

# **Guidance for calculating the occupational health code for chemical products used by shoe repair men and orthopedic shoe technicians**

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# Index

## 1. Introduction

- The choice for an occupational health code
- Definition

## 2. Calculating the health code

- Calculating the potential inhalation risks (first digit)
- Calculating the dermal hazard (second digit)

## 3. Organization

- Who
- Visualization
- Notification/labeling
- Maintenance of the code

## 4. References

APPENDIX 1. List of commonly used substances and their f-factor and OEL sorted by CAS-number.

APPENDIX 2. Full list of R-phrases and their AWARE<sub>2</sub>-classification

APPENDIX 3. List of the European Occupational Exposure Limits (OEL's)

APPENDIX 4. List of evaporation factors conform ASTM-D3539

# 1. Introduction

## The choice for an occupational health code

In cooperation with suppliers, employers and the Dutch Ministry of Social Affairs, The Dutch branch organizations of shoe repair men (NSV) and orthopedic shoe technicians (NVOS) have developed an occupational health code for their chemical products. The health code gives an indication of the inhalation and dermal hazards associated with their daily use in the workplace.

The health code is based upon previous experiences with classification systems developed in Denmark, Norway and the Netherlands. The health code of shoe technicians is made out of two numbers:

- The Occupational Air Requirement (OAR) for potential inhalation risks
- AWARE<sub>2</sub>: a classification scheme for dermal hazards based on the risk phrases of chemical products.

This guide describes the manner in which the health code should be calculated and the organizational rules.

## Definition

The health code is applicable to all chemical products used by shoe technicians for which a Material Safety Data Sheet is available.

## 2. Calculating the health code

### The choice for a two digit health code: OAR – AWARE<sub>2</sub>

In cooperation with suppliers of chemical products, employers and the Ministry of Social Affairs the Dutch branch organizations for shoe technicians have chosen for a two digit health code that is meant to differentiate between inhalation risks and hazards related contact with the skin. The risks by inhalation are calculated with the algorithm of the Occupational Air Requirement (OAR); the hazards through contact with the skin are derived from the classification scheme of AWARE<sub>2</sub>. (Figure 1)

Figure 1. The health code for shoe technicians

OAR + AWARE <sub>2</sub>
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The OAR represents the quantity of air (m<sup>3</sup>) required to dilute the vapour concentration in the work room resulting from 1 L product to a concentration below the Occupational Exposure Limit (OEL) (Brouwer *et al.* 2005; Zock *et al.*; 1998).

$$\text{OAR} = \sum_{i \rightarrow \infty} d \cdot \frac{10000 \cdot c_i \cdot f_i}{\text{OEL}_i}$$

With:

d = density of the product (kg dm<sup>-3</sup>)

c<sub>i</sub> = mass percentage of volatile substance 'i' in the product (% (w/w))

f<sub>i</sub> = volatility factor of volatile substance 'i' (0 ≤ f<sub>i</sub> ≤ 2)

OEL<sub>i</sub> = Occupational Exposure Limit of volatile substance 'i' (mg m<sup>-3</sup>)

A low OAR-score indicates little (potential) inhalation risk a high OAR-score indicates a more hazardous product for inhalation

The second digit (AWARE<sub>2</sub>) is based on the Risk-phrases (R-phrases) of the product (Krop en van Broekhuizen; 2006). These are the R-phrases given in paragraph 15 of the Material Safety Data Sheet. A classification scheme divides chemical products in five possible classes ('I' to 'V'). A low AWARE<sub>2</sub>-score indicates little dermal hazards; a high AWARE<sub>2</sub>-score indicates a hazardous product in case of (frequent) skin contact.

## Calculating the potential inhalation risk

The first number of the health code gives an indication of the inhalation hazards. For the calculation the algorithm of the Occupational Air Requirement (OAR) is used. This method has been shown to give a reasonably good indication of relative inhalation risk when applying a chemical product with a roller or brush (Brouwer *et al*; 2005).

The OAR of a chemical product is calculated with:

- Per product <sup>1</sup>
  - o The concentrations of the individual volatile substances
  - o The density of the product
- Per substance
  - o The Occupational Exposure Limit (OEL)
  - o The volatility factor

The necessary product-based information (density, concentration of the individual volatile compounds, the R-phrases) can be found on the European MSDS. Table 1 gives an overview of the MSDS paragraph where information can be found.

*Table 1. Product information needed for calculating the OAR*

Necessary information	Where?	Alternative	Missing?
Density of the product (kg/m <sup>3</sup> )	MSDS, paragraph 9	True composition	Use "1" as a default
Highest concentration of a volatile compound stated in the MSDS	MSDS, paragraph 2	True composition	N.a.

### *Information on the substances used*

Regarding substance-related information it is vital that all parties concerned use the same values for:

- The Occupational Exposure Limit (OEL) of a substance
- The volatility-factor of a substance
- Naphtha

**NB. A list of commonly used substances with their appropriate OEL and volatility factor is given in appendix 1.**

### Occupational Exposure Limits (OEL's)

The OEL is the health based exposure limit for exposure to hazardous compounds in workplaces. Unfortunately, the derivation of an OEL for a substance has only recently become an European affair. Therefore most substances have multiple OEL's throughout Europe. For example: the German OEL for toluene in Germany is 190 mg/m<sup>3</sup>; the Dutch OEL for toluene is 150 mg/m<sup>3</sup>.

To ensure uniformity in calculating the health code the following hierarchy has been approved in cooperation with suppliers and employers (table 3).

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<sup>1</sup> Product are for instance glues and modeling pastes. A product is defined as a ready for use mixture of one or more substances. Substances are the individual components out of which a product is made, for instance toluene or acetone.

Table 3. Deriving the right OEL – hierarchy

1.	European OEL: Indicative Limit Value <sup>1</sup>
2.	Dutch OEL: Maximaal Aanvaarde Concentratie <sup>2</sup>
3.	Lowest value according to supplier
4.	Lowest value on another EU-25 Member State
5.	Lowest OEL in the US
6.	Default method

1 see Appendix 1 for a complete list

2 please refer to [http://www.ser.nl/zoek/default.asp?desc=zoek\\_mac](http://www.ser.nl/zoek/default.asp?desc=zoek_mac).

### Volatility factor (f)

The volatility factor of a volatile substance gives an indication of how rapidly it becomes available for inhalation. A high volatility factor (f-factor) indicates that a substance evaporates rapidly after application of the product.

The OAR-method differentiates between six classes of volatility-factors (Norwegian State Pollution Control Authority, 1998 cited in Zock *et al*; 1998 ):

0 - 0,3 - 0,7 - 1 - 1,4 and 2,0.

The volatility factor is derived from an NEN-standardized lab test (ASTM-D3539). In appendix 2 substances are listed for which an f-factor has been derived. If an ASTM-based f-factor is not present, the f-factor of a substance can be estimated with its vapor pressure (table 4).

Table 4. Estimating the f-factor with the vapor pressure

Vapor pressure (VP <sup>2</sup> ; mm Hg at 20 °C)	f-factor
VP ≤ 0,1	0
0,1 < VP ≤ 1	0,3
1 < VP ≤ 3	0,7
3 < VP ≤ 10	1,0
10 < VP ≤ 200	1,4
VP > 200	2,0

### Naphtha

Naphtha is an oil fraction composed of many different components. In the shoe repair sector mostly naphtha's with CAS-number 64742-49-0, CAS-number 92062-15-2 and CAS-number 69476-50-8 are used. Per CAS-number the composition may vary slightly, but also shows similarities. All naphtha's are aliphatic de-aromatized mixtures with a molecular weight between 80-110.

For the calculation of the occupational health code the following has been agreed upon:

(1) The OEL is derived from the guidelines proposed by the Hydrocarbon Solvents Products Association (HSPA) of CEFIC. HSPA suggests an OEL of 1200 mg/m<sup>3</sup> (CEFIC/HSPA; 1997).

(2) The same list is used to derive an f-factor of 1,4, based upon a vapor pressure of 2700 Pa = 20 mm Hg.

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<sup>2</sup> Conversion table:

- mm Hg = 133,33 Pa;
- bar = 10<sup>5</sup> Pa;
- mbar = 100 Pa

Example: Cement glue X:

Paragraph 2 of the MSDS of Cement glue X mentions:

Substance	CAS-number	%
Naphta	64742-49-0	90
Aceton	67-64-1	5-20
Rosin, powder	8050-09-7	1,2

Paragraph 8 of the MSDS mentions a density of 0,69 kg/dm<sup>3</sup>.

For the calculation of the health code the upper limit of the concentration range is used. Thus a concentration of 20% for acetone is used

Volatility factor (f-factor):

- Naphta has an f-factor of 1,4.
- Appendix 1 reveals the f-factor of acetone: 1,4
- Rosin is a powder and doesn't evaporate. Therefore, the f-factor equals 0

OEL's:

- Naphta has an OEL of 1200 mg/m<sup>3</sup>
- Acetone has an European OEL of 1210 mg/m<sup>3</sup>
- The OEL of rosin isn't relevant, because it has an f-factor of 0.

Calculating the OAR:

$$\text{OAR} = \frac{0,69 \times 10.000 \times 90 \times 1,4}{1200} + \frac{0,69 \times 10.000 \times 20 \times 1,4}{1210}$$

**OAR = 884**

## Calculating the second number: AWARE<sub>2</sub>

The second number of the health code gives an indication of the dermal hazards. For this the classification scheme of AWARE<sub>2</sub> is used (table 2). Appendix 3 gives a complete overview of R-phrases, including all possible combinations and the correct AWARE<sub>2</sub>-class. For further information on the origins of AWARE please refer to (REF). The R-phrase(s) of the product are the only data one needs to calculate the second number of the health code. The R-phrase(s) of a chemical product can be found in paragraph 15 of the MSDS.

In case of multiple R-phrases the R-phrase leading to the highest class is used to assign AWARE<sub>2</sub>.

Table 2. Classification scheme of AWARE<sub>2</sub>

R-phrases of the product	Indicative meaning	AWARE <sub>2</sub>
None of the R-phrases mentioned below	Products with no or a very low potential hazardous effect	I
20, 21, 22, 65, 68/20/21/22, 48/20/21/22, 62, 63, 66, 36/37/38 + combinations of these R-phrases	Products that contain harmful or irritating substances for all exposure routes.	II
23, 24, 25, 29, 31, 39/23/24/25, 33, 34, 40, 41, 64, 68 + combinations of these R-phrases	Products containing substances that are toxic to all exposure routes or corrosive. These substances may also cause serious irreversible effects.	III
26, 27, 28, 32, 39/26/27/28, 35, 42, 43, 60, 61, 48/23/24/25 + combinations of these R-phrases	Products with substances that are very toxic, very corrosive or allergenic, or that may cause serious irreversible effects. Chronic exposure is a risk for serious health damage.	IV
45, 46, 49 + combinations of these R-phrases	Products with substances that are mutagenic or are carcinogenic.	V

Example: Cement glue X (continued):

Paragraph 15 of the MSDS mentions R-phrases:

- R11 Highly flammable
- R38 Irritating to skin
- R43 May cause skin sensitization
- R65 Harmful: may cause lung damage if swallowed
- R67 Vapors may cause drowsiness and dizziness

The classification scheme of AWARE<sub>2</sub> only mentions R38 and R43.

R38 → class II;

R43 → class IV.

AWARE<sub>2</sub> is based on the highest of the classes, therefore AWARE<sub>2</sub> = IV.

### 3. Organization

#### Who

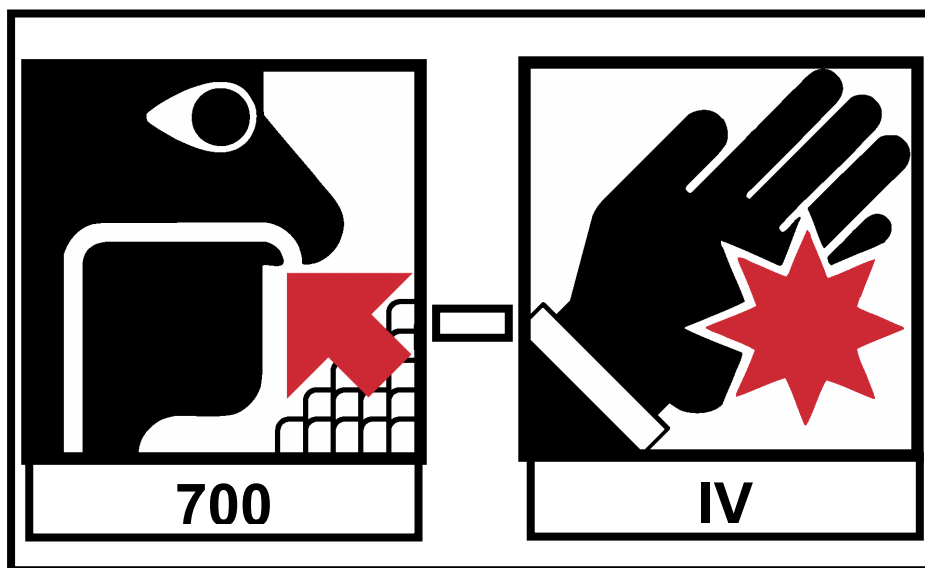
Suppliers of chemical products are free to calculate the health code using the exact composition of their products.

*If a supplier chooses not to calculate the health code on the basis of the composition the information on the MSDS will be used. Since the upper limit of the concentration range given in the MSDS is used this might lead to an over-estimation of the 'true' health code.*

The websites of NSV and NVOS will show only one health code per product. A clear demarcation will be used to indicate the source that has been used to calculate the health code (MSDS or composition).

#### Visualization

The health code for shoe technicians is depicted as follows:



#### Notification/labeling

The health code will be used in the database of a digital chemical risk management tool. This web based tool will be freely available to all shoe technicians. Branch organization NSV and NVOS ask their suppliers of chemical products to label their products with the health code.

Furthermore, chemical suppliers are free, but not obliged, to mention the health code on:

- The MSDS
- The product information sheet
- Their product catalogues

## **Maintenance**

All information on products and substances can change. For instance: new products that appear on the market, changes in chemical legislation, or new insights in the toxicity of substances used. Maintenance of the product code is thus necessary.

After the introduction of the health code branche organizations NSV and NVOS take ownership and responsibility of keeping the product code up to date.

## References

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- CEFIC/ HSPA (1997). *Hydrocarbon Solvents Product Association: assigning occupational exposure limits to hydrocarbon solvents, a recommended approach*. Brussels, Belgium: CEFIC.
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- Norwegian State Pollution Control Authority (1998). *Guidelines for Norwegian regulations concerning labeling, sale etc. of chemical substances and products which may involve a hazard to health and for regulations concerning marking/labelling of flammable and explosive goods*.
- Zock, J.P., Stouten, Th.J., van Hemmen, J.J.. 1998. *Occupational Air Requirement (OAR) en vervanging van oplosmiddelen voor verf en verfproducten*. Rapport V98.1241, TNO Voeding, Zeist.

## **APPENDIX 1. List of commonly used substances and their f-factor and OEL sorted by CAS-number**

<b>Naam</b>	<b>CASnr</b>	<b>f-factor*</b>	<b>OEL in mg/m<sup>3</sup>*</b>
methanol	67-56-1	1,4	260
2-propanol/ isopropanol	67-63-0	1,4	650
aceton	67-64-1	1,4	1210
ethanol	64-17-5	1,4	1000
n-butaan	71-36-3	1,0	45
propaan	74-98-6	2	1800
Dichloormethaan	75-09-2	2	350
2-butaan/ methylethylketon	78-93-3	1,4	600
methylmethacrylaat	80-62-6	1,4	40
Polymethacrylaat = MMA – methylmethacrylaat	80-62-6	1,4	40
butylbenzylftalaat	85-68-7	0	5
2-methyl-m-phenylendiisocyaan	91-08-7	1,4	0,04
2-dimethylaminoethanol	100-37-8	0,7	9,6
ethylbenzeen	100-41-4	1,0	442
styreen	100-42-5	1,0	107
benzylalcohol	100-51-6	0,3	45
butaan	106-97-8	2,0	1430
2-methylpentaan	107-83-5	1,4	720
1-methoxy-2-propanol	107-98-2	1	375
methylisobutylketon	108-10-1	1,0	83
tolueen	108-88-3	1,4	150
cyclohexanon	108-94-1	0,7	40,8
pentaan	109-66-0	2	1800
Dimethoxymethaan	109-87-5	2	1000
n-Hexaan	110-54-3	1,4	90
cyclohexaan	110-82-7	1,4	875
morpholine	110-91-8	1,0	36
diacetonolcohol	123-42-2	0,3	120
n-buthylacetaat	123-86-4	1,0	480
ethylacetaat	141-78-6	1,4	550
heptaan isomerenmengsel	142-82-5	1,4	1250
2,4-tolueendiisocyaan	584-84-9	0,0	0,04
NMP	872-50-4	0,3	80
borax	1303-96-4/ 1330-43-4	0,3	2
xyleen	1330-20-7	1,0	221
Ammonia in oplossing	1336-21-6	2	14
ethyl-2-cyanoacrylaat	7085-85-0	0,3	1,0
naphta (aardolie), met waterstof ontzwaveld zwaar	64742-82-1	1,4	1200
solvent naphta	92062-15-2	1,4	1200
4,4 methyleendiphenyl-diisocyaan	26447-40-5/ 101-68-8	0	0,05

\* The f-factors en OEL's mentioned in this table have been derived according the procedure laid down in chapter 2 of this manual

## APPENDIX 2. Full list of R-phrases and their AWARE<sub>2</sub>-classification

R-phrase		AWARE <sub>2</sub>
R1	Explosive when dry.	I
R2	Risk of explosion by shock, friction, fire or other sources of ignition.	I
R3	Extreme risk of explosion by shock, friction, fire or other sources of ignition.	I
R4	Forms very sensitive explosive metallic compounds.	I
R5	Heating may cause an explosion.	I
R6	Explosive with or without contact with air.	I
R7	May cause fire.	I
R8	Contact with combustible material may cause fire.	I
R9	Explosive when mixed with combustible material.	I
R10	Flammable	I
R11	Highly flammable	I
R12	Extremely flammable	I
R14	Reacts violently with water	I
R14/15	Reacts violently with water, liberating extremely flammable gases.	I
R15	Contact with water liberates extremely flammable gases	I
R15/29	Contact with water liberates toxic, extremely flammable gas	I
R16	Explosive when mixed with oxidizing substances.	I
R17	Spontaneously flammable in air.	I
R18	In use, may form flammable/explosive vapour-air mixture.	I
R19	May form explosive peroxides.	I
R20	Harmful by inhalation.	II
R20/21	Harmful by inhalation and in contact with skin.	II
R20/22	Harmful by inhalation and if swallowed.	II
R20/21/22	Harmful by inhalation, in contact with skin and if swallowed.	II
R21	Harmful in contact with skin.	II
R21/22	Harmful in contact with skin and if swallowed.	II
R22	Harmful if swallowed.	II
R23	Toxic by inhalation.	III
R23/24	Toxic by inhalation and in contact with skin.	III
R23/25	Toxic by inhalation and if swallowed	III
R23/24/25	Toxic by inhalation, in contact with skin and if swallowed.	III
R24	Toxic in contact with skin	III
R24/25	Toxic in contact with skin and if swallowed.	III
R25	Toxic if swallowed.	III
R26	Very toxic by inhalation	IV
R26/27	Very toxic by inhalation and in contact with skin	IV
R26/28	Very toxic by inhalation and if swallowed	IV
R26/27/28	Very toxic by inhalation, in contact with skin and if swallowed	IV
R27	Very toxic in contact with skin	IV
R27/28	Very toxic in contact with skin and if swallowed	IV
R28	Very toxic if swallowed.	IV
R29	Contact with water liberates toxic gas.	III
R30	Can become highly flammable in use.	III
R31	Contact with acids liberates toxic gas.	III
R32	Contact with acids liberates very toxic gas.	IV
R33	Danger of cumulative effects.	III
R34	Causes burns.	III
R35	Causes severe burns.	IV

<b>R36</b>	Irritating to eyes.	II
<b>R36/37</b>	Irritating to eyes and respiratory system.	II
<b>R36/38</b>	Irritating to eyes and skin.	II
<b>R36/37/38</b>	Irritating to eyes, respiratory system and skin	II
<b>R37</b>	Irritating to respiratory system.	II
<b>R37/38</b>	Irritating to respiratory system and skin.	II
<b>R38</b>	Irritating to skin	II
<b>R39/23</b>	Toxic: danger of very serious irreversible effects through inhalation.	III
<b>R39/24</b>	Toxic: danger of very serious irreversible effects in contact with skin.	III
<b>R39/25</b>	Toxic: danger of very serious irreversible effects if swallowed.	III
<b>R39/23/24</b>	Toxic: danger of very serious irreversible effects through inhalation and in contact with skin.	III
<b>R39/23/25</b>	Toxic: danger of very serious irreversible effects through inhalation and if swallowed.	III
<b>R39/24/25</b>	Toxic: danger of very serious irreversible effects in contact with skin and if swallowed.	III
<b>R39/23/24/25</b>	Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed.	III
<b>R39/26</b>	Very toxic: danger of very serious irreversible effects through inhalation.	IV
<b>R39/27</b>	Very toxic: danger of very serious irreversible effects in contact with skin.	IV
<b>R39/28</b>	Very toxic: danger of very serious irreversible effects if swallowed.	IV
<b>R39/26/27</b>	Very toxic: danger of very serious irreversible effects through inhalation and in contact with skin.	IV
<b>R39/26/28</b>	Very toxic: danger of very serious irreversible effects through inhalation and if swallowed.	IV
<b>R39/27/28</b>	Very toxic: danger of very serious irreversible effects in contact with skin and if swallowed.	IV
<b>R39/26/27/28</b>	Very toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed.	IV
<b>R40</b>	Possible risk of cancer.	III
<b>R41</b>	Risk of serious damage to eyes.	III
<b>R42</b>	May cause sensitization by inhalation.	IV
<b>R42/43</b>	May cause sensitization by inhalation and skin contact	IV
<b>R43</b>	May cause sensitization by skin contact.	IV
<b>R44</b>	Risk of explosion if heated under confinement.	I
<b>R45</b>	May cause cancer.	V
<b>R46</b>	May cause heritable genetic damage.	V
<b>R48/20</b>	Harmful: danger of serious damage to health by prolonged exposure through inhalation.	II
<b>R48/21</b>	Harmful: danger of serious damage to health by prolonged exposure in contact with skin.	II
<b>R48/22</b>	Harmful: danger of serious damage to health by prolonged exposure if swallowed.	II
<b>R48/20/21</b>	Harmful: danger of serious damage to health by prolonged exposure through inhalation and in contact with skin.	II
<b>R48/20/22</b>	Harmful: danger of serious damage to health by prolonged exposure through inhalation and if swallowed.	II
<b>R48/21/22</b>	Harmful: danger of serious damage to health by prolonged exposure in contact with skin and if swallowed.	II
<b>R48/20/21/22</b>	Harmful: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed.	II
<b>R48/23</b>	Toxic: danger of serious damage to health by prolonged exposure through inhalation.	IV
<b>R48/24</b>	Toxic: danger of serious damage to health by prolonged exposure in contact with skin.	IV
<b>R48/25</b>	Toxic: danger of serious damage to health by prolonged exposure if swallowed.	IV
<b>R48/23/24</b>	Toxic: danger of serious damage to health by prolonged exposure through inhalation and in contact with skin.	IV
<b>R48/23/25</b>	Toxic: danger of serious damage to health by prolonged exposure through inhalation and if swallowed.	IV
<b>R48/24/25</b>	Toxic: danger of serious damage to health by prolonged exposure in contact with skin and if swallowed.	IV
<b>R48/23/24/25</b>	Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed.	IV
<b>R49</b>	May cause cancer by inhalation.	V
<b>R50</b>	Very toxic to aquatic organisms.	I
<b>R50/53</b>	Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.	I

<b>R51</b>	Vergiftig voor in het water levende organismen	I
<b>R51/53</b>	Vergiftig voor in het water levende organismen; kan in het aquatisch milieu op lange termijn schadelijke effecten veroorzaken	I
<b>R52</b>	Schadelijk voor in het water levende organismen	I
<b>R52/53</b>	Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.	I
<b>R53</b>	May cause long-term adverse effects in the aquatic environment.	I
<b>R54</b>	Toxic to flora.	I
<b>R55</b>	Toxic to fauna.	I
<b>R56</b>	Toxic to soil organisms.	I
<b>R57</b>	Toxic to bees.	I
<b>R58</b>	May cause long-term adverse effects in the environment.	I
<b>R59</b>	Dangerous for the ozone layer.	I
<b>R60</b>	May impair fertility.	IV
<b>R61</b>	May cause harm to the unborn child.	IV
<b>R62</b>	Possible risk of impaired fertility.	II
<b>R63</b>	Possible risk of harm to the unborn child.	II
<b>R64</b>	May cause harm to breastfed babies.	III
<b>R65</b>	Harmful: may cause lung damage if swallowed.	II
<b>R66</b>	Repeated exposure may cause skin dryness or cracking.	II
<b>R67</b>	Vapours may cause drowsiness and dizziness.	I
<b>R68</b>	Possible risks of irreversible effects.	III
<b>R68/20</b>	Harmful: possible risk of irreversible effects through inhalation.	II
<b>R68/21</b>	Harmful: possible risk of irreversible effects in contact with skin.	II
<b>R68/22</b>	Harmful: possible risk of irreversible effects if swallowed.	II
<b>R68/20/21</b>	Harmful: possible risk of irreversible effects through inhalation and in contact with skin.	II
<b>R68/20/22</b>	Harmful: possible risk of irreversible effects through inhalation and if swallowed.	II
<b>R68/21/22</b>	Harmful: possible risk of irreversible effects in contact with skin and if swallowed.	II
<b>R68/20/21/22</b>	Harmful: possible risk of irreversible effects through inhalation, in contact with skin and if swallowed	II

### APPENDIX 3. List of the European Occupational Exposure Limits

#### INDICATIVE OCCUPATIONAL EXPOSURE LIMIT VALUES

Einecs No.	CAS No.	Name of agent	Directive	8h TWA		STEL		Notation
				mg/m <sup>3</sup>	ppm	mg/m <sup>3</sup>	ppm	
2 001 933	54-11-5	Nicotine	91/322	0.5	—	—	—	—
200-467-2	60-29-7	Diethylether	2000/39	308	100	616	200	—
2 005 791	64-18-6	Formic acid	91/322	9	5	—	—	—
2 005 807	64-19-7	Acetic acid	91/322	25	10	—	—	—
2 006 596	67-56-1	Methanol	91/322	260	200	—	—	—
200-662-2	67-264-1	Acetone	2000/39	1 210	500	—	—	—
200-663-8	67-66-3	Chloroform	2000/39	10	2	—	—	Skin
200-756-3	71-55-6	1,1,1-Trichloroethane	2000/39	555	100	1 110	200	—
200-834-7	75-04-7	Ethylamine	2000/39	9.4	5	—	—	—
2 008 352	75-05-8	Acetonitrile	91/322	70	40	—	—	—
200-863-5	75-34-3	1,1-Dichloroethane	2000/39	412	100	—	—	Skin
200-870-3	75-44-5	Phosgene	2000/39	0.08	0.02	0.4	0.1	—
200-871-9	75-45-6	Chlorodifluoro-methane	2000/39	3 600	1 000	—	—	—
201-159-0	78-93-3	Butanone	2000/39	600	200	900	300	—
201-176-3	79-09-4	Propionic acid	2000/39	31	10	62	20	—
2 018 659	88-89-1	Picric acid	91/322	0.1	—	—	—	—
2 020 495	91-20-3	Naphtalene	91/322	50	10	—	—	—
202-422-2	95-47-6	o-Xylene	2000/39	221	50	442	100	Skin
202-425-9	95-50-1	1,2-Dichlorobenzene	2000/39	122	20	306	50	Skin
202-436-9	95-63-6	1,2,4-Trimethylbenzene	2000/39	100	20	—	—	—
202-704-5	98-82-8	Cumene	2000/39	100	20	250	50	Skin
202-705-0	98-83-9	2-Phenylpropene	2000/39	246	50	492	100	—
2 027 160	98-95-3	Nitrobenzene	91/322	5	1	—	—	—
202-849-4	100-41-4	Ethylbenzene	2000/39	442	100	884	200	Skin
203-313-2	105-60-2	e-Caprolactam, (dust and vapour)	2000/39	10	—	40	—	—
203-388-1	106-35-4	Heptan-3-one	2000/39	95	20	—	—	—
203-396-5	106-42-3	p-Xylene	2000/39	221	50	442	100	Skin
203-400-5	106-46-7	1,4-Dichlorobenzene	2000/39	122	20	306	50	—

203-470-7	107-18-6	Allyl alcohol	2000/39	4.8	2	12.1	5	Skin
203-473-3	107-21-1	Ethylene glycol	2000/39	52	20	104	40	Skin
203-539-1	107-98-2	1-Methoxypropanol-2	2000/39	375	100	568	150	Skin
203-550-1	108-10-1	4-Methylpentan-2-one	2000/39	83	20	208	50	—
203-576-3	108-38-3	m-Xylene	2000/39	221	50	442	100	Skin
2 035 852	108-46-3	Resorcinol	91/322	45	10	—	—	—
203-603-9	108-65-6	2-Methoxy-1-methylethylacetate	2000/39	275	50	550	100	Skin
203-604-4	108-67-8	Mesitylene (Trimethylbenzenes)	2000/39	100	20	—	—	—
203-628-5	108-90-7	Chlorobenzene	2000/39	47	10	94	20	—
203-631-1	108-94-1	Cyclohexanone	2000/39	40.8	10	81.6	20	Skin
203-632-7	108-95-2	Phenol	2000/39	7.8	2	—	—	Skin
2 037 163	109-89-7	Diethylamine	91/322	30	10	—	—	—
203-726-8	109-99-9	Tetrahydrofuran	2000/39	150	50	300	100	Skin
203-737-8	110-12-3	5-Methylhexan-2-one	2000/39	95	20	—	—	—
203-767-1	110-43-0	Heptan-2-one	2000/39	238	50	475	100	Skin
203-808-3	110-85-0	Piperazine	2000/39	0.1	—	0.3	—	—
2 038 099	110-86-1	Pyridine	91/322	15	5	—	—	—
203-905-0	111-76-2	2-Butoxyethanol	2000/39	98	20	246	50	Skin
203-933-3	112-07-2	2-Butoxyethyl acetate	2000/39	133	20	333	50	Skin
204-065-8	115-10-6	Dimethylether	2000/39	1 920	1 000	—	—	—
204-428-0	120-82-1	1,2,4-Trichlorobenzene	2000/39	15.1	2	37.8	5	Skin
204-469-4	121-44-8	Triethylamine	2000/39	8.4	2	12.6	3	Skin
204-662-3	123-92-2	Isopentylacetate	2000/39	270	50	540	100	—
2 046 969	124-38-9	Carbon dioxide	91/322	9000	5000	—	—	—
204-697-4	124-40-3	Dimethylamine	2000/39	3.8	2	9.4	5	—
204-826-4	127-19-5	N,N-Dimethylacetamide	2000/39	36	10	72	20	Skin
205-480-7	141-32-2	n-Butylacrylate	2000/39	11	2	53	10	—
205-563-8	142-82-5	n-Heptane	2000/39	2 085	500	—	—	—
2 056 343	144-62-7	Oxalic acid	91/322	1	—	—	—	—
2 069 923	420-04-2	Cyanamide	91/322	2	—	—	—	—
208-394-8	526-73-8	1,2,3-Trimethylbenzene	2000/39	100	20	—	—	—
208-793-7	541-85-5	5-Methylheptan-3-one	2000/39	53	10	107	20	—

210-946-8	626-38-0	1-Methylbutylacetate	2000/39	270	50	540	100	—
211-047-3	628-63-7	Pentylacetate	2000/39	270	50	540	100	—
	620-11-1	3-Pentylacetate	2000/39	270	50	540	100	—
	625-16-1	Amylacetate, tert	2000/39	270	50	540	100	—
2 151 373	1305-62-0	Calcium dihydroxide	91/322	5	—	—	—	—
2 152 361	1314-56-3	Disphosphorus pentaoxide	91/322	1	—	—	—	—
2 152 424	1314-80-3	Disphosphorus pentasulphide	91/322	1	—	—	—	—
2 152 932	1319-77-3	Cresols (all isomers)	91/322	22	5	—	—	—
8215-535-7	1330-20-7	Xylene, mixed isomers, pure	2000/39	221	50	442	100	Skin
222-995-2	3689-24-5	Sulphotep	2000/39	0.1	—	—	—	Skin
231-634-8	7664-39-3	Hydrogen fluoride	2000/39	1.5	1.8	2.5	3	—
231-131-3	7440-22-4	Silver, metallic	2000/39	0.1	—	—	—	—
2 314 843	7580-67-8	Lithium hydride	91/322	0.025	—	—	—	—
231-595-7	7647-01-0	Hydrogen chloride	2000/39	8	5	15	10	—
231-633-2	7664-38-2	Orthophosphoric acid	2000/39	1	—	2	—	—
231-635-3	7664-41-7	Ammonia, anhydrous	2000/39	14	20	36	50	—
2 317 781	7726-95-6	Bromine	91/322	0.7	0.1	—	—	—
231-954-8	7782-41-4	Fluorine	2000/39	1.58	1	3.16	2	—
231-978-9	7783-07-5	Dihydrogen selenide	2000/39	0.07	0.02	0.17	0.05	—
	8003-34-7	Pyrethrum	91/322	5	—	—	—	—
2 330 603	10026-13-8	Phosphorus pentachloride	91/322	1	—	—	—	—
233-113-0	10035-10-6	Hydrogen bromide	2000/39	—	—	6.7	2	—
2 332 710	10102-43-9	Nitrogen monoxide	91/322	30	25	—	—	—
247-852-1	26628-22-8	Sodium azide	2000/39	0.1	—	0.3	—	Skin
252-104-2	34590-94-8	(2-Methoxymethylethoxy) propanol	2000/39	308	50	—	—	Skin
		Fluorides, inorganic	2000/39	2.5	—	—	—	—
		Barium (soluble compounds as Ba)	91/322	0.5	—	—	—	—
		Silver (soluble compounds as Ag)	91/322	0.01	—	—	—	—

		Tin (inorganic compounds as Sn)	91/322	2	—	—	—	—
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Einecs: European Inventory of Existing Chemical Substances

CAS: Chemical Abstract Series Number

8Hr TWA: Measured or calculated in relation to a reference period of eight hours time-weighted-average

STEL: Short Term Exposure Limit - a limit value above which exposure should not occur and is related to a 15 minute period, unless otherwise specified

mg/m<sup>3</sup>: milligrams per cubic metre of air at 20°C and 101.3 KPa

ppm: parts per million by volume in air (ml/m<sup>3</sup>)

f/ml: fibres per millilitre

Notation: a skin notation assigned to the OEL identifies the possibility of significant uptake through the skin

## APPENDIX 4. List of evaporation factors conform ASTM-D3539

CAS-nr.	Substance	V <sub>D</sub> (mbar)	f
75-07-0	acetaldehyde	990	2
67-64-1	acetone	247	1,4
75-31-0	2-aminopropaan (isopropylamine, 2-propylamine)	635	2
628-63-7	amylacetaat ( <i>n</i> -pentylacetaat)	6	1
71-43-2	benzene	100	1,4
106-99-0	1,3-butadieen	2400	2
71-36-3	1-butanol	7	1
78-92-2	2-butanol	17	1
78-93-3	butanone (methylethylketon, MEK)	105	1,4
111-76-2	2-butoxyethanol (butyl glycol, ethyleenglycolmonobutylether, butylcellosolve)	1	0,3
112-07-2	2-butoxyethylacetaat (butylglycolacetaat, ethyleenglycolmonobutyletheracetaat, butylcellosolve)	0,4	0,3
123-86-4	<i>n</i> -butylacetaat	10,7	1
141-32-2	<i>n</i> -butylacrylaat	5	1
109-73-9	<i>n</i> -butylamine	96	1,4
67-66-3	chloroform (trichloormethaan)	212	2
110-82-7	cyclohexaan	104	1,4
108-93-0	cyclohexanol	1,3	0,7
108-94-1	cyclohexanon	4,7	0,7
84-74-2	dibutylfalaat	0,00002	0
75-34-3	1,1-dichloorethaan	243	2
107-06-2	1,2-dichloorethaan	87	1,4
75-35-4	1,1-dichlooretheen	665	2
75-09-2	dichloormethaan (methyleenchloride)	470	2
78-87-5	1,2-dichloorpropaan (propyleenchloride)	56	1,4
542-75-6	1,3-dichloorpropeen (propyleendichloride)	40	1,4
109-89-7	diethylamine	250	2
60-29-7	diethylether (ether)	587	2
84-66-2	diethylfalaat	< 0,01	0
101-84-8	difenylether (difenyloxide)	0,08	0
108-18-9	diisopropylamine	80	1,4
108-20-3	diisopropylether (isopropylether)	175	1,4
109-87-5	dimethoxymethaan (formal, methylal, methyleendimethylether)	440	2
131-11-3	dimethylfalaat	0,013	0
123-91-1	1,4-dioxaan	41	1,4
106-89-8	epichloorhydrine	17	1,4
64-17-5	ethanol (ethylalcohol)	58,5	1,4
141-78-66	ethylacetaat	97	1,4
140-88-5	ethylacrylaat	39	1,4
100-41-4	ethylbenzeen	9,3	1
107-15-3	ethyleendiamine (1,2-diaminoethaan)	13,3	1
107-21-1	ethyleenglycol (1,2-ethaandiol)	0,12	0
110-80-5	ethyleenglycolmonoethylether (cellosolve, 2-ethoxyethanol, ethylglycol)	5	1

CAS-nr.	Substance	V <sub>D</sub> (mbar)	f
111-15-9	ethyleenglycolmonoetheracetaat (cellosolve acetaat, 2-ethoxyethylacetaat, ethylglycolacetaat)	2,6	0,7
109-86-4	ethyleenglycolmonomethylether (2-methoxyethanol)	11	1
110-49-6	ethyleenglycolmonomethyletheracetaat (2-methoxyethylacetaat, methylglycolacetaat)	9,3	0,7
97-63-2	ethylmethacrylaat	21,3	1,4
96-29-7	ethylmethylketonoxim (MEK-oxim)	1,4	0,7
100-74-3	N-ethylmorpholine	8	1
142-82-5	n-heptaan	48	1,4
110-43-0	2-heptanon	3,4	0,7
106-35-4	3-heptanon (butylethylketon, ethylbutylketon)	5,3	1
110-54-3	n-hexaan	160	1,4
107-41-5	hexyleenglycol (2-methyl-2,4-pentadiol)	0,07	0
110-19-0	isobutylacetaat	20	1
78-59-1	isoforon (3,5,5-trimethyl-2-cyclohexen-1-on)	0,3	0,3
67-63-0	isopropanol (2-propanol, isopropylalcohol)	43	1,4
98-82-8	isopropylbenzeen (cumeen)	4,3	1
108-20-3	isopropylether	175	1,4
138-86-3	limoneen (dipenteen)	2,1	0,7
67-56-1	methanol (methylalcohol)	128	1,4
79-20-9	methylacetaat	230	2
96-33-3	methylacrylaat	93	1,4
591-78-6	methylbutylketon (2-hexanon, MBK)	3,5	1,4
110-12-3	methylisoamylketon (5-methyl-2-hexanon)	2	1
108-10-1	methylisobutylketon (4-methyl-2-pentanon, MIBK)	7	1
624-83-9	methylisocyanaat	464	2
80-62-6	methylmethacrylaat	47	1,4
107-87-9	methylpropylketon (2-pentanon)	16	1,4
872-50-4	N-methyl-2-pyrrolidon	0,7	0,3
111-84-2	n-nonaan	4,2	1
111-65-9	n-octaan	14	1
109-66-0	n-pentaaan	573	2
71-41-0	1-pentanol	3	0,7
628-63-7	n-pentylacetaat (n-amylacetaat)	6	1
127-18-4	perchlooretheen (tetrachlooretheen, perchloorethyleen, PER)	18	1
71-23-8	1-propanol (propylalcohol)	19	1
109-60-4	propylacetaat	33	1,4
107-10-8	propylamine	329	2
57-55-6	1,2-propyleenglycol (1,2-propaandiol)	0,13	0
107-98-2	propyleenglycolmonomethylether (PGME)	10,8	1
110-86-1	pyridine	20	1
100-42-5	styreen	6	1
8006-64-2	terpentijn	2,5	0,7
25265-77-4	texanol (2,2,4-trimethyl-1,3-pentaandiolmonoisobutyraat)	< 0,01	0
64742-89-8	thinner	mrt-20	1
108-88-3	tolueen	38	1,4
96-18-4	1,2,3-trichloorpropaan	4,5	1
95-63-6	1,2,4-trimethylbenzeen	2,1	0,7

CAS-nr.	Substance	V <sub>D</sub> (mbar)	f
71-55-6	1,1,1-trichloorethaan (methylchloroform)	133	1,4
79-00-5	1,1,2-trichloorethaan	25	1,4
79-01-6	1,1,2-trichlooretheen (tri, ethyleentrichloride, trichlooeethyleen)	77	1,4
121-44-8	triethylamine	70	1,4
108-05-4	vinylacetaat	120	1,4
611-15-4	vinyltolueen (methylstyreen)	2,6	0,7
64742-82-1	white spirit (terpentine)		0,7
64742-95-6	white spirit high aromatic		0,7
64742-94-5	white spirit high aromatic high flash		0,3
64742-81-0	white spirit high aromatic high flash (evaporation rate < 0,01)		0
64742-82-1	white spirit high flash		0,3
64742-48-9	white spirit low aromatic		0,7
64742-48-9	white spirit low aromatic high flash		0,3
64742-48-9	white spirit low aromatic high flash (evaporation rate < 0,01)		0
1330-20-7	xyleen (isomerenmengsel)	8	1
108-38-3	<i>m</i> -xyleen	8	1
75-15-0	zwavelkoolstof (koolstofdissulfide)	400	2