Occupational Health Guideline for o-Methylcyclohexanone

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $C_7H_{12}O$
- Synonyms: 2-Methylcyclohexanone
- Appearance and odor: Colorless liquid with a weak peppermint odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for o-methylcyclohexanone is 100 parts of o-methylcyclohexanone per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 460 milligrams of o-methylcyclohexanone per cubic meter of air (mg/m^3). The American Conference of Governmental Industrial Hygienists has recommended for o-methylcyclohexanone a Threshold Limit Value of 50 ppm with a skin notation.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

o-Methylcyclohexanone can affect the body if it is inhaled, comes in contact with the eyes or skin, or swallowed.

- **Effects of overexposure**

There are no reported effects of human exposure to o-methylcyclohexanone. In animal experiments o-methylcyclohexanone has caused drowsiness, unconsciousness, irritation of the eyes, nose, and throat, and skin rash.

- **Reporting signs and symptoms**

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to o-methylcyclohexanone.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to o-methylcyclohexanone at potentially hazardous levels:

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from o-methylcyclohexanone exposure.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of o-methylcyclohexanone might cause exacerbation of symptoms due to its irritant properties.

—Liver disease: Although o-methylcyclohexanone is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—Kidney disease: Although o-methylcyclohexanone is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Skin disease: o-Methylcyclohexanone is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Neurologic disorders: By analogy to effects observed in animals, the nervous system may be adversely affected by o-methylcyclohexanone.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

- **Summary of toxicology**

o-Methylcyclohexanone vapor irritates the eyes and mucous membranes in animals; at high concentrations it

---

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Freedom_0007521_0001

Occupational Health Guideline for o-Methylcyclohexanone

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $C_7H_{12}O$
- Synonyms: 2-Methylcyclohexanone
- Appearance and odor: Colorless liquid with a weak peppermint odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for o-methylcyclohexanone is 100 parts of o-methylcyclohexanone per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 460 milligrams of o-methylcyclohexanone per cubic meter of air (mg/m^3). The American Conference of Governmental Industrial Hygienists has recommended for o-methylcyclohexanone a Threshold Limit Value of 50 ppm with a skin notation.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

o-Methylcyclohexanone can affect the body if it is inhaled, comes in contact with the eyes or skin, or swallowed.

- **Effects of overexposure**

There are no reported effects of human exposure to o-methylcyclohexanone. In animal experiments o-methylcyclohexanone has caused drowsiness, unconsciousness, irritation of the eyes, nose, and throat, and skin rash.

- **Reporting signs and symptoms**

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to o-methylcyclohexanone.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to o-methylcyclohexanone at potentially hazardous levels:

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from o-methylcyclohexanone exposure.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of o-methylcyclohexanone might cause exacerbation of symptoms due to its irritant properties.

—Liver disease: Although o-methylcyclohexanone is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—Kidney disease: Although o-methylcyclohexanone is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Skin disease: o-Methylcyclohexanone is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Neurologic disorders: By analogy to effects observed in animals, the nervous system may be adversely affected by o-methylcyclohexanone.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

- **Summary of toxicology**

o-Methylcyclohexanone vapor irritates the eyes and mucous membranes in animals; at high concentrations it

---

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Freedom_0007521_0002

causes narcosis. Several species of animals exposed to 3500 ppm suffered marked irritation of the mucous membranes, became incoordinated after 15 minutes of exposure, and prostrate after 30 minutes. Repeated daily application to the skin of rabbits of large doses of the liquid caused irritation of the skin, tremors, narcosis, and death. Exposure of mice to 450 ppm for an unspecified time period resulted in irritation of the eyes and respiratory tract. Repeated or prolonged contact of the liquid with the skin may cause dermatitis.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 112.2
2. Boiling point (760 mm Hg): 165 C (329 F)
3. Specific gravity (water = 1): 0.93
4. Vapor density (air = 1 at boiling point of o-methylcyclohexanone): 3.9
5. Melting point: −14 C (6.8 F)
6. Vapor pressure at 20 C (68 F): 1 mm Hg (approximately)
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Data not available

- **Reactivity**

1. Conditions contributing to instability: None hazardous
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving o-methylcyclohexanone.
4. Special precautions: o-Methylcyclohexanone will attack some forms of plastics, rubber, and coatings.

- **Flammability**

1. Flash point: 47.8 C (118 F) (Closed cup)
2. Autoignition temperature: Data not available
3. Flammable limits in air, % by volume: Data not available
4. Extinguishant: Foam, dry chemical, carbon dioxide

- **Warning properties**

1. Odor Threshold: No quantitative information is available concerning the odor threshold of o-methylcyclohexanone.
2. Irritation Level: According to Patty, eye and respiratory irritation may occur below the permissible exposure limit.
3. Evaluation of Warning Properties: Through its irritant effects, o-methylcyclohexanone can be detected at the permissible exposure limit. For the purposes of this guideline, therefore, it is treated as a material with good warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Method**

An analytical method for o-methylcyclohexanone is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 4, 1978, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00317-3).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid o-methylcyclohexanone.
- Clothing wet with o-methylcyclohexanone should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of o-methylcyclohexanone from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the o-methylcyclohexanone, the person performing the operation should be informed of o-methylcyclohexanone's hazardous properties.
- Non-impervious clothing which becomes contaminated with o-methylcyclohexanone should be removed

Freedom_0007521_0003

causes narcosis. Several species of animals exposed to 3500 ppm suffered marked irritation of the mucous membranes, became incoordinated after 15 minutes of exposure, and prostrate after 30 minutes. Repeated daily application to the skin of rabbits of large doses of the liquid caused irritation of the skin, tremors, narcosis, and death. Exposure of mice to 450 ppm for an unspecified time period resulted in irritation of the eyes and respiratory tract. Repeated or prolonged contact of the liquid with the skin may cause dermatitis.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 112.2
2. Boiling point (760 mm Hg): 165 C (329 F)
3. Specific gravity (water = 1): 0.93
4. Vapor density (air = 1 at boiling point of o-methylcyclohexanone): 3.9
5. Melting point: −14 C (6.8 F)
6. Vapor pressure at 20 C (68 F): 1 mm Hg (approximately)
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Data not available

- **Reactivity**

1. Conditions contributing to instability: None hazardous
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving o-methylcyclohexanone.
4. Special precautions: o-Methylcyclohexanone will attack some forms of plastics, rubber, and coatings.

- **Flammability**

1. Flash point: 47.8 C (118 F) (Closed cup)
2. Autoignition temperature: Data not available
3. Flammable limits in air, % by volume: Data not available
4. Extinguishant: Foam, dry chemical, carbon dioxide

- **Warning properties**

1. Odor Threshold: No quantitative information is available concerning the odor threshold of o-methylcyclohexanone.
2. Irritation Level: According to Patty, eye and respiratory irritation may occur below the permissible exposure limit.
3. Evaluation of Warning Properties: Through its irritant effects, o-methylcyclohexanone can be detected at the permissible exposure limit. For the purposes of this guideline, therefore, it is treated as a material with good warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Method**

An analytical method for o-methylcyclohexanone is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 4, 1978, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00317-3).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid o-methylcyclohexanone.
- Clothing wet with o-methylcyclohexanone should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of o-methylcyclohexanone from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the o-methylcyclohexanone, the person performing the operation should be informed of o-methylcyclohexanone's hazardous properties.
- Non-impervious clothing which becomes contaminated with o-methylcyclohexanone should be removed

Freedom_0007521_0004

promptly and not reworn until the o-methylcyclohexanone is removed from the clothing.

• Employees should be provided with and required to use splash-proof safety goggles where liquid o-methylcyclohexanone may contact the eyes.

SANITATION

• Skin that becomes contaminated with o-methylcyclohexanone should be promptly washed or showered with soap or mild detergent and water to remove any o-methylcyclohexanone.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to o-methylcyclohexanone may occur and control methods which may be effective in each case:

Operation	Controls
Use as a solvent in plastic industry; manufacture of lacquers and varnishes; as a co-solvent with cyclohexanone	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment
Use in leather industry; use as a rust remover	Process enclosure; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• **Eye Exposure**

If liquid o-methylcyclohexanone gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

If liquid o-methylcyclohexanone gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If liquid o-methylcyclohexanone soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• **Breathing**

If a person breathes in large amounts of o-methylcyclohexanone, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Swallowing**

When o-methylcyclohexanone has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If o-methylcyclohexanone is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and reclaimed or atomized in a suitable combustion chamber. o-Methylcyclohexanone should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive concentrations of o-methylcyclohexanone vapors are permitted.

• Waste disposal methods:

o-Methylcyclohexanone may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.
2. By atomizing in a suitable combustion chamber.

REFERENCES

• American Conference of Governmental Industrial Hygienists: "o-Methylcyclohexanone," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.

• Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.

• Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.

• Sax, N. I.: *Dangerous Properties of Industrial Materials* (3rd ed.), Van Nostrand Reinhold, New York, 1968.

• Treon, J. F., et al.: "The Physiological Response of Rabbits to Cyclohexane, Methylcyclohexane, and Certain Derivatives of These Compounds. I. Oral Adminis-

Freedom_0007521_0005

promptly and not reworn until the o-methylcyclohexanone is removed from the clothing.

• Employees should be provided with and required to use splash-proof safety goggles where liquid o-methylcyclohexanone may contact the eyes.

SANITATION

• Skin that becomes contaminated with o-methylcyclohexanone should be promptly washed or showered with soap or mild detergent and water to remove any o-methylcyclohexanone.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to o-methylcyclohexanone may occur and control methods which may be effective in each case:

Operation	Controls
Use as a solvent in plastic industry; manufacture of lacquers and varnishes; as a co-solvent with cyclohexanone	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment
Use in leather industry; use as a rust remover	Process enclosure; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• **Eye Exposure**

If liquid o-methylcyclohexanone gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

If liquid o-methylcyclohexanone gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If liquid o-methylcyclohexanone soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• **Breathing**

If a person breathes in large amounts of o-methylcyclohexanone, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Swallowing**

When o-methylcyclohexanone has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If o-methylcyclohexanone is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and reclaimed or atomized in a suitable combustion chamber. o-Methylcyclohexanone should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive concentrations of o-methylcyclohexanone vapors are permitted.

• Waste disposal methods:

o-Methylcyclohexanone may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.
2. By atomizing in a suitable combustion chamber.

REFERENCES

• American Conference of Governmental Industrial Hygienists: "o-Methylcyclohexanone," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.

• Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.

• Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.

• Sax, N. I.: *Dangerous Properties of Industrial Materials* (3rd ed.), Van Nostrand Reinhold, New York, 1968.

• Treon, J. F., et al.: "The Physiological Response of Rabbits to Cyclohexane, Methylcyclohexane, and Certain Derivatives of These Compounds. I. Oral Adminis-

Freedom_0007521_0006

tration and Cutaneous Application," *Journal of Industrial Hygiene and Toxicology*, 25:199-214, 1943.
• Treon, J. F., et al.: "The Physiological Response of Rabbits to Cyclohexane, Methylcyclohexane, and Certain Derivatives of These Compounds. II. Inhalation," *Journal of Industrial Hygiene and Toxicology*, 25:323-347, 1943.

RESPIRATORY PROTECTION FOR o-METHYLCYCLOHEXANONE

Condition	Minimum Respiratory Protection* Required Above 100 ppm
Vapor Concentration	
1000 ppm or less	Any chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s).
2500 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 2500 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Freedom_0007521_0007

tration and Cutaneous Application," *Journal of Industrial Hygiene and Toxicology*, 25:199-214, 1943.
• Treon, J. F., et al.: "The Physiological Response of Rabbits to Cyclohexane, Methylcyclohexane, and Certain Derivatives of These Compounds. II. Inhalation," *Journal of Industrial Hygiene and Toxicology*, 25:323-347, 1943.

RESPIRATORY PROTECTION FOR o-METHYLCYCLOHEXANONE

Condition	Minimum Respiratory Protection* Required Above 100 ppm
Vapor Concentration	
1000 ppm or less	Any chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s).
2500 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 2500 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Freedom_0007521_0008