient to disrupt endocrine function in wildlife and humans. The physicochemical properties of the APE metabolites (NP, NPE1-4, OP, NPE4-6), in particular the high Kow values, indicate that they will partition effectively into sediments following discharge from STPs. The aqueous solubility data for the APE metabolites indicate that the concentration in water combined with the high partition coefficients will provide a significant reservoir (load) in various environmental compartments. Data from studies conducted in many regions across the world have shown significant levels in samples from every environmental compartment examined. In the US and Europe, levels in NP range from 0.1 to 81 ng/m3, with seasonal trends observed. Concentrations of APE metabolites in treated wastewater effluents in the US range from <0.1 to 39 µg/l, in Spain they were between 6 and 340 µg/l and concentrations up to 330 µg/l were found in the UK. Levels in sediments reflected the high partition coefficients with concentrations reported ranging from <0.1 to 13,700 µg/kg for sediments in the US. Fish in the UK were found to contain up to 0.8 µg/kg NP in muscle tissue. APEs degraded faster in the water column than in sediment. Aerobic conditions facilitate easier further biotransformation of APE metabolites than anaerobic conditions.

Nonylphenols are susceptible to photochemical degradation. Using natural, filtered, lake water it was found that nonylphenol had a half-life of approximately 10-15 h under continuous, noon, summer sun in the surface water layer, with a rate approximately 1.5 times slower at depths 20-25 cm. Photoysis was much slower with ethoxylated nonylphenol, and so it is unlikely to be a significant event in removal of the ethoxylates.

Air: Alkylphenols released to the atmosphere will exist in the vapour phase and is thought to be degraded by reaction with photochemically produced hydroxyl radicals, with a calculated half-life, for nonylphenol, of 0.3 days.

Water: Abiotic degradation of alkylphenol is negligible. Biodegradation does not readily take place. The half-life in surface water may be around 30 days.

Degradation: Alkylphenol ethoxylates (APES) may abiotically degrade into the equivalent alkylphenol. During degradation ethylene oxide units are cleaved off the ethylene oxide chain until only short-chain alkylphenol ethoxylates remain, typically mono- and diethylene oxides. Oxidation of these oligomers creates the corresponding carboxylic acids. This leaves several degradation products: short-chain ethoxylates, their carboxylic acids, and alkylphenols.

Biodegradation: Alkylphenols are not readily biodegradable. Several mechanisms of microbial aromatic ring degradation have been reported, the most common being formation of catechol from phenol, followed by ring scission between or adjacent to the two hydroxyl groups. The full breakdown pathway for APES has not yet been determined, and all studies have so far focused on identification of intermediates in bacterial culture media, rather than studying cell-free systems or purified enzymes. It is, however, likely that microbial metabolism usually starts by an attack on the ethoxylate chain, rather than on the ring or the hydrophobic chain. The ethoxylate groups are progressively removed, either by ether cleavage, or by terminal alcohol oxidation followed by cleavage of the resulting carboxylic acid. Biodegradation of APES produces less biodegradable products: alkylphenol mono- and di ethoxylates, alkylphenoxacyclic and alkylphenoxypychoytic acids, and alkylphenols. These metabolites frequently persist through sewage treatment and in rivers. Anaerobic conditions generally lead to the accumulation of alkylphenols. The rate of biodegradation seems to decrease with increasing length of the ethylene oxide chain.

Bioaccumulation: Metabolites of APES accumulate in organisms, with bioconcentration factors varying from ten to several thousand, depending on species, metabolite and organ. The bioaccumulation factors for APES are generally more toxic than the original compounds. APES have LC50s above about 1.5 mg/l, whereas alkylphenols, such as nonylphenol, have LC50s are generally around 0.1 mg/l.

Oestrogenic activity: The role of alkyl chain length and branching, substitute position, number of alkylated groups, and the requirement of a phenolic ring structure was assessed in fish. The results showed that most alkylphenols were oestrogenic, although with 3-300 thousand times lower potency than the endogenous estrogen 17beta-estradiol. Mono-substituted tertiary alkylphenols with moderate (C4-C5) and long alkyl chain length (C8-C9) in the para position exhibited the highest oestrogenic potency. Substitution with multiple alkyl groups, presence of substituents in the ortho- and meta-position and lack of a hydroxyl group on the benzene ring reduced the oestrogenic activity, although several oestrogenic alkylphenols were identified.

Human exposure: Alkylphenols were first found to be oestrogenic (oestrogen-mimicking) in the 1930s, but more recent research has highlighted the implications of these effects. The growth of cultured human breast cancer cells is affected by nonylphenol at concentrations as low as 1 µM (220 µg/l) or concentrations of octylphenol as low as 0.1 µM (20 µg/l). Oestrogenic effects have also been shown on rainbow trout hepatocytes, chicken embryo fibroblasts and a mouse oestrogen receptor. The insecticide chlordane (Kepone) shows similar behaviour to alkylphenols, accumulating in liver and adipose tissue, and eliciting oestrogenic activity. Workers exposed to this insecticide can suffer reproductive effects such as low sperm counts and sterility. In addition, the oestrogenic effects of chlordane on MCF7 cells occur at similar concentrations to those of alkylphenols, suggesting that alkylphenols will be a similar health hazard if exposed to µM levels of these compounds. By comparing environmental concentrations, bioconcentration factors and in vitro oestrogenic effect levels, current environmental levels of alkylphenol compounds are probably high enough to affect the hormonal control systems of some organisms. It is also possible that human health could be being affected. Prevent, by any means available, spillage from entering drains or water courses. DO NOT discharge into sewer or waterways.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Persistence: Water/Soil</th>
<th>Persistence: Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-nonylphenol, branched</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>N-aminomethylpiperazine</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>diethylenetriamine</td>
<td>LOW</td>
<td>LOW</td>
</tr>
<tr>
<td>bisphenol A</td>
<td>HIGH (Half-life = 360 days)</td>
<td>LOW (Half-life = 0.31 days)</td>
</tr>
</tbody>
</table>

12.3. Bioaccumulative potential

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<th>Bioaccumulation</th>
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</thead>
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<tr>
<td>4-nonylphenol, branched</td>
<td>LOW (BCF = 271)</td>
</tr>
<tr>
<td>N-aminomethylpiperazine</td>
<td>LOW (LogKOW = 1.5677)</td>
</tr>
<tr>
<td>diethylenetriamine</td>
<td>LOW (BCF = 1.7)</td>
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<tr>
<td>bisphenol A</td>
<td>LOW (BCF = 100)</td>
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12.4. Mobility in soil

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-nonylphenol, branched</td>
<td>LOW (KOC = 56010)</td>
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12.5 Results of PBT and vPvB assessment

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<th>B</th>
<th>T</th>
</tr>
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<tbody>
<tr>
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</tr>
<tr>
<td>PBT Criteria fulfilled?</td>
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<td>Not Applicable</td>
</tr>
</tbody>
</table>

12.6 Other adverse effects
No data available

SECTION 13 DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product / Packaging disposal

- Containers may still present a chemical hazard/danger when empty.
- Return to supplier for reuse/recycling if possible.
- Otherwise:
  - If container cannot be cleaned sufficiently well to ensure that residuals do not remain or if the container cannot be used to store the same product, then puncture containers, to prevent re-use, and bury at an authorised landfill.
  - Where possible retain label warnings and SDS and observe all notices pertaining to the product.
  - DO NOT allow wash water from cleaning or process equipment to enter drains.
  - It may be necessary to collect all wash water for treatment before disposal.
  - In all cases disposal to sewer may be subject to local laws and regulations and these should be considered first.
  - Where in doubt contact the responsible authority.
  - Recycle wherever possible.
  - Consult manufacturer for recycling options or consult local or regional waste management authority for disposal if no suitable treatment or disposal facility can be identified.
  - Treat and neutralise at an approved treatment plant.
  - Treatment should involve: Mixing or stirring in water; Neutralisation with suitable dilute acid followed by: burial in a landfill specifically licensed to accept chemical and/or pharmaceutical wastes or Incineration in a licensed apparatus (after admixture with suitable combustible material).
  - Decontaminate empty containers. Observe all label safeguards until containers are cleaned and destroyed.

<table>
<thead>
<tr>
<th>Waste treatment options</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Sewage disposal options</td>
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</tr>
</tbody>
</table>

SECTION 14 TRANSPORT INFORMATION

Labels Required

Limited Quantity: 8331-14G, 8331-50ML, 8331-200ML kits

Land transport (ADR)

14.1 UN number | 3263 |
14.2 UN proper shipping name | CORROSIVE SOLID, BASIC, ORGANIC, N.O.S. (contains silver and nonylphenol and n-aminoethylpiperazine) |
14.3 Transport hazard class(es) | Class 8 |
| Subrisk | Not Applicable |
14.4 Packing group | II |
14.5 Environmental hazard | Environmentally hazardous |

14.6 Special precautions for user

- Hazard identification (Kemler) | 80 |
- Classification code | C8 |
- Hazard Label | 8 |
- Special provisions | 274 |
- Limited quantity | 1 kg |

Air transport (ICAO-IATA / DGR)

14.1 UN number | 3263 |
14.2 UN proper shipping name | Corrosive solid, basic, organic, n.o.s. * (contains silver and nonylphenol and n-aminoethylpiperazine) |
14.3 Transport hazard class(es) | ICAO/IATA Class 8 |
| ICAO / IATA Subrisk | Not Applicable |
| ERG Code | 8L |
### 14.4. Packing group
- II

### 14.5. Environmental hazard
- Environmentally hazardous

### 14.6. Special precautions for user
- Special provisions: A3 A803
- Cargo Only Packing Instructions: 863
- Cargo Only Maximum Qty / Pack: 50 kg
- Passenger and Cargo Packing Instructions: 859
- Passenger and Cargo Maximum Qty / Pack: 15 kg
- Passenger and Cargo Limited Quantity Packing Instructions: Y844
- Passenger and Cargo Limited Maximum Qty / Pack: 5 kg

#### Sea transport (IMDG-Code / GGVSee)

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<thead>
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<table>
<thead>
<tr>
<th>14.3. Transport hazard class(es)</th>
<th>IMDG Class: 8</th>
<th>IMDG Subrisk: Not Applicable</th>
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</thead>
</table>

#### Inland waterways transport (ADN)

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<tr>
<td>14.2. UN proper shipping name</td>
<td>CORROSIVE SOLID, BASIC, ORGANIC, N.O.S. (contains silver and nonylphenol and n-aminoethylpiperazine)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>14.3. Transport hazard class(es)</th>
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<th>Not Applicable</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>14.6. Special precautions for user</th>
<th>EMS Number: F.A., S-B</th>
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<tbody>
<tr>
<td>Special provisions: 274</td>
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<tr>
<td>Limited Quantities: 1 kg</td>
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</tbody>
</table>

#### SECTION 15 REGULATORY INFORMATION

15.1. Safety, health and environmental regulations / legislation specific for the substance or mixture

- **SILVER**(7440-22-4) IS FOUND ON THE FOLLOWING REGULATORY LISTS
  - EU European Chemicals Agency (ECHA) Community Rolling Action Plan (CoRAP) List of Substances
  - European Customs Inventory of Chemical Substances ECICS (English)
  - UK Workplace Exposure Limits (WELs)

- **4-NONYLPHENOL, BRANCHED**(84852-15-3) IS FOUND ON THE FOLLOWING REGULATORY LISTS
  - EU European Chemicals Agency (ECHA) Community Rolling Action Plan (CoRAP) List of Substances
  - European Trade Union Confederation (ETUC) Priority List for REACH Authorisation
  - European Union - European Inventory of Existing Commercial Chemical Substances (EINECS) (English)

- **N-AMINOETHYLPIPERAZINE**(140-31-8) IS FOUND ON THE FOLLOWING REGULATORY LISTS
  - EU European Chemicals Agency (ECHA) Candidate List of Substances of Very High Concern for Authorisation
  - European Customs Inventory of Chemical Substances ECICS (English)

- **8331-B Silver Conductive Epoxy Adhesive**
15.2. Chemical safety assessment

No Chemical Safety Assessment has been carried out for this substance/mixture by the supplier.

### National Inventory Status

<table>
<thead>
<tr>
<th>National Inventory</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia - AICS</td>
<td>Y</td>
</tr>
<tr>
<td>Canada - DSL</td>
<td>Y</td>
</tr>
<tr>
<td>Canada - NDSL</td>
<td>N (4-nonylphenol; branched; N-aminoethylpiperazine; bisphenol A diglycidyl ether diethylenetriamine reaction products; bisphenol A; diethylenetriamine; silver)</td>
</tr>
<tr>
<td>China - IECSC</td>
<td>Y</td>
</tr>
<tr>
<td>Europe - EINECS / ELINCS / NLP</td>
<td>Y</td>
</tr>
<tr>
<td>Japan - ENCS</td>
<td>N (4-nonylphenol; branched; bisphenol A diglycidyl ether diethylenetriamine reaction products; silver)</td>
</tr>
<tr>
<td>Korea - KECI</td>
<td>Y</td>
</tr>
<tr>
<td>New Zealand - NZIoC</td>
<td>Y</td>
</tr>
<tr>
<td>Philippines - PICCS</td>
<td>Y</td>
</tr>
<tr>
<td>USA - TSCA</td>
<td>Y</td>
</tr>
</tbody>
</table>

**Legend:**

- Y = All ingredients are on the inventory
- N = Not determined or one or more ingredients are not on the inventory and are not exempt from listing (see specific ingredients in brackets)

### SECTION 16 OTHER INFORMATION

<table>
<thead>
<tr>
<th>Revision Date</th>
<th>Initial Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/10/2018</td>
<td>06/10/2016</td>
</tr>
</tbody>
</table>

Full text Risk and Hazard codes

- H312 Harmful in contact with skin.
- H318 Causes serious eye damage.
- H332 Harmful if inhaled.
- H335 May cause respiratory irritation.
- H361f Suspected of damaging fertility.
- H361fd Suspected of damaging fertility. Suspected of damaging the unborn child.
- H412 Harmful to aquatic life with long lasting effects.
Other information

Ingredients with multiple cas numbers

<table>
<thead>
<tr>
<th>Name</th>
<th>CAS No</th>
</tr>
</thead>
<tbody>
<tr>
<td>bisphenol A diglycidyl ether</td>
<td>68411-71-2, 68515-86-6, 68609-13-2</td>
</tr>
<tr>
<td>diethylenetriamine reaction products</td>
<td></td>
</tr>
<tr>
<td>bisphenol A</td>
<td>80-05-7, 27360-89-0, 28106-82-3, 37808-08-5, 137885-53-1</td>
</tr>
</tbody>
</table>

Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.

The SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

For detailed advice on Personal Protective Equipment, refer to the following EU CEN Standards:

- EN 166 Personal eye-protection
- EN 340 Protective clothing
- EN 374 Protective gloves against chemicals and micro-organisms
- EN 13832 Footwear protecting against chemicals
- EN 133 Respiratory protective devices

Definitions and abbreviations

- PC – TWA: Permissible Concentration-Time Weighted Average
- PC – STEL: Permissible Concentration-Short Term Exposure Limit
- IARC: International Agency for Research on Cancer
- ACGIH: American Conference of Governmental Industrial Hygienists
- STEL: Short Term Exposure Limit
- TEL: Temporary Emergency Exposure Limit
- IDLH: Immediately Dangerous to Life or Health Concentrations
- OSF: Odour Safety Factor
- NOAEL: No Observed Adverse Effect Level
- LOAEL: Lowest Observed Adverse Effect Level
- TLV: Threshold Limit Value
- LOD: Limit Of Detection
- OTV: Odour Threshold Value
- BCF: BioConcentration Factors
- BEI: Biological Exposure Index

Reason for Change

A-1.00 - Format changes to section 1, 2, 14, 15, and 16 as well as starting a new versioning system.

end of SDS