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Probit function technical support document

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substance name	CAS number
Phosphorous trichloride	**7719-12-2**

This draft document describes the derivation of a probit function for application in a quantitative risk analysis (QRA).

This document has been checked for completeness by the Netherlands' National Institute of Public Health and the Environment (RIVM), and has been assigned the status "proposed". The document is open for discussion by the scientific expert panel on probit functions. Interested parties are invited to submit comments and suggestions concerning this document within 6 weeks after the issue date to the e-mail address mentioned above.

If the proposed probit function is approved by the expert panel on scientific grounds, the status of the document and probit function will be raised to "interim".

Subsequently, a committee of governmental representatives will perform a second tier evaluation to decide whether the probit function will be formally implemented. The decision on actual implementation will primarily be based on the results of a consequence analysis.

Detailed information on the procedures for derivation, evaluation and formalization of probit functions is available at http://www.rivm.nl/milieuportaal/bibliotheek/databases/probitrelaties.jsp.

Technical support document Phosphorous Trichloride

1 Substance identification

CAS-number:	7719-12-2
IUPAC name:	phosphorous trichloride
Synonyms:	Trichlorophosphine, phosphorous chloride, phosphorous trichloride,
Molecular formula:	PCl_3
Molecular weight:	137.33 g/mol
Physical state:	liquid (at 20°C and 101.3 kPa)
Melting point (°C):	-112 (at 101.3 kPa)
Boiling point (°C):	76 (at 101.3 kPa)
Vapour pressure (kPa):	13.3 (at 20°C)
Saturated vapour conc:	760,000 mg/m^3 (at 20°C and 101.3 kPa)
Conversion factor:	1 mg/m^3 = 0.175 ppm (at 20°C and 101.3 kPa) 1 ppm = 5.71 mg/m^3
Labeling:	R: 14-26/28-35-48/20

2 Mechanism of action and toxicological effects following acute exposure[1]

Special considerations: Phosporous trichloride (PCl_3) hydrolyses to HCl, phosphonic acid and pyrophosphonic acids, which substances may (partly) be responsible for the irritation effects next to the parent compound. However, the mechanism of action of PCl_3 is not completely understood, where the rate and completeness of the hydrolysis are unknown. Based on a comparison between 4h lethal concentrations (25% and 50% mortality) of PCl_3, when corrected for chlorine content, and that of HCl, PCl_3 seems to be slightly more toxic with differences of a factor 2 to 4 (see section 6).

Acute effects: The main target organs in inhalation exposure are the cornea, skin and respiratory tract. Signs and symptoms that can be expected are: burning eyes, shortness of breath, throat irritation, lacrimation, headache, nausea, burning sensation on the skin, sputum production, chest pains, wheezing, skin rash, blurred vision, vomiting, and abdominal pain. Lethality is caused by tissue damage of the respiratory tract (pulmonary oedema) resulting in dyspnoea. Ultimately, hypoxemia will result in CNS depression and cardiovascular effects that may finally lead to death.

Long-term effects: Similar effects as for acute exposure are expected after chronic exposure. Asthmatic bronchitis was observed after 1-8 week exposure but resolved upon cessation of exposure.

3 Human toxicity data

No reliable and informative studies with details about both human exposure as well as lethality have been identified.

[1] Source: AEGL document (interim, 2006) and Chemiekaart (2008)

4 Animal acute toxicity data

Animal lethal toxicity data considering acute exposure are described in Appendix 1. A total of 8 studies have been identified where PCl_3 lethality was studied. No studies have been assigned with status A for PCl_3, but two studies with quality A for HCl have been added to the appendix. One study has been assigned with status B, and seven have been assessed to be unfit (status C) for human probit function derivation.
During a literature search the following technical support documents and databases have been consulted:

1) AEGL document (interim, 2006), ERPG document (final, 2004), Dutch Intervention Values (2000), Chemiekaart (2008)
2) An additional search covering publications from 1980 - 2008 was performed in HSDB, RTECS, PubMed/Medline, Toxcenter and IUCLID using the following key words:
    a. CAS-number,
    b. lethal*,
    c. mortal*,
    d. LC, LC_{50},
    e. probit
    f. Phosphorous trichloride and synonyms

Sensory irritation
No studies were identified in which sensory irritation was studied.

5 Probit functions

The identified studies are reported in Appendix 1. Animal probit functions could not be derived for phosphorous trichloride from the available data.

6 Evaluation

Lethal toxicity data on PCl_3 are not suitable for probit function derivation. The Monsanto (1986) study was given the B status, but does not include sufficient information to derive a reliable LC_{50} value. The study by Weeks et al (1964) did provide LC_{50} values for the rat and guinea pig as potential point of departure, but these values were considered to be too unreliable for the following reasons. Underlying concentration-response data were not provided by the authors. Despite the fact that up to 40% of PCl_3 was reported to be hydrolysed during exposure, no information was provided about the rate of the hydrolysis and whether the hydrolysis was accounted for in the LC_{50} calculations. Therefore, it is unknown whether the LC_{50} calculations were based on nominal, actual or target concentrations and the LC_{50} values cannot be judged on their merits. Furthermore, data from another study in rats (Monsanto, 1986) using the same time duration of four hours showed contrasting results. No mortality was found by Monsanto (1986) at concentrations that were approximately similar to the calculated LC_{50} value of Weeks *et al.* (1964).

Because the toxicity data on PCl_3 cannot be used, it was decided to use the lethal toxicity data on HCl to derive a probit function for PCl_3. In order to justify this approach a comparison was made between lethal concentrations of PCl_3 and HCl, adjusted for their

chlorine contents. Data from the Monsanto (1986) study was used, where 25% of the animals died after an exposure to 857 mg/m^3 (150 ppm) PCl_3 (based on P content). This corresponds to a chlorine adjusted exposure of **450 ppm**, which then was compared to a (chlorine adjusted) calculated LC_{25} of **824 ppm** for HCl (based on the derived animal probit function of study A.2). Based on this comparison, it seems that PCl_3 is about a factor 2 more toxic than HCl after molar adjustment for chlorine content.

As the point of departure for deriving the human probit function the 30 min LC_{50} value of 6654 mg/m^3 of HCl for the rat was taken, which equals 4378 ppm. Complete hydrolysis of 1 mole PCl_3 produces 3 moles of HCl. In addition, a correction factor of 2 will be applied for the toxic potency of PCl_3 compared to that of HCl after molar adjustment. Therefore the 30 min LC_{50} value of PCl_3 is estimated as 4378 / 6 = 730 ppm (4168 mg/m^3 PCl_3). The human equivalent LC_{50} was subsequently calculated by applying the following assessment factors:

Assessment factor for:	**Factor**	**Rationale**
Animal to human extrapolation:	3	
RD_{50}	3	Based on the HCl RD_{50} values ranging from 470 to 1,160 mg/m^3
Nominal concentration	1	Analytical data used in HCl studies
Adequacy of database:	3	Comparison between HCl and PCl_3 is based on two data points, which is considered weak.

The estimated human equivalent 30-minute LC_{50} value is 4168 / 27 = 154 **mg/m^3**.

Because the toxicity of PCl_3 could not be explained by HCl formation alone, it was decided not to apply the experimentally determined n-value for HCl. Instead, as a default a n-value of **2** is considered. Assuming a regression coefficient (b×n) of 2 for the slope of the curve, the b-value can be calculated as 2 / n = **1**.

The human probit function is then calculated on the human equivalent 30 min LC_{50} and using the above parameters to solve the following equation to obtain the a-value (the intercept): $5 = a + 1 \times \ln (154^2 \times 30)$ resulting in the a-value of **-8.48**.

$Pr = -8.5 + 1 \times \ln (C^2 \times t)$ with C in mg/m^3 and t in min.

The derived human probit function has a scientifically weak basis. Data on PCl_3 do not allow probit function derivation. The probit function is, therefore, based on one comparison between the lethal toxicity of PCl_3 and HCl in the rat, under the assumption that PCl_3 toxicity predominantly can be predicted by HCl formation. Based on the comparison, an additional correction factor of 2 was deemed necessary to account for the fact that PCl_3 is approximately a factor 2 more toxic than HCl. The HCl probit function itself is based on two studies in the rat, with A quality.

The human 60 min LC_1 (Pr = 2.67) calculated with this probit equation is 34 mg/m^3 and the calculated human 60 min $LC_{0.1}$ (Pr = 1.91) is 24 mg/m^3.

Estimated level	**30 min (mg/m^3)**	**60 min (mg/m^3)**
1% lethality, this probit	49	34
0.1% lethality, this probit	33	24
AEGL-3 (2006, interim)	40	32
ERPG-3 (2004)		86
LBW (2007)		50

Comparing to equivalent (inter)national guideline levels as presented in the table above, the derived lethality concentrations with the proposed probit function agree well to averagely in comparison to the ERPG-3 value.

Appendix 1 Animal experimental research

Study ID: A.1

Author, year: Arts 2000 (Art00)

Substance: Hydrogen Chloride

Species, strain, sex: Male and female rats, unspecified strain
Number/sex/concentration group: 1 / concentration / sex, total number of animals was 58
Age and weight: unspecified
Observation period: 14 days

Criteria	*Comment*
Study carried out according to GLP	*No GLP declaration provided*
Study carried out according to guideline(s)	*Equivalent to OECD 403 except for group size (1 / concentration / sex)*
Stability of test compound in test atmosphere	*Some evidence of aerosol formation at 12300 and 23400 mg/m^3 concentrations. May have resulted in chamber wall loss due to deposition/condensation.*
Use of vehicle (other than air)	*Air (relative humidity 1%)*
Whole body / nose-only (incl. head/nose-only) exposure	*Nose only*
Pressure distribution.	*Positive pressure at the nose of the animals, negative pressure at tail end*
Homogeneity of test atmosphere at breathing zone of animals	*Exact number of sampling points in the test column and their location not specified*
Number of air changes per hour	*25ℓ/min for 20 rats, i.e. in excess of threshold of 1 ℓ/min/rat*
Actual concentration measurement	*Acid/base titration based on color change of titration fluid and amount of air passed through. Appears adequate.*
Particle size distribution measurement in breathing zone of the animals in case of aerosol exposure;	*N/A*
Assessment of Reliability	***A***

Results

Each concentration / time group consisted of 1 male and 1 female rat. The table provides the numerator of the lethal proportion - the denominator is always 1. The publication provides 2 sets of exposure data (table 4.1 and appendix 1.2; Art00). The exposure data from table 4.1 were used for the calculations below.

Species	Concentration (mg/m^3)	Exposure duration (min)	Lethality	
			Male	Female
Rat	4890	45/60/90/120/180	0/0/0/0/1	0/0/0/0/0
Rat	6620	30/45/60/90/120	0/0/0/0/1	0/0/0/0/0
Rat	9020	15/20/30/40/60	0/0/0/0/0	0/0/0/0/0
Rat	9250	60/90/120/150	1/1/1/1	1/1/1/1
Rat	12300	20/30/45/60/90	0/0/1/0/1	0/0/0/1/1
Rat	23400	10/20/30/45/60	0/1/1/1/1	0/1/1/1/1

Probit function
The probit function and associated LC-values have been calculated using the DoseResp program by Wil ten Berge (version December 2006) as Pr = a + b lnC + c lnT + d S.

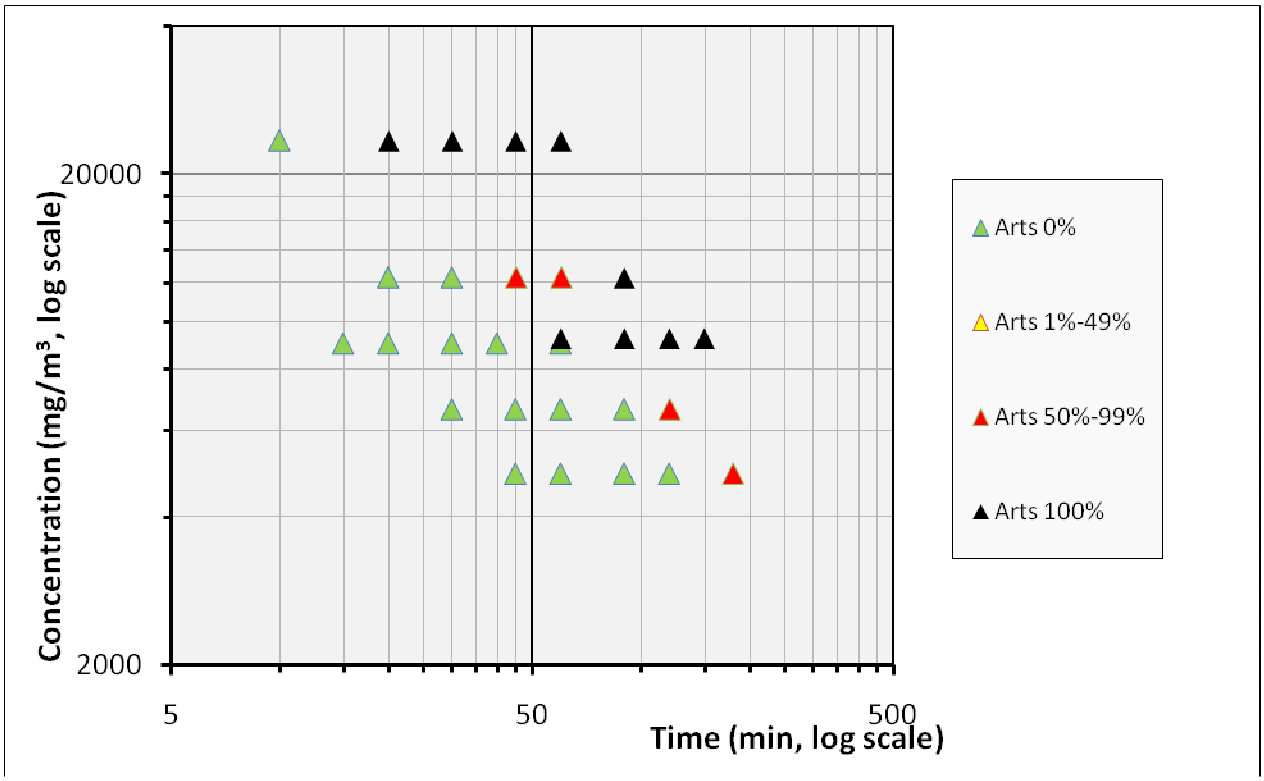
Probit function	*Species*	*a*	*b*	*c*	*d*	*n-value*
Sex as covariate	*Rat*	*-73,9*	*6,67*	*4,19*	*0,53*	*1,59 (1,26 - 1,92)*
Sexes combined	*Rat*	*-73,3*	*6,64*	*4,17*		*1,59 (1,26 - 1,93)*

The 30 minute LC_{50} for both sexes differed by less than a factor 2, nor did analysis with sex as covariate give any indication that sex differences exist. This does not support that sex differences exist in the lethal response. For this reason the data from both sexes were pooled and analyzed to derive the animal probit function (last column in table below). The results for males and females were derived from the analysis with sex as covariate.

Duration (minutes)	*LC_{50} (mg/m^3) 95%-C.I.* ***Male***	*LC_{50} (mg/m^3) 95%-C.I.* ***Female***	*LC_{50} (mg/m^3) 95%-C.I.* ***Combined***
10	29930 (21780 - 42990)	32420 (23560 - 47120)	31070 (22970 - 44100)
30	15000 (12460 - 18570)	16250 (13480 - 20360)	15580 (13350 - 18770)
60	9702 (8376 - 11440)	10510 (9066 - 12540)	10070 (9096 - 11420)

If the male and female datasets were analyzed separately, the outcome was slightly different. The 30 minute LC_{50} value (mg/m^3) for males was 15.930 (11.750 - 24.810) and for females 15.130 (12.030 - 24.860). The meaning of these values is questionable because of the low number of animals per group.

A graphical overview of the data is presented below. Each concentration-time experiment (with 1 male and 1 female animal) represents one point in the plot.



Study ID: A.2
Author, year: Hartzell 1985 (Har85)
Substance: Hydrogen Chloride
Species, strain, sex: Rat, male Sprague-Dawley
Number/sex/concentration group: 6-8 / group (all male)
Age and weight: adult, weight unspecified
Observation period: 14 days

Criteria	*Comment*
Study carried out according to GLP	*No GLP declaration*
Study carried out according to guideline(s)	*No mention of adherence to OECD 403*
Stability of test compound in test atmosphere	*Instable: aerosol formation with possible chamber wall loss due to deposition/ condensation.*
Use of vehicle (other than air)	*Air*
Whole body / nose-only (incl. head/nose-only) exposure	*Head-only (in restrainer tubes), placed in small clean air space during chamber equilibration.*
Pressure distribution.	*Not specified*
Homogeneity of test atmosphere at breathing zone of animals	*Not specified*
Number of air changes per hour	*Not specified*
Actual concentration measurement	*Batch sampling with soda lime near breathing zone to determine analytical concentration.* *Intermittent sampling of small aliquots analyzed with Ion Specific Electrode and continuous sampling (conductivity detector) to maintain stable HCl level during the test.*
Particle size distribution measurement in breathing zone of the animals in case of aerosol exposure;	*N/A*
Assessment of Reliability	***A***

Results

Species	Concentration (mg/m^3)	Exposure duration (min)	Lethality	
			Exposed	responded
rat	13984	5	6	0
rat	16530	5	6	3
rat	19128	5	6	2
rat	21747	5	6	0
rat	23498	5	6	3
rat	30856	5	6	6
rat	8275	10	6	0
rat	11596	10	6	1
rat	12333	10	8	5
rat	12806	10	8	1
rat	13938	10	6	6
rat	6627	15	6	0
rat	9380	15	6	3
rat	12130	15	6	4
rat	13619	15	6	4
rat	15185	15	6	6
rat	7393	22,5	6	2
rat	9749	22,5	6	4
rat	11380	22,5	6	6
rat	12317	22,5	6	2
rat	13142	22,5	8	4
rat	15408	22,5	6	6
rat	3967	30	6	2
rat	5644	30	6	4
rat	6217	30	6	1
rat	8780	30	8	8
rat	9834	30	6	4
rat	12586	30	6	6

Species	Concentration (mg/m^3)	Exposure duration (min)	Lethality Exposed	responded
rat	2725	60	6	0
rat	3467	60	6	3
rat	3952	60	6	1
rat	6501	60	8	7
rat	6779	60	6	6
rat	7378	60	6	6

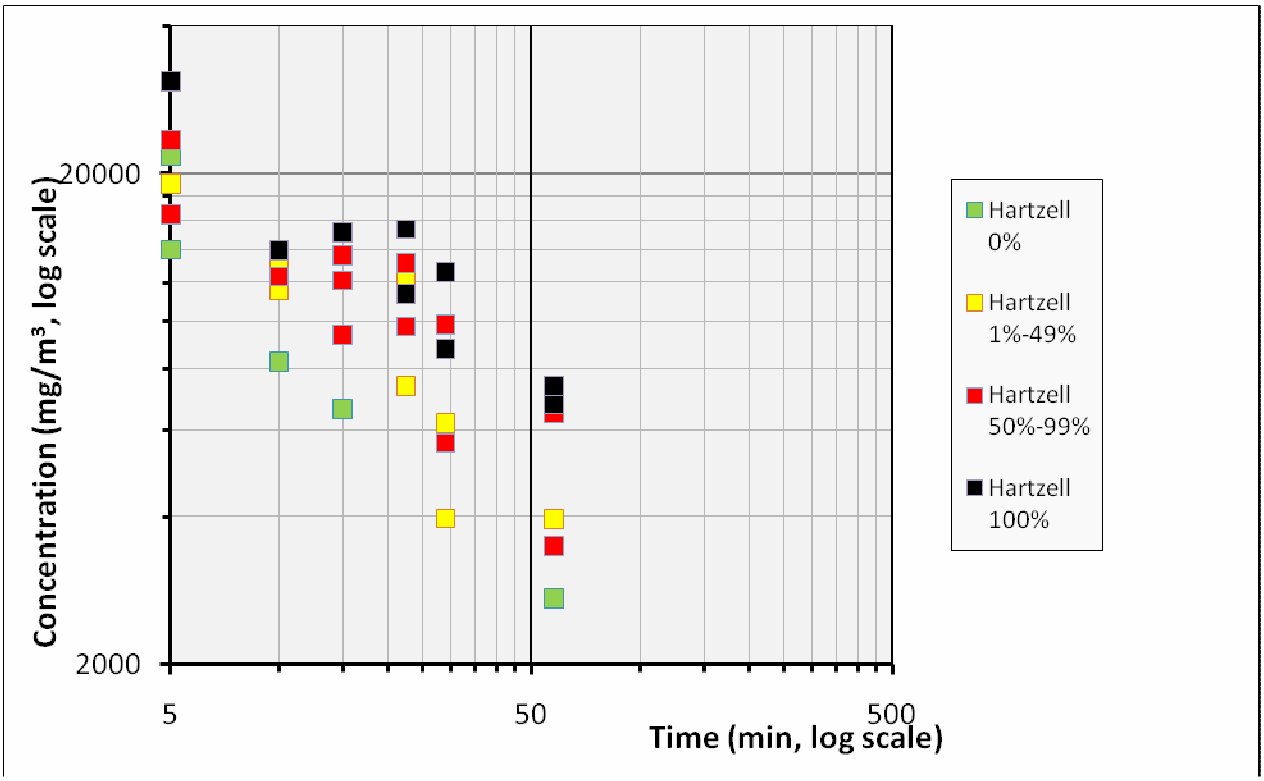
Probit function
The probit function and associated LC-values have been calculated using the DoseResp program by Wil ten Berge (version December 2006) as Pr = a + b lnC + c lnT.
Usually 5 minute data are excluded from the calculation; to assess the influence of including the 5 minute data, the calculations were performed with and without the 5 minute data.

Probit function	*Species*	*a*	*b*	*c*	*n-value*
Including 5 min. exposure	*Rat*	*-21,58*	*2,39*	*1,64*	*1,46 (1,12 - 1,79)*
Excluding 5 min exposure	*Rat*	*-20,68*	*2,31*	*1,56*	*1,48 (0,97 - 1,99)*

The analysis with and without the 5 minute exposure essentially gave the same result, and are both presented below.

Duration (minutes)	*LC_{50} (mg/m^3) 95%-C.I.* ***With 5 min data***	*LC_{50} (mg/m^3) 95%-C.I.* **Without 5 min data**
10	14190 (12170 - 16730)	13990 (10870 - 18320)
30	6671 (5527 - 7730)	6654 (5390 - 7770)
60	4144 (3081 - 5176)	4163 (2891 - 5415)

A graphical overview of the data is presented below. Each concentration-time experiment (with 6-8 animals) represents one point in the plot.


Concentration (mg/m³, log scale)
20000
2000
5
50
500
Time (min, log scale)
Hartzell 0%
Hartzell 1%-49%
Hartzell 50%-99%
Hartzell 100%

Study ID: B.1
Author, year: Monsanto, 1986 (MSDS)
Substance: PCl_3
Species, strain: Rat, strain not specified
Number/sex/concentration group: 10 rats/concentration; unspecified sex
Age and weight: not specified
Observation period: 14 days

Criteria	*Comment*
Study carried out according to GLP	*No information*
Study carried out according to guideline(s)	*No information*
Stability of test compound in test atmosphere	*Hydrolysis occurs*
Use of vehicle (other than air)	*No information*
Whole body / nose-only (incl. head/nose-only) exposure	*Whole body and nose-only*
Pressure distribution.	*No information*
Homogeneity of test atmosphere at breathing zone of animals	*Not specified, mother compound unlikely to be homogenous due to hydrolysis.*
Number of air changes per hour	*Not specified*
Actual concentration measurement	*Chamber analysis based on inorganic phosphorous content and chlorine*
Particle size distribution measurement in breathing zone of the animals in case of aerosol exposure;	*MMAD: < 0.65 microns in the high concentrations and 1.75 microns at the lowest concentration group (based on OECD SIDS 2004 document).*
Assessment of Reliability	***B*** *Actual concentrations are insufficiently reported; some mortality was reported at the highest concentration tested; an LC_{50} value cannot be calculated.*

Results
The authors observed a large difference between the nominal concentration and the analytical concentration, which might be explained by hydrolysis of PCl_3. However, no information is available on the rate and extent of the hydrolysis. In the table below the nominal concentrations are given.

Species	Concentration (mg/m^3)			Exposure duration (min)	Lethality	
					Nose only	Whole body
	Nominal	Analytical based on Cl content	Analytical based on P content			

Rats	162	91	-	240	0/10	0/10
	577	577	468	240	0/10	0/10
	1587	908	674	240	0/10	0/10
	2586	1256	857	240	2/10	3/10

Probit function

An animal probit function and associated LC-values could not be calculated, since only one exposure duration is tested and (some) mortality was only observed at the highest concentration tested. Based on this study the 4-hour LC_{50} is supposedly higher than 2586 mg/m^3 (nominal concentration).

Study ID: C.1
Author, year: Weeks et al., 1964[2]
Substance: PCl_3
Species, strain: rat, unspecified strain
Number/sex/concentration group: 20 female rats/concentration group; no details are available on the number of groups or the concentrations tested
Age and weight: young-adults, weights not specified
Observation period: 14 days

Criteria	*Comment*
Study carried out according to GLP	*No*
Study carried out according to guideline(s)	*Cannot be determined* *Concentration groups not specified* *Number of groups not specified*
Stability of test compound in test atmosphere	*Hydrolysis occurs to the extent of about 40% during testing*
Use of vehicle (other than air)	*Mainly air (dried oil-pumped nitrogen to make substance airborne)*
Whole body / nose-only (incl. head/nose-only) exposure	*Whole body*
Pressure distribution.	*Whole body: negative pressure in test unit: not specified*
Homogeneity of test atmosphere at breathing zone of animals	*Not specified, mother compound unlikely to be homogenous due to hydrolysis.*
Number of air changes per hour	*15 per hour (100 L/min in 400 L chamber)*
Actual concentration measurement	*Airborne compounds were estimated by sampling and analyses of the atmosphere. Knowlton filter paper was used to collect particulate matter. Phosphorus was analyzed by the molybdenum blue method, chloride by the Caldwell and Moyer modification of the Volhard method. A cascade impactor was used to determine the particle sizes.*
Particle size distribution measurement in breathing zone of the animals in case of aerosol exposure;	*MMAD measured to be about 7.8 µm*
Assessment of Reliability	***C*** *The results are considered to be of*

[2] *An unsuccessful attempt was made to retrieve the original dataset from this study by contacting the responsible authority (US Army).*

	insufficient quality to derive a probit function because: • *The absence of data on the rate of the hydrolysis and how this is accounted for;* • *The absence of data on exposure conditions;* • *It is not known whether the calculated LC_{50} is based on actual PCl_3 concentrations.*

Results
A 4-hour LC_{50} of 594 mg/m^3 was reported for female rats.

Probit function
An animal probit function and associated LC-values could not be calculated based on data from Weeks et al. (1964).

Study ID: C.2
Author, year: Weeks et al., 1964; [3]
Substance: PCl_3
Species, strain: guinea pig, strain not specified
Number/sex/concentration group: 10 male guinea pigs/concentration group
Age and weight: not specified
Observation period: 14 days

Criteria	*Comment*
Study carried out according to GLP	*No*
Study carried out according to guideline(s)	*Cannot be determined* *Concentration groups not specified* *Number of groups not specified*
Stability of test compound in test atmosphere	*Hydrolysis occurs to the extent of about 40% during testing*
Use of vehicle (other than air)	*Mainly air (dried oil-pumped nitrogen to make substance airborne)*
Whole body / nose-only (incl. head/nose-only) exposure	*Whole body*
Pressure distribution.	*Whole body: negative pressure in test unit: not specified*
Homogeneity of test atmosphere at breathing zone of animals	*Not specified, mother compound unlikely to be homogenous due to hydrolysis.*
Number of air changes per hour	*15 per hour (100 L/min in 400 L chamber)*
Actual concentration measurement	*Airborne compounds were estimated by sampling and analyses of the atmosphere. Knowlton filter paper was used to collect particulate matter. Phosphorus was analyzed by the molybdenum blue method, chloride by the Caldwell and Moyer modification of the Volhard method. A cascade impactor was used to determine the particle sizes.*
Particle size distribution measurement in breathing zone of the animals in case of aerosol exposure;	*MMAD measured to be about 7.8 µm*
Assessment of Reliability	***C*** *The results are considered to be of insufficient quality to derive a probit*

[3] *An unsuccessful attempt was made to retrieve the original dataset from this study by contacting the responsible authority (US Army).*

	function because: • *The absence of data on the rate of the hydrolysis and how this is accounted for;* • *The absence of data on exposure conditions;* • *It is not known whether the calculated LC_{50} is based on actual PCl_3 concentrations.*

Results
A 4-hour LC_{50} of 286 mg/m^3 was reported for male guinea pigs.

Probit function
An animal probit function and associated LC-values could not be calculated based on data from Weeks et al.

Study ID: C.3
Author, year: Butjagin, 1904
Substance: PCl_3
Species, strain: Cat, strain not specified
Number/sex/concentration group: 1 cat/concentration
Age and weight: weights varied from 2100-3540g
Observation period: varied from none to 7 days

Criteria	*Comment*
Study carried out according to GLP	*No*
Study carried out according to guideline(s)	*No*
Stability of test compound in test atmosphere	*The substance hydrolyses in test atmosphere by an unknown percentage*
Use of vehicle (other than air)	*unknown*
Whole body / nose-only (incl. head/nose-only) exposure	*Whole body*
Pressure distribution.	*Whole body: negative pressure in test unit: not specified*
Homogeneity of test atmosphere at breathing zone of animals	*Not specified, mother compound unlikely to be homogenous due to hydrolysis.*
Number of air changes per hour	*No data available*
Actual concentration measurement	*Mohr, Volhard and weight analyses were performed.*
Particle size distribution measurement in breathing zone of the animals in case of aerosol exposure;	*MMAD: not specified*
Assessment of Reliability	***C***
	Outdated study is not considered very reliable. Data not usable for probit derivation. Animals were not handled according to one protocol. Uncertain to what levels the animals were exposed.

Results

Species	Concentration backcalculated (mg/m^3)	Exposure duration (min)	Lethality
Cats	4.45	180	0/1
	16.3	360	0/1
	19.8	360	0/1

	29.6	360	0/1
	64	420	0/1
	64	600	0/1
	324	360	0/1
	326	360	0/1
	551	360	0/1
	753	390	1/1
	784	306	1/1
	988	240	1/1
	3536	181	1/1

Probit function

An animal probit function and associated LC-values could not be calculated based on data from Butjagin (1904).

Study ID: C.4
Author, year: Butjagin, 1904
Substance: PCl_3
Species, strain: Rabbit, strain not specified
Number/sex/concentration group: 1 rabbit/concentration
Age and weight: weights varied from 1050-1710g
Observation period: varied from none to 7 days

Criteria	*Comment*
Study carried out according to GLP	*No*
Study carried out according to guideline(s)	*No*
Stability of test compound in test atmosphere	*The substance hydrolyses in test atmosphere by an unknown percentage*
Use of vehicle (other than air)	*unknown*
Whole body / nose-only (incl. head/nose-only) exposure	*Whole body*
Pressure distribution.	*No data available*
Homogeneity of test atmosphere at breathing zone of animals	*Not specified, mother compound unlikely to be homogenous due to hydrolyzes.*
Number of air changes per hour	*No data available*
Actual concentration measurement	*Mohr, Volhard and weight analyses were performed.*
Particle size distribution measurement in breathing zone of the animals in case of aerosol exposure;	*MMAD: not specified*
Assessment of Reliability	*C*
	Outdated study is not considered very reliable. Data not usable for probit derivation. Animals were not handled according to one protocol. Uncertain to what concentrations animals were exposed.

Results

Species	Concentration (mg/m^3)	Exposure duration (min)	Lethality	
Rabbit	16.3	360	0/1	
	19.8	360	0/1	
	29.6	360	0/1	
	64	420	0/1	
	64	600	0/1	
	326	360	0/1	

	988	240	0/1	
	3536	181	1/1	

Probit function

An animal probit function and associated LC-values could not be calculated based on data from Butjagin (1904).

Study ID: C.5
Author, year: Molodkina, 1973
In Russian, obtained from ERPG-document, original reference not available.
Substance: PCl_3
Species, strain: Rat, strain not specified
Number/sex/concentration group: not specified
Age and weight: not specified
Observation period: not specified

Criteria	*Comment*
Study carried out according to GLP	*Not specified*
Study carried out according to guideline(s)	*Not specified*
Stability of test compound in test atmosphere	*The substance hydrolyses in test atmosphere by an unknown percentage*
Use of vehicle (other than air)	*unknown*
Whole body / nose-only (incl. head/nose-only) exposure	*Not specified*
Pressure distribution.	*No data available*
Homogeneity of test atmosphere at breathing zone of animals	*Not specified*
Number of air changes per hour	*No data available*
Actual concentration measurement	*Not specified*
Particle size distribution measurement in breathing zone of the animals in case of aerosol exposure;	*MMAD: not specified*
Assessment of Reliability	*C*
	Only LC_{50} reported, no exposure time given.

Results
An LC_{50} value of 223 mg/m^3 (unknown exposure time)

Study ID: C.6
Author, year: Roshchin, 1977
Substance: PCl_3
Species, strain: not specified
Number/sex/concentration group: 646 white rats, 57 guinea pigs, 102 white mice, 12 rabbits in total for entire study (includes also other compounds and subacute studies.
Age and weight: not specified
Observation period: not specified

Criteria	*Comment*
Study carried out according to GLP	*No*
Study carried out according to guideline(s)	*No*
Stability of test compound in test atmosphere	*The substance hydrolyses in test atmosphere by an unknown percentage*
Use of vehicle (other than air)	*unknown*
Whole body / nose-only (incl. head/nose-only) exposure	*Not specified*
Pressure distribution.	*Not specified*
Homogeneity of test atmosphere at breathing zone of animals	*Not specified, mother compound unlikely to be homogenous due to hydrolysis.*
Number of air changes per hour	*Not specified*
Actual concentration measurement	*Mohr, Volhard and weight analyses were performed.*
Particle size distribution measurement in breathing zone of the animals in case of aerosol exposure;	*MMAD: not specified*
Assessment of Reliability	*C*
	No study details were provided. An LC_{50} of 226 mg/m^3 was reported without information about the species or the exposure conditions.

Results
No relevant results were reported.

Appendix 3 Reference list

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