International Chemical Safety Cards

OZONE

ICSC: 0068

O_3
Molecular mass: 48.0
(cylinder)

ICSC # 0068
CAS # 10028-15-6
RTECS # RS8225000

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible but enhances combustion of other substances. Many reactions may cause fire or explosion.	NO open flames, NO sparks, and NO smoking. NO contact with combustible substances.	In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION	Risk of fire and explosion when heated or on contact with combustible substances (alkene, ethers).	Closed system, ventilation, explosion-proof electrical equipment and lighting.	In case of fire: keep cylinder cool by spraying with water. Combat fire from a sheltered position.
EXPOSURE		STRICT HYGIENE!	
•INHALATION	Cough. Headache. Shortness of breath. Sore throat.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Half-upright position. Artificial respiration if indicated. Refer for medical attention.
•SKIN	ON CONTACT WITH LIQUID: FROSTBITE.	Cold-insulating gloves.	ON FROSTBITE: rinse with plenty of water, do NOT remove clothes. Refer for medical attention.
•EYES	Redness. Pain. Loss of vision.	Face shield or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION			

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Consult an expert! Ventilation. If in liquid state: NEVER direct water jet on liquid (extra personal protection: self-contained breathing	Fireproof if in building. Separated from all substances. Cool. Ozone is frequently stored refrigerated in halons.	R: S:

apparatus).		

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0068	Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1998. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

OZONE

ICSC: 0068

I	**PHYSICAL STATE; APPEARANCE:**	**ROUTES OF EXPOSURE:** The substance can be absorbed into
PHYSICAL PROPERTIES	Boiling point: -112°C Melting point: -193°C	Solubility in water, g/100 ml at 0°C: 0.1 Relative vapour density (air = 1): 1.6
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to vegetation.	

N O T E S

The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential. Immediate administration of an appropriate spray, by a doctor or a person authorized by him/her, should be

Turn leaking cylinder with the leak up to prevent escape of gas in liquid state.

ADDITIONAL INFORMATION	

ICSC: 0068 **OZONE**

IMPORTANT LEGAL NOTICE:	Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

NIOSH Pocket Guide to Chemical Hazards

Ozone	**CAS** 10028-15-6
O_3	**RTECS** RS8225000
Synonyms & Trade Names Triatomic oxygen	**DOT ID & Guide**

Exposure Limits	NIOSH REL: C 0.1 ppm (0.2 mg/m^3)
	OSHA PEL†: TWA 0.1 ppm (0.2 mg/m^3)

IDLH 5 ppm See: 10028156	**Conversion** 1 ppm = 1.96 mg/m^3

Physical Description
Colorless to blue gas with a very pungent odor.

MW: 48.0	BP: -169°F	FRZ: -315°F	Sol(32°F): 0.001%
VP: >1 atm	IP: 12.52 eV	RGasD: 1.66	
Fl.P: NA	UEL: NA	LEL: NA	

Nonflammable Gas, but a powerful oxidizer.

Incompatibilities & Reactivities
All oxidizable materials (both organic & inorganic)

Measurement Methods
OSHA ID214
See: NMAM or OSHA Methods

Personal Protection & Sanitation Skin: No recommendation Eyes: No recommendation Wash skin: No recommendation Remove: No recommendation Change: No recommendation	**First Aid** (See procedures) Eye: Medical attention Breathing: Fresh air; 100% O_2

Respirator Recommendations NIOSH/OSHA
Up to 1 ppm: (APF = 10) Any chemical cartridge respirator with cartridge(s) providing protection against the compound of concern¿/(APF = 10) Any supplied-air respirator
Up to 2.5 ppm: (APF = 25) Any supplied-air respirator operated in a continuous-flow mode/(APF = 25) Any powered, air-purifying respirator with cartridge(s) providing protection against the compound of concern¿
Up to 5 ppm: (APF = 50) Any chemical cartridge respirator with a full facepiece and cartridge(s) providing protection against the compound of concern¿/(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern¿/(APF = 50) Any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous-flow mode/(APF = 50) Any self-contained breathing apparatus with a full facepiece/(APF = 50) Any supplied-air respirator with a full facepiece
Emergency or planned entry into unknown concentrations or IDLH conditions: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full

facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern¿/Any appropriate escape-type, self-contained breathing apparatus
Exposure Routes inhalation, skin and/or eye contact
Symptoms Irritation eyes, mucous membrane; pulmonary edema; chronic respiratory disease
Target Organs Eyes, respiratory system
See also: INTRODUCTION See ICSC CARD: 0068 See MEDICAL TESTS: 0172

Ozone

IDLH Documentation

CAS number: 10028156
NIOSH REL: 0.1 ppm (0.2 mg/m^3) CEILING
Current OSHA PEL: 0.1 ppm (0.2 mg/m^3) TWA
1989 OSHA PEL: 0.1 ppm (0.2 mg/m^3) TWA, 0.3 ppm (0.6 mg/m^3) STEL
1993-1994 ACGIH TLV: 0.1 ppm (0.2 mg/m^3) CEILING
Description of substance: Colorless to blue gas with a very pungent odor.
LEL: . . Nonflammable Gas
Original (SCP) IDLH: 10 ppm
Basis for original (SCP) IDLH: The chosen IDLH is based on the statement by AIHA [1966] that pulmonary edema developed in welders who had a severe acute exposure to an estimated 9 ppm ozone plus other air pollutants [Kleinfeld et al. 1957]. Patty [1963] reported that 15 to 20 ppm is lethal to small animals within 2 hours [Witheridge and Yaglou 1937]. AIHA [1966] also reported that on the basis of animal data, exposure at 50 ppm for 60 minutes will probably be fatal to humans [King 1963].
Existing shortterm exposure guidelines: National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):
1hour EEGL: 1 ppm
24hour EEGL: 0.1 ppm

ACUTE TOXICITY DATA:
Lethal concentration data:

Species	Reference	LC_{50} (ppm)	LC_{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
Mouse	Clamann & Bancroft 1957					
Human	Deichmann & Gerarde 1969					
Rabbit	Mittler et al. 1956	-----	12.6	3 hr	23 ppm (1.8)	2.3 ppm
		-----	50	30 min	50 ppm (1.0)	5.0 ppm
Mouse	Mittler et al. 1956	-----	36	3 hr	65 ppm (1.8)	6.5 ppm
		-----	21	3 hr	38 ppm (1.8)	3.8 ppm
Rat	Mittler et al. 1956	-----	21.8	3 hr	39 ppm (1.8)	3.9 ppm
		-----	24.8	3 hr	45 ppm (1.8)	4.5 ppm
G. pig	Mittler et al. 1957	-----	4.8	4 hr	10 ppm (2.0)	1.0 ppm
Rat	Stokinger 1957					

Other animal data: It has been reported that 15 to 20 ppm is lethal to small animals within 2 hours [Witheridge and Yaglou 1937].
Human data: Pulmonary edema developed in welders who had a severe acute exposure to an estimated 9 ppm ozone plus other air pollutants [Kleinfeld et al. 1957]. It has been reported that on the basis of animal data, exposure at 50 ppm for 60 minutes will probably be fatal to humans [King 1963].

Revised IDLH: 5 ppm

Basis for revised IDLH: The revised IDLH for ozone is 5 ppm based on acute inhalation toxicity data in humans [Deichmann and Gerarde 1969; Kleinfeld et al. 1957].

REFERENCES:

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OSHA comments from the January 19, 1989 Final Rule on Air Contaminants Project extracted from 54FR2332 et. seq. This rule was remanded by the U.S. Circuit Court of Appeals and the limits are not currently in force.

OZONE

CAS: 10028-15-6; Chemical Formula: O_3

The former OSHA PEL for ozone was 0.1 ppm TWA. In the interval since this limit was adopted in 1971, the ACGIH has recommended that 15-minute short-term exposures to ozone not exceed 0.3 ppm. NIOSH has no REL for ozone. OSHA proposed, and the final rule establishes, permissible exposure limits of 0.1 ppm TWA and 0.3 ppm STEL for ozone. The Agency notes that the ACGIH has placed ozone on its 1988-89 Notice of Intended Changes and is proposing a new TLV of 0.1 ppm as a ceiling value. Ozone is a liquid or an explosive gas.

Ozone is highly injurious and lethal in experimental animals at concentrations as low as a few parts per million (Stokinger 1957/Ex. 1-97). A study in which young mice were exposed to 1 ppm ozone for one or two days reported damage to alveolar tissue (Bils 1970/Ex. 1-58). Human populations chronically exposed to lower concentrations of ozone have been observed to have changes in lung function. In one study, human volunteers exposed to 0.5 ppm ozone for three hours per day, six days per week, for 12 weeks showed significant changes in lung function (Jaffe 1967/Ex. 1-101). Other authors reported a 20-percent reduction in timed vital capacity in persons exposed to average concentrations of ozone of 1.5 ppm (range not indicated) for two hours (Griswold, Chambers, and Motley 1957/Ex. 1-128). Welders exposed to maximal ozone concentrations of 9 ppm were observed to have pulmonary congestion (Kleinfeld and Giel 1956/Ex. 1-120).

OSHA received a number of comments on the proposed PEL for ozone. The Edison Electric Institute (EEI) (Ex. 133A, pp. 22-23) stated that the studies by Bils (1970/Ex. 1-58), Jaffe (1967/Ex. 1-101), and Griswold et al. (1957/Ex. 1-128), cited above, do not provide substantial evidence for the proposed PEL. With regard to Bils' (1970/Ex. 1-58) finding of damaged alveolar tissue in mice exposed to a 1-ppm concentration of ozone for one or two days, EEI notes that "OSHA does not explain how these data can be translated to humans in the workplace" (Ex. 133A, p. 22). In addition, EEI is concerned that "OSHA neither critically evaluates...nor explains why the changes in lung function reported by [the Jaffe (1967/ Ex. 1-101)] study represent a significant risk...," and OSHA has not presented a substitute for a STEL of 0.3 ppm. Finally, EEI questions the relevance of the study by Griswold et al. (1957/Ex. 1-128) to the formulation of the proposed PEL (Ex. 133A, p. 23). The Agency believes that these three studies point to the short-term effect (i.e., less than eight hours) of ozone exposure; the Bils (1970/Ex. 1-58) data demonstrate that the lung is the target organ; the Jaffe (1967/Ex. 1-101) data point to an effect level of 0.5 ppm and show that a STEL of 0.3 ppm will afford protection; and the Griswold et al. (1957/Ex. 1-128) data provide further evidence of reduced lung function as a result of short-term, acute exposure, rather than chronic exposure.

In addition, EEI commented that "OSHA's health assessment and feasibility analysis with respect to the facilities of the electric utility industry are deficient. Thus, EEI recommends that OSHA consider explaining that its ozone proposal does not apply to that industry" (Ex. 133A, p. 22). This same concern was reflected in the submission of the second commenter, Gulf Power Company (Ex. 3-938, p. 3). In response to these comments, OSHA emphasizes that the standards established in this rulemaking are based on the evidence of adverse health effects associated with exposure to toxic substances in the workplace. These effects would be the same, regardless of industry sector, if the exposure levels were the same. If, as EEI and Gulf Power Company contend, ozone exposures in power plants pose no significant risk to workers' health because they are controlled at or below the permissible exposure limits being promulgated in this rulemaking, then the electric utility industry is already in compliance and will not be impacted by the new PELs. The Agency has determined that the scientific evidence establishes the need for a short-term limit to substantially reduce the significant risk of pulmonary dysfunction that exists as a result of acute or chronic intermittent exposure to ozone.

The Gulf Power Company also expressed its belief that the 0.3-ppm short-term limit proposed by OSHA is unsubstantiated:

> Exposing someone to 1 ppm of ozone for 15 minutes may be just as valid a ceiling limit as 0.3 ppm.... We think that it is arbitrary to select a value of 0.3 ppm without further study (Ex. 3-938, pp. 3-4; see also Ex. 3-1144).

The Agency notes, again, that an effect level of 0.5 ppm is demonstrated by the Jaffe (1967/Ex. 1-101) data. Further justification for a STEL of 0.3 ppm is found in Proctor, Hughes, and Fischman (Chemical Hazards of the Workplace, 2nd ed., 1988), who report that, "except for one report, the threshold for effects in humans appears to be between 0.2 and 0.4 ppm" (Menzel 1984, as cited in Proctor, Hughes, and Fischman 1988, p. 388). The selection of 0.3 ppm as a short-term limit was neither invalid nor arbitrary, but rather, was based on the best available scientific evidence.

NIOSH (Ex. 8-47, Table N2) believes that ozone's toxicity requires an even more stringent limit. According to NIOSH, "Ozone is a chemical capable of inducing serious adverse health effects at low exposure concentrations, tenths of a part per million...." The AFL-CIO (Ex. 194) agrees with NIOSH's assessment. OSHA agrees that ozone's health effects require a protective limit, and it is for this reason that the final rule promulgates TWA and STEL limits for ozone.

In the final rule, OSHA is retaining the 8-hour TWA limit of 0.1 ppm and establishing a 15-minute STEL of 0.3 ppm for ozone based on observations that significant declines in pulmonary function can result from repeated intermittent exposures or even from a single short-term exposure (Bils 1970/Ex. 1-58; Jaffe 1967/Ex. 1-101; Griswold, Chambers, and Motley 1957/Ex. 1-128). OSHA believes that, in the absence of a STEL, employees will continue to be at significant risk of material impairment in pulmonary functional capacity associated with short-term exposures that could occur if exposures are controlled only by an 8-hour TWA. Thus the Agency concludes that it is necessary to supplement the former PEL with a STEL of 0.3 ppm to substantially reduce this risk.