Carbendazim

sc-211014

Material Safety Data Sheet

Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

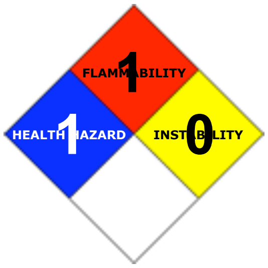
PRODUCT NAME

Carbendazim

STATEMENT OF HAZARDOUS NATURE

CONSIDERED A HAZARDOUS SUBSTANCE ACCORDING TO OSHA 29 CFR 1910.1200.

NFPA



SUPPLIER

Company: Santa Cruz Biotechnology, Inc.
Address:
2145 Delaware Ave
Santa Cruz, CA 95060

Telephone: 800.457.3801 or 831.457.3800

Emergency Tel: **CHEMWATCH: From within the US and Canada: 877-715-9305**

Emergency Tel: **From outside the US and Canada: +800 2436 2255 (1-800-CHEMCALL) or call +613 9573 3112**

PRODUCT USE

■

- Material is mixed and used in accordance with manufacturers directions

A benzimidazole carbamic acid ester used as an active ingredient in fungicides, for timber treatment, food crops and turf-ornamentals. Acts by inhibiting development of germ tubes, the formation of appressoria and the growth of mycelia. Intermediate

SYNONYMS

C9-H9-N3-O2, "2-benzimidazolecarbamic acid, methyl ester", "benzimidazole-2-carbamic acid, methyl ester", "1H-benzimidazol-2-ylcarbamic acid methyl ester", N-2-(benzimidazolyl)carbamate, 2-(methoxycarbonylamino)-benzimidazole, "methyl 1H-benzemedazol-2-ylcarbamate", "methyl 2-benzimidazolecarbamate", "methyl benzimidazole-2-yl carbamate", "methyl benzimidazol-2-yl carbamate", BAS-3460, "BAS 67054", BCM, BMC, "CTR 6669", "HOE 17411", MBC, U-32.104, "Carbendazime Carbendazole Carbendazym Derosal Kemdazin", "benzimidazole pesticide/ fungicide"

Section 2 - HAZARDS IDENTIFICATION

CHEMWATCH HAZARD RATINGS

		Min	Max
Flammability:	1	▬	
Toxicity:	2	▬▬	
Body Contact:	2	▬▬	
Reactivity:	1	▬	

Min/Nil=0
Low=1
Moderate=2
High=3
Extreme=4

Chronic: 3

CANADIAN WHMIS SYMBOLS

EMERGENCY OVERVIEW

RISK

Harmful in contact with skin.
May cause heritable genetic damage.
May impair fertility.
May cause harm to the unborn child.
Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

■ Accidental ingestion of the material may be damaging to the health of the individual.

■ Acute toxicity of carbendazim is very low. Carbendazim is the major metabolite of benomyl and thiophanate-methyl (TM). Acute toxicity of TM in rats caused tremors leading to tonic or clonic convulsions, nose bleeding and lachrymation. In rats carbendazim is rapidly metabolised and eliminated (< 12 hours) and does not accumulate in animal tissue.

In rabbits and dogs TM produced decreased respiration rate, lethargy, loss of abdominal muscle tone, discharge from the eyes, and mydriasis prior to death.

EYE

■ Although the material is not thought to be an irritant, direct contact with the eye may cause transient discomfort characterized by tearing or conjunctival redness (as with windburn). Slight abrasive damage may also result. The material may produce foreign body irritation in certain individuals.

SKIN

■ Skin contact with the material may be harmful; systemic effects may resultfollowing absorption.

■ The material is not thought to be a skin irritant (as classified using animal models). Abrasive damage however, may result from prolonged exposures. Good hygiene practice requires that exposure be kept to a minimum and that suitable gloves be used in an occupational setting.

■ Open cuts, abraded or irritated skin should not be exposed to this material.

■ Entry into the blood-stream, through, for example, cuts, abrasions 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.

INHALED

■ The material is not thought to produce either adverse health effects or irritation of the respiratory tract following inhalation (as classified using animal models). Nevertheless, adverse effects have been produced following exposure of animals by at least one other route and good hygiene practice requires that exposure be kept to a minimum and that suitable control measures be used in an occupational setting.

■ Persons with impaired respiratory function, airway diseases and conditions such as emphysema or chronic bronchitis, may incur further disability if excessive concentrations of particulate are inhaled.

CHRONIC HEALTH EFFECTS

■ Based on experiments and other information, there is ample evidence to presume that exposure to this material can cause genetic defects that can be inherited.

Ample evidence exists from experimentation that reduced human fertility is directly caused by exposure to the material.

Ample evidence exists, from results in experimentation, that developmental disorders are directly caused by human exposure to the material.

Exposure to the material may result in a possible risk of irreversible effects. The material may produce mutagenic effects in man. This concern is raised, generally, on the basis of
appropriate studies using mammalian somatic cells in vivo. Such findings are often supported by positive results from in vitro mutagenicity studies.

There has been some concern that this material can cause cancer or mutations but there is not enough data to make an assessment.

There is some evidence that inhaling this product is more likely to cause a sensitization reaction in some persons compared to the general population.

Long term exposure to high dust concentrations may cause changes in lung function i.e. pneumoconiosis; caused by particles less than 0.5 micron penetrating and remaining in the lung. Prime symptom is breathlessness; lung shadows show on X-ray.

Carbendazim is the major metabolite of benomyl and thiophanate-methyl (TM).

Carbendazim was administered by gavage for 5-days to mice showed no effect on body weight gain, but testes weight was reduced. Flow cytometric measurements on testicular and epididymal sperm cells showed that spermatogenesis was affected at high doses resulting in an altered ratio of testicular cell types. In addition abnormalities were seen in sperm head morphology and chromatin structure. Administration of carbendazim to rats was found to cause a dose related elevation in serum follicle stimulating hormone and pituitary luteinising hormone (route and duration unspecified).

Residue data on dog and rat tissues from a 2-year chronic feeding study show that benomyl or its metabolites do not accumulate in animal tissues. Benomyl was not embryotoxic or teratogenic to rats at dietary levels of 5000 ppm (373 mg/kg/day). Rabbits fed 500 ppm (20 mg/kg/day) showed no evidence of teratogenicity. However gavage administration did produce teratogenic responses at dose levels of 62.5 mg/kg/day.

Experimental evidence suggests that benomyl is not a heritable gene mutagen. It does not interact with DNA, induce point or germ cell mutations and is not clastogenic. Benomyl does however produce numerical chromosome aberration or aneuploidy (this is the mechanism by

which benomyl exerts its fungicidal effect).
Maternal and paternal reproductive effects were reported in rats following repeated administration of TM prior to mating. It is reported that a metabolite of TM, methyl 2-benzimidazole carbamate (MBC) may cause mutagenic risk in the form of heritable spindle effects and is a hepatocarcinogen in mice.
A number of benzimidazoles have been shown to also inhibit mammalian tubulin polymerisation and to be aneugenic in vivo. Aneugens affect cell division and the mitotic spindle apparatus resulting in loss or gain of whole chromosomes, thereby inducing an "aneuploidy". Mitotic aneuploidy is a characteristic of many types of tumorigenesis (in cancer). Several benzimidazoles have been shown to be genotoxic. Genotoxicity may arise as aneugens may also be clastogens, or may produce clastogenic metabolites. Clastogens increase the rate of genetic mutation by interfering with the function of nucleic acids. A clastogen is a specific mutagen that causes breaks in chromosomes.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
carbendazim	10605-21-7	>98
impurities in the commercial product may include		
aniline	62-53-3	

Section 4 - FIRST AID MEASURES

SWALLOWED

■

- If swallowed do NOT induce vomiting.
- If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.
- Observe the patient carefully.
- Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious.
- Give water to rinse out mouth, then provide liquid slowly and as much as casualty can comfortably drink.
- Seek medical advice.

EYE

■ 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.
- If pain persists or recurs seek medical attention.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

SKIN

■ 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.

INHALED

■

- If dust is inhaled, remove from contaminated area.
- Encourage patient to blow nose to ensure clear breathing passages.
- Ask patient to rinse mouth with water but to not drink water.
- Seek immediate medical attention.

NOTES TO PHYSICIAN

■ Treat symptomatically.
In male rats following administration of 3 mg/kg, 66% was eliminated in the urine in 6 hours.

Section 5 - FIRE FIGHTING MEASURES

Vapor Pressure (mmHg):	0.675mPa (20 C)
Upper Explosive Limit (%):	Not available
Specific Gravity (water=1):	1.45
Lower Explosive Limit (%):	Not available

EXTINGUISHING MEDIA

■

- Foam.
- Dry chemical powder.
- BCF (where regulations permit).

- Carbon dioxide.
- Water spray or fog - Large fires only.

FIRE FIGHTING

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- Alert Emergency Responders and tell them location and nature of hazard.
- Wear breathing apparatus plus protective gloves.
- Prevent, by any means available, spillage from entering drains or water course.
- Use water delivered as a fine spray to control fire and cool adjacent area.
- DO NOT approach containers suspected to be hot.
- Cool fire exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.
- Equipment should be thoroughly decontaminated after use.

GENERAL FIRE HAZARDS/HAZARDOUS COMBUSTIBLE PRODUCTS

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- Combustible solid which burns but propagates flame with difficulty.
- Avoid generating dust, particularly clouds of dust in a confined or unventilated space as dusts may form an explosive mixture with air, and any source of ignition, i.e. flame or spark, will cause fire or explosion. Dust clouds generated by the fine grinding of the solid are a particular hazard; accumulations of fine dust may burn rapidly and fiercely if ignited.
- Dry dust can be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport.
- Build-up of electrostatic charge may be prevented by bonding and grounding.
- Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.

Combustion products include: carbon monoxide (CO), carbon dioxide (CO2), nitrogen oxides (NOx), other pyrolysis products typical of burning organic material.

FIRE INCOMPATIBILITY

■ Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids,chlorine bleaches, pool chlorine etc. as ignition may result.

PERSONAL PROTECTION

Glasses:
Chemical goggles.
Gloves:
Respirator:
Type AK-P Filter of sufficient capacity

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS

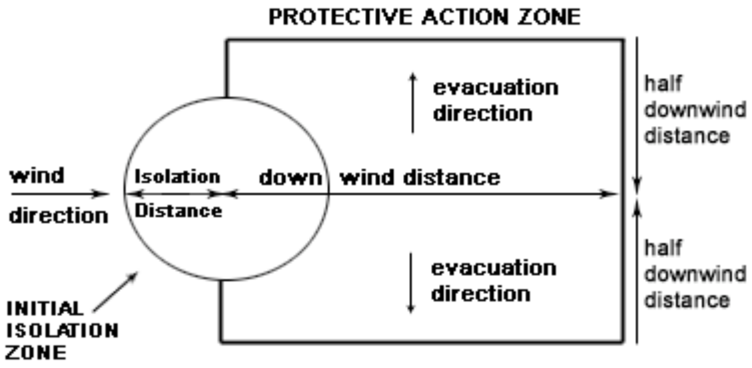
■

- Remove all ignition sources.
- Clean up all spills immediately.
- Avoid contact with skin and eyes.
- Control personal contact by using protective equipment.
- Use dry clean up procedures and avoid generating dust.
- Place in a suitable, labelled container for waste disposal.

Environmental hazard - contain spillage.
MAJOR SPILLS
■ Environmental hazard - contain spillage.
Moderate hazard.

- CAUTION: Advise personnel in area.
- Alert Emergency Responders 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.
- Recover product wherever possible.
- 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.
- If contamination of drains or waterways occurs, advise emergency services.

PROTECTIVE ACTIONS FOR SPILL



From IERG (Canada/Australia)	
Isolation Distance	-
Downwind Protection Distance	10 meters

From US Emergency Response Guide 2000 Guide 171

FOOTNOTES

1 PROTECTIVE ACTION ZONE is defined as the area in which people are at risk of harmful exposure. This zone assumes that random changes in wind direction confines the vapour plume to an area within 30 degrees on either side of the predominant wind direction, resulting in a crosswind protective action distance equal to the downwind protective action distance.
2 PROTECTIVE ACTIONS should be initiated to the extent possible, beginning with those closest to the spill and working away from the site in the downwind direction. Within the protective action zone a level of vapour concentration may exist resulting in nearly all unprotected persons becoming incapacitated and unable to take protective action and/or incurring serious or irreversible health effects.
3 INITIAL ISOLATION ZONE is determined as an area, including upwind of the incident, within which a high probability of localised wind reversal may expose nearly all persons without appropriate protection to life-threatening concentrations of the material.
4 SMALL SPILLS involve a leaking package of 200 litres (55 US gallons) or less, such as a drum (jerrican or box with inner containers). Larger packages leaking less than 200 litres and compressed gas leaking from a small cylinder are also considered "small spills". LARGE SPILLS involve many small leaking packages or a leaking package of greater than 200 litres, such as a cargo tank, portable tank or a "one-tonne" compressed gas cylinder.
5 Guide 171 is taken from the US DOT emergency response guide book.
6 IERG information is derived from CANUTEC - Transport Canada.

ACUTE EXPOSURE GUIDELINE LEVELS (AEGL) (in ppm)

aniline					
AEGL Type	10 min	30 min	60 min	4 hr	8 hr
1	48	16	8	2	GALSYN~
2	72	24	12	3	GALSYN~
3	120	40	20	5	GALSYN~

AEGL 1: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.
AEGL 2: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.
AEGL 3: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR 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 storing and handling recommendations.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Empty containers may contain residual dust which has the potential to accumulate following settling. Such dusts may explode in the presence of an appropriate ignition source.

- Do NOT cut, drill, grind or weld such containers.
- In addition ensure such activity is not performed near full, partially empty or empty containers without appropriate workplace safety authorisation or permit.

RECOMMENDED STORAGE METHODS

■

- Polyethylene or polypropylene container.
- Check all containers are clearly labelled and free from leaks.

STORAGE REQUIREMENTS

■ Observe manufacturer's storing and handling recommendations.

SAFE STORAGE WITH OTHER CLASSIFIED CHEMICALS

X X + X X +

X: Must not be stored together
O: May be stored together with specific preventions
+: May be stored together

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

Source	Material	TWA ppm	TWA mg/m^3	STEL ppm	STEL mg/m^3	Peak ppm	Peak mg/m^3	TWA F/CC	Notes
US - Minnesota Permissible Exposure Limits (PELs)	aniline (Aniline and homologs)	2	8						
Canada - British Columbia Occupational Exposure Limits	aniline (Aniline)	2							Skin
Canada - Alberta Occupational Exposure Limits	aniline (Aniline)	2	7.6						
US - California Permissible Exposure Limits for Chemical Contaminants	aniline (Aniline)	2	7.6						
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	aniline (Aniline and homologs)	2	8						
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	aniline (Aniline and homologs)	5	19						
US - Idaho - Limits for Air Contaminants	aniline (Aniline)	5	19						
US ACGIH Threshold Limit Values (TLV)	aniline (Aniline)	2							TLV Basis: methemoglobinemia
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	aniline (Aniline)	2		4					Skin
US - Washington Permissible exposure limits of air contaminants	aniline (Aniline and homologues)	2		4					
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	aniline (Aniline (o-, p-isomers) - Skin)	5	19	5	19				

US - Hawaii Air Contaminant Limits	aniline (Aniline and homologs)	2	8	5	20	
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	aniline (Aniline)	2	7,6			
Canada - Prince Edward Island Occupational Exposure Limits	aniline (Aniline)	2				TLV Basis: methemoglobinemia
Canada - Nova Scotia Occupational Exposure Limits	aniline (Aniline)	2				TLV Basis: methemoglobinemia
US OSHA Permissible Exposure Levels (PELs) - Table Z1	aniline (Aniline and homologs)	5	19			
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	aniline (Aniline and homologs)	2	8			
Canada - Ontario Occupational Exposure Limits	aniline (Aniline and homologues)	2	8			Skin
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	aniline (Aniline and homologs)	5	19			
US - Michigan Exposure Limits for Air Contaminants	aniline (Aniline and homologues)	2	8			
US - Alaska Limits for Air Contaminants	aniline (Aniline and homologs)	2	8			
Canada - Northwest Territories Occupational Exposure Limits (English)	aniline (Aniline and homologues - Skin)	2	7.6	5	19	
US - Oregon Permissible Exposure Limits (Z-1)	aniline (Aniline and homologs)	5	19			

The following materials had no OELs on our records

- carbendazim: CAS:10605-21-7

EMERGENCY EXPOSURE LIMITS

Material	aniline
Original IDLH Value (ppm)	

ODOR SAFETY FACTOR (OSF)

OSF=0.91 (ANILINE)

- Exposed individuals are NOT reasonably expected to be warned, by smell, that the Exposure Standard is being exceeded.

Odor Safety Factor (OSF) is determined to fall into either Class C, D or E.
The Odor Safety Factor (OSF) is defined as:
OSF= Exposure Standard (TWA) ppm/ Odor Threshold Value (OTV) ppm
Classification into classes follows:

Class	OSF	Description
A	550	Over 90% of exposed individuals are aware by smell that the Exposure Standard (TLV-TWA for example) is being reached, even when distracted by working activities
B	26-550	Idem for 50-90% of persons being distracted
C	1-26	Idem for less than 50% of persons being distracted
D	0.18-1	0-50% of persons aware of being tested perceive by smell that the Exposure Standard is being reached
E	<0.18	Idem for less than 10% of persons aware of being tested

Amoore and Hautala * have determined that it is only at an OSF value of 26 that 50% of distracted persons can detect the substance at the Exposure Standard value. In the case of alerted persons, an OSF of 26 means that 99% of them can detect the odor at the Exposure Standard value. It is ONLY for substances belonging to Class A and B that there is a reasonable chance of being warned in time, that the Exposure Standard is being exceeded. * Journal Applied Toxicology: Vol 3, 1983, p272
NOTE: The use of the OSF may be inappropriate for mixtures where substances mask the odor of others.

MATERIAL DATA

CARBENDAZIM:

- It is the goal of the ACGIH (and other Agencies) to recommend TLVs (or their equivalent) for all substances for which there is evidence of health effects at airborne concentrations encountered in the workplace.

At this time no TLV has been established, even though this material may produce adverse health effects (as evidenced in animal experiments or clinical experience). Airborne concentrations must be maintained as low as is practically possible and occupational exposure must be kept to a minimum.
NOTE: The ACGIH occupational exposure standard for Particles Not Otherwise Specified (P.N.O.S) does NOT apply.
OEL STEL (Russia): 0.1 mg/m3
REL TWA: 0.5 mg/m3 * [* = Aventis]

ANILINE:
■ For aniline:
Odour Threshold Value: 0.58-10 ppm (detection)
Threshold odour concentration, 50% recognition is >0.1 ppm,
identification at 1 ppm.
NOTE: Detector tubes for aniline, measuring in excess of 0.5 ppm are commercially available.
Increased levels of methaemoglobin are detected in the blood of animals exposed at 5 ppm and following skin exposure by humans. The TLV-TWA is thought to provide protection against the significant risk of systemic effects.
Odour Safety Factor(OSF)
OSF=0.91 (ANILINE).

PERSONAL PROTECTION

Consult your EHS staff for recommendations

EYE

■

- Safety glasses with side shields
- Chemical goggles.
- Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

HANDS/FEET

■ Wear chemical protective gloves, eg. PVC.
Wear safety footwear or safety gumboots, eg. Rubber.
Suitability and durability of glove type is dependent on usage. Important factors in the selection of gloves include: such as:

- frequency and duration of contact,
- chemical resistance of glove material,
- glove thickness and
- dexterity

Select gloves tested to a relevant standard (e.g. Europe EN 374, US F739).

- 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) 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) is recommended.
- Contaminated gloves should be replaced.

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.

OTHER

■

- Overalls.
- P.V.C. apron.
- Barrier cream.
- Skin cleansing cream.
- Eye wash unit.

RESPIRATOR

■

- 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 . 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.

RESPIRATOR

■

Protection Factor	Half-Face Respirator	Full-Face Respirator	Powered Air Respirator
10 x PEL	AK P1	-	AK PAPR-P1
	Air-line*	-	-
50 x PEL	Air-line**	AK P2 AK	PAPR-P2
100 x PEL	-	AK P3	-

		Air-line*	-
100+ x PEL	-	Air-line**	AK PAPR-P3

* - Negative pressure demand ** - Continuous flow
Explanation of Respirator Codes:
Class 1 low to medium absorption capacity filters.
Class 2 medium absorption capacity filters.
Class 3 high absorption capacity filters.
PAPR Powered Air Purifying Respirator (positive pressure) cartridge.
Type A for use against certain organic gases and vapors.
Type AX for use against low boiling point organic compounds (less than 65ºC).
Type B for use against certain inorganic gases and other acid gases and vapors.
Type E for use against sulfur dioxide and other acid gases and vapors.
Type K for use against ammonia and organic ammonia derivatives
Class P1 intended for use against mechanically generated particulates of sizes most commonly encountered in industry, e.g. asbestos, silica.
Class P2 intended for use against both mechanically and thermally generated particulates, e.g. metal fume.
Class P3 intended for use against all particulates containing highly toxic materials, e.g. beryllium.
The local concentration of material, quantity and conditions of use determine the type of personal protective equipment required.
Use appropriate NIOSH-certified respirator based on informed professional judgement. In conditions where no reasonable estimate of exposure can be made, assume the exposure is in a concentration IDLH and use NIOSH-certified full face pressure demand SCBA with a minimum service life of 30 minutes, or a combination full facepiece pressure demand SAR with auxiliary self-contained air supply. Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be used.

ENGINEERING CONTROLS

■

- Local exhaust ventilation is required where solids are handled as powders or crystals; even when particulates are relatively large, a certain proportion will be powdered by mutual friction.
- Exhaust ventilation should be designed to prevent accumulation and recirculation of particulates in the workplace.
- If in spite of local exhaust an adverse concentration of the substance in air could occur, respiratory protection should be considered. Such protection might consist of:

(a): particle dust respirators, if necessary, combined with an absorption cartridge;
(b): filter respirators with absorption cartridge or canister of the right type;
(c): fresh-air hoods or masks

- Build-up of electrostatic charge on the dust particle, may be prevented by bonding and grounding.
- Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.

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

Type of Contaminant:	Air Speed:
direct spray, spray painting in shallow booths, drum filling, conveyer loading, crusher dusts, gas discharge (active generation into zone of rapid air motion)	1-2.5 m/s (200-500 f/min.)
grinding, abrasive blasting, tumbling, high speed wheel generated dusts (released at high initial velocity into zone of very high rapid air motion).	2.5-10 m/s (500-2000 f/min.)

Within each range the appropriate value depends on:

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

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 4-10 m/s (800-2000 f/min) for extraction of crusher dusts generated 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.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL PROPERTIES

Solid.
Does not mix with water.
Sinks in water.

State	Divided solid	Molecular Weight	191.18
Melting Range (°F)	575.6- 584.6	Viscosity	Not Applicable
Boiling Range (°F)	Not applicable.	Solubility in water (g/L)	Partly miscible

Flash Point (°F)	Not available.	pH (1% solution)	Not available.
Decomposition Temp (°F)	590	pH (as supplied)	Not applicable
Autoignition Temp (°F)	Not available.	Vapor Pressure (mmHg)	0.675mPa (20 C)
Upper Explosive Limit (%)	Not available	Specific Gravity (water=1)	1.45
Lower Explosive Limit (%)	Not available	Relative Vapor Density (air=1)	6.6
Volatile Component (%vol)	Not available.	Evaporation Rate	Not available

CARBENDAZIM	
■ log Kow (Sangster 1997):	1.43

APPEARANCE

White to light grey crystalline solid with negligible odour. Solubility in water at 24 C: (29 mg/l (pH 4), 8 mg/l (pH 7), 7mg/l (pH 8)). Other solubilities (g/l, 24 C): dimethylformamide 5, acetone 0.3, ethanol 0.3, chloroform 0.1, ethyl acetate 0.135, dichloromethane 0.068, benzene 0.036, cyclohexane <0.01, diethyl ether <0.01, hexane 0.0005 Soluble in acidic solutions and acetic acid. Decomposes slowly in alkaline solutions DT50 (22 C): >350 days (pH 5 and 7), 124 days (pH 9). Stable in acids forming water-soluble salts. pKa 4.5. Stable for at least two years below 50 C. Stable after 7 days at 20000 lux.

log Kow 0.90-0.98

Material	Value
■ log Kow (Sangster 1997)	1.43
■ log Kow (Sangster 1997)	0.9

Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY

■

- Presence of incompatible materials.
- Product is considered stable.
- Hazardous polymerization will not occur.

STORAGE INCOMPATIBILITY

■

- Carbamates are incompatible with strong acids and bases, and especially incompatible with strong reducing agents such as hydrides.
- Flammable gaseous hydrogen is produced by the combination of active metals or nitrides with carbamates.
- Strongly oxidizing acids, peroxides, and hydroperoxides are incompatible with carbamates.

For incompatible materials - refer to Section 7 - Handling and Storage.

Section 11 - TOXICOLOGICAL INFORMATION

CARBENDAZIM

TOXICITY AND IRRITATION

■ unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.

TOXICITY	IRRITATION
Oral (rat) LD50: 6400 mg/kg	Skin (rabbit): non-irritating *
Dermal (rat) LD50: 2000 mg/kg	Eye (rabbit): non-irritating *
Dermal (rabbit) LD50: 8500 mg/kg	
Oral (dog) LD50: >2500 mg/kg *	
Intraperitoneal (Rat, adult male) LD50: 7320 mg/kg *	
Intraperitoneal (Rat, adult female) LD50: 15000 mg/kg *	

■ [* The Pesticides Manual, Incorporating The Agrochemicals Handbook, 10th Edition, Editor Clive Tomlin, 1994, British Crop Protection Council].
Inhalation LC50 (4 h) for rats, rabbits, guinea pigs or cats no effect with suspension (10 g/l water). *
NOEL (2 y) for dogs 300 mg/kg diet, corresponding to 6-7 mg/kg b.w.
ADI 0.01 mg/kg b.w. *
Toxicity Class WHO III;EPA IV

CARCINOGEN

CARBENDAZIM	US Environmental Defense Scorecard Suspected Carcinogens	Reference(s)	OPP-CAN
Aniline	International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs	Group	3

Nitrate or nitrite (ingested) under conditions that result in endogenous nitrosation	International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs	Group	2A
Aniline	ND	Carcinogenicity	B2
Aniline	ND	Carcinogen Category	B2
Aniline	ND	Carcinogen Category	A3
ANILINE	US Environmental Defense Scorecard Recognized Carcinogens	Reference(s)	P65
ANILINE	US Environmental Defense Scorecard Suspected Carcinogens	Reference(s)	P65
Aniline	US Air Toxics Hot Spots TSD for Describing Available Cancer Potency Factors	IARC Class	3
Aniline and homologues	ND	Carcinogen	Ca

SKIN

aniline	ND	Notes	Skin
aniline	US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants - Skin	Skin Designation	X
aniline	US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants - Skin	Skin Designation	X
aniline	US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants - Skin	Skin Designation	X
aniline	US - Washington Permissible exposure limits of air contaminants - Skin	Skin	X
aniline	ND	Skin Designation	Yes
aniline	ND	Notation	Skin
aniline	US - Minnesota Permissible Exposure Limits (PELs) - Skin	Skin Designation	X
aniline	US - Hawaii Air Contaminant Limits - Skin Designation	Skin Designation	X
aniline	ND	Skin Designation	X
aniline	US OSHA Permissible Exposure Levels (PELs) - Skin	Skin Designation	X
aniline	ND	Skin	X
aniline	US - California Permissible Exposure Limits for Chemical Contaminants - Skin	Skin	X
aniline	US - California Permissible Exposure Limits for Chemical Contaminants - Skin	Skin	S
aniline	Canada - Alberta Occupational Exposure Limits - Skin	Substance Interaction	1

Section 12 - ECOLOGICAL INFORMATION

Refer to data for ingredients, which follows:
ANILINE:
CARBENDAZIM:
■ DO NOT discharge into sewer or waterways.
■ 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.
■ Very toxic to aquatic organisms.
CARBENDAZIM:

Marine Pollutant:	Yes
■ log Kow (Sangster 1997):	1.43

/53#90carbendaz#90carb#90etox1
Kow 24 (pH 5), 32 (pH 7), 31 (pH 9):
separate study gives 36 (pH 5), 59 (pH 7).
Environmental Fate:
Readily absorbed by plants.
One degradation product is 2-aminobenzimidazole.
Soil and water: 2-Aminobenzimidazole has been identified as a minor metabolite.
Half-life in soil is 8-32 days under outdoor conditions. Decomposes in the environment with half-lives of 6-12 months on bare soil, 3 to 6 months on turf, and 2 and 25 months in water under aerobic and anaerobic conditions. Mainly decomposed by micro-organisms. 2-Aminobenzimidazole is a major degradation product and is further decomposed by microbial action.
Koc 200-250
Ecotoxicity:
Birds: Acute Oral (quail) LD50:> 10000 mg/kg
Oral (chicken) LD50: 1800 mg/kg
Fish LC50 (96 h): carp 0.61 mg/l., rainbow trout 0.83 mg/l; bluegill sunfish
> 17.5mg/L.

Daphnia Magna EC50 (48h): 0.22 mg/l
Bees: Not toxic to bees.
ANILINE:

Marine Pollutant:	Yes
■ Hazardous Air Pollutant:	Yes
■ Fish LC50 (96hr.) (mg/l):	134
■ Daphnia magna EC50 (48hr.) (mg/l):	0.1- 0.65
■ log Kow (Sangster 1997):	0.9
■ log Pow (Verschueren 1983):	0.90/0.98

■ For aniline:
log Kow : 0.90-0.98
Koc : 25.5
Half-life (hr) air : 3.3
Half-life (hr) H2O surface water : 52-520
Henry's Pa m3 /mol: 0.136
BOD 5 1.42-2.26,62%
COD : 2.4,94%
ThOD : 2.41-3.18
BCF : <148
Log BCF : 0.6-0.78
Degradation Biological: v sig
Environmental fate:

Terrestrial Fate: If released on land, aniline will exhibit low to moderate sorption to soils with the sorption being stronger at lower pH. Binding to humic materials results in covalent bond formation and slow oxidation. It will also sorb to clay minerals and, again, the sorption will be stronger under acidic conditions. However, its sorption to colloidal organic matter is extremely high and may increase its rate of leaching into the ground water. Aniline is readily biodegraded aerobic conditions, especially after a short acclimation period, and substantial loss can be expected by this means. Aniline has only been reported in ground water associated with wastes.

Aquatic Fate: If released into water, aniline will extensively biodegrade, photodegrade, and to some extent adsorb to sediment and humic materials, especially in more acidic situations. Biodegradation rates most appropriate for natural systems include a half-life of 6 days in a eutrophic pond, as well as 75-90% mineralisation in 21 days in an oligotrophic lake. Photodegradation will occur in surface waters with estimated half-lives ranging from hours to weeks. The only reported half-life in a natural aquatic ecosystem which included all loss processes was 2.3 days in an industrial river. Although aniline does not bioconcentrate in fish, it is taken up and metabolized in fish.

Atmospheric Fate: If released into the atmosphere, aniline will degrade primarily by reaction with photochemically produced hydroxyl radicals (estimated half-life 3.3 hr).

Ecotoxicity:
Fish LC50 (96 h): 134 mg/L
Toxicity invertebrate: cell mult. inhib. 24-130mg/L
Bioaccumulation : not sig
Nitrif. inhib. : 75% inhib at 2.5-7.7mg/L
Effects on algae and plankton: decr. in BOD,tox-0.4-10mg/L,LD50-20ppm.

■ Aromatic amines (arylamines), particularly primary aromatic amines, covalently and irreversibly bind to humic substances present in most natural waters.

All metabolites with moieties of: anilines, benzidines and toluidines are of environmental concern. Anilines and benzidines are both acutely toxic and toxic depending on the specific aquatic species (except algae). Toluidines represent a similar concern, It has been speculated that aqueous solutions of aromatic amines can be oxidised by organic radicals, but there are no actual data on reaction rates. Based on a study of reaction rate data for these compounds an estimate of the half-life of aromatic amines in water is approximately 100 days, assuming a peroxy radical concentration of 10-10 mole/L in sunlit, oxygenated water.

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
carbendazim	HIGH		LOW	MED
aniline	HIGH		LOW	HIGH

Section 13 - DISPOSAL CONSIDERATIONS

US EPA Waste Number & Descriptions

B. Component Waste Numbers

When carbendazim is present as a solid waste as a discarded commercial chemical product, off-specification species, as a container residue, or a spill residue, use EPA waste number U372 (waste code T).

When aniline is present as a solid waste as a discarded commercial chemical product, off-specification species, as a container residue, or a spill residue, use EPA waste number U012 (waste code I,T).

Disposal Instructions

All waste must be handled in accordance with local, state and federal regulations.

¦ Puncture containers to prevent re-use and bury at an authorized landfill.

Legislation addressing waste disposal requirements may differ by country, state and/ or territory. Each user must refer to laws operating in their area. In some areas, certain wastes must be tracked.

A Hierarchy of Controls seems to be common - the user should investigate:

- Reduction
- Reuse

- Recycling
- Disposal (if all else fails)

This material may be recycled if unused, or if it has not been contaminated so as to make it unsuitable for its intended use. Shelf life considerations should also be applied in making decisions of this type. Note that properties of a material may change in use, and recycling or reuse may not always be appropriate.

DO NOT allow wash water from cleaning equipment to enter drains. Collect all wash water for treatment before disposal.

- Recycle wherever possible.
- Consult manufacturer for recycling options or consult Waste Management Authority for disposal if no suitable treatment or disposal facility can be identified.
- Dispose of by: Burial in a licensed land-fill 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.

Section 14 - TRANSPORTATION INFORMATION

DOT:

Symbols:	G	Hazard class or Division:	9
Identification Numbers:	UN3077	PG:	III
Label Codes:	9	Special provisions:	8, 146, 335, B54, IB8, IP3, N20, T1, TP33
Packaging: Exceptions:	155	Packaging: Non-bulk:	213
Packaging: Exceptions:	155	Quantity limitations: Passenger aircraft/rail:	No limit
Quantity Limitations: Cargo aircraft only:	No limit	Vessel stowage: Location:	A
Vessel stowage: Other:	None	S.M.P.:	YES

Hazardous materials descriptions and proper shipping names:
Environmentally hazardous substance, solid, n.o.s

Air Transport IATA:

ICAO/IATA Class:	9	ICAO/IATA Subrisk:	None
UN/ID Number:	3077	Packing Group:	III
Special provisions:	A97		

Shipping Name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. *(CONTAINS CARBENDAZIM)

Maritime Transport IMDG:

IMDG Class:	9	IMDG Subrisk:	None
UN Number:	3077	Packing Group:	III
EMS Number:	F-A , S-F	Special provisions:	179 274 335 909
Limited Quantities:	5 kg	Marine Pollutant:	Yes

Shipping Name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.(contains carbendazim)

Section 15 - REGULATORY INFORMATION

REGULATIONS

ND

Ingredient	CAS	% de minimus concentration
aniline	62-53-3	1.0

ND

Ingredient	CAS	RQ
aniline	62-53-3	5000 lb (2270 kg)

carbendazim (CAS: 10605-21-7) is found on the following regulatory lists;

"Canada Domestic Substances List (DSL)","OECD Representative List of High Production Volume (HPV) Chemicals","US - Vermont Hazardous Constituents","US - Vermont Hazardous wastes which are Discarded Commercial Chemical Products or Off-Specification Batches of Commercial Chemical Products or Spill Residues of Either","US - Washington Dangerous waste constituents list","US - Washington Discarded Chemical Products List - ""U"" Chemical Products","US Department of Transportation (DOT) List of Hazardous Substances and Reportable Quantities - Hazardous Substances Other Than Radionuclides","US EPA High Production Volume Chemicals 1994 List of Additions","US List of Lists - Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-to-Know Act (EPCRA) and Section 112(r) of the Clean Air Act","US RCRA (Resource Conservation & Recovery Act) - Hazardous Constituents - Appendix VIII to 40 CFR 261","US RCRA (Resource Conservation & Recovery Act) - List of Hazardous Wastes","US RCRA (Resource Conservation & Recovery Act) - Phase 4 LDR Rule - Universal Treatment Standards","US Toxic Substances Control Act (TSCA) - Inventory"

Regulations for ingredients

aniline (CAS: 62-53-3) is found on the following regulatory lists;

"Canada - Alberta Occupational Exposure Limits","Canada - British Columbia Occupational Exposure Limits","Canada - Nova Scotia Occupational Exposure Limits","Canada - Prince Edward Island Occupational Exposure Limits","Canada - Prince Edward Island Occupational Exposure Limits - Carcinogens","Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)","Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits","Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances","Canada ARET (Accelerated Reduction / Elimination of Toxics) Substance List","Canada Domestic Substances List (DSL)","Canada Environmental Quality Guidelines (EQGs) Water: Aquatic life","Canada Ingredient Disclosure List (SOR/88-64)","Canada Priority Substances List (PSL1, PSL 2)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (French)","GESAMP/EHS Composite List - GESAMP Hazard Profiles","IMO IBC Code Chapter 17: Summary of minimum requirements","IMO MARPOL 73/78 (Annex II) - List of Noxious Liquid Substances Carried in Bulk","International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs","International Chemical Secretariat (ChemSec) REACH SIN* List (*Substitute It Now!) 1.0","OECD Representative List of High Production Volume (HPV) Chemicals","US - California Occupational Safety and Health Regulations (CAL/OSHA) - Hazardous Substances List","US - California Permissible Exposure Limits for Chemical Contaminants","US - California Proposition 65 - Carcinogens","US - California Proposition 65 - No Significant Risk Levels (NSRLs) for Carcinogens","US - California Toxic Air Contaminant List Category II","US - Connecticut Hazardous Air Pollutants","US - Hawaii Air Contaminant Limits","US - Idaho - Limits for Air Contaminants","US - Maine Chemicals of High Concern List","US - Massachusetts Oil & Hazardous Material List","US - Minnesota Hazardous Substance List","US - Minnesota Permissible Exposure Limits (PELs)","US - New Jersey Right to Know Hazardous Substances","US - Pennsylvania - Hazardous Substance List","US - Rhode Island Hazardous Substance List","US - Vermont Hazardous Constituents","US - Vermont Hazardous wastes which are Discarded Commercial Chemical Products or Off-Specification Batches of Commercial Chemical Products or Spill Residues of Either","US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants","US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants","US - Washington Class A toxic air pollutants: Known and Probable Carcinogens","US - Washington Dangerous waste constituents list","US - Washington Discarded Chemical Products List - ""U"" Chemical Products","US - Washington Permissible exposure limits of air contaminants","US ACGIH Threshold Limit Values (TLV)","US ACGIH Threshold Limit Values (TLV) - Carcinogens","US CAA (Clean Air Act) - HON Rule - Organic HAPs (Hazardous Air Pollutants)","US Clean Air Act - Hazardous Air Pollutants","US CWA (Clean Water Act) - List of Hazardous Substances","US CWA (Clean Water Act) - Reportable Quantities of Designated Hazardous Substances","US Department of Transportation (DOT) List of Hazardous Substances and Reportable Quantities - Hazardous Substances Other Than Radionuclides","US DOE Temporary Emergency Exposure Limits (TEELs)","US EPA Acute Exposure Guideline Levels (AEGLs) - Final","US EPA Carcinogens Listing","US EPA High Production Volume Program Chemical List","US EPA Master Testing List - Index I Chemicals Listed","US EPA National Priorities List - Superfund Chemical Data Matrix (SCDM) - Hazard Ranking System - Hazardous Substance Benchmarks","US EPCRA Section 313 Chemical List","US List of Lists - Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-to-Know Act (EPCRA) and Section 112(r) of the Clean Air Act","US Postal Service (USPS) Hazardous Materials Table: Postal Service Mailability Guide","US RCRA (Resource Conservation & Recovery Act) - Appendix IX to Part 264 Ground-Water Monitoring List 1","US RCRA (Resource Conservation & Recovery Act) - Hazardous Constituents - Appendix VIII to 40 CFR 261","US RCRA (Resource Conservation & Recovery Act) - List of Hazardous Wastes","US RCRA (Resource Conservation & Recovery Act) - Phase 4 LDR Rule - Universal Treatment Standards","US SARA Section 302 Extremely Hazardous Substances","US Toxic Substances Control Act (TSCA) - Inventory","US TSCA Section 4/12 (b) - Sunset Date/Status","US TSCA Section 8 (d) - Health and Safety Data Reporting"

Section 16 - OTHER INFORMATION

LIMITED EVIDENCE

■ Ingestion may produce health damage*.
■ Limited evidence of a carcinogenic effect*.
■ Possible respiratory sensitizer*.
* (limited evidence).

■ Classification of the mixture 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.
A list of reference resources used to assist the committee may be found at:
www.chemwatch.net/references.

■ The (M)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.

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