

Committee for Risk Assessment
RAC

Annex 1
Background document
to the Opinion proposing harmonised classification
and labelling at EU level of

ethanethiol; ethyl mercaptan

EC Number: 200-837-3
CAS Number: 75-08-1

CLH-O-0000007153-80-01/F

The background document is a compilation of information considered relevant by the dossier submitter or by RAC for the proposed classification. It includes the proposal of the dossier submitter and the conclusion of RAC. It is based on the official CLH report submitted to consultation. RAC has not changed the text of this CLH report but inserted text which is specifically marked as 'RAC evaluation'. Only the RAC text reflects the view of RAC.

Adopted
15 September 2022

CLH report

Proposal for Harmonised Classification and Labelling

**Based on Regulation (EC) No 1272/2008 (CLP Regulation),
Annex VI, Part 2**

Chemical name:

ethanethiol; ethyl mercaptan

EC Number: 200-837-3

CAS Number: 75-08-1

Index Number: 016-022-00-9

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Version number: 02

Date: November 2021

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ABBREVIATIONS


ATE	Acute Toxicity Estimate
bw	body weight
CAS	Chemical Abstract Service
CL	Confidence Limit
CLH	Harmonised Classification and Labelling
CLP	Classification, Labelling and Packaging Regulation (EC) No 1272/2008
d	day
Dgr	Danger
GLP	Good Laboratory Practice
IPCS	International Programme on Chemical Safety
Kow	Partition coefficient octanol/water
LD ₅₀	Lethal dose, 50%
LC ₅₀	Lethal concentration, 50%
m/f	male/female
OECD	Organisation for Economic Co-operation and Development
PC	Product Category
WHO	World Health Organization

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1 IDENTITY OF THE SUBSTANCE

1.1 Name and other identifiers of the substance

Table 1: Substance identity and information related to molecular and structural formula of the substance

Name(s) in the IUPAC nomenclature or other international chemical name(s)	ethanethiol; ethyl mercaptan
Other names (usual name, trade name, abbreviation)	1-mercaptoethane ethyl mercaptan aethanethiol aethylmercaptan thioethanol
ISO common name (if available and appropriate)	-
EC number (if available and appropriate)	200-837-3
EC name (if available and appropriate)	ethanethiol
CAS number (if available)	75-08-1
Other identity code (if available)	-
Molecular formula	C ₂ H ₆ S
Structural formula	 <p>(source: European Chemicals Agency, http://echa.europa.eu/)</p>
SMILES notation (if available)	CCS
Molecular weight or molecular weight range	62.13 g/mol
Information on optical activity and typical ratio of (stereo) isomers (if applicable and appropriate)	-
Description of the manufacturing process and identity of the source (for UVCB substances only)	-
Degree of purity (%) (if relevant for the entry in Annex VI)	-

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1.2 Composition of the substance

Ethanethiol is a mono-constituent substance.

Table 2: Constituents (non-confidential information)

Constituent (Name and numerical identifier)	Concentration range (% w/w minimum and maximum in multi-constituent substances)	Current CLH in Annex VI Table 3 (CLP)	Current self-classification and labelling (CLP)
Ethanethiol	>98%	Flam. Liq. 2, H225 Acute Tox. 4*, H332 Aquatic Acute 1, H400 Aquatic Chronic 1, H410	Flam. Liq. 1, H224 Acute Tox. 4, H302 Acute Tox. 4, H332 Skin Sens. 1B, H317 Aquatic Acute 1, H400 Aquatic Chronic 1, H410

Table 3: Impurities (non-confidential information) if relevant for the classification of the substance

Impurity (Name and numerical identifier)	Concentration range (% w/w minimum and maximum)	Current CLH in Annex VI Table 3 (CLP)	Current self-classification and labelling (CLP)	The impurity contributes to the classification and labelling
Unknown impurities	<2%	-	-	-

Impurities not relevant for classification.

Information on the test substances (if available) is given in the study descriptions.

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2 PROPOSED HARMONISED CLASSIFICATION AND LABELLING

2.1 Proposed harmonised classification and labelling according to the CLP criteria

Table 4: For substance with an existing entry in Annex VI of CLP

	Index No	Chemical name	EC No	CAS No	Classification		Labelling			Specific Conc. Limits, M-factors and ATEs	Notes
					Hazard Class and Category Code(s)	Hazard statement Code(s)	Pictogram, Signal Word Code(s)	Hazard statement Code(s)	Suppl. Hazard statement Code(s)		
Current Annex VI entry	016-022-00-9	ethanethiol; ethyl mercaptan	200-837-3	75-08-1	Flam. Liq. 2 Acute Tox. 4* Aquatic Acute 1 Aquatic Chronic 1	H225 H332 H400 H410	GHS02 GHS09 GHS07 Dgr	H225 H332 H410			
Dossier submitters proposal	016-022-00-9	ethanethiol; ethyl mercaptan	200-837-3	75-08-1	Add Acute Tox. 4 Modify Flam. Liq. 1 Acute Tox. 3	Add H302 Modify H224 H331	Add GHS06 Remove GHS07	Add H302 Modify H224 H331		Add oral: ATE = 680 mg/kg bw inhalation: ATE = 7.14 mg/L (vapours)	
Resulting Annex VI entry if agreed by RAC and COM	016-022-00-9	ethanethiol; ethyl mercaptan	200-837-3	75-08-1	Flam. Liq. 1 Acute Tox. 4 Acute Tox. 3 Aquatic Acute 1 Aquatic Chronic 1	H224 H302 H331 H400 H410	GHS02 GHS06 GHS09 Dgr	H224 H302 H331 H410		oral: ATE = 680 mg/kg bw inhalation: ATE = 7.14 mg/L (vapours)	

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Table 5: Reason for not proposing harmonised classification and status under consultation

Hazard class	Reason for no classification	Within the scope of consultation
Explosives	<i>hazard class not assessed in this dossier</i>	No
Flammable gases (including chemically unstable gases)	<i>hazard class not assessed in this dossier</i>	No
Oxidising gases	<i>hazard class not assessed in this dossier</i>	No
Gases under pressure	<i>hazard class not assessed in this dossier</i>	No
Flammable liquids	Flam Liq. 1, H224	Yes
Flammable solids	<i>hazard class not assessed in this dossier</i>	No
Self-reactive substances	<i>hazard class not assessed in this dossier</i>	No
Pyrophoric liquids	<i>hazard class not assessed in this dossier</i>	No
Pyrophoric solids	<i>hazard class not assessed in this dossier</i>	No
Self-heating substances	<i>hazard class not assessed in this dossier</i>	No
Substances which in contact with water emit flammable gases	<i>hazard class not assessed in this dossier</i>	No
Oxidising liquids	<i>hazard class not assessed in this dossier</i>	No
Oxidising solids	<i>hazard class not assessed in this dossier</i>	No
Organic peroxides	<i>hazard class not assessed in this dossier</i>	No
Corrosive to metals	<i>hazard class not assessed in this dossier</i>	No
Acute toxicity via oral route	Acute Tox. 4, H302	Yes
Acute toxicity via dermal route	<i>hazard class not assessed in this dossier</i>	No
Acute toxicity via inhalation route	Acute Tox. 3, H331	Yes
Skin corrosion/irritation	<i>hazard class not assessed in this dossier</i>	No
Serious eye damage/eye irritation	<i>hazard class not assessed in this dossier</i>	No
Respiratory sensitisation	<i>hazard class not assessed in this dossier</i>	No
Skin sensitisation	<i>hazard class not assessed in this dossier</i>	No
Germ cell mutagenicity	<i>hazard class not assessed in this dossier</i>	No
Carcinogenicity	<i>hazard class not assessed in this dossier</i>	No
Reproductive toxicity	<i>hazard class not assessed in this dossier</i>	No
Specific target organ toxicity-single exposure	<i>hazard class not assessed in this dossier</i>	No
Specific target organ toxicity-repeated exposure	<i>hazard class not assessed in this dossier</i>	No
Aspiration hazard	<i>hazard class not assessed in this dossier</i>	No
Hazardous to the aquatic environment	<i>hazard class not assessed in this dossier</i>	No
Hazardous to the ozone layer	<i>hazard class not assessed in this dossier</i>	No

3 HISTORY OF THE PREVIOUS CLASSIFICATION AND LABELLING

Ethanethiol already has a harmonized classification. It has been discussed by the TC C&L and included into Annex I of Directive 67/548/EEC with the 25th ATP (F; R11 Xn; R20 N; R50-53). No further information is available.

4 JUSTIFICATION THAT ACTION IS NEEDED AT COMMUNITY LEVEL

[B.] Justification that action is needed at Community level is required.

Reason for a need for action at Community level:

- Change in existing entry due to new data
- Change in existing entry due to new interpretation/evaluation of existing data
- Change in existing entry due to changes in the criteria

Further detail on need of action at Community level

Ethanethiol has been harmonized classified based on the criteria of Directive 67/548/EEC and the data available at the time of evaluation.

A proposal from a manufacturer, importer or downstream user which has new information that could lead to a change in the current harmonised classification and labelling (Article 37(6), CLP) has been received by the Austrian CA. For evaluation of flammability more recent data is available indicating the need for a more stringent classification to protect workers. Evaluation of available acute toxicity data shows that an additional classification for oral toxicity is indicated.

For inhalation toxicity minimum classification (*) has been assigned which is reassessed in this dossier.

5 IDENTIFIED USES

Ethanethiol is registered in the EU in the tonnage band of $\geq 1\ 000$ to $< 10\ 000$ T. It may be used as odorant for natural gas, intermediate and starting material in manufacture of plastics, insecticides and antioxidants¹.

Table 6: The following uses are indicated at ECHA dissemination site [accessed August 2021]:

Categories	Use(s)	Technical function
Manufacture	Manufacture of ethanethiol	-
Formulation	Formulation into mixture under strictly controlled conditions (PC 28: perfumes, fragrances)	-
Uses at industrial sites	Use as an intermediate under strictly controlled conditions (PC 19: intermediate) Injection in gas under strictly controlled conditions (PC 28: perfumes, fragrances) Use as an anti-coking agent under strictly controlled conditions (PC 20: Products such as pH-regulators, flocculants,	-

¹ [Ethanethiol | C2H5SH - PubChem \(nih.gov\)](https://pubchem.ncbi.nlm.nih.gov/compound/Ethanethiol)

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	precipitants, neutralisation agents)	
Uses by professional workers	-	-
Consumer Uses	Combustion as gas odorant (PC 13: fuels) Injection of gas odorant-tracer in LPG or natural gas (PC 13: fuel)	-
Article service life	-	-

6 DATA SOURCES

ECHA dissemination site <https://echa.europa.eu/de/substance-information/-/substanceinfo/100.103.524>

Original study reports provided by the registrant(s) as well as scientific literature served as information sources. Please see section 14 References for details.

7 PHYSICOCHEMICAL PROPERTIES

Table 7: Summary of physicochemical properties

Property	Value	Reference	Comment (e.g. measured or estimated)
Physical state at 20°C and 101,3 kPa	liquid	ECHA dissemination site [Feb, 2021]	value taken from regulatory review document
Melting/freezing point	-144.4°C	ECHA dissemination site [Feb, 2021]	value taken from regulatory review document
Boiling point	34°C at 100.9 kPa	ECHA dissemination site [Feb, 2021]	measured OECD 103 (differential scanning calorimetry)
Relative density	0.839 g/cm ³	ECHA dissemination site [Feb, 2021]	value taken from regulatory review document
Vapour pressure	58.9 kPa at 20°C	ECHA dissemination site [Feb, 2021]	value taken from regulatory review document
Surface tension	23.1 mN/m at 25°C and 1 g/L	ECHA dissemination site [Feb, 2021]	value taken from reliable peer reviewed secondary source.
Water solubility	8.86 g/l at 20°C	ECHA dissemination site [Feb, 2021]	non-guideline test
Partition coefficient n-octanol/water (LogKow)	1.5 at 20 °C and pH 7	ECHA dissemination site [Feb, 2021]	value taken from regulatory review document
Flash point	<-30°C	ECHA dissemination site [Feb, 2021]	measured EC, A9 (closed cup)
Flammability	extremely flammable liquid	ECHA dissemination site [Feb, 2021]	there is no indication, on the basis of chemical structure or experience in handling and use, that the substance is pyrophoric

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Property	Value	Reference	Comment (e.g. measured or estimated)
			(flammable in contact with air) or flammable in contact with water
Explosive properties	non explosive	ECHA dissemination site [Feb, 2021]	substance contains no chemical groups that are associated with explosive properties
Self-ignition temperature	299°C	ECHA dissemination site [Feb, 2021]	value taken from regulatory review document
Oxidising properties	not oxidising	ECHA dissemination site [Feb, 2021]	substance is incapable of reacting exothermically with combustible materials on the basis of its chemical structure
Granulometry	-	ECHA dissemination site [Feb, 2021]	substance is a liquid
Stability in organic solvents and identity of relevant degradation products	-	-	-
Dissociation constant	pKa 10 at 20°C	ECHA dissemination site [Feb, 2021]	QSAR, not expected to dissociate in the environment
Viscosity	0.000287 Pa.s at 25°C	ECHA dissemination site [Feb, 2021]	value taken from reliable peer reviewed secondary source

8 EVALUATION OF PHYSICAL HAZARDS

8.1 Explosives

Not evaluated.

8.2 Flammable gases (including chemically unstable gases)

Not evaluated.

8.3 Oxidising gases

Not evaluated.

8.4 Gases under pressure

Not evaluated.

8.5 Flammable liquids

Table 8: Summary table of studies on flammable liquids

Method	Results	Remarks	Reference
DSC (ASTM E537-86) (EC method A.2 and OECD 103) 1 (reliable without restriction) GLP	boiling point 34.1 °C	ethanethiol, purity 99.84% 2 measurements at 100.9 kPa (34.1 °C and 34.5 °C)	Anonymous, 2012
Closed cup method according to Abel (EN ISO 13736) (EC method A.9) 1 (reliable without restriction) GLP	flash point < -30 °C	ethanethiol, purity 99.97% 2 measurements to 101.325 kPa corrected results: -26.2 °C and -31.8 °C	Anonymous, 2010

8.5.1 Short summary and overall relevance of the provided information on flammable liquids

The boiling point was measured by differential scanning calorimetry. The lowest result of two measurements at 100.9 kPa (34.1 °C and 34.5 °C) was converted to standard atmospheric pressure by applying the Sidney-Young-equation, which can be applied when the pressure difference is less than 5 kPa. The boiling point was determined to be 34.1 °C. The accuracy criteria according to OECD 103 is fulfilled and the study was conducted according to GLP. The Klimisch score is 1.

This is supported by a boiling point of 35 °C, taken from the WHO IPCS International Chemical Safety Cards (ICSC 0470, 2004²). No information on the primary source of these data or the method used is available. However, this information is taken from an internationally peer-reviewed chemical safety card and can be considered reliable and suitable for use as a supporting evidence for this endpoint.

The flash point was measured by EN ISO 13736. With -26.2 °C and -31.8 °C both measurements gave values below the CLP criteria (< 23 °C). The lowest result of two determinations is decisive, which lies below the recommended temperature range of -30 to 75 °C for this method. Therefore, the result is stated with < -30 °C. The study was conducted according to GLP. The Klimisch score is 1.

The study is considered reliable and suitable for evaluation of this endpoint. This is supported by a flash point of -48.3 °C, taken from the WHO IPCS International Chemical Safety Cards (ICSC 0470, 2004). Although no information on the primary source of the data or the method used is available, this information is taken from an internationally peer-reviewed chemical safety card and can be considered reliable and suitable for use as a supporting evidence for this endpoint.

8.5.2 Comparison with the CLP criteria

A flammable liquid has to be classified in one of the three categories if:

Category	Criteria
1	Flash point < 23 °C and initial boiling point ≤ 35 °C
2	Flash point < 23 °C and initial boiling point > 35 °C
3	Flash point ≥ 23 °C and ≤ 60 °C

² ICSC 0470, 2004: https://www.ilo.org/dyn/icsc/showcard.display?p_lang=en&p_card_id=0470&p_version=2

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For ethanethiol the flash point is < -30 °C and the boiling point is 34.1 °C.

8.5.3 Conclusion on classification and labelling for flammable liquids

Based on the presented studies the flash point was determined to be < -30 °C and the boiling point was determined to be 34.1 °C. Comparing the results with CLP regulation, Table 2.6.1, a harmonised classification of ethanethiol as Flammable Liquid, Category 1, H224 (Extremely flammable liquid and vapour) is proposed.

8.6 Flammable solids

Not evaluated.

8.7 Self-reactive substances

Not evaluated.

8.8 Pyrophoric liquids

Not evaluated.

8.9 Pyrophoric solids

Not evaluated.

8.10 Self-heating substances

Not evaluated.

8.11 Substances which in contact with water emit flammable gases

Not evaluated.

8.12 Oxidising liquids

Not evaluated.

8.13 Oxidising solids

Not evaluated.

8.14 Organic peroxides

Not evaluated.

8.15 Corrosive to metals

Not evaluated.

RAC evaluation of physical hazards

Summary of the Dossier Submitter's proposal

Flammable liquids

The dossier submitter (DS) presented a study for determination of flash point using the Abel closed cup method according to EC method A.9 with ethanethiol (purity 99.97 %), reporting a flash point of < -30 °C (Anonymous, 2010). This is supported by a flash point of -48.3 °C, taken from the WHO IPCS International Chemical Safety Cards (ICSC 0470, 2004).

The boiling point was measured by differential scanning calorimetry (DSC) according to EN ISO 537-86 and EC method A.2 (Anonymous, 2012). The lowest result of two measurements at 100.9 kPa (34.1 °C and 34.5 °C) was converted to standard atmospheric pressure (101.3 kPa) by applying the Sidney-Young-equation, which can be applied when the pressure difference is less than 5 kPa. The boiling point was determined to be 34.1 °C. This is supported by a boiling point of 35 °C, taken from the WHO IPCS International Chemical Safety Cards (ICSC 0470, 2004).

The DS proposed classification as Flam. Liq. 1, H224 (Extremely flammable liquid and vapour).

Comments received during public consultation

No comments were received.

Assessment and comparison with the classification criteria

Based on presented measurements, the flash point was determined to be < -30 °C and the boiling point was determined to be 34.1 °C. RAC agrees with the DS that ethanethiol meets the classification criteria of the CLP Regulation, Table 2.6.1, (Flash point < 23 °C and initial boiling point ≤ 35 °C) for **Flam. Liq. 1, H224 (Extremely flammable liquid and vapour)**.

9 TOXICOKINETICS (ABSORPTION, METABOLISM, DISTRIBUTION AND ELIMINATION)

Based on a water solubility of 8860 mg/l and a log Kow of 1.5 (20°C, pH 7) ethanethiol will be absorbed effectively via the dermal and oral route. The dermal penetration rate of a saturated aqueous solution of ethanethiol, calculated from the physico-chemical data, is 0.57 mg/cm²/hour (Fiserova-Bergerova, 1990, cited in DFG, 2005).

Shibata (1966b, cited in DFG, 2005) showed that 60-80 % of inhaled ethanethiol (based on concentrations of 50 ml/m³ for 35-60 min) was absorbed by humans.

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The metabolism was investigated by Snow (1957) using radiolabeled compounds related to ethanethiol (diethyl disulphide, S-ethyl thiolbenzoate). They have been rapidly absorbed and distributed in the body tissues without any notable local concentration after oral and subcutaneous administration in mice.

In rodents, excretion of compounds related to ethanethiol occurred mainly via the kidney as inorganic sulfate. Organic metabolites, ethyl methyl sulfone, and an unidentified product accounted for 10-20% of the sulfur excreted in the urine. There was little fecal excretion, but approximately 14% of the dose was excreted in the breath. It was hypothesized that oxidation converted the thiol to the sulphide and then to the sulfone (Snow, 1957; National Research Council, 2013).

Metabolism of simple thiols is in general described by JEFCA (2000). Ethanethiol is not explicitly mentioned in this report, however it can be assumed that the principles also apply to this substance: Simple thiols may be metabolized along several pathways. (1) Simple aliphatic and aromatic thiols undergo S-methylation in mammals to produce the corresponding methyl thioether or sulfide. Methylation is catalysed by thiopurine methyltransferase in the cytoplasm and thiol methyltransferase in microsomes, and both reactions require S-adenosyl-l-methionine as a methyl group donor. Thiopurine methyltransferase is present in human liver, kidney, and erythrocytes; preferential substrates for this enzyme include aromatic and heterocyclic thiols. S-Methylation of aliphatic thiols is catalysed by microsomal thiol methyltransferase, and the resulting methyl thioether (sulfide) metabolite would undergo S-oxidation to give the methyl sulfoxide and methyl sulfone analogues as urinary products. (2) Thiols may react with glutathione and other endogenous thiol substances to form mixed disulfides. Both microsomal and cytoplasmic thioltransferases have been reported to catalyse the formation of mixed disulfides. The resulting mixed disulfides can undergo reduction back to thiols, oxidative desulfuration, or oxidation to a sulfonic acid via the intermediate thiosulfinate and sulfinic acids. The principal form in the circulation would probably be a mixed disulfide formed with albumin. (3) S-Glucuronidation of aromatic thiols has been reported, and this may be a pathway for the metabolism of aromatic thiols (thiophenols) and simple aromatic disulfides after their reduction. Glucuronyl transferases behave similarly towards hydroxyl and sulfydryl groups, and the two activities have the same subcellular location and optimal pH. (4) Thiols may be oxidized to form sulfenic acids (RSOH), which are unstable and readily undergo further oxidation to sulfinic (RSO₂H) and sulfonic (RSO₃H) acids or combine with nucleophiles. The sulfonic acid group is a highly polar centre and makes molecules highly soluble in water. In general, sulfonic acids are stable to metabolism. (5) Alkyl thiols of low relative molecular mass undergo oxidative desulfuration *in vivo* to yield CO₂ and SO₄⁼. This reaction has been shown, for example, for methanethiol. Whereas the carbon atom from thiols may be used in the biosynthesis of amino acids, the sulfur atom is not used significantly in the synthesis of sulfur-containing amino acids.

Ethanethiol is a metabolite of the human body and is excreted in the breath of normal individuals; patients with advanced liver disease excrete it at higher concentrations (National Research Council, 2013).

10 EVALUATION OF HEALTH HAZARDS

Acute toxicity

10.1 Acute toxicity - oral route

Table 9: Summary table of animal studies on acute oral toxicity

Method, guideline, deviations if any	Species, strain, sex, no/group	Test substance,	Dose levels, duration of exposure	Value LD ₅₀	Reference
similar to OECD 420 non-GLP key study 2 (reliable with	rats, Wistar derived, males n= 5 m/group	ethanethiol, undiluted	single oral dose, gavage 210, 420, 840, 1680, or 3360 mg/kg bw	LD ₅₀ (15d) = 682 mg/kg bw in males (CL: 517 – 900 mg/kg bw)	Fairchild and Stokinger, 1958

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Method, guideline, deviations if any	Species, strain, sex, no/group	Test substance,	Dose levels, duration of exposure	Value LD ₅₀	Reference
restrictions) derivations: no information on age of rats and fasting, body weight development not documented, generalized information on clinical and pathological observations			observation period: 15 d	LD ₅₀ (24h) = 1034 mg/kg bw in males (CL: 667 – 1603 mg/kg bw)	

10.1.1 Short summary and overall relevance of the provided information on acute oral toxicity

Fairchild and Stokinger (1958) investigated acute oral toxicity of nine organic sulphur compounds, including ethanethiol. Ethanethiol (undiluted) was administered (via gavage) to male Wistar rats (200±20g) (5/dose) at single doses of 210, 420, 840, 1680, or 3360 mg/kg bw. The animals were subsequently observed for a period of 15 days. Mortality data are shown in

Table 10. In the highest dose group, all animals (5/5) died within 7h after administration. In the 1680 mg/kg bw test group all animals died before the end of the study period. High mortality was observed in the 840 mg/kg bw group (4/5) at the end of the study and no mortality (0/5) was observed in the 210 and 420 mg/kg bw dose groups. Clinical signs of toxicity were described generally for the group of thiols³ as sedative action or deep comatose sleep for 48 hours (at maximal sublethal doses), and diarrhea (at high doses) and have not been allocated to the individual substances. Gross pathology generally did not show significant gross or microscopic tissue changes. Survivors of near lethal doses showed changes, which, although inconsistent, were indicative of liver and kidney damage. Microscopic examinations revealed occasional marked changes in the kidneys of rats (degeneration with swelling, some necrosis of the tubular epithelium, thickening of Bowman’s capsule, hyaline deposition in glomerular tufts). More often only minor lesions with varying degrees of cloudy swelling of the tubules and hyaline casts in the lumina were seen. In general, liver changes were characterized by lymphocytic infiltration, occasional necrotic foci with small haemorrhages, and varying degrees of fatty degeneration. Only rarely tissue studies showed significant pathologic conditions as the result of relatively small doses of thiols. The oral LD₅₀ for ethanethiol was determined to be 682 mg/kg bw (CL: 517 – 900 mg/kg bw) (calculated by the method of Weil, 1954).

Table 10: Mortality following single oral administration of ethanethiol (Fairchild and Stokinger, 1958).

Single oral dose [mg/kg bw]	Cumulative mortality following single oral administration					
	day 1	day 2	day 3	day 5	day 10	day 15
210	0/5	0/5	0/5	0/5	0/5	0/5
420	0/5	0/5	0/5	0/5	0/5	0/5
840	2/5	2/5	2/5	2/5	3/5 (7 th day)	4/5 (11 th day)
1680	4/5	4/5	4/5	5/5	-	-

³ In the study report, the testing results for nine sulfur compounds are described (ethanethiol, 1-propanethiol, 2-methyl-1-propanethiol, 2-methyl-2-propanethiol, 1-butanethiol, 1-hexanethiol, methyl heptanethiol, benzenethiol, α-toluenethiol). Mortality data are presented in detail for each substance but the general signs of toxicity are only summarized as common effects of thiols. Therefore, allocation of (severity of) effects to single substances is not possible.

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3360	5/5 (from 4 to 7h)	-	-	-	-	-
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10.1.2 Comparison with the CLP criteria

According to Table 3.1.1 of Regulation (EC) No. 1272/2008 a substance shall be classified as

- Acute Tox 4 (oral) if the LD₅₀/ATE values are > 300 and ≤ 2000 mg/kg bw.
- Acute Tox 3 (oral) if the LD₅₀/ATE values are > 50 and ≤ 300 mg/kg bw.

For evaluation of acute oral toxicity of ethanethiol one study (Klimisch 2) with male rats is available determining an LD₅₀ value of 682 mg/kg bw (CL: 517 – 900 mg/kg bw) (Fairchild and Stokinger, 1958).

10.1.3 Conclusion on classification and labelling for acute oral toxicity

Single oral administration of ethanethiol resulted in a LD₅₀ in rats of 682 mg/kg bw (CL: 517 – 900 mg/kg bw) (Fairchild and Stokinger, 1958). Referring to the criteria laid down in Table 3.1.1. of CLP regulation ethanethiol meets the criteria for classification as Acute Tox 4, H302 (Harmful if swallowed).

An ATE value of 680 mg/kg bw (rounded value) has to be assigned based on the study by Fairchild and Stokinger (1958).

10.2 Acute toxicity - dermal route

Not evaluated.

10.3 Acute toxicity - inhalation route

For the evaluation of this endpoint four studies with rats and one with mice are available. A conversion factor of 1ppm = 2.578 mg/m³ has been applied (DFG, 2019).

Table 11: Summary table of animal studies on acute inhalation toxicity

Method, guideline, deviations if any	Species, strain, sex, no/group	Test substance, form and particle size (MMAD)	Dose levels, duration of exposure	Value LC ₅₀	Reference
no guideline followed non-GLP key study 2 (reliable with restrictions) remarks: no information on age of rats, body weight development not documented, generalized information on	rats, Wistar derived, males n= 5m/group	ethanethiol vapour chamber exposure	2600, 3150, 3573, 4438, 4832, 4868, 5100, 5125 ppm (6.61, 8.00, 9.08, 11.28, 12.28, 12.37, 12.98, 13.02 mg/L) exposure duration: 4h observation period: 15 d	LC ₅₀ (15d) = 11.39 mg/L (4420 ppm; CL: 4299-4541 ppm) LC ₅₀ (48h) = 11.77 mg/L (4565 ppm; CL: 4448-4682 ppm) LC ₅₀ (24h) = 12.55 mg/L (4870 ppm; CL: 4783-4957 ppm)	Fairchild and Stokinger, 1958

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Method, guideline, deviations if any	Species, strain, sex, no/group	Test substance, form and particle size (MMAD)	Dose levels, duration of exposure	Value LC ₅₀	Reference
clinical and pathological observations					
no guideline followed non-GLP Key study 2 (reliable with restrictions) remarks: no information on age of rats, body weight development not documented, generalized information on clinical and pathological observations	mice, Swiss-derived, males n=10m/group	ethanethiol vapour chamber exposure	2600, 3150, 3573, 4438, 4832 ppm (6.61, 8.00, 9.08, 11.28, 12.28 mg/L) exposure duration: 4h observation period: 15 d	LC ₅₀ (48h) = 7.14 mg/L (2770 ppm) (CL: 2661-2879 ppm)	Fairchild and Stokinger, 1958
similar to OECD 403 non-GLP 2 (reliable with restrictions) derivations: acclimatization for 3 d, rats were 6-8 weeks old, temperature and humidity in the animal holding area exceeded the OECD guideline range on several occasions.	rat, Sprague Dawley, CrI:CD(SD)BR strain m/f n= 5/sex/dose	ethanethiol vapour head only exposure (dynamic conditions)	0 and 991 ppm (analytic concentration) (nominal atmosphere concentration 1445 ppm) exposure duration: 4h observation period: 14 d	LC ₅₀ > 2.56 mg/L (991 ppm) No mortality was observed.	Anonymous, 1987
similar to OECD 403 non-GLP 2 (reliable with restrictions)	rat, Sprague Dawley m/f n= 5/sex/dose	ethanethiol vapour whole body	0 and 1.93 mg/L (nominal concentration) analytical concentration was 0.11 mg/L or 44.09 ppm ± 12.59	LC ₅₀ > 0.11 mg/L (44 ppm) No mortality was observed.	Anonymous, 1983

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Method, guideline, deviations if any	Species, strain, sex, no/group	Test substance, form and particle size (MMAD)	Dose levels, duration of exposure	Value LC ₅₀	Reference
			exposure duration: 4h observation period: 16 d		
no guideline followed non-GLP 3 (not reliable)	rat, Sprague Dawley m/f n= 5/sex/dose	ethanethiol vapour whole body	m: 28400 ppm f: 15000 ppm 27000 ppm exposure duration: 1h	No LC ₅₀ can be derived m: no mortality f: 27000 ppm (69.6 mg/L): 3/5 15000 ppm (38.6 mg/L): 0/5	Vernot, 1977

10.3.1 Short summary and overall relevance of the provided information on acute inhalation toxicity

Fairchild and Stokinger (1958) conducted acute inhalation toxicity studies with nine organic sulphur compounds⁴ (single substance administration) in rats (n=5m/group) and mice (n=10m/group). For ethanethiol concentrations up to 5125 ppm were used with an exposure duration of 4h. The generation of thiol vapours was accomplished by either of two methods: (1) bubbling a stream of nitrogen gas (to prevent possible oxidation to sulfide) through a midjet fritted-glass bubbler, which contained the liquid thiol, or (2) by passage of nitrogen into a borosilicate glass nebulizer which contained the thiol. Each of the described methods was used interchangeably, but with some of the lower boiling point thiols the bubbler proved more manageable and gave more uniform chamber concentrations than the nebulizer. During exposure the concentrations within the chamber were determined routinely. Variations between extremes of vapour concentrations measured during any test was never greater than 15%, usually being about 9%; the minimum variation between concentrations was 0.4% while the mean variation for all exposures was approximately 4%. LC₅₀ values were calculated by the method of Miller and Tainter (1944).

In male rats (Wistar derived) (200 ± 20g) mortality was observed at 4438 ppm and above (see Table 12). The LC₅₀ was determined to be 12.55 mg/L (4870 ppm) at 24 hours, 11.77 mg/L (4565 ppm) at 48 hours, and 11.39 mg/L (4420 ppm) at 15 days after the exposure period.

Mice were more susceptible than rats. All male mice (Swiss-derived, 25-28g) exposed to concentrations of 4438 and 4832 ppm died. At 3573 ppm 8/10 died during 4-exposure period and 10/10 died within 24h. At 3150 ppm and 2600 ppm 7/10 and 4/10 animals died within 24h, respectively. For more details see Table 12. An LC₅₀ = 7.14 mg/L (2770 ppm) has been determined at 48h after exposure.

⁴ ethanethiol, 1-propanethiol, 2-methyl-1-propanethiol, 2-methyl-2-propanethiol, 1-butanethiol, 1-hexanethiol, methyl heptanethiol, benzenethiol, α-toluenethiol. For each substance a separate acute toxicity study was made, however method of vapour generation as well as general signs of toxicity were described generally and therefore cannot be allocated to the relevant substance ethanethiol.

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Signs of intoxication for rats and mice were described as a summary for the tested thiols as increased respiration and hyperactivity, uncoordinated movement and staggering gait, muscular weakness, partial skeletal muscle paralysis beginning in hind limbs, light to severe cyanosis, tolerance of prone position and mild to heavy sedation. Animals exposed to maximal lethal concentrations died from respiratory arrest, animals exposed to minimal lethal concentrations died while in a semiconscious condition of long duration. Animals exposed to ethanethiol very often remained in a semiconscious condition of sedation and lethargy 4 to 6 h post-exposure before showing signs of recovery. Thiols were irritating to the mucous membranes within approximately 15 min after exposure and animals in high concentrations showed rubbing of the eyes and nose, eye closure, occasional sneezing, watering of the eyes and retracting of the head.

Table 12: Cumulative mortality following acute inhalation exposure to ethanethiol vapour (Fairchild and Stokinger, 1958).

Analysed conc. [ppm and mg/L]	Cumulative Mortality							
	rats				mice			
	0-4h	24h	48	15d	0-4h	24h	48h	15d
2600 (6.7 mg/l)	0/5	0/5	0/5	0/5	1/10	4/10	4/10	4/10
3150 (8.12 mg/L)	0/5	0/5	0/5	0/5	4/10	7/10	7/10	7/10
3573 (9.21 mg/L)	0/5	0/5	0/5	0/5	8/10	10/10	-	-
4438 (11.44 mg/L)	0/5	0/5	1/5	1/5	10/10	-	-	-
4832 (12.46 mg/L)	1/6	3/6	3/6	4/6	10/10	-	-	-
4868 (12.55 mg/L)	1/5	2/5	2/5	2/5	-	-	-	-
5100 (13.15 mg/L)	2/5	5/5	-	-	-	-	-	-
5125 (13.21 mg/L)	2/6	2/6	2/6	2/6	-	-	-	-

Anonymous (1987) reported an acute inhalation study with male and female Sprague-Dawley rats exposed for 4h to concentrations of 0 and 991 ppm (2.56 mg/L, analytic concentration) (head only). Vapour was generated using a 'J' tube with in-line filter. Air flow rates were monitored continuously at half-hourly intervals. No mortality was observed, therefore no LC₅₀ could be derived. Transient signs of exposure included chromodacryorrhea, nasal secretion and respiratory distress shortly after exposure, with a full recovery observed in less than 24 hours. A slight reduction in control and exposed animal's body weights was noted and believed to be caused from the restraint procedure. Body weights recovered by day 7. No gross observations were noted at necropsy.

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Anonymous (1983) exposed 5 male and 5 female rats in a glass chamber with a volume of 38L to a nominal concentration of 1.93 mg/L. Vapour was generated using a water-jacketed counter-flow column and monitored. The analytical concentration was 0.11 mg/L or 44.09 ppm \pm 12.59 SD. No mortality was observed, no clinical signs were observed and no cross observations were noted at necropsy. A slight reduction in female mean body weight was noted on day 4. No LC₅₀ could be derived.

According to Vernot (1977) five male rats (Sprague Dawley, 200-300g) survived 1h inhalation exposure to a concentration of 28400 ppm and five female rats to a concentration of 15000 ppm (concentration measured by standard techniques, very limited reporting). However, 3/5 female rats died after 1h exposure to 27000 ppm (69.6 mg/L). Information on the observation period is not available. Due to very limited information the study was rated as not reliable.

10.3.2 Comparison with the CLP criteria

According to Table 3.1.1 of Regulation (EC) No. 1272/2008 a substance (vapour) shall be classified as

- Acute Tox 4 (inhal) if the LC₅₀ values are > 10.0 mg/L and \leq 20.0 mg/L (4h exposure)
- Acute Tox 3 (inhal) if the LC₅₀ values are > 2.0 mg/L and \leq 10.0 mg/L (4h exposure)
- Acute Tox 2 (inhal) if the LC₅₀ values are > 0.5 and \leq 2 mg/L (4h exposure)
- Acute Tox 1 (inhal) if the LC₅₀ values are \leq 0.5 mg/L (4h exposure)

Based on the available studies it can be summarized that mice are more susceptible with a LC₅₀ = 7.14 mg/L (2770 ppm) compared to rats with a LC₅₀ = 11.39 mg/L (4420 ppm) (Fairchild and Stockinger, 1958). Due to the applied dosing regimen other studies could not identify LC₅₀ values.

10.3.3 Conclusion on classification and labelling for acute inhalation toxicity

In general, classification is based on the lowest ATE value available i.e. the lowest ATE in the most sensitive appropriate species tested. Acute inhalation exposure to ethanethiol vapours resulted in a LC₅₀ in mice of 7.14 mg/L (Fairchild and Stokinger, 1958).

Referring to the criteria laid down in Table 3.1.1. of CLP regulation ethanethiol meets the criteria for classification as Acute Tox 3, H331 (Toxic if inhaled).

An ATE value of 7.14 mg/L has to be assigned based on the study by Fairchild and Stokinger (1958).

RAC evaluation of acute toxicity

Summary of the Dossier Submitter's proposal

Acute oral toxicity

In one acute oral toxicity study in rats (Fairchild and Stokinger, 1958). Ethanethiol (undiluted) was administered (via gavage) to male Wistar rats (5/dose) at five single doses from 210 to 3360 mg/kg bw. The animals were subsequently observed for a period of 15 days. Mortality is summarised in the table below.

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Table: Mortality following single oral administration of ethanethiol (Fairchild and Stokinger, 1958).

Dose (mg/kg bw)	Mortality in males
210	0/5
420	0/5
840	4/5 (mortality within 11d after administration)
1680	5/5 (mortality within 5d after administration)
3360	5/5 (mortality within 7h after administration)

The oral LD₅₀ for ethanethiol was determined to be 682 mg/kg bw (calculated by the method of Weil, 1954).

The DS proposed classification as Acute Tox. 4; H302 with an ATE of 680 mg/kg bw based on an acute oral toxicity study in rats.

Acute inhalation toxicity

There are four acute inhalation toxicity studies with rats and one with mice available.

In a study by Fairchild and Stokinger (1958), ethanethiol concentrations up to 13.21 mg/L (5125 ppm) and 12.46 (4832 ppm) were used with an exposure duration of 4h in rats and mice, respectively. The generation of ethanethiol vapours was accomplished by methods appropriate to prevent possible oxidation to sulfide. During exposure the concentrations within the chamber were determined routinely. Variations between extremes of vapour concentrations measured during any test was never greater than 15 %, while the mean variation for all exposures was approximately 4 %. The animals were subsequently observed for a period of 15 days. Mortality is summarised in the table below.

Table: Mortality following acute inhalation exposure to ethanethiol vapour for 4h (Fairchild and Stokinger, 1958).

Analysed Concentration		Mortality	
mg/L	ppm	Rats (Wistar) males	Mice (Swiss) males
6.7	2600	0/5	4/10 (within 24h after exp.)
8.12	3150	0/5	7/10 (within 24h after exp.)
9.21	3573	0/5	10/10 (within 24h after exp.)
11.44	4438	1/5 (within 48h after exp.)	10/10 (within 4h after exp.)
12.46	4832	4/6 (within 15d after exp.)	10/10 (within 4h after exp.)
12.55	4868	2/5 (within 24h after exp.)	-
13.15	5100	5/5 (within 24h after exp.)	-
13.21	5125	2/6 (within 4h after exp.)	-

LC₅₀ values were calculated by the method of Miller and Tainter (1944).

In male rats (Wistar) the LC₅₀ was determined to be 11.39 mg/L (4420 ppm) at 15 days after the exposure period. In male mice (Swiss) the LC₅₀ = 7.14 mg/L (2770 ppm) has been determined. Mice were more susceptible than rats.

Anonymous (1987) reported an acute inhalation study with male and female Sprague-Dawley rats exposed for 4h to concentrations of 0 and 991 ppm (2.56 mg/L, analytic

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concentration) (head only). No mortality was observed, therefore no LC₅₀ could be derived. Transient effects of exposure included chromodacryorrhea, nasal secretion and respiratory distress shortly after exposure, with a full recovery observed in less than 24h.

Anonymous (1983) exposed five male and five female rats in a glass chamber with a volume of 38 L to a nominal concentration of 1.93 mg/L. The analytical concentration was 0.11 mg/L or 44.09 ppm ± 12.59 SD. No mortality and no clinical signs were observed. No LC₅₀ could be derived.

According to Vernot (1977), five male rats (Sprague Dawley) survived 1h inhalation exposure to a concentration of 28400 ppm (73.22 mg/L) and five female rats to a concentration of 15000 ppm (38.67 mg/L) (concentration measured by standard techniques, very limited reporting). However, 3/5 female rats died after 1h exposure to 27000 ppm (69.6 mg/L). Information on the observation period is not available. Due to very limited information the study was rated as not reliable.

The DS proposed Acute Tox. 3; H331 (Toxic if inhaled) with an ATE of 7.14 mg/L (vapours) based on an acute inhalation study in mice as the most sensitive species (Fairchild and Stokinger, 1958).

Comments received during public consultation

One MSCA supported the DS's proposal for classification and ATE values for both acute oral and inhalation toxicity based on the results of the studies available.

One Company/Manufacturer did not agree with the change in classification for acute inhalation toxicity from category 4 to 3, as proposed by DS, based on the following arguments:

- in a survey published in 1978 there were approximately 23100 workers in the US engaged in activities involving potential exposure to ethyl mercaptan with no reported fatalities caused by inhalation of ethyl mercaptan alone (NIOSH, 1978);
- in a recent search no reports were found of direct fatalities reported from acute inhalation of ethyl mercaptan and no evidence of serious injury. There are reports of fatalities, either accidental or intentional (suicide), from exposure to propane containing ethyl mercaptan as an odour signal but the cause of death was determined to be asphyxiation from propane (Aquila *et al.*, 2020; Lowry *et al.*, 1991). A report by the US Bureau of Labor Statistics identifying the top 14 chemicals involved in workplace inhalation fatalities (BLS, 2017) did not identify ethyl mercaptan as a significant contributor to workplace inhalation fatalities;
- the lowest LC₅₀ reported from animal studies is 2770 ppm for a 4-h exposure in mice (Fairchild and Stokinger, 1958), while the odour detection threshold for ethyl mercaptan is approximately 1.4×10^{-4} ppm (NRC, 2013), thus 27 million-fold lower than potentially lethal concentrations in the air;
- current workplace practices for ethyl mercaptan have been effective in the manufacturing setting for protecting workplace health;
- according to all available inhalation study guidelines, and as specified in OECD TG 403 protocol, the preferred species is the rat (OECD, 2018, 2009; US EPA, 1998), although the CLP guidelines advise classification based on the lowest ATE in the

most sensitive species tested (ECHA, 2017) and the use of species other than the preferred species be supported by suitable justification and application of scientific judgement (ECHA, 2017, page 241);

- selecting the lowest LC₅₀ value does not constitute scientific justification for the selection of an alternative species over the preferred species; the Fairchild and Stokinger 1958 publication includes a study in rats, the preferred species; in this study the reported LC₅₀ is 442 ppm (12.5 mg/L) which would justify the historical use of GHS category 4 classification criteria for acute inhalation toxicity.

The DS responded to the above comments by stating that classification according to the CLP Regulation should be based on intrinsic hazards, and the proposal for harmonised classification has been prepared based on the information and studies reported in the registration dossier and original studies provided by registrant(s). All available relevant data needs to be included in the CLH report and considered in the derivation of the appropriate hazard classification to allow an independent assessment by RAC. Omission of relevant information needs to be explicitly justified which is not applicable for the data on mice based on the information given in the reference (Fairchild, 1958). When experimental data for acute toxicity are available in several animal species, scientific judgement shall be used in selecting the most appropriate LC₅₀ value from among valid, well-performed tests. As mentioned above, in general, classification is based on the lowest ATE value available i.e., the lowest ATE in the most sensitive appropriate species tested. If there is information available to inform on species relevance, then the studies conducted in the species most relevant for humans should normally be given precedence over the studies in other species (CLP guidance, 2017). No such information is available; therefore, the LC₅₀ value from the most sensitive species has been used for classification.

Assessment and comparison with the classification criteria

Acute oral toxicity

The key data consists of the acute oral toxicity study in rats (similar to OECD 420 test guideline, not GLP compliant; Fairchild and Stokinger, 1958). The LD₅₀ was > 420 and < 840 mg/kg bw for male rats; LD₅₀ calculated by the method of Weil⁵ was 682 mg/kg bw (95 % confidence limit 517-900 mg/kg bw).

The disadvantage of the above study is that only male rats were tested. Considering that an inhalation study by Vernot (1977) indicates that female rats are more sensitive than males, and the LD₅₀ for female rats would be lower than that obtained for male rats. However, a lower LD₅₀ for females is not expected to be below the criteria for Acute Tox. 4 (< 300 mg/kg bw).

Based on results of one acute oral toxicity study available, RAC agrees with the DS that ethanethiol meets the classification criteria of the CLP Regulation, Table 3.3.1, (the LD₅₀ values > 300 and ≤ 2000 mg/kg bw.) for **Acute Tox. 4; H302** (Harmful if swallowed), with an **ATE of 680 mg/kg bw** (rounded-off).

⁵ Weil, C.S.: Tables for Convenient Calculation of Median-Effective Dose (LD₅₀ or ED₅₀) and Instruction in Their Use. Biometrics, 8: 249-304 (1954)

Acute inhalation toxicity

In the key study on acute inhalation toxicity in rats and mice (Fairchild and Stokinger, 1958) lethal concentrations were in the range between 11.44 and 13.15 mg/L (> 4438 and < 4832 ppm) for male rats and in a range between 6.7 and 9.21 mg/L (> 2600 and < 3150 ppm) air for male mice. The LC₅₀ calculated by the method of Miller and Tainter (1944) was 11.39 mg/L (4420 ppm) for male rats and 7.14 mg/L (2770 ppm) for male mice. Mice were more susceptible than rats.

It is noted that the saturated vapour concentration is 1500 mg/L (581846 ppm) calculated from the ideal gas law equation for vapour pressure of ethanethiol of 58.9kPa at 20 °C. Therefore, the concentrations of the tested ethanethiol are much lower than the saturated vapour concentration at 20 °C. Therefore, a test atmosphere consisting of mist of ethanethiol is not expected. The generation of the ethanethiol atmosphere in the above study was accomplished with a bubbler or nebulizer and thus the test material was inhaled in a form of vapour as reported in the study description. Due to the fact that the temperature in the chamber is below the boiling point and the vapour pressure at 20 °C is below 101.3 kPa, ethanethiol is not considered as a gas.

The DS further presented two non-standard acute inhalation toxicity studies in rats (Anonymous, 1987; Anonymous, 1983), where no mortality was observed and an LC₅₀ could not be derived, and one poorly reported acute inhalation study (Vernot, 1977) in rats (1 h exposure) which was considered as not reliable.

Both studies in rats and mice by Fairchild and Stokinger, 1958, were conducted following the same procedure. The generation of ethanethiol vapours and measurements of its concentration were carried out by the same methods in both mice and rat tests. More reliable data was obtained in the mice study, as there were more animals per group than in the rat study. According to Guidance on IR&CSA, Section R.7.4.5.1 "*when equally reliable data from several species are available, priority should be given to the data relating to the most sensitive species, unless there are reasons to believe that this species is not an appropriate model for humans*". Taking all available data into account there is no evidence indicating which a species of animals is more relevant to humans taking into account the mode of action of ethanethiol. Thus, the LC₅₀ obtained in the most sensitive species should be used for classification of acute inhalation toxicity of ethanethiol. It should be noted that only male rodents were tested in the key acute inhalation toxicity study by Fairchild and Stokinger (1958), but female rats were known to be more susceptible than male rats, as shown by the Vernot (1977) study. Therefore, it can be assumed that the (actual) LC₅₀ for male and female rats combined would be lower than the LC₅₀ obtained for male rats only.

Based on results of the key acute inhalation toxicity study and LC₅₀ value from the most sensitive species, mice (Fairchild and Stokinger, 1958), RAC agrees with the DS that ethanethiol meets the classification criteria of the CLP Regulation, Table 3.3.1, (LC₅₀ > 2.0 and ≤ 10.0 mg/L, 4h exposure to vapours) for **Acute Tox. 3; H331 (Toxic if inhaled), with an ATE value of 7.1 mg/L (vapours).**

10.4 Skin corrosion/irritation

Not evaluated.

10.5 Serious eye damage/eye irritation

Not evaluated.

10.6 Respiratory sensitisation

Not evaluated.

10.7 Skin sensitisation

Not evaluated.

10.8 Germ cell mutagenicity

Not evaluated.

10.9 Carcinogenicity

Not evaluated.

10.10 Reproductive toxicity

Not evaluated.

10.11 Specific target organ toxicity-single exposure

Not evaluated.

10.12 Specific target organ toxicity-repeated exposure

Not evaluated.

10.13 Aspiration hazard

Not evaluated.

11 EVALUATION OF ENVIRONMENTAL HAZARDS

Not evaluated.

12 EVALUATION OF ADDITIONAL HAZARDS

Not evaluated.

13 ADDITIONAL LABELLING

Not relevant.

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