

OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR COBALT HYDROCARBONYL

INTRODUCTION

This guideline summarizes pertinent information about cobalt hydrocarbonyl (measured as cobalt) for workers and employers as well as for physicians, industrial hygienists, and other occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether new information is available.

SUBSTANCE IDENTIFICATION

• Formula



• Synonyms

Tetracarbonylhydrocobalt; hydridotetracarbonyl cobalt; hydrocobalt tetracarbonyl; tetracarbonylhydridocobalt

• Identifiers

1. CAS No.: 16842-03-8
2. RTECS No.: GG0900000
3. DOT UN: 1954 22 (Flammable gas, n.o.s.)
4. DOT label: Flammable gas

• Appearance and odor

Cobalt hydrocarbonyl is a flammable gas that is unstable and decomposes rapidly at room temperature.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 171.98
2. Boiling point (760 mm Hg): Data not available
3. Specific gravity: Data not available
4. Relative gas density: 5.93
5. Freezing point: -26.2°C (-15.2°F)
6. Vapor pressure at 20°C (68°F): >1 atm
7. Solubility: Sparingly soluble in water
8. Evaporation rate: Not applicable

• Reactivity

1. Conditions contributing to instability: Contact of cobalt hydrocarbonyl with air causes decomposition.
2. Incompatibilities: None reported
3. Hazardous decomposition products: Toxic gases (such as carbon monoxide) may be released in a fire involving cobalt hydrocarbonyl.
4. Special precautions: None reported

• Flammability

The National Fire Protection Association has not assigned a flammability rating for cobalt hydrocarbonyl; however, this substance is flammable.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health
Education and Information Division

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

1. Flash point: Not applicable (Flammable gas)
2. Autoignition temperature: Data not available
3. Flammable limits in air: Data not available
4. Extinguishant: Use dry chemical or carbon dioxide for small fires and water spray or fog for large fires.

Fires involving cobalt hydrocarbonyl should be fought upwind from the maximum distance possible. Isolate the hazard area and deny access to unnecessary personnel. Emergency personnel should stay out of low areas and ventilate closed spaces before entering. Vapor explosion and poison hazards may occur indoors, outdoors, or in sewers. Vapors may travel to a source of ignition and flash back. Containers of cobalt hydrocarbonyl may explode in the heat of the fire and should be moved from the fire area if it is possible to do so safely. If this is not possible, cool containers from the sides with water until well after the fire is out. Stay away from the ends of containers. Personnel should withdraw immediately if they hear a rising sound from a venting safety device or if a container becomes discolored as a result of fire. Dikes should be used to contain fire-control water for later disposal. If a tank car or truck is involved in a fire, personnel should isolate an area of a half mile in all directions, and let the tank car or truck burn unless the leak can be stopped. Firefighters should wear a full set of protective clothing and self-contained breathing apparatus when fighting fires involving cobalt hydrocarbonyl. Structural firefighters' protective clothing will provide limited protection.

EXPOSURE LIMITS

• OSHA PEL

The Occupational Safety and Health Administration (OSHA) has not promulgated a permissible exposure limit (PEL) for cobalt hydrocarbonyl [29 CFR 1910.1000, Table Z-1].

• NIOSH REL

The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) of 0.1 mg/m³ as a TWA for up to a 10-hr workday and a 40-hr workweek [NIOSH 1992].

• ACGIH TLV

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned cobalt hydrocarbonyl a threshold limit value (TLV) of 0.1 mg/m³ as a TWA for a normal 8-hr workday and a 40-hr workweek [ACGIH 1993].

• Rationale for limits

The NIOSH limit is based on the risk of respiratory irritation associated with exposure to cobalt hydrocarbonyl. The ACGIH limit is based on the risk of lung, liver, and kidney effects associated with exposure to cobalt hydrocarbonyl.

HEALTH HAZARD INFORMATION

• Routes of exposure

Exposure to cobalt hydrocarbonyl can occur through inhalation and eye or skin contact.

• Summary of toxicology

1. *Effects on Animals:* In animals, cobalt hydrocarbonyl affects the respiratory system. The 2-hr LC₅₀ for cobalt hydrocarbonyl is 46.2 mg/m³ in rats and 17.5 mg/m³ in mice [NIOSH 1993]. Acutely poisoned animals showed signs of chemical pneumonitis before death [Palmer et al. 1959]. Dogs, rats, and guinea pigs exposed 6-hr/day on 71 occasions within a 3-month period to cobalt hydrocarbonyl decomposition products at an average cobalt concentration of 9 mg/m³ showed elevated hemoglobin levels (rats) and foam cell aggregates in the lungs; these signs disappeared after the cessation of exposure [Palmer et al. 1959].

2. *Effects on Humans:* No adverse effects of exposure to cobalt hydrocarbonyl have been reported in humans.

• Signs and symptoms of exposure

1. *Acute or sub-chronic exposure:* Based on effects seen in animals, subchronic exposure to cobalt hydrocarbonyl may cause difficult breathing, coughing, reduced lung function, and fluid in the lungs.

2. *Chronic exposure:* No signs or symptoms of chronic exposure to cobalt hydrocarbonyl have been reported.

• **Emergency procedures**

WARNING!

Seek immediate medical attention for severely affected victims or for victims with signs and symptoms of toxicity or irritation!

Keep unconscious victims warm and on their sides to avoid choking if vomiting occurs. Initiate the following emergency procedures:

1. *Eye exposure:* Irritation may result. **Immediately and thoroughly** flush the eyes with large amounts of water, occasionally lifting the upper and lower eyelids.
2. *Skin exposure:* Irritation may result. **Thoroughly** wash contaminated skin with soap and water.
3. *Inhalation exposure:* Move the victim to fresh air **immediately**.

If the victim is not breathing, clean any chemical contamination from the victim's lips and perform cardiopulmonary resuscitation (CPR); if breathing is difficult, give oxygen.
4. *Rescue:* Remove an incapacitated worker from further exposure and implement appropriate emergency procedures (e.g., those listed on the material safety data sheet required by OSHA's hazard communication standard [29 CFR 1910.1200]). All workers should be familiar with emergency procedures and the location and proper use of emergency equipment.

EXPOSURE SOURCES AND CONTROL METHODS

The following operations may involve cobalt hydrocarbonyl and may result in worker exposures to this substance:

- Manufacture of cobalt hydrocarbonyl
- Use as a catalyst

The following are methods that are effective in controlling worker exposures to cobalt hydrocarbonyl, depending on the feasibility of implementation:

- Process enclosure

- Local exhaust ventilation
- General dilution ventilation
- Personal protective equipment

Good sources of information about control methods are as follows:

1. ACGIH [1992]. *Industrial ventilation—a manual of recommended practice*. 21st ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
2. Burton DJ [1986]. *Industrial ventilation—a self study companion*. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
3. Alden JL, Kane JM [1982]. *Design of industrial ventilation systems*. New York, NY: Industrial Press, Inc.
4. Wadden RA, Scheff PA [1987]. *Engineering design for control of workplace hazards*. New York, NY: McGraw-Hill.
5. Plog BA [1988]. *Fundamentals of industrial hygiene*. Chicago, IL: National Safety Council.

MEDICAL MONITORING

Workers who may be exposed to chemical hazards should be monitored in a systematic program of medical surveillance that is intended to prevent occupational injury and disease. The program should include education of employers and workers about work-related hazards, early detection of adverse health effects, and referral of workers for diagnosis and treatment. The occurrence of disease or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical monitoring program is intended to supplement, not replace, such measures. To place workers effectively and to detect and control work-related health effects, medical evaluations should be performed (1) before job placement, (2) periodically during the term of employment, and (3) at the time of job transfer or termination.

• **Preplacement medical evaluation**

Before a worker is placed in a job with a potential for exposure to cobalt hydrocarbonyl, the licensed health

care professional should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on the function and integrity of the respiratory system. Medical monitoring for respiratory disease should be conducted using the principles and methods recommended by the American Thoracic Society [ATS 1987].

A preplacement medical evaluation is recommended to detect and assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to cobalt hydrocarbonyl at or below the prescribed exposure limit. The licensed health care professional should consider the probable frequency, intensity, and duration of exposure as well as the nature and degree of any applicable medical condition. Such conditions (which should not be regarded as absolute contraindications to job placement) include a history and other findings consistent with diseases of the respiratory system.

• Periodic medical examinations and biological monitoring

Occupational health interviews and physical examinations should be performed at regular intervals during the employment period, as mandated by any applicable Federal, State, or local standard. Where no standard exists and the hazard is minimal, evaluations should be conducted every 3 to 5 years or as frequently as recommended by an experienced occupational health physician. Additional examinations may be necessary if a worker develops symptoms attributable to cobalt hydrocarbonyl exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of cobalt hydrocarbonyl on the respiratory system. Current health status should be compared with the baseline health status of the individual worker or with expected values for a suitable reference population.

Biological monitoring involves sampling and analyzing body tissues or fluids to provide an index of exposure to a toxic substance or metabolite. No biological monitoring test acceptable for routine use has yet been developed for cobalt hydrocarbonyl.

• Medical examinations recommended at the time of job transfer or termination

The medical, environmental, and occupational history interviews, the physical examination, and selected phys-

iological or laboratory tests that were conducted at the time of placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared with those expected for a suitable reference population.

WORKPLACE MONITORING AND MEASUREMENT

A worker's exposure to airborne cobalt hydrocarbonyl (measured as cobalt) is determined by using a mixed cellulose ester filter (MCEF) (0.8 micron). Samples are collected at a recommended flow rate of 2.0 liters/min until a recommended air volume of 960 liters is collected. Analysis is conducted by atomic absorption spectroscopy for total cobalt. This method is described in the OSHA Laboratory In-House Methods File [OSHA 1989].

PERSONAL HYGIENE

If cobalt hydrocarbonyl contacts the skin, the victim should immediately and thoroughly wash the affected areas with soap and water.

Clothing contaminated with cobalt should be removed immediately.

A worker who is exposed to cobalt hydrocarbonyl should thoroughly wash hands, forearms, and face with soap and water before eating, using tobacco products, using toilet facilities, or applying cosmetics.

Workers should not eat, drink, use tobacco products, or apply cosmetics in areas where cobalt hydrocarbonyl is generated.

STORAGE

Cobalt hydrocarbonyl should be stored in a cool, dry, well-ventilated area in tightly sealed containers that are labeled in accordance with OSHA's hazard communication standard [29 CFR 1910.1200]. Containers of cobalt hydrocarbonyl should be protected from physical damage and should be stored separately from air, heat, sparks, and open flame.

LEAKS

In the event of a leak involving cobalt hydrocarbonyl, persons not wearing protective equipment and clothing

should be restricted from contaminated areas until cleanup has been completed. The following steps should be undertaken following a leak:

1. Notify safety personnel.
2. Remove all sources of heat and ignition.
3. Ventilate potentially explosive atmospheres.

SPECIAL REQUIREMENTS

U.S. Environmental Protection Agency (EPA) requirements for emergency planning, reportable quantities of hazardous releases, community right-to-know, and hazardous waste management may change over time. Users are therefore advised to determine periodically whether new information is available.

• Emergency planning requirements

Cobalt hydrocarbonyl is not subject to EPA emergency planning requirements under the Superfund Amendments and Reauthorization Act (SARA) [42 USC 11022].

• Reportable quantity requirements for hazardous releases

Employers are not required by the emergency release notification provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [40 CFR 355.40] to notify the National Response Center of an accidental release of cobalt hydrocarbonyl; there is no reportable quantity for this substance.

• Community right-to-know requirements

Employers are not required by Section 313 of SARA to submit a Toxic Chemical Release Inventory Form (Form R) to EPA reporting the amount of cobalt hydrocarbonyl emitted or released from their facility annually.

• Hazardous waste management requirements

EPA considers a waste to be hazardous if it exhibits any of the following characteristics: ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR 261.21-261.24. Although cobalt hydrocarbonyl is not specifically listed as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) [42 USC 6901

et seq.], EPA requires employers to treat waste as hazardous if it exhibits any of the characteristics discussed above.

Providing detailed information about the removal and disposal of specific chemicals is beyond the scope of this guideline. The U.S. Department of Transportation, EPA, and State and local regulations should be followed to ensure that removal, transport, and disposal of this substance are conducted in accordance with existing regulations. To be certain that chemical waste disposal meets EPA regulatory requirements, employers should address any questions to the RCRA hotline at (800) 424-9346 or at (202) 382-3000 in Washington, D.C. In addition, relevant State and local authorities should be contacted for information about their requirements for waste removal and disposal.

RESPIRATORY PROTECTION

• Conditions for respirator use

Good industrial hygiene practice requires that engineering controls be used where feasible to reduce workplace concentrations of hazardous materials to the prescribed exposure limit. However, some situations may require the use of respirators to control exposure. Respirators must be worn if the ambient concentration of cobalt hydrocarbonyl exceeds prescribed exposure limits. Respirators may be used (1) before engineering controls have been installed, (2) during work operations such as maintenance or repair activities that involve unknown exposures, (3) during operations that require entry into tanks or closed vessels, and (4) during emergencies. Workers should use only respirators that have been approved by NIOSH and the Mine Safety and Health Administration (MSHA).

• Respiratory protection program

Employers should institute a complete respiratory protection program that, at a minimum, complies with the requirements of OSHA's respiratory protection standard [29 CFR 1910.134]. Such a program must include respirator selection, an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, respirator fit testing, periodic workplace monitoring, and regular respirator maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program (including selection of the correct respirator) requires that a knowl-

edgeable person be in charge of the program and that the program be evaluated regularly. For additional information about the selection and use of respirators and about the medical screening of respirator users, consult the *NIOSH Respirator Decision Logic* [NIOSH 1987b] and the *NIOSH Guide to Industrial Respiratory Protection* [NIOSH 1987a].

PERSONAL PROTECTIVE EQUIPMENT

Protective clothing should be worn to prevent skin contact with cobalt hydrocarbonyl. Chemical protective clothing should be selected on the basis of available performance data, manufacturers' recommendations, and evaluation of the clothing under actual conditions of use. No reports have been published on the resistance of various protective clothing materials to cobalt hydrocarbonyl permeation. If permeability data are not readily available, protective clothing manufacturers should be requested to provide information on the best chemical protective clothing for workers to wear when they are exposed to cobalt hydrocarbonyl.

Safety glasses, goggles, or face shields should be worn during operations in which cobalt hydrocarbonyl might contact the eyes. Eyewash fountains and emergency showers should be available within the immediate work area whenever the potential exists for eye or skin contact with cobalt hydrocarbonyl.

REFERENCES CITED

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