CLH-Report

PROPOSAL FOR HARMONISED CLASSIFICATION AND LABELLING

Substance Name: **Trimagnesium diphosphide**

EC Number: **235-023-7**

CAS Number: **12057-74-8**

Submitted by: **Germany**

Date: **March 2011**

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PROPOSAL FOR HARMONISED CLASSIFICATION AND LABELLING

Substance Name: **Trimagnesium diphosphide**

EC Number: **235-023-7**

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Purity: Min. > 88 % w/w

Impurities/Additives: The confidential information can be found in the "Confidential Annex" or the technical dossier.

The current Annex VI entry and the proposed harmonised classification

	CLP Regulation (EC) No 1272/2008	**Directive 67/548/EEC (Dangerous Substances Directive; DSD)**
Current entry in Annex VI, CLP Regulation	Water-react. 1 H260 EUH029 Acute Tox. 2* H300 Aquatic Acute 1 H400 M = 100	F; R15/29 T+; R28 N; R50 C ≥ 0,25 % N; R50
Current proposal for consideration by RAC	Acute Tox. 2 H300 Acute Tox. 3 H311 EUH032	Xn; R21 R32
Resulting harmonised classification (future entry in Annex VI, CLP Regulation)	Water-react. 1 H260 EUH029 EUH032 Acute Tox. 2 H300 Acute Tox. 3 H311 Aquatic Acute 1 H400 M = 100	F; R15/29 T+; R28 Xn; R21 R32 N; R50 C ≥ 0,25 % N; R50

*Minimum classification

Proposed classification based on Regulation (EC) No 1272/2008:

Classification		Wording
Hazard classes, Hazard categories	Water-react. 1 Acute Tox. 2 Acute Tox. 3 Aquatic Acute 1	

Proposed labelling based on Regulation (EC) No 1272/2008:

Labelling		Wording
Pictograms	GHS02 GHS06 GHS09	
Signal Word	Danger	
Hazard statements	H260 H300 H311 H400	In contact with water releases flammable gases which may ignite spontaneously Fatal if swallowed Toxic in contact with skin Very toxic to aquatic life
Suppl. Hazard statements	EUH029 EUH032	Contact with water liberates toxic gas Contact with acids liberates very toxic gas
Precautionary statements	P223 P231 + P232 P234 P273 P280 P301 + P310 P321 P335 P370 + P378 P402 + P404 P405 P501	Keep away from any possible contact with water, because of violent reaction and possible flash fire Handle under inert gas. Protect from moisture Keep only in original container Avoid release to the environment Wear protective gloves/ protective clothing/ eye protection/ face protection IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician Specific treatment (see … on this label) Brush off loose particles from skin In case of fire: Use … for extinction Store in a dry place. Store in a closed container Store locked up Dispose of contents/container to …

Proposed labelling based on Directive 67/548/EEC:

Labelling		Wording
Hazard Symbols, Indications of danger	F T+ N	Highly flammable Very toxic Dangerous to the environment
R-phrases	R15/29 R21 R28 R32 R50	Contact with water liberates toxic extremely flammable gas Harmful in contact with skin Very toxic if swallowed Contact with acids liberates very toxic gas Very toxic to aquatic organisms
S-phrases	S(1/2) S3/9/14/49 S8 S22 S30 S36/37 S43 S45 S60 S61	Keep locked up and out of the reach of children Keep only in the original container in a cool, well-ventilated place away from ... (incompatible materials to be indicated by the manufacturer) Keep container dry Do not breathe dust Never add water to this product. Wear suitable protective clothing and gloves. In case of fire use … Never use water In case of accident or if you feel unwell, seek medical advice immediately. (Show the label where possible.) This material and/or its container must be disposed of as hazardous waste Avoid release to the environment. Refer to special instructions/ Safety data sheet

Proposed specific concentration limits (if any):

According to the 1th ATP (Regulation 790/2009) of the CLP Regulation an M-Factor of 100 is given.

Proposed notes (if any):

None.

JUSTIFICATION

1 IDENTITY OF THE SUBSTANCE AND PHYSICAL AND CHEMICAL PROPERTIES

1.1 Name and other identifiers of the substance

Chemical Name: Trimagnesium diphosphide

EC Name: Trimagnesium diphosphide

CAS Number: 12057-74-8

IUPAC Name: Trimagnesium diphosphide

1.2 Composition of the substance

The confidential information can be found in the “Confidential Annex” or the technical dossier.

Chemical Name: Trimagnesium diphosphide

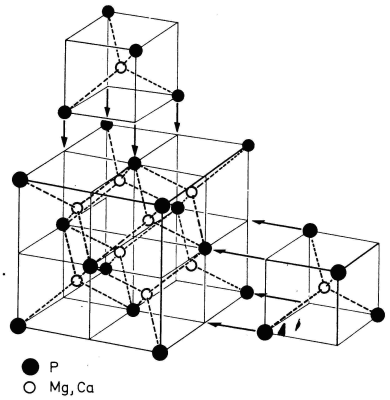
EC Number: 235-023-7

CAS Number: 12057-74-8

IUPAC Name: Trimagnesium diphosphide

Molecular Formula: Mg_3P_2

Structural Formula:



Molecular Weight: 134.86 g/mol

Typical concentration (% w/w): Min. > 88

1.3 Physico-chemical properties

Table 1: Summary of physico- chemical properties of trimagnesium diphosphide

REACH ref Annex, §	Property	IUCLID section	Value	[enter comment/reference or delete column]
VII, 7.1	Physical state at 20°C and 101.3 kPa	4.1	grey powder with a foul fishy, garlic-like odour	EC Safety Data Sheet (2004), Detia Freyberg GmbH
VII, 7.2	Melting/freezing point	4.2	no melting point was observed under test conditions up to 500 °C	Smeykal, H. (2002); report no. 20020428.01
VII, 7.3	Boiling point	4.3	no boiling point was observed under test conditions up to 500 °C at 1013.3 hPa	Smeykal, H. (2002); report no. 20020428.01
VII, 7.4	Relative density	4.4	1.47 at 23.8 °C	Smeykal, H. (2002); report no. 20020428.02
VII, 7.5	Vapour pressure	4.6	<< 10-5 Pa at 25 °C	Smeykal, H. (2002); report no. 20020428.01
VII, 7.6	Surface tension	4.10	not determined (hydrolysis)	
VII, 7.7	Water solubility	4.8	not determined (hydrolysis)	
VII, 7.8	Partition coefficient n-octanol/water (log value)	4.7	not determined (hydrolysis)	
VII, 7.9	Flash point	4.11	only required for liquids	
VII, 7.10	Flammability	4.13	Flammable solids: The test substance could not be ignited with a flame. The substance is not a highly flammable solid in the sense of Guideline 92/69/EEC, A.10. Flammability in contact with water: In contact with water the test substance evolves highly flammable gases in dangerous quantities. The gas ignites spontaneously. The substance is highly flammable in the sense of Guideline 92/69/EEC, A.12 Pyrophoric properties: The classification procedure need not to be applied because the inorganic substance is known to be stable into contact with air at room temperature for prolonged periods of time (days).	Smeykal, H. (2002); report no. 20020428.03 Smeykal, H. (2002); report no. 20020428.03 BAM, II.21

VII, 7.11	Explosive properties	4.14	OECD Test No.113 (DSC): ΔH< 500J/g (exothermic decomposition energy) explosive properties can be excluded.	Smeykal, H. (2002); report no. 20020428.04
VII, 7.12	Relative Self-ignition temperature for solids	4.12	Guideline 96/69/EEC, A.16: No self ignition was registered until the maximum temperature of 405 °C.	Smeykal, H. (2002); report no. 20020428.04
VII, 7.13	Oxidising properties	4.15	The classification procedure need not be applied because the inorganic substance does not contain oxygen or halogen atoms.	BAM, II.2 (2010)
	Thermal stability	4.19	OECD Test No.113 (DSC): Neither an endothermic nor an exothermal effect until 500°C (No self-reactive substance)	Smeykal, H. (2002); report no. 20020428.01

Table 2: Summary of physico- chemical properties of phosphine

REACH ref Annex, §	Property	IUCLID section	Purity/Specification	Value	[enter comment/reference or delete column]
VII, 7.1	Physical state at 20°C and 101.3 kPa	4.1	Phosphine, technical purity unknown	Gaseous with a fouly, fishy or garlic -like odour	Römpp, 2006: Version 2.10. Georg Thieme Verlag 2006
VII, 7.2	Melting/freezing point	4.2	Phosphine, technical purity unknown	-133°C	Römpp, 2006: Version 2.10. Georg Thieme Verlag 2006
VII, 7.3	Boiling point	4.3	Phosphine, technical purity unknown	-87°C	Römpp, 2006: Version 2.10. Georg Thieme Verlag 2006
VII, 7.4	Relative density	4.4	Phosphine, technical purity unknown	1.53 at 20 °C A density of 1.41 g/L was calculated on the basis of an ideal gas.	Römpp, 2006: Version 2.10. Georg Thieme Verlag 2006
VII, 7.5	Vapour pressure	4.6	Phosphine, technical purity unknown	3295 kPa at 22 °C	CRC Handbook of Chemistry and Physics 1991: 82nd Edition 1991-1992, page 6-91
VII, 7.6	Surface tension	4.10		The test has not be conducted as a surface tension of > 60mN/m at 20°C is expected to due the chemical structure of the substance.	
VII, 7.7	Water solubility	4.8	Phosphine, purity unknown	24 ml / 100 ml water at 24 °C	Phosphine and Selected Metal Phosphides, WHO, Geneva, 1988, p. 17–19
VII, 7.8	Partition coefficient n-octanol/water (log value)	4.7	Phosphine, technical purity unknown	Log Pow 0.9 at 21 °C	W. Schlösser, 1989: Untersuchungsbericht Octanol-Wasser-Verteilungskoeffizient von PH3, Labor für Geoanalytik, Hildesheim, Germany, Auftrags-Nr. 05011, 29.09.1989
VII, 7.9	Flash point	4.11		The submission of data or the performance of a test on the flash-point of Phosphine is not considered to be required since it is no liquid whose	Justification, Detia, 2004

				vapours can be ignited.	
VII, 7.10	Flammability	4.13	Phosphine pure grade	auto ignition temperature of 38°C Extremely flammable and pyrophoric	Phosphine and Selected Metal Phosphides, WHO, Geneva, 1988, p. 17 – 19
VII, 7.11	Explosive properties	4.14	Phosphine, purity unknown	Phosphine forms explosive mixtures with air concentrations greater than 1.8%	Phosphine and Selected Metal Phospides, WHO, Geneva, 1988, p. 17 – 19
VII, 7.12	Relative Self-ignition temperature for solids	4.12		Test item is no solid.	
VII, 7.13	Oxidising properties	4.15		Only for solids (EC method A. 17)	
	Thermal stability	4.19		Thermal decomposition at 550°C	Application for registration of "Detia Gas-Ex-B forte", Detia Freyberg GmbH, Laudenbach, B/7, 16.12.94

2 MANUFACTURE AND USES

2.1 Manufacture

2.2 Identified uses

2.3 Uses advised against

3 CLASSIFICATION AND LABELLING

3.1 Classification in Annex I of Directive 67/548/EEC

F; R15/29
T+; R28
N; R50
(Index number: 015-005-00-3)

3.2 Classification in Annex I of Regulation (EC) No. 790/2009 (1st ATP to Regulation (EC) No. 1272/2008)

Water-react. 1, H260
Acute Tox. 2*, H300 (* Minimum classification)
Aquatic Acute 1, H400
(Index number: 015-004-00-8)

3.3 Self classification(s)

The applicant under Dir. 98/8/EC proposed classification as under section 3.1.

4 ENVIRONMENTAL FATE PROPERTIES

No modifications of existing environmental classification is proposed.

5 HUMAN HEALTH HAZARD ASSESSMENT

The assessment presented in the following subsections is based on the notion that the toxicity of metal phosphides is primarily characterised by the effects caused by liberation of hydrogen phosphide (PH_3) gas. For this reason, studies performed with other metal phosphides or PH_3 itself were considered adequate for assessing Mg_3P_2 toxicity. If a different metal phosphide than trimagnesium diphosphide was used as test material, dose levels were converted based on the respective maximum amount of PH3 liberable by the respective compounds. Unless otherwise noted, studies were conducted under GLP conditions.

5.1 Toxicokinetics (absorption, metabolism, distribution and elimination)

Table 3: Summary of toxicokinetic studies

Method/ Guideline	Route	Species, Strain, Sex, No/group	Dose levels, Duration of exposure	Results	Reference
No guideline, Non-GLP	Oral	Rats, number, bw and sex not stated	Zinc ^{32}P-phosphide, suspension in milk 40 mg/kg bw (> LD_{50}) and lower dose (not specified), single application	Mortality↑ at high dose, PH_3 detectable in liver	Curry, A.S. et al. (1959); Nature 184, 642 – 643
		Rats, sex not stated, 6 animals	Zinc ^{32}P-phosphide, suspension in milk 10 mg/rat, single application	Mortality↑, phosphide and PH_3 detectable in liver	
		Rats and guinea pigs, no further information given	No information given	Urinary excretion: main product is hypophosphite	
No guideline, Non-GLP	Oral, subcutan-eous, per rectum	Rattus norvegicus Berk, number, bw and sex not stated	Zinc ^{32}P-phosphide, suspended in water 40 mg/kg bw	Oral application: After 6-8 h, ^{32}P was detectable in all organs and tissues with temporarily higher levels in liver and medulla oblongata. Application per rectum: After 24 h ^{32}P was detectable in large intestine, arterial blood, liver and kidneys. Subcutaneous injection: After 24 h ^{32}P was detectable only around the point of injection	Andreev, S.B. et al. (1959): 2nd Int. Conf. Peaceful Uses Atomic Energy 1958 (27), 85 – 92
	Oral		Zinc phosphide, ^{32}P- and ^{65}Zn- labelled, pure compound Sublethal, lethal, 2-, 3- and 4-fold lethal doses	The distribution of ^{32}P was similar to that in the above experiment. ^{65}Zn was found in all organs. The ratio of ^{32}P to ^{65}Zn was different in different tissues.	
Not applicable	Inhalation			Inhaled PH_3 is considered to be readily absorbed through the lungs, excretion with urine as hypophosphite and phosphite and via lungs as PH_3	WHO (1988), Environmental Health Criteria 73, pp 48-51 (1)

(1) This refers to a section on the toxicokinetics and metabolism in mammals within a WHO monograph on phosphine and metal phosphides. Although not a study report in itself, it represents an opinion peer-reviewed by a round of international experts and should be used to complement the submitted data base in the absence of other experimental data.

The available studies for this endpoint are of low reliability. However, in light of the chemical nature of trimagnesium phosphide as well as for reasons of animal welfare, it was decided that further testing would not provide essential new information and that the available studies could be used for risk assessment.

Following oral administration of zinc phosphide, ^{32}P was rapidly absorbed from the gastrointestinal tract. Inhaled PH_3 is considered to be rapidly and quantitatively absorbed through the lungs. ^{32}P was detectable in all organs and tissues, with temporarily higher levels in liver and medulla oblongata. PH_3 is excreted as such with the expired air or, after metabolic oxidation, with the urine in the form of hypophosphite and phosphite.

In the absence of experimental data, for dermal absorption of both trimagnesium diphosphide and PH_3 a default value of a maximum of 10 % was assumed based on expert judgement in consideration of the following reasoning:

- Due to the nature of the formulated product (pellets or tablets), only a minor part of the a.s., if any, is expected to come into contact with the skin.
- Contact with the (humid) skin surface would be expected to initiate liberation of PH_3 gas making systemic absorption highly unlikely.
- In previous evaluations by both the WHO (Environmental Health Criteria 73 of 1988) and the German 'MAK Commission' for trimagnesium diphosphide/PH_3 dermal absorption was stated to be ‘negligible’.
- In decades of approved use, no casualties or serious intoxications have been reported for operators dermally exposed to trimagnesium diphosphide.

5.2 Acute toxicity

5.2.1 Acute toxicity: oral

Table 4: Summary of acute toxicity studies

Method/ Guideline	**Route**	**Species, Strain, Sex, No/group**	**Dose levels (mg/kg bw)**	**Value LD_{50}/LC_{50} (mg/kg bw)**	**Remarks**	**Reference**
Similar to OECD 401, Non-GLP	Oral	Rat, Wistar albino 5M+5F	Trimagnesium diphosphide, 1 % in vaseline (petrolatum) 8.97-10-11.3-12.6 (calculated as pure a.s.)	M+F: 11.2	**R 28**	Sterner, W. and Chibanguza, G. (1980), report no. 1-4-666-79
OECD 401	Oral	Mouse, NMRI/HAN Bö 5M+5F	Aluminium phosphide, suspended in sesame oil 6.81-10.0-14.7-21.5	M+F: 14.8 (Expressed as Mg_3P_2: 17.2)	**R 28**	Leuschner, J. (1992), report no. 7129/92

Trimagnesium diphosphide is of high toxicity when administered orally to rats. In mice, only a study performed with aluminium phosphide is available, demonstrating comparable acute toxicity. The minimum classification as “Acute Tox. 2”, H300 is confirmed.

5.2.2 Acute toxicity: inhalation

This endpoint is not covered in this proposal.

5.2.3 Acute toxicity: dermal

Table 5: Summary of acute toxicity studies

Method/ Guideline	Route	Species, Strain, Sex, No/group	Dose levels (mg/kg bw)	Value LD_{50}/LC_{50} (mg/kg bw)	Reference
OECD 402	Dermal	Rat, Wistar albino 5M+5F	Aluminium phosphide (without further vehicle) 500-1000-2000	LD_{50} M+F (d 14): 900 Expressed as Mg_3P_2: 1047 **R21**	Dickhaus, S. and Heisler, E. (1987), report no. 1-4-142-87

Only a dermal study performed with aluminium phosphide is available, demonstrating moderate acute dermal toxicity. Since both metal phosphides react with moisture to produce phosphine gas, the substance responsible for the toxicity of the product, tests with aluminium phosphide, can be used to assess the toxicity of trimagnesium phosphide. Assuming that aluminium phosphide has been applied to the skin as crystalline granules and not moistened, the contact to the skin would have been less intimate than when a fluid had been present so that higher doses would be needed to yield the same effects as with a fluid. However, moistening would have led to an immediate liberation of phosphine gas and thus to a lower dermal dose of the toxic principle which would have been lost to the environment before the application site was covered. In both cases the amount of substance in contact with the skin cannot be determined accurately and, therefore, it is unlikely that the difference in skin contact properties would lead to a different classification. The dermal LD_{50} of aluminium phosphide was 1520 mg/kg bw (24 hours) or 900 mg/kg bw (day 14) for both sexes. A comparable amount of phosphine gas is expected to be liberated from a dose of 1047 mg/kg bw of trimagnesium phosphide. Based on the read-across between aluminium and trimagnesium phosphide, additional classification/labelling for acute dermal toxicity (R21 according to Annex VI of Council Directive 67/548/EEC; Acute Tox 3 H311 according to Annex I of Regulation (EC) No. 1272/2008) is proposed for trimagnesium phosphide.

5.2.4 Acute toxicity: other routes

No data are available.

5.2.5 Summary and discussion of acute toxicity

The toxicity of trimagnesium phosphide is related to the liberation of phosphine gas upon contact with moisture. It is considered to display moderate acute dermal toxicity based on a read-across from data on aluminium phosphide. Therefore, additional classification/labelling for acute dermal toxicity (R21 according to Annex VI of Council Directive 67/548/EEC; Acute Tox 3 H311 according to Annex I of Regulation (EC) No. 1272/2008) is proposed.

As it is believed that PH_3 is liberated from metal phosphides rather more readily by acids than by water, this appears to be accidental. It is proposed to harmonise C & L in this regard, i.e. label Mg_3P_2 also with R32.

5.3 Irritation

5.3.1 Skin

This endpoint is not covered in this proposal.

5.3.2 Eye

This endpoint is not covered in this proposal.

5.3.3 Respiratory tract

No experimental data available.

5.3.4 Summary and discussion of irritation

No modification of the existing classification is proposed.

5.4 Corrosivity

This endpoint is not covered in this proposal.

5.5 Sensitisation

5.5.1 Skin

This endpoint is not covered in this proposal.

5.5.2 Respiratory system

No experimental data are available.

5.5.3 Summary and discussion of sensitisation

No modification of the existing classification is proposed.

5.6 Repeated dose toxicity

This endpoint is not covered in this proposal.

5.7 Mutagenicity

This endpoint is not covered in this proposal.

5.8 Carcinogenicity

This endpoint is not covered in this proposal.

5.9 Toxicity for reproduction

This endpoint is not covered in this proposal.

5.10 Other effects

This endpoint is not covered in this proposal.

5.11 Derivation of DNEL(s) or other quantitative or qualitative measure for dose response

Not relevant for this type of dossier.

6 HUMAN HEALTH HAZARD ASSESSMENT OF PHYSICO-CHEMICAL PROPERTIES

6.1 Explosivity

In a standard study (Smeykal, H. (2002); report no. 20020428.04), Trimagnesium diphosphide was found not to exhibit any explosive properties.

No classification for explosivity is proposed.

6.2 Flammability

In standard study (Smeykal, H. (2002); report no. 20020428.03) Trimagnesium diphosphide was classified as highly flammable in the sense of Guideline 92/69/EEC, A.12. In contact with water the test substance evolves highly flammable gases in dangerous quantities. The gas ignites spontaneously.
In standard study (Smeykal, H. (2002); report no. 20020428.03) Trimagnesium diphosphide could not be ignited with a flame. The substance is not a highly flammable solid in the sense of Guideline 92/69/EEC, A.10, and did not exhibit any pyrophoric properties. In standard study (Smeykal, H. (2002); report no. 20020428.04) no self ignition according to Guideline 92/69/EEC, A.16 was registered until the maximum temperature of 405 °C.

Proposed classification and labelling based on Directive 67/548/EEC:

F Highly flammable; R15/R29 Contact with water liberates extremely flammable toxic gases.

Proposed classification and labelling based on Regulation (EC) No 1272/2008:

Water-react. 1, H260; EUH029, GHS02, Danger

6.3 Oxidising potential

No experimental data on oxidising properties:

Testing can be waived based on a consideration of the chemical structure in accordance with REACH Column 2 of Annex VII, section 7.13: The classification procedure need not be applied because the inorganic substance does not contain oxygen or halogen atoms,

No classification for oxidising properties is proposed.

7 ENVIRONMENTAL HAZARD ASSESSMENT

No modifications of existing environmental classification is proposed.

JUSTIFICATION THAT ACTION IS REQUIRED ON A COMMUNITY-WIDE BASIS

There was agreement on Community Level that for active ingredients in biocidal and plant protection products harmonised C & L should be sought for all phys.-chem., toxicological, and ecotoxicological endpoints addressed by the corresponding legislations.

OTHER INFORMATION

The data and conclusions presented here have already undergone a peer review by experts from the company applying for annex I inclusion, the European Member States, and the European Commission (ECB/EFSA) in the context of the inclusion procedure for trimagnesium diphosphide into annex I of Dir. 98/8/EC and annex I of Dir. 91/414/EEC, respectively.

REFERENCES

Author(s)	**Year**	**Title,** **Company Report No.** **(where applicable),** **GLP (where relevant) / (Un)Published**
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Anon.	1997	IPCS International Programme on Chemical Safety. Poisons Information Monograph 865. Phosphine.
Benzing, L	1992	Erste Hilfe und Therapiemaßnahmen, pp. 414-415, Verlag Alfred Strothe, non-GLP, published
CRC	1991	Handbook of Chemistry and Physics 1991, 82nd Edition 1991-1992, page 6-91, published
Curry, AS et al.	1959	Absorption of Zinc phosphide particles, Nature 184, 642-643, non-GLP, published
Dickhaus, S & Heisler E	1987	Acute percutaneous toxicity, report no. 1-4-142-87, PHARMAROX Beratung und Forschung GmbH, Detia Freyberg GmbH, 1987-09, GLP, unpublished
Leuschner, J	1992	Acute toxicity study of AlP by oral administration to nmri mice, report no. 7129/92, Laboratory of Pharmacology and Toxicology, Detia Freyberg GmbH, 1992-06-15, GLP, unpublished
Newton, PE	1993	Inhalation toxicity of Phosphin in the rat, Bio/dynamics Inc., unpublished
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Sato, K & Suwanai, M	1974	Adsorption of hydrogen phosphide to cereal products, Appl. Entomol. Zool. 9, 127-132, published
Shimizu, Y et al.	1982	Acute inhalation toxicity testing of hydrogen phosphide in rats, NRI 82-7489, NOMURA RESEARCH INSTITUTE, Degesch Japan Co., 1982-05, non-GLP, unpublished
Smeykal, H.	2002	Magnesium phosphide technical: melting point/melting range, boiling point/boiling range, vapour pressure, Siemens Axiva GmbH & Co. KG, Frankfurt, Germany.; unpublished report no. 20020427.01, July 09, 2002
Smeykal, H.	2002	Magnesium phosphide: Relative density. Siemens Axiva GmbH & Co. KG, Frankfurt, Germany; unpublished report no.: 20020427.02, July 9, 2002
Smeykal, H.	2002	Magnesium phosphide technical: Flammability (Solids), Flammability (substances and preparations which, in contact with water or damp air, evolve highly flammable gases in dangerous quantities. Siemens Axiva GmbH & Co. KG, Frankfurt, Germany; unpublished report no.: 20020428.03, July 5, 2002
Smeykal, H.	2002	Magnesium phosphide technical: Explosive properties, Auto-Flammability (Solids – Determination of relative self-ignation temperature). Siemens Axiva GmbH & Co. KG, Frankfurt, Germany; unpublished report no.: 20020428.04, July 5, 2002
Sterner, W & Chibanguza, G	1980	Acute toxicological study of 1% Magnesiumphosphid in vaseline in Rats, IBR International Bio-Research, 1-4-666-79, not GLP, unpublished
Unknown	2008	EC-Safety Data Sheet, Detia Freyberg GmbH, Laudenbach, Germany, non-GLP, May 2008
Waritz, RS & Brown, RM	1975	Acute and subacute inhalation toxicities of phosphine, phenylphosphine and triphenylphosphine, Am. Ind. Hyg. Assoc. J. 36(6), 452-458, published
WHO	1988	Phosphine and Selected Metal Phosphides. Environmental Health Criteria 73, WHO Geneva, non-GLP, published