Formaldehyde

Incident management

Key Points

Fire

- Flammable
- Reactive with strong oxidising agents, bases and acrylonitrile
- Emits toxic fumes of carbon monoxide and carbon dioxide when heated to decomposition; and hydrogen gas on reaction with strong bases
- In the event of a fire involving formaldehyde, use alcohol resistant foam, or normal foam if not available, and liquid tight protective clothing with breathing apparatus

Health

- Due to its gaseous nature, inhalation and ocular exposure are most likely
- Inhalation of formaldehyde can lead to irritation of the mucous membranes and respiratory tract. In severe cases laryngeal and pulmonary oedema, pneumonitis and acute respiratory distress syndrome may occur.
- Ingestion of concentrated formaldehyde solutions can cause burns and ulceration to the GI tract. Common features are a burning sensation in the mouth and throat, chest or abdominal pain, nausea, vomiting, diarrhoea and GI haemorrhage.
- Dermal exposure to formaldehyde solutions may cause skin irritation
- Formaldehyde is irritating to the eyes

Environment

- Avoid release into the environment
- Inform Environment Agency of substantial incidents

CRCE HQ, HPA
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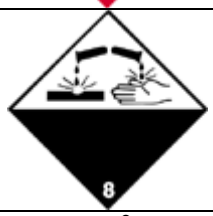
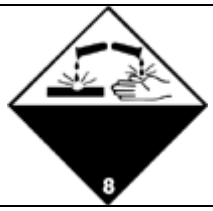
Version 2

Hazard Identification

Standard (UK) Dangerous Goods Emergency Action Codes[a]

UN		**1198**	Formaldehyde solution, flammable	
EAC		**•2W**	Use alcohol resistant foam but, if not available, fine water spray can be used. Wear liquid-tight chemical protective clothing in combination with breathing apparatus*. Danger that the substance can be violently or explosively reactive. Spillages and decontamination run-off should be prevented from entering drains and watercourses.	
APP		**A(fl)**	Gas-tight chemical protective suit with breathing apparatus **	
Hazards	**Class**	**3**	Flammable liquid	
	Sub risks	**8**	Corrosive substance	
HIN		**38**	Flammable liquid (flash point between 23°C and 60°C inclusive), slightly corrosive or self-heating liquid, corrosive	

UN		**2209**	Formaldehyde solution, with not less than 25 % formaldehyde	
EAC		**•2X**	Use alcohol resistant foam but, if not available, fine water spray can be used. Wear liquid-tight chemical protective clothing in combination with breathing apparatus*. Spillages and decontamination run-off should be prevented from entering drains and watercourses.	
APP		**-**		
Hazards	**Class**	**8**	Corrosive substance	
	Sub risks	**-**		
HIN		**80**	Corrosive or slightly corrosive substance	

UN – United Nations number; EAC – Emergency Action Code; APP – Additional Personal Protection; HIN - Hazard Identification Number

[a] Dangerous Goods Emergency Action Code List 2011. National Chemical Emergency Centre (NCEC). The Stationary Office, London.

*Liquid-tight chemical protective clothing (BS 8428or EN 14605) in combination with self-contained open circuit positive pressure compressed air breathing apparatus (BS EN 137).

** Gas-tight chemical protective clothing conforming to BS EN 943 part 2 in combination with self-contained open circuit positive pressure compressed air breathing apparatus to BS EN 137.

Chemical Hazard Information and Packaging for Supply Classification[(a)]

Classification	**Carc. Cat 3**	Category 3 carcinogen	
	T	Toxic	
	C	Corrosive	
Risk phrases	**R23/24/25**	Toxic by inhalation, in contact with skin and if swallowed	
	R34	Causes burns	
	R40	Limited evidence of a carcinogenic effect	
	R43	May cause sensitisation by skin contact	
Safety phrases	**S1/2**	Keep locked up and out of the reach of children	
	S26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice	
	S36/37/39	Wear suitable protective clothing, gloves and eye/face protection	
	S45	In case of accident or if you feel unwell seek medical advice immediately (show the label where possible)	
	S51	Use only in well-ventilated areas	

Specific concentration limits

Concentration	Classification
C ≥25 %	T; R23/24/25
5 % ≤ C < 25 %	Xn; R20/21/22
C ≥25 %	C; R34
5 % ≤ C < 25 %	Xi; R36/37/38
C ≥ 0,2 %	R43

[a] Annex VI to Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures- Table 3.2.
http://esis.jrc.ec.europa.eu/index.php?PGM=cla (accessed 03/2012)

Globally Harmonised System of Classification and Labelling of Chemicals (GHS)[a]

Hazard Class and Category	Carc. 2	Carcinogenicity, category 2	
	Acute Tox. 3	Acute toxicity, category 3	
	Skin Corr. 1B	Skin corrosion, category 1B	
	Skin Sens. 1	Skin sensitizer, category 1	
Hazard Statement	**H351**	Suspected of causing cancer	
	H331	Toxic if inhaled	
	H311	Toxic in contact with skin	
	H301	Toxic if swallowed	
	H314	Causes severe skin burns and eye damage	
	H317	May cause an allergic skin reaction	
Signal Words	DANGER		

Implemented in the EU on 20 January 2009.

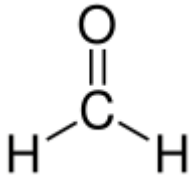
Specific concentration limits

Concentration	Hazard Class and Category	Hazard Statement	
C ≥ 25 %	Skin Corr. 1B	**H314**	Causes severe skin burns and eye

[a] Annex VI to Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures- Table 3.1.
http://esis.jrc.ec.europa.eu/index.php?PGM=cla (accessed 03/2012)

			damage
5 % ≤ C < 25 %	Skin Irrit. 2	**H315**	Causes skin irritation
5 % ≤ C < 25 %	Eye Irrit. 2	**H319**	Causes serious eye irritation
C ≥ 5 %	STOT SE 3	**H335**	May cause respiratory irritation
C ≥ 0,2 %	Skin Sens. 1	**H317**	May cause an allergic skin reaction

Physicochemical Properties

CAS number	50-00-0
Molecular weight	30
Empirical formula	CH_2O
Common synonyms	Methanal; Methylene glycol; Oxomethane; Methylene oxide; Methyl aldehyde
State at room temperature	Gas
Volatility	Vapour pressure 3,890 mm Hg at 25°C
Specific gravity	1.1 at 25°C (air = 1)
Flammability	Flammable
Lower explosive limit	7.0%
Upper explosive limit	73.0%
Water solubility	Soluble in water at 25°C
Reactivity	Reactive. Formaldehyde can react violently with strong oxidising agents, causing risk of fire and explosion. Reacts with strong bases, producing hydrogen gas which is flammable. Reacts violently with acrylonitrile
Reaction or degradation products	Releases toxic fumes of carbon monoxide and carbon dioxide when heated to decomposition. Produces hydrogen gas on reaction with strong bases
Odour	Pungent, suffocating
Structure	

References[a,b,c]

[a] Formaldehyde (HAZARDTEXT® Hazard Management). In: Klasco RK (Ed): TOMES® System, Thomson Micromedex, Greenwood Village, Colorado, USA. (electronic version). RightAnswer.com, Inc., Midland, MI, USA, Available at: http://www.rightanswerknowledge.com/data/dt/dt149.htm (accessed 01/2012).

[b] The Merck Index (14th Edition). Entry 4235: Formaldehyde, 2006.

[c] The Dictionary of Substances and their Effects. Ed. S Gangolli. Second Edition, Volume 4, 1999.

Threshold Toxicity Values

EXPOSURE VIA INHALATION			
ppm	**mg m^{-3}**	**SIGNS AND SYMPTOMS**	
0.05	**0.06**	Slight eye irritation	a
0.08 – 2.5	**0.1 - 3**	Throat and upper respiratory tract irritation	a
>5	**>6**	Lower airway and pulmonary irritation	a

[a] International Programme on Chemical Safety, Environmental Health Criteria 89: Formaldehyde, 1989.

Published Emergency Response Guidelines

Emergency Response Planning Guideline (ERPG) Values[a]

	Listed value (ppm)	Calculated value (mg m^{-3})
ERPG-1*	1	1.2
ERPG-2**	10	12
ERPG-3***	40	48

***** Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odour.
****** Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.
******* Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing life-threatening health effects.

Interim Acute Exposure Guideline Levels (AEGLs)[b]

	ppm				
	10 min	**30 min**	**60 min**	**4 hr**	**8 hr**
AEGL-1†	0.9	0.9	0.9	0.9	0.9
AEGL-2††	14	14	14	14	14
AEGL-3†††	100	70	56	35	35

† The level of the chemical in air at or above which the general population could experience notable discomfort.
†† The level of the chemical in air at or above which there may be irreversible or other serious long-lasting effects or impaired ability to escape.
††† The level of the chemical in air at or above which the general population could experience life-threatening health effects or death.

[a] American Industrial Hygiene Association (AIHA). 2011 Emergency Response Planning Guideline Values. http://www.aiha.org/insideaiha/GuidelineDevelopment/ERPG/Documents/2011erpgweelhandbook_table-only.pdf (accessed 03/2012).
[b] U.S. Environmental Protection Agency. Acute Exposure Guideline Levels, http://www.epa.gov/oppt/aegl/pubs/chemlist.htm (accessed 03/2012).

Exposure Standards, Guidelines or Regulations

Occupational standards

WEL[a] http://www.hse.gov.uk/	LTEL(8 hour reference period): 2 ppm (2.5 mg m^{-3})
	STEL(15 min reference period): 2 ppm (2.5 mg m^{-3})

Public health guidelines

DRINKING WATER QUALITY GUIDELINE[b] http://www.who.int/en/	No formal guideline value specified
AIR QUALITY GUIDELINE[c] http://www.who.int/en/	0.1 mg m^{-3} as a 30 minute average
SOIL GUIDELINE VALUE AND HEALTH CRITERIA VALUES	No guideline value specified

WEL – Workplace exposure limit; LTEL - Long-term exposure limit; STEL – Short-term exposure limit

[a] EH40/2005 Workplace Exposure Limits (second edition, published 2011). http://www.hse.gov.uk/pubns/priced/eh40.pdf (accessed 01/2012)
[b] Guidelines for Drinking-Water Quality, Fourth Edition. WHO, Geneva. 2011.
[c] Air Quality Guidelines for Europe. World Health Organization Regional Office for Europe, Copenhagen WHO Regional Publications, European Series, No. 91, Second Edition, 2000.

Health Effects

Major route of exposure[a-b]

- Due to its gaseous nature, inhalation is the most likely route of exposure.
- Exposure to formaldehyde solutions may occur via ingestion and skin or eye contact.

Immediate Signs or Symptoms of Acute Exposure[b-e]

- Inhalation of formaldehyde causes irritation of the mucous membranes and respiratory tract. Sore throat, rhinitis, nasal irritation, bronchospasm and breathlessness are common
- In severe cases, laryngeal and pulmonary oedema, pneumonitis and acute respiratory distress syndrome may occur.
- Ingestion of concentrated formaldehyde solutions can cause burns and ulceration to the GI tract. Common features are a burning sensation in the mouth and throat, chest or abdominal pain, nausea, vomiting, diarrhoea and GI haemorrhage. The most severe damage is found in the stomach; perforation has been reported. Rarely, free fluid has been demonstrated in the abdomen in the absence of obvious perforation.
- Hypotension and shock are common. Restlessness, drowsiness, coma and convulsions may also occur. Respiratory failure occasionally secondary to acute respiratory distress syndrome may also complicate severe poisoning. Death from circulatory collapse may occur in severe cases.
- Other clinical features include metabolic acidosis, disseminated intravascular coagulation, jaundice, proteinuria, albuminuria, haematuria, hyperglycaemia , minor increase in transaminase activity and methaemoglobinaemia.
- Dermal contact with solutions of formaldehyde may produce skin irritation. Sensitisation caused by dermal contact has been reported frequently. In some individuals, formaldehyde can react with proteins in the epidermis, producing hapten-protein complexes that are capable of sensitising T lymphocytes so that subsequent exposures result in allergic contact dermatitis through a type IV hypersensitivity reaction.
- Formaldehyde is irritating to the eyes.

TOXBASE - http://www.toxbase.org (accessed 01/2012)
[a] TOXBASE: Formaldehyde, 2011
[b] TOXBASE: Formalin and formaldehyde solutions- ingestion, 2011
[c] TOXBASE: Formaldehyde – Inhalation, 2011
[d] TOXBASE: Formalin and formaldehyde solutions – skin contact, 2011.
[e] TOXBASE: Formalin and formaldehyde solutions – eye contact, 2011.

Decontamination and First Aid

Important Notes

- Ambulance staff, paramedics and emergency department staff treating chemically-contaminated casualties should be equipped with Department of Health approved, gas-tight (Respirex) decontamination suits based on EN466:1995, EN12941:1998 and prEN943-1:2001, where appropriate.
- Decontamination should be performed using local protocols in designated areas such as a decontamination cubicle with adequate ventilation.

Dermal exposure[(a)]

- Remove patient from exposure.
- Do **NOT** apply neutralising chemicals as heat produced during neutralization reactions may cause thermal burns and increase injury.
- Contaminated clothing and any particulate matter adherent to skin should be removed and the patient washed with copious amounts of water under low pressure for at least 10-15 minutes, or until pH of skin is normal (pH of the skin is 4.5 – 6 although it may be closer to 7 in children, or after irrigation). The earlier irrigation begins, the greater the benefit.
- Pay special attention to skin folds, fingernails and ears.
- Recheck pH of affected areas after a period of 15-20 minutes and repeat irrigation if abnormal. Burns with strong solutions may require irrigation for several hours or more.
- Once the pH is normal and stabilised, treat as per a thermal injury.
- Burns totalling more than 15% of body surface area in adults (>10% in children) will require standard fluid resuscitation as for thermal burns.
- Moderate/severe chemical burns should be reviewed by a burns specialist. Excision or skin grafting may be required.
- Other measures as indicated by the patient's clinical condition

Ocular exposure[(b)]

- Remove patient from exposure.
- Remove contact lenses if present and immediately irrigate the affected eye thoroughly with water or 0.9% saline for at least 10-15 minutes. Continue until the conjunctival sac pH is normal (7.5 - 8.0), retest after 20 minutes and use further irrigation if necessary..
- Any particles lodged in the conjunctival recesses should be removed.
- Patients with corneal damage or those whose symptoms do not resolve rapidly should be referred for urgent ophthalmological assessment.

Inhalation[(c)]

- Remove patient from exposure.
- Ensure a clear airway and adequate ventilation.
- Give high-flow oxygen through a tight-fitting mask.
- Apply other supportive measures as indicated by the patient's clinical condition.

TOXBASE - http://www.toxbase.org (accessed 01/2012)
[a] TOXBASE: Skin decontamination – corrosives, 2010.
[b] TOXBASE: Chemicals splashed or sprayed into the eyes, 2007.
[c] TOXBASE: Formaldehyde – Inhalation, 2011

Ingestion[(a)]

- Ensure a clear airway and adequate ventilation.
- There is no role for either gastric lavage or activated charcoal.
- Look for evidence of burns in the mouth and throat and watch for features of GI haemorrhage.
- Monitor pulse, blood pressure and urine output.
- Apply other supportive measures as indicated by the patient's clinical condition.

This document from the HPA Centre for Radiation, Chemical and Environmental Hazards reflects understanding and evaluation of the current scientific evidence as presented and referenced in this document.

TOXBASE - http://www.toxbase.org (accessed 01/2012)

[a] TOXBASE: Formalin and formaldehyde solutions- ingestion, 2011