



Operating Instructions Phosgene Dura-Badge (Part Number: 382065)

Introduction

Phosgene is a colorless, highly toxic gas with an odor resembling moldy hay. It is an insidious poison. There is no immediate irritation even when fatal concentrations are inhaled. It may cause severe pulmonary edema (abnormal fluid buildup in the lungs) or pneumonia. Inhalation of high concentrations causes choking, coughing and painful breathing. OSHA PEL (permissible) exposure limit for phosgene is 0.1 ppm (averaged over an 8-hour work shift). NIOSH IDLH (immediately dangerous to life or health) exposure limit for phosgene is 2 ppm.

Phosgene is used in the manufacturing of numerous organic chemicals. It is also used in the production of glass, resins, dyes and plastics.

Principle of Operation

The SafeAir Phosgene Dura-Badge is a monitoring system designed to indicate the presence of phosgene. The SafeAir Phosgene Dura-Badge detects the presence of phosgene by forming a color change in the shape of an exclamation mark inside the triangle. This indication is produced by a color-forming reaction, which occurs when phosgene reacts with a flat indicator layer.

Physical Specifications:

Dimensions	74 mm x 41 mm x 1 mm
Weight	1.5 g
Shelf life	1 year at 25°C
Color change	white to red

Sampling Parameters:

Exposure dose:	
Badge	1.2 ppm·min
Badge with color comparator	1.2 – 450 ppm·min
Maximum recommended sampling time	5 consecutive days
Minimum recommended sampling time	1 minute
Relative humidity range	20% - 95%
Face velocity range	5 - 168 cm/sec
Temperature range	12°C to 37.5°C (54°F – 99.5°F)
Light effect – Indirect sunlight	no effect
Light effect – Artificial light	no effect
Known Interferences	Acyl halides, benzoyl chloride, cyanuric chloride, carbonyl bromide, chlorine monoxide and chloroformates

Operating Instructions

1. Remove the badge from its protective pouch.
2. Remove activation label prior to use.
3. For personnel monitoring, attach the badge near the user's breathing zone (i.e. the collar) with the front side exposed to the surrounding atmosphere.
4. ***Between work shifts, store the badge in a sealed bag in a cool, dark environment.***
5. The exclamation mark appears within the triangle when phosgene is present. Please note that the exclamation mark will appear underneath the printed exposure dose (sensitivity).
6. A SafeAir color comparator (PN: 383022) is available for use with this badge. To obtain the average concentration, divide the exposure dose (ppm·min) by the exposure time in minutes (min).

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Operating Instructions Phosgene Medi-Badge (Part Number: 382060)

Introduction

Phosgene is a colorless, highly toxic gas with an odor resembling moldy hay. It is an insidious poison. There is no immediate irritation even when fatal concentrations are inhaled. It may cause severe pulmonary edema (abnormal fluid buildup in the lungs) or pneumonia. Inhalation of high concentrations causes choking, coughing and painful breathing. OSHA PEL (permissible exposure limit) for phosgene is 0.1 ppm (averaged over an 8-hour work shift). NIOSH IDLH (immediately dangerous to life or health) exposure limit for phosgene is 2 ppm.

Phosgene is used in the manufacturing of numerous organic chemicals. It is also used in the production of glass, resins, dyes and plastics.

Principle of Operation

The SafeAir phosgene badge is a monitoring system designed to indicate the presence of phosgene. The SafeAir phosgene badge detects the presence of phosgene by forming a color change in the shape of an exclamation mark inside the triangle. This indication is produced by a color-forming reaction, which occurs when phosgene reacts with a flat indicator layer.

Physical Specifications:

Dimensions	74 mm x 41 mm x 1 mm
Weight	1.5 g
Shelf life	1 year at 25°C
Color change	white to red

Sampling Parameters:

Exposure dose:	
Badge	10 ppm-min
Badge with color comparator	10 – 450 ppm.min
Maximum recommended sampling time	5 consecutive days
Minimum recommended sampling time	1 minute
Relative humidity range	20% - 100%
Face velocity range	5 - 168 cm/sec
Temperature range	13°C to 50°C (55°F - 122°F)
Light effect – UV (direct sunlight)	no effect
Light effect – visible	no effect
Known Interferences:	acyl halides, benzoyl chloride, cyanuric chloride, carbonyl bromide, chlorine monoxide and chloroformates

Operating Instructions

1. Remove the badge from its protective pouch.
2. Remove activation label prior to use.
3. For personnel monitoring, attach the badge near the user's breathing zone (i.e. the collar) with the front side exposed to the surrounding atmosphere.
4. **Between work shifts, store the badge in a sealed bag in a cool, dark environment.**
5. The exclamation mark appears within the triangle when phosgene is present. Please note that the exclamation mark will appear underneath the printed exposure dose (sensitivity).
6. A SafeAir color comparator (PN: 383020) is available for use with this badge. To obtain the average concentration, divide the exposure dose (ppm-min) by the exposure time in minutes (min).

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Operating Instructions Phosgene Badge (Part Number: 382036)

Introduction

Phosgene is a colorless, highly toxic gas with an odor resembling moldy hay. It is an insidious poison. There is no immediate irritation even when fatal concentrations are inhaled. It may cause severe pulmonary edema (abnormal fluid buildup in the lungs) or pneumonia. Inhalation of high concentrations causes choking, coughing and painful breathing. OSHA PEL (permissible exposure limit) for phosgene is 0.1 ppm (averaged over an 8-hour work shift). NIOSH IDLH (immediately dangerous to life or health) exposure limit for phosgene is 2 ppm.

Phosgene is used in the manufacturing of numerous organic chemicals. It is also used in the production of glass, resins, dyes and plastics.

Principle of Operation

The SafeAir phosgene badge is a monitoring system designed to indicate the presence of phosgene at concentrations below the permissible exposure limit. The SafeAir phosgene badge detects the presence of phosgene by forming a color change in the shape of an exclamation mark inside the triangle. This indication is produced by a color-forming reaction, which occurs when phosgene reacts with a flat indicator layer.

Physical Specifications:

Dimensions	74 mm x 41 mm x 1 mm
Weight	1.5 g
Refrigerated shelf life	1 year
Color change	yellow to red

Sampling Parameters:

Exposure dose:	
Badge	0.5 ppm-min (8.3 ppb-hr)
Badge with color comparator ext. range	0.5 - 450 ppm-min
Minimum detectable limit (8 hours)	0.001 ppm
Maximum recommended sampling time	3 days
Minimum recommended sampling time*	1 minute
Relative humidity range	10% - 100%
Face velocity range	5 - 168 cm/sec
Temperature range	12°C - 37°C (55°F - 99°F)
Light effect – UV (direct sunlight)**	no effect
Light effect – visible	no effect
Known Interferences	acyl halides, benzoyl chloride, cyanuric chloride, carbonyl bromide and chloroformates

* Badge responds instantly to phosgene. However, the shortest experimentally quantifiable exposure sampling time is 1 minute.

** Extensive exposure to direct sunlight will lead to darkening of the background. This may cause difficulty reading exposures less than 5 ppm-min.

Operating Instructions

1. Allow the badge to warm to room temperature prior to removing the badge from its protective pouch.
2. Remove activation label before monitoring.
3. For personnel monitoring, attach the badge near the user's breathing zone (i.e. the collar) with the front side exposed to the surrounding atmosphere.
4. For area monitoring, attach the badge to a stand and mount in a centralized area with the front side exposed to the surrounding atmosphere.
5. The exclamation mark appears within the triangle when phosgene is present. Please note that the exclamation mark will appear underneath the printed exposure dose (sensitivity).
6. A SafeAir phosgene color comparator (PN: 383016) is available for use with this badge. To obtain the average concentration, divide the exposure dose (ppm-min) by the exposure time in minutes (min).

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**Operating Instructions
Hydrazine Dual Level Badge
(Part Number: 382020)**

Introduction

Hydrazine is a colorless liquid with a penetrating odor resembling that of ammonia. It is extremely destructive to the tissues of the mucous membranes and upper respiratory tract. Symptoms of exposure may include coughing, wheezing, laryngitis, and shortness of breath, headache, nausea and vomiting. OSHA exposure limit for hydrazine is 1 ppm (TWA). NIOSH exposure limit for hydrazine is 0.03 ppm (2 hour ceiling). NIOSH recommends that hydrazine be handled as a potential occupational carcinogen in the workplace.

Hydrazine is used predominantly as a fuel for rocket and jet engines and in the manufacturing of pharmaceuticals. Hydrazine salts are used in refining and as corrosion inhibitors.

Principle of Operation

The SafeAir hydrazine dual level badge is a monitoring system designed to indicate the presence of hydrazine at concentrations below the permissible exposure limit. The SafeAir hydrazine dual level badge detects the presence of hydrazine by forming a color change in the shape of a half triangle. This indication is produced by a color-forming reaction which occurs when hydrazine reacts with a flat indicator layer. A color change may appear on the front and/or the back side of the badge, depending upon the exposure dose.

Physical Specifications:

Dimensions	74 mm x 41 mm x 1 mm
Weight	1.5 g
Refrigerated shelf life	1 year
Color change	orange to maroon

Sampling Parameters:

	Front	Back
Exposure dose:	8 ppb•hr	4 ppb•hr
Minimum detectable limit (8 hours)	1 ppb	0.5 ppb
Maximum recommended sampling time	2 days	2 days
Minimum recommended sampling time	5 minutes	5 minutes
Relative humidity range	23% - 83%	23% - 83%
Face velocity range	5 – 168 cm/sec	5 – 168 cm/sec
Temperature range	15°C - 35°C (60°F - 95°)	15°C - 35°C (60°F - 95°F)
Light effect – UV (direct sunlight)	no effect	no effect
Light effect – visible	no effect	no effect
Color stability	4 weeks	4 weeks

Known Interferences: Methyl hydrazine and high concentrations of aromatic amines

Operating Instructions

1. Prior to opening and removing a badge from its inner silver pouch, allow the badges to warm to room temperature. Store the remaining badges in the inner silver pouch zip-closed inside the white outer pouch.
Once the silver pouch is opened, the remaining badges must be used within 30 days.
2. Allow the badge to warm to room temperature prior to removing the badge from its protective pouch.
3. For personnel monitoring, attach the badge near the user's breathing zone (i.e. the collar) with the front side exposed to the surrounding atmosphere.
4. For area monitoring, attach the badge to a stand and mount in a centralized area with the front side exposed to the surrounding atmosphere.
5. The half triangle will appear on the back-side of the badge when hydrazine is present at or above 4 ppb•hr. The half triangle will appear on the front-side of the badge when hydrazine is present at or above 8 ppb•hr.

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Operating Instructions Hydrogen Sulfide Badge (Part Number: 382015)

Introduction

Hydrogen sulfide is a colorless gas with a strong odor resembling rotten eggs. Continuous exposure to low concentrations (15 - 20 ppm) generally causes irritation to the mucous membranes. It may also cause headaches and dizziness. High concentrations (200 - 300 ppm) can result in respiratory arrest leading to unconsciousness. Exposure for more than 30 minutes at concentrations as high as 700 ppm has been fatal. Continuous inhalation of low concentrations may cause loss of the sense of smell which makes the detection of its presence by odor ineffective. OSHA PEL (permissible exposure limit) for hydrogen sulfide is 20 ppm (TWA). NIOSH REL (recommended exposure limit) for hydrogen sulfide is 10 ppm (TWA).

Hydrogen sulfide is a widely spread pollutant. It is emitted as a byproduct in many industries such as oil refineries, production of sulfuric acid, leather, gelatin, artificial silk and sugar. As a product of normal biodegradation of bioproducts, hydrogen sulfide is spread in waste water treatment locations.

Principle of Operation

The SafeAir hydrogen sulfide badge is a monitoring system designed to indicate the presence of hydrogen sulfide at concentrations below the permissible exposure limit. The SafeAir hydrogen sulfide badge detects the presence of hydrogen sulfide by forming a color change in the shape of an exclamation mark inside the triangle. This indication is produced by a color-forming reaction which occurs when hydrogen sulfide reacts with a flat indicator layer

Physical Specifications:

Dimensions	74 mm x 41 mm x 1 mm
Weight	1.5 g
Refrigerated shelf life	1 year
Color change	pale blue to gray

Sampling Parameters:

Exposure level	2.0 ppm-hr
Minimum detectable limit (8 hours)	0.25 ppm
Maximum recommended sampling time	48 hours
Minimum recommended sampling time	15 minutes
Relative humidity range	15% - 90%
Face velocity range	10 - 150 cm/sec
Temperature range	10°C - 40°C (50°F - 104°F)
Light effect - UV (direct sunlight)	no effect
Light effect - visible	no effect
Color stability	6 days
Known Interferences	No interferences are known

Operating Instructions

1. Prior to opening and removing a badge from its inner silver pouch, allow the badges to warm to room temperature. Store the remaining badges in the inner silver pouch zip-closed inside the white outer pouch.
Once the silver pouch is opened, the remaining badges must be used within 30 days.
2. For personnel monitoring, attach the badge near the user's breathing zone (i.e. the collar) with the front side exposed to the surrounding atmosphere.
3. For area monitoring, attach the badge to a stand and mount in a centralized area with the front side exposed to the surrounding atmosphere.
4. The exclamation mark appears within the triangle when hydrogen sulfide is present. Please note that the exclamation mark will appear underneath the printed exposure dose (sensitivity).

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Operating Instructions Sulfur Dioxide Badge (Part Number: 382014)

Introduction

Sulfur dioxide is a colorless gas with a characteristic, irritating, pungent odor. It is corrosive and irritating to the upper and lower respiratory tracts, skin and eyes. Symptoms of mild exposure to sulfur dioxide include coughing, wheezing, shortness of breath, headache and vomiting. Exposure to high concentrations of sulfur dioxide is extremely destructive to the respiratory tract tissues. Exposure of the eyes to high concentrations may result in ulceration of the conjunctiva and cornea, whereas contact with skin causes severe burns. OSHA PEL (permissible exposure limit) for sulfur dioxide is 5 ppm (TWA). NIOSH REL (recommended exposure limit) for sulfur dioxide is 2 ppm (TWA).

Sulfur dioxide is a widely spread air pollutant. It is emitted as a byproduct in burning coal fuels in electric power generating plants, industrial boilers and molten sulfide ores in metallurgical plants. Sulfur dioxide is also used in the production and treatment of metals, sugar, cellulose, leather, fertilizers, ceramic, batteries, paper and many others.

Principle of Operation

The SafeAir sulfur dioxide badge is a monitoring system designed to indicate the presence of sulfur dioxide at concentrations below the permissible exposure limit. The SafeAir sulfur dioxide badge detects the presence of sulfur dioxide by forming a color change in the shape of an exclamation mark inside the triangle. This indication is produced by a color-forming reaction, which occurs when sulfur dioxide reacts with a flat indicator layer.

Physical Specifications:

Dimensions	74 mm x 41 mm x 1 mm
Weight	1.5 g
Refrigerated shelf life	1 year
Color change	off-white to cranberry

Sampling Parameters:

Exposure level	0.2 ppm·hr
Minimum detectable limit (8 hours)	0.025 ppm
Maximum recommended sampling time	48 hours
Minimum recommended sampling time	15 minutes
Relative humidity range	15% - 90%
Face velocity range	10 – 150 cm/sec
Temperature range	15°C - 36°C (59°F - 97°F)
Light effect – UV (direct sunlight)	not recommended
Light effect – visible	no effect
Color stability	2 weeks
Known Interferences	No interferences are known

Operating Instructions

1. Prior to opening and removing a badge from its inner silver pouch, allow the badges to warm to room temperature. Store the remaining badges in the inner silver pouch zip-closed inside the white outer pouch.
Once the silver pouch is opened, the remaining badges must be used within 30 days.
2. For personnel monitoring, attach the badge near the user's breathing zone (i.e. the collar) with the front side exposed to the surrounding atmosphere.
3. For area monitoring, attach the badge to a stand and mount in a centralized area with the front side exposed to the surrounding atmosphere.
4. The exclamation mark appears within the triangle when sulfur dioxide is present. Please note that the exclamation mark will appear underneath the printed exposure dose (sensitivity).

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Operating Instructions Formaldehyde Badge (Part Number: 382011)

Introduction

Formaldehyde is a colorless gas with a pungent, suffocating odor. It is a potent irritant to eyes, nose and throat. The most common effects of low level formaldehyde inhalation are eye, nose and upper respiratory irritation. Chronic symptoms of exposure are itching eyes, dry and sore throat, and possible difficulty in sleeping and unusual thirst after awakening. OSHA PEL (permissible exposure limit) for formaldehyde is 0.75 ppm (TWA). NIOSH REL (recommended exposure limit) is 0.016 ppm (TWA). NIOSH also recommends that formaldehyde be handled as a potential occupational carcinogen in the workplace.

Formaldehyde workplace exposure occurs because of its extensive use as an industrial chemical in the manufacturing of resins for adhesives, plastics, coatings and fabrics. Additional exposure to formaldehyde emissions comes from its use as a fumigant and sterilant. The major source of atmospheric discharge of formaldehyde is from combustion processes, specifically from the photo-oxidation of hydrocarbons in auto emissions.

Principle of Operation

The SafeAir formaldehyde badge is a monitoring system designed to indicate the presence of formaldehyde at concentrations below the permissible exposure limit. The SafeAir formaldehyde badge detects the presence of formaldehyde by forming a color change from yellowish-brown to dark brown in the shape of an exclamation mark inside the triangle. This indication is produced by a color-forming reaction which occurs when formaldehyde reacts with a flat indicator layer.

Physical Specifications:

Dimensions	74 mm x 41 mm x 1 mm
Weight	1.5 g
Refrigerated shelf life	1 year
Color change	yellowish-brown to dark brown

Sampling Parameters:

Exposure level	0.2 ppm-hr
Minimum detectable limit (8 hours)	0.025 ppm
Maximum recommended sampling time	16 hours
Minimum recommended sampling time	15 minutes
Relative humidity range	20% - 80%
Face velocity range	10 – 150 cm/sec
Temperature range	15°C - 35°C (59°F - 95°F)
Light effect – UV (direct sunlight)	no effect
Light effect – visible	no effect
Color stability	18 hours
Known Interferences	acrolein, cigarette smoke

Operating Instructions

1. Allow the badge to warm to room temperature prior to removing the badge from its protective pouch.
2. Remove activation label before monitoring.
3. For personnel monitoring, attach the badge near the user's breathing zone (i.e. the collar) with the front side exposed to the surrounding atmosphere.
4. For area monitoring, attach the badge to a stand and mount in a centralized area with the front side exposed to the surrounding atmosphere.

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Operating Instructions Ammonia Badge (Part Number: 382010)

Introduction

Ammonia is a colorless gas with a sharp, irritating odor. It is a typical respiratory and eye irritant. Depending on the concentration, it may cause burning sensations, coughing, wheezing, headaches and conjunctivitis. High exposures cause caustic skin burns, eye swelling with possible loss of vision, shortness of breath and nausea. Ammonia causes chemical pneumonitis (deep lung inflammation) and pulmonary edema (abnormal fluid buildup in the lungs). OSHA PEL (permissible exposure limit) for ammonia is 50 ppm (TWA). NIOSH REL (recommended exposure limit) for ammonia is 25 ppm (TWA).

Ammonia is a commonly used chemical. As a product of normal degradation of bio products, it is spread as a pollutant in poultry plants and animal farms. Ammonia is used in the production of nitric acid, ammonia salts, fertilizers, leather, cooling and freezing systems, cleaning liquids, etc.

Principle of Operation

The SafeAir ammonia badge is a monitoring system designed to indicate the presence of ammonia at concentrations below the permissible exposure limit. The SafeAir ammonia badge detects the presence of ammonia by forming a color change from beige to black in the shape of an exclamation mark inside the triangle. This indication is produced by a color-forming reaction that occurs when ammonia reacts with a flat indicator layer.

Physical Specifications:

Dimensions	74 mm x 41 mm x 1 mm
Weight	1.5 g
Refrigerated shelf life	1 year
Color change	beige to tan to black*

*Final color is humidity dependent. Low humidity final color is black, high humidity final color is green/black.

Sampling Parameters:

Exposure level	4.0 ppm-hr
Minimum detectable limit (8 hours)	0.50 ppm
Maximum recommended sampling time	48 hours
Minimum recommended sampling time	15 minutes
Relative humidity range	15% - 90%
Face velocity range	10 – 150 cm/sec
Temperature range	10°C - 40°C (50°F - 104°F)
Light effect – UV (direct sunlight)	not recommended
Light effect – visible	no effect
Color stability	4 weeks
Known Interferences	primary aliphatic amines

Operating Instructions

1. Prior to opening and removing a badge from its inner silver pouch, allow the badges to warm to room temperature. Store the remaining badges in the inner silver pouch zip-closed inside the white outer pouch.
Once the silver pouch is opened, the remaining badges must be used within 30 days.
2. For personnel monitoring, attach the badge near the user's breathing zone (i.e. the collar) with the front side exposed to the surrounding atmosphere.
3. For area monitoring, attach the badge to a stand and mount in a centralized area with the front side exposed to the surrounding atmosphere.
4. The exclamation mark appears within the triangle when ammonia is present. The exclamation mark will appear underneath the printed exposure dose (sensitivity).
Please note that additional color development may occur for up to five minutes after the end of the sampling period.

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Operating Instructions Chlorine Badge (Part Number: 382009)

Introduction

Chlorine is a greenish-yellow gas with a pungent, irritating odor. Generally, chlorine is a potent respiratory system irritant. Mild exposures to chlorine cause burning of eyes, nose and mouth. Exposure to high concentrations (e.g. 1000 ppm) is likely to be fatal. The OSHA PEL (permissible exposure limit) for chlorine is 1 ppm (ceiling), whereas the NIOSH REL (recommended exposure limit) is 0.5ppm (TWA).

Chlorine is an important chemical commodity widely used in the production of safe drinking water. It is used extensively in the production of paper products, dyestuffs, textiles, petroleum products, chlorinated solvents, etc.

Principle of Operation

The SafeAir chlorine badge is a monitoring system designed to indicate the presence of chlorine at concentrations below the permissible exposure limit. The SafeAir chlorine badge detects the presence of chlorine by forming a yellow to orange color change in the shape of an exclamation mark inside the triangle. This indication is produced by a color-forming reaction that occurs when chlorine reacts with a flat indicator layer.

Physical Specifications:

Dimensions	74 mm x 41 mm x 1 mm
Weight	1.5 g
Refrigerated shelf life	1 year
Color change	yellow to orange

Sampling Parameters:

Exposure dose:	
Badge	0.18 ppm-hr
Badge with color comparator	0.03 - 3.0 ppm-hr
Minimum detectable limit (8 hours)	0.023 ppm
Maximum recommended sampling time	48 hours
Minimum recommended sampling time	15 minutes
Relative humidity range	30% - 90%
Face velocity range	10 – 150 cm/sec
Temperature range	15°C - 32°C (60°F - 91°F)
Light effect – UV (direct sunlight)	no effect
Light effect – visible	no effect
Color stability	4 weeks
Known Interferences	bromine, iodine and hydrogen chloride

Operating Instructions

1. Prior to opening and removing a badge from its inner silver pouch, allow the badges to warm to room temperature. Store the remaining badges in the inner silver pouch zip-closed inside the white outer pouch.
Once the silver pouch is opened, the remaining badges must be used within 30 days.
2. For personnel monitoring, attach the badge near the user's breathing zone (i.e. the collar) with the front side exposed to the surrounding atmosphere.
3. For area monitoring, attach the badge to a stand and mount in a centralized area with the front side exposed to the surrounding atmosphere.
4. The exclamation mark appears within the triangle when chlorine is present.
5. A SafeAir chlorine color comparator (PN: 383010) is available for use with this badge. To obtain the average concentration, divide the exposure dose (ppm-hr) by the exposure time in hours (hr).
6. **When using a comparator, read badge within one hour of the end of the sampling period.**

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**Operating Instructions
Mercury Dual Level Badge
(Part Number: 382005)**

Introduction

Mercury is a silver-white, heavy, mobile, liquid metal with no specific odor. It is readily absorbed through the skin, the gastrointestinal tract and the respiratory tract. Chronic exposure may cause inflammation of the mouth and gums, kidney damage, muscle tremors, depression and nervousness. Mercury spills and heated mercury are particularly hazardous. OSHA PEL (permissible exposure limit) in the general industry for mercury is 0.1 mg/m³ (TWA). NIOSH REL (recommended exposure limit) for mercury is 0.05 mg/m³ (TWA).

Mercury is used in barometers, thermometers, hydrometers, pyrometers, and in mercury arc lamps producing ultraviolet rays. It is also used in pharmaceuticals, agricultural chemicals and antifouling paints.

Principle of Operation

The SafeAir mercury badge is a monitoring system designed to indicate the presence of mercury at concentrations below the permissible exposure limit. The SafeAir mercury badge detects the presence of mercury by forming a color change in the shape of an exclamation mark inside the triangle. This indication is produced by a color-forming reaction that occurs when mercury reacts with a flat indicator layer.

Physical Specifications:

Dimensions	74 mm x 41 mm x 1 mm
Weight	1.5 g
Refrigerated shelf life	1 year
Color change	white to purple

Sampling Parameters:

	Front	Back
Exposure level	0.25 mg/m ³ · hr	0.08 mg/m ³ · hr
Minimum detectable limit (8 hours)	0.031 mg/m ³	0.01 mg/m ³
Maximum recommended sampling time	48 hours	48 hours
Minimum recommended sampling time	15 minutes	15 minutes
Relative humidity range	10% - 86%	10% - 86%
Face velocity range	10 – 150 cm/sec	10 – 150 cm/sec
Temperature range	10°C - 40°C (50°F - 104°F)	10°C - 40°C (50°F - 104°F)
Light effect – UV (direct sunlight)	no effect	no effect
Light effect – visible	no effect	no effect
Color stability	2 days	2 days

Known Interferences: Arsine, phosphine and other hydrides

Operating Instructions

1. Prior to opening and removing a badge from its inner silver pouch, allow the badges to warm to room temperature. Store the remaining badges in the inner silver pouch zip-closed inside the white outer pouch.
Once the silver pouch is opened, the remaining badges must be used within 30 days.
2. For personnel monitoring, attach the badge near the user's breathing zone (i.e. the collar) with the front side exposed to the surrounding atmosphere.
3. For area monitoring, attach the badge to a stand and mount in a centralized area with the front side exposed to the surrounding atmosphere.
4. The exclamation mark appears within the triangle when mercury is present. Please note that an exclamation mark may appear on either the back or the front and the back of the badge.

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Operating Instructions For Ozone Badge (Part Number: 382004)

Introduction

Ozone is a bluish gas with a pleasant, characteristic odor in concentrations of less than 2 ppm. In higher concentrations, the odor is pungent and irritating. Ozone is a severe irritant to the eyes and the mucous membranes. Long-term exposures will cause pulmonary edema (abnormal fluid buildup in the lungs) and chronic respiratory disease. OSHA and NIOSH exposure limit for ozone is 0.1 ppm (TWA).

Ozone is used as a disinfectant for air and water. It is also used to bleach waxes, textiles and oils.

Principle of Operation

The SafeAir ozone badge is a monitoring system designed to indicate the presence of ozone at concentrations below the permissible exposure limit. The SafeAir ozone badge detects the presence of ozone by forming a color change from blue to white in the shape of an exclamation mark inside the triangle. This indication is produced by a color-forming reaction that occurs when ozone reacts with a flat indicator layer.

Physical Specifications:

Dimensions	74 mm x 41 mm x 1 mm
Weight	1.5 g
Refrigerated shelf life	1 year
Color change	blue to white

Sampling Parameters:

Exposure level	0.05 ppm-hr
Minimum detectable limit (8 hours)	0.006 ppm
Maximum recommended sampling time	48 hours
Minimum recommended sampling time	15 minutes
Relative humidity range	30% - 80%
Face velocity range	10 – 150 cm/sec
Temperature range	15°C - 32°C (60°F - 91°F)
Light effect – UV (direct sunlight)	not recommended
Light effect – visible	no effect
Color stability	4 weeks
Known Interferences	hydrogen peroxide, and nitrogen dioxide up to 1 ppm

Operating Instructions

1. Allow the badge to warm to room temperature prior to removing the badge from its protective pouch.
2. Remove activation label before monitoring.
3. For personnel monitoring, attach the badge near the user's breathing zone (i.e. the collar) with the front side exposed to the surrounding atmosphere.
4. For area monitoring, attach the badge to a stand and mount in a centralized area with the front side exposed to the surrounding atmosphere.
5. The exclamation mark appears within the triangle when ozone is present.

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**Operating Instructions
Chlorine & Chlorine Dioxide Badge
(Part Number: 382003)**

Introduction

Chlorine is a greenish-yellow gas with a pungent, irritating odor. Generally, chlorine is a potent respiratory system irritant. Mild exposures to chlorine cause burning of eyes, nose and mouth. Exposure to high concentrations (e.g. 1000 ppm) is likely to be fatal. The OSHA PEL (permissible exposure limit) for chlorine is 1 ppm (ceiling), whereas the NIOSH REL (recommended exposure limit) is 0.5 ppm (TWA).

Chlorine is an important chemical commodity widely used in the production of safe drinking water. It is also extensively used in the production of paper products, dyestuffs, textiles, petroleum products, chlorinated solvents, etc.

Chlorine dioxide is a yellow to reddish-yellow gas with an unpleasant odor similar to chlorine and suggestive of nitric acid. Exposure may be highly irritating to the skin and mucous membranes of the respiratory tract and may cause pulmonary edema (abnormal fluid buildup in the lungs). OSHA and NIOSH exposure limit for chlorine dioxide is 0.1 ppm (TWA).

Chlorine dioxide is used in the purification of water, the tanning and detanning of leather and the bleaching of cellulose, flour, leather, fats and textiles, as well as in the paper and pulp industry.

Principle of Operation

The SafeAir chlorine & chlorine dioxide badge is a monitoring system designed to indicate the presence of chlorine and/or chlorine dioxide at concentrations below the permissible exposure limit. The SafeAir chlorine & chlorine dioxide badge detects the presence of chlorine and/or chlorine dioxide by forming a color change in the shape of an exclamation mark inside the triangle. This indication is produced by a color-forming reaction, which occurs when the contaminant(s) react with a flat indicator layer. The SafeAir chlorine & chlorine dioxide badge is a dual-purpose badge. The color change may appear on the front if chlorine is present and/or the backside of the badge if chlorine dioxide is present depending upon the level of exposure of the two contaminants.

Physical Specifications:

Dimensions	74 mm x 41 mm x 1 mm
Weight	1.5 g
Refrigerated shelf life	1 year
Color change:	
Chlorine	yellow to orange
Chlorine Dioxide	off-white to gray

Sampling Parameters:

	Chlorine	Chlorine Dioxide
Exposure level	0.18 ppm-hr	0.2 ppm-hr
Minimum detectable limit (8 hours)	0.025 ppm	0.025 ppm
Maximum recommended sampling time	10 hours	10 hours
Minimum recommended sampling time	15 minutes	15 minutes
Relative humidity range	25% - 90%	25% - 90%
Face velocity range	10 – 150 cm/sec	10 – 150 cm/sec
Temperature range	10°C - 40°C (50°F - 104°F)	10°C - 40°C (50°F - 104°F)
Light effect – UV (direct sunlight)	no effect for 16 hr	no effect for 10 hr
Light effect – visible	no effect	no effect
Color stability	4 weeks	4 weeks

Known Interferences: **Chlorine:** bromine, iodine and hydrogen chloride.
Chlorine Dioxide: nitrogen dioxide and high concentrations of ozone

Operating Instructions

1. Allow the badge to warm to room temperature prior to removing the badge from its protective pouch.
2. Remove activation label before monitoring.
3. For personnel monitoring, attach the badge near the user's breathing zone (i.e. the collar) with the front side exposed to the surrounding atmosphere.
4. For area monitoring, attach the badge to a stand and mount in a centralized area with the front side exposed to the surrounding atmosphere.
5. The exclamation mark appears within the triangle on the front side of the badge when chlorine is present at or above 0.18 ppm-hr. The exclamation mark appears within the triangle on the back side of the badge when chlorine dioxide is present at or above 0.2 ppm-hr.

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Operating Instructions Hydrazine Badge (Part Number: 382002)

Introduction

Hydrazine is a colorless liquid with a penetrating odor resembling that of ammonia. It is extremely destructive to the tissues of the mucous membranes and upper respiratory tract. Symptoms of exposure may include coughing, wheezing, laryngitis, and shortness of breath, headache, nausea and vomiting. OSHA PEL (permissible exposure limit) for hydrazine is 1 ppm (TWA). NIOSH REL (recommended exposure limit) for hydrazine is 0.03 ppm (2 hour ceiling). NIOSH recommends that hydrazine be handled as a potential occupational carcinogen in the workplace.

Hydrazine is used predominantly as a fuel for rocket and jet engines and in the manufacturing of pharmaceuticals. Hydrazine salts are used in refining and as corrosion inhibitors.

Principle of Operation

The SafeAir hydrazine badge is a monitoring system designed to indicate the presence of hydrazine at concentrations below the permissible exposure limit. The SafeAir hydrazine badge detects the presence of hydrazine by forming a color change in the shape of an exclamation mark inside the triangle. This indication is produced by a color-forming reaction, which occurs when hydrazine reacts with a flat indicator layer.

Physical Specifications:

Dimensions	74 mm x 41 mm x 1 mm
Weight	1.5 g
Refrigerated shelf life	1 year
Color change	orange to maroon

Sampling Parameters:

Exposure dose:	
Badge	8 ppb·hr
Badge with color comparator	4.5 – >300 ppb·hr
Minimum detectable limit (8 hours)	1 ppb
Maximum recommended sampling time	2 days
Minimum recommended sampling time	5 minutes
Relative humidity range	23% - 83%
Face velocity range	5 – 168 cm/sec
Temperature range	17°C - 35°C (63°F - 95°F)
Light effect – UV (direct sunlight)	no effect
Light effect – visible	no effect
Color stability	4 weeks
Known Interferences	Monomethyl hydrazine, and aromatic amines

Operating Instructions

1. Prior to opening and removing a badge from its inner silver pouch, allow the badges to warm to room temperature. Store the remaining badges in the inner silver pouch zip-closed inside the white outer pouch.
Once the silver pouch is opened, the remaining badges must be used within 30 days.
2. For personnel monitoring, attach the badge near the user's breathing zone (i.e. the collar) with the front side exposed to the surrounding atmosphere.
3. For area monitoring, attach the badge to a stand and mount in a centralized area with the front side exposed to the surrounding atmosphere.
4. The exclamation mark appears within the triangle when hydrazine is present. Please note that the exclamation mark will appear underneath the printed exposure dose (sensitivity).
5. To determine the exposure dose, a SafeAir hydrazine color comparator (PN: 383001) is available for use with this badge. To obtain the average concentration, divide the exposure dose (ppb·hr) by the exposure time in hours (hr).

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Warning: Keep out of reach of children. If ingested seeks medical attention immediately.



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**Operating Instructions
TDI/MDI Badge
For the detection of
Toluene Diisocyanate (TDI) and
Methylene Diphenyl Diisocyanate (MDI)
(Part Number: 382001)**

Introduction

Based on the available toxicity data in animals and epidemiologic studies of humans, aromatic diisocyanates such as toluene diisocyanate (TDI) and methylene diphenyl diisocyanate (MDI) are strong respiratory sensitizers.¹ Repeated exposures, or a single large dose, may cause sensitization. Chronic overexposure has also been reported to cause lung damage including fibrosis. OSHA and NIOSH exposure limit for TDI is 0.02 ppm (TWA), the OSHA exposure limit for MDI is 0.02 ppm (ceiling) and the NIOSH exposure limit for MDI is 0.005 ppm (TWA).

TDI and MDI are commonly used to make various polymers including polyurethanes. Polyurethanes have significant application in the manufacture of rigid and flexible foams. They are also used in the production of adhesives, elastomers and coatings. Polyurethane coatings are preferred in the automotive refinishing industry where high performance coatings are required.

1 American Chemistry Council - Frequently Asked Questions (<https://dii.americanchemistry.com/Frequently-Asked-Questions/>)

Principle of Operation

The SafeAir TDI/MDI badge is a monitoring system designed to indicate the presence of TDI and/or MDI at concentrations below the permissible exposure limit. The SafeAir TDI/MDI badge detects the presence of TDI and/or MDI by forming a color change in the shape of an exclamation mark inside the triangle. This indication is produced by a color-forming reaction, which occurs when TDI and/or MDI react with a flat indicator layer.

Physical Specifications:

Dimensions	74 mm x 41 mm x 1 mm
Weight	1.5 g
Refrigerated shelf life	1 year
Color change	off-white to red

Sampling Parameters:

Sensitivity (exposure dose):	
Badge	5 ppb-hr
Badge with MDI color comparator	5 – 140 ppb-hr
Badge with TDI color comparator	5 – 140 ppb-hr
Minimum detectable limit (8 hours)	0.6 ppb
Maximum recommended sampling time	24 hours
Minimum recommended sampling time	15 minutes
Relative humidity range	11% - 87%
Face velocity range	10 – 100 cm/sec
Temperature range	15°C - 32°C (60°F - 91°F)
Light effect – UV (direct sunlight)	not recommended >4hrs
Light effect – visible	no effect
Color stability	two weeks

Known Interferences: Other aromatic diisocyanates and high concentrations of hydrazine

Operating Instructions

- 1) Prior to opening and removing a badge from its inner silver pouch, allow the badges to warm to room temperature. Store the remaining badges in the inner silver pouch zip-closed inside the white outer pouch.
Once the silver pouch is opened, the remaining badges must be used within 30 days.
- 2) For personnel monitoring, attach the badge near the user's breathing zone (i.e. the collar) with the front side exposed to the surrounding atmosphere.
- 3) For area monitoring, attach the badge to a stand and mount in a centralized area with the front side exposed to the surrounding atmosphere.
- 4) The exclamation mark begins to appear within the triangle on the front of the badge when TDI and/or MDI are present at the sensitivity level.
- 5) To determine exposure dose, a SafeAir TDI color comparator (PN: 383005) and SafeAir MDI color comparator (PN: 383006) are available for use with this badge. To obtain the average concentration, divide the exposure dose (ppb-hr) by the exposure time in hours (hr).
- 6) **When using a comparator, read badge within one hour of the end of the sampling period.**

WARRANTY EXCLUSIONS AND LIMITATION OF LIABILITY

IF THE USER DOES NOT ACCEPT THE FOLLOWING TERMS, THE USER SHOULD NOT USE THE SAFEAIR BADGES AND COLOR COMPARATORS.

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