

**FAO SPECIFICATIONS AND EVALUATIONS  
FOR AGRICULTURAL PESTICIDES**

2006

**FENTHION**

***O,O*-dimethyl *O*-4-methylthio-*m*-tolyl  
phosphorothioate**



**Food and Agriculture Organization  
of the United Nations**

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## FENTHION

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## DISCLAIMER<sup>1</sup>

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FAO specifications are developed with the basic objective of promoting, as far as practicable, the manufacture, distribution and use of pesticides that meet basic quality requirements.

Compliance with the specifications does not constitute an endorsement or warranty of the fitness of a particular pesticide for a particular purpose, including its suitability for the control of any given pest, or its suitability for use in a particular area. Owing to the complexity of the problems involved, the suitability of pesticides for a particular purpose and the content of the labelling instructions must be decided at the national or provincial level.

Furthermore, pesticides which are manufactured to comply with these specifications are not exempted from any safety regulation or other legal or administrative provision applicable to their manufacture, sale, transportation, storage, handling, preparation and/or use.

FAO disclaims any and all liability for any injury, death, loss, damage or other prejudice of any kind that may arise as a result of, or in connection with, the manufacture, sale, transportation, storage, handling, preparation and/or use of pesticides which are found, or are claimed, to have been manufactured to comply with these specifications.

Additionally, FAO wishes to alert users to the fact that improper storage, handling, preparation and/or use of pesticides can result in either a lowering or complete loss of safety and/or efficacy.

FAO is not responsible, and does not accept any liability, for the testing of pesticides for compliance with the specifications, nor for any methods recommended and/or used for testing compliance. As a result, FAO does not in any way warrant or represent that any pesticide claimed to comply with a FAO specification actually does so.

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<sup>1</sup> This disclaimer applies to all specifications published by FAO.

## INTRODUCTION

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FAO establishes and publishes specifications\* for technical material and related formulations of agricultural pesticides, with the objective that these specifications may be used to provide an international point of reference against which products can be judged either for regulatory purposes or in commercial dealings.

From 2002, the development of WHO specifications follows the **New Procedure**, described in the 1st edition of “Manual for Development and Use of FAO and WHO Specifications for Pesticides” (2002) and amended with the supplement of this manual (2006), which is available only on the internet through the FAO and WHO web sites. This **New Procedure** follows a formal and transparent evaluation process. It describes the minimum data package, the procedure and evaluation applied by FAO and the Experts of the FAO/WHO Joint Meeting on Pesticide Specifications (JMPS). [Note: prior to 2002, the Experts were of the FAO Panel of Experts on Pesticide Specifications, Registration Requirements, Application Standards and Prior Informed Consent, which now forms part of the JMPS, rather than the JMPS.]

FAO Specifications now only apply to products for which the technical materials have been evaluated. Consequently from the year 2000 onwards the publication of FAO specifications under the **New Procedure** has changed. Every specification consists now of two parts namely the specifications and the evaluation report(s):

**PART ONE: The Specification** of the technical material and the related formulations of the plant protection product in accordance with chapter 4, 5 and 6 of the 5<sup>th</sup> edition of the “Manual on the development and use of FAO specifications for plant protection products”.

**PART Two: The Evaluation Report(s)** of the plant protection product reflecting the evaluation of the data package carried out by FAO and the JMPS. The data are to be provided by the manufacturer(s) according to the requirements of Appendix A, annex 1 or 2 of the “Manual on the development and use of FAO specifications for plant protection products” and supported by other information sources. The Evaluation Report includes the name(s) of the manufacturer(s) whose technical material has been evaluated. Evaluation reports on specifications developed subsequently to the original set of specifications are added in a chronological order to this report.

FAO specifications under the **New Procedure** do not necessarily apply to nominally similar products of other manufacturer(s), nor to those where the active ingredient is produced by other routes of manufacture. FAO has the possibility to extend the scope of the specifications to similar products but only when the JMPS has been satisfied that the additional products are equivalent to that which formed the basis of the reference specification.

**Specifications bear the date (month and year) of publication of the current version. Dates of publication of the earlier versions, if any, are identified in a footnote. Evaluations bear the date (year) of the meeting at which the recommendations were made by the JMPS.**

\* NOTE: PUBLICATIONS ARE AVAILABLE ON THE INTERNET AT  
(<http://www.fao.org/pest-and-pesticide-management/en/>)

OR IN HARDCOPY FROM THE PLANT PROTECTION INFORMATION OFFICER.

## PART ONE

### SPECIFICATIONS

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## FENTHION

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### INFORMATION

*ISO common names*

fenthion (E-ISO, (m) F-ISO, BSI, ESA, BAN)

*Synonyms*

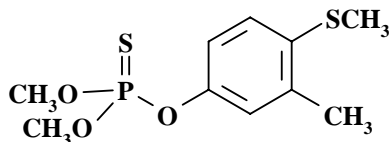
MPP (JMAF)

*Chemical names*

*IUPAC* O,O-dimethyl O-4-methylthio-*m*-tolyl phosphorothioate

*CA* O,O-dimethyl O-[3-methyl-4-(methylthio)phenyl] phosphorothioate

*Structural formula*



*Empirical formula*

C<sub>10</sub>H<sub>15</sub>O<sub>3</sub>PS<sub>2</sub>

*Relative molecular mass*

278.3

*CAS Registry number*

55-38-9

*CIPAC number*

79

*Identity tests*

RP-HPLC retention time (UV detection), capillary GC retention time

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## FENTHION TECHNICAL MATERIAL

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### FAO specification 79/TC (December 2006\*)

*This specification, which is PART ONE of this publication, is based on an evaluation of data submitted by the manufacturer whose name is listed in the evaluation reports (79/2004). It should be applicable to TC produced by this manufacturer but it is not an endorsement of those products, nor a guarantee that they comply with the specifications. The specification may not be appropriate for TC produced by other manufacturers. The evaluation reports (79/2004), as PART TWO, form an integral part of this publication.*

#### 1 Description

The material shall consist of fenthion, together with related manufacturing impurities, and shall be a yellowish to reddish-brownish liquid, free from visible extraneous matter and added modifying agents.

#### 2 Active ingredient

##### 2.1 Identity tests (79/TC/M/2, CIPAC Handbook L, p.81, 2006)

The active ingredient shall comply with an identity test and, where the identity remains in doubt, shall comply with at least one additional test.

##### 2.2 Fenthion content (79/TC/M/3, CIPAC Handbook L, p.81, 2006)

The fenthion content shall be declared (not less than 940 g/kg) and, when determined, the average measured content shall not be lower than the declared minimum content.

#### 3 Relevant impurities (Note 1)

##### 3.1 Water (MT 30.5, CIPAC Handbook J, p.120, 2000)

Maximum: 1 g/kg.

#### 4 Physical properties

##### 4.1 Acidity (MT 31, CIPAC Handbook F, p.96, 1995)

Maximum acidity: 3 g/kg calculated as H<sub>2</sub>SO<sub>4</sub>.

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**Note 1** There are no relevant impurities to be controlled in products of the manufacturer identified in evaluation report 79/2004. However, if O,O,O',O'-tetramethyl dithiopyrophosphate (sulfo-TMPP) could occur at ≥1 g/kg in the TC of other manufacturers, it would be designated as a relevant impurity and a clause would be required to limit its concentration.

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\* Specifications may be revised and/or additional evaluations may be undertaken. Ensure the use of current versions by checking at: <http://www.fao.org/pest-and-pesticide-management/en/>

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## FENTHION DUSTABLE POWDER

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### FAO specification 79/DP (November 2006\*)

*This specification, which is PART ONE of this publication, is based on an evaluation of data submitted by the manufacturer whose name is listed in the evaluation reports (79/2004). It should be applicable to relevant products of this manufacturer, and those of any other formulators who use only TC from the evaluated source. The specification is not an endorsement of those products, nor a guarantee that they comply with the specification. The specification may not be appropriate for the products of other manufacturers who use TC from other sources. The evaluation reports (79/2004), as PART TWO, form an integral part of this publication.*

## 1 Description

The material shall consist of an homogeneous mixture of fenthion, complying with the requirements of FAO specification 79/TC (November 2006), together with carriers and any other necessary formulants. It shall be in the form of a fine, free-flowing beige powder, free from visible extraneous matter and hard lumps.

## 2 Active ingredient

### 2.1 Identity tests (79/DP/M/2, CIPAC Handbook, Note 1)

The active ingredient shall comply with an identity test and, where the identity remains in doubt, shall comply with at least one additional test.

### 2.2 Fenthion content (79/DP/M/3, CIPAC Handbook, Note 1)

The fenthion content shall be declared (g/kg) and, when determined, the average content measured shall not differ from that declared by more than the following tolerances.

Declared content in g/kg	Tolerance
up to 25 g/kg	± 25% of the declared content
above 25 up to 100 g/kg	± 10% of the declared content
Note: in each range the upper limit is included	

## 3 Relevant impurities (Note 2)

### 3.2 Water (MT 30.5, CIPAC Handbook J, p.120, 2000)

Maximum: 10 g/kg.

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\* Specifications may be revised and/or additional evaluations may be undertaken. Ensure the use of current versions by checking at: <http://www.fao.org/pest-and-pesticide-management/en/>



## 4 Physical properties

### 4.1 Dry sieve test (MT 59.1, CIPAC Handbook F, p.177, 1995)

Maximum: 5% retained on a 75 µm test sieve. Not more than  $(0.005 \times X)\%$  of the mass of the sample used for the determination shall be present as fenthion in the residue on the sieve, where X is the fenthion content (g/kg) found under 2.2 (Note 3).

## 5 Storage stability

### 5.1 Stability at elevated temperature (MT 46.3, CIPAC Handbook J, p.128, 2000)

After storage at  $54 \pm 2^\circ\text{C}$  for 14 days, the determined average active ingredient content must not be lower than 80% relative to the determined mean content found before storage (Note 4) and the formulation shall continue to comply with the clause for:

- dry sieve test (4.1).

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**Note 1** Extension of methods for the identification and determination of fenthion content, to DP, was adopted by CIPAC in 2006 but the details are not yet published in a Handbook. Prior to publication of the Handbook, copies of the methods may be obtained through the CIPAC website, <http://www.cipac.org>.

**Note 2** There are no relevant impurities to be controlled in products of the manufacturer identified in evaluation report 79/2004. However, if O,O,O',O'-tetramethyl dithiopyrophosphate (sulfo-TMPP) could occur at  $\geq 1$  g/kg of the fenthion content in products of other manufacturers, it would be designated as a relevant impurity and a clause would be required to limit its concentration.

**Note 3** For example, if the formulation is found to contain fenthion at 40 g/kg and 20 g of sample is used in the test, then the amount of fenthion in the residue on the sieve should not exceed 0.040 g, i.e.

$$\frac{(0.005 \times 40) \times 20}{100} \text{ g}$$

**Note 4** Samples of the formulation taken before and after the storage stability test should be analyzed together after the test in order to reduce the analytical error.

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## FENTHION WETTABLE POWDER

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### FAO specification 79/WP (December 2006\*)

*This specification, which is PART ONE of this publication, is based on an evaluation of data submitted by the manufacturer whose name is listed in the evaluation reports (79/2004). It should be applicable to relevant products of this manufacturer, and those of any other formulators who use only TC from the evaluated source. The specification is not an endorsement of those products, nor a guarantee that they comply with the specification. The specification may not be appropriate for the products of other manufacturers who use TC from other sources. The evaluation reports (79/2004), as PART TWO, form an integral part of this publication.*

## 1 Description

The material shall consist of an homogeneous mixture of technical fenthion, complying with the requirements of FAO specification 79/TC (December 2006), together with filler(s) and any other necessary formulants. It shall be in the form of a fine powder free from visible extraneous matter and hard lumps.

## 2 Active ingredient

### 2.1 Identity tests (79/WP/M/2, CIPAC Handbook L, p.81, 2006)

The active ingredient(s) shall comply with an identity test and, where the identity remains in doubt, shall comply with at least one additional test.

### 2.2 Fenthion content (79/WP/M/3, CIPAC Handbook, p.81, 2006)

The fenthion content shall be declared (g/kg) and, when determined, the average content measured shall not differ from that declared by more than the following tolerance.

Declared content in g/kg	Tolerance
Above 250 g/kg up to 500 g/kg	±5% of the declared content
Note: the upper limit is included in the range	

## 3 Relevant impurities (Note 1)

### 3.2 Water (MT 30.5, CIPAC Handbook J, p.120, 2000)

Maximum: 10 g/kg.

## 4 Physical properties

### 4.1 Acidity (MT 31, CIPAC Handbook F, p.96, 1995)

Maximum acidity: 3 g/kg calculated as H<sub>2</sub>SO<sub>4</sub>.

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\* Specifications may be revised and/or additional evaluations may be undertaken. Ensure the use of current versions by checking at: <http://www.fao.org/pest-and-pesticide-management/en/>

4.2 **Wet sieve test** (MT 185, CIPAC Handbook K, p.149, 2003)

Maximum: 2% retained on a 75 µm test sieve.

4.3 **Suspensibility** (MT 184, CIPAC Handbook K, p.142, 2003) (Notes 2, 3 & 4)

A minimum of 60% of the fenthion content found under 2.2 shall be in suspension after 30 min in CIPAC standard water D at  $30 \pm 2^\circ\text{C}$ .

4.4 **Persistent foam** (MT 47.2, CIPAC Handbook F, p.152, 1995) (Note 5)

Maximum: 25 ml after 1 min.

4.5 **Wettability** (MT 53.3, CIPAC Handbook F, p.164 1995)

The formulation shall be completely wetted in 2 min without swirling.

## 5 Storage stability

5.1 **Stability at elevated temperature** (MT 46.3, CIPAC Handbook J, p.128, 2000)

After storage at  $54 \pm 2^\circ\text{C}$  for 14 days, the determined average active ingredient content must not be lower than 90% relative to the determined average content found before storage (Note 6) and the formulation shall continue to comply with the clauses for:

- acidity (4.1),
- wet sieve test (4.2),
- suspensibility (4.3),
- wettability (4.5).

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Note 1 There are no relevant impurities to be controlled in products of the manufacturer identified in evaluation report 79/2004. However, if O,O,O',O'-tetramethyl dithiopyrophosphate (sulfo-TMPP) could occur at  $\geq 1$  g/kg of the fenthion content in products of other manufacturers, it would be designated as a relevant impurity and a clause would be required to limit its concentration.

Note 2 The formulation should be tested at the highest and lowest rates of use recommended by the supplier, provided this does not exceed the conditions given in method MT 184.

Note 3 This test will normally only be carried out after the heat stability test, 5.1.

Note 4 Chemical assay is the only fully reliable method to measure the mass of active ingredient still in suspension. However, simpler methods such as gravimetric and solvent extraction determination may be used on a routine basis provided that these methods have been shown to give equal results to those of chemical assay. In case of dispute, chemical assay shall be the "referee method".

Note 5 The mass of sample to be used in the test should be at the highest rate of use recommended by the supplier. The test is to be conducted in CIPAC standard water D.

Note 6 Samples of the formulation taken before and after the storage stability test should be analyzed concurrently after the test in order to reduce the analytical error.

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## FENTHION ULTRA LOW VOLUME LIQUID

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### FAO specification 79/UL (December 2006\*)

*This specification, which is PART ONE of this publication, is based on an evaluation of data submitted by the manufacturer whose name is listed in the evaluation reports (79/2004). It should be applicable to relevant products of this manufacturer, and those of any other formulators who use only TC from the evaluated source. The specification is not an endorsement of those products, nor a guarantee that they comply with the specification. The specification may not be appropriate for the products of other manufacturers who use TC from other sources. The evaluation reports (79/2004), as PART TWO, form an integral part of this publication.*

## 1 Description

The material shall consist of technical fenthion, complying with the requirements of FAO specification 79/TC (December 2006), together with any necessary formulants. It shall be in the form of a clear brown, stable and homogeneous liquid, free from visible suspended matter and sediment.

## 2 Active ingredient

### 2.1 Identity tests (79/UL/M/2, CIPAC Handbook, Note 1)

The active ingredient shall comply with an identity test and, where the identity remains in doubt, shall comply with at least one additional test.

### 2.2 Fenthion content (79/UL/M/3, CIPAC Handbook, Note 1)

The fenthion content shall be declared (g/kg or g/l at  $20 \pm 2^\circ\text{C}$ , Note 2) and, when determined, the average content measured shall not differ from that declared by more than the following tolerance:

Declared content in g/kg or g/l at $20 \pm 2^\circ\text{C}$	Tolerance
above 500	$\pm 25$ g/kg or g/l

## 3 Relevant impurities (Note 3)

### 3.1 Water (MT 30.5, CIPAC Handbook J, p.120, 2000)

Maximum: 2 g/kg.

## 4 Physical properties

### 4.1 Acidity (MT 31, CIPAC Handbook F, p.96, 1995)

Maximum acidity: 5 g/kg calculated as  $\text{H}_2\text{SO}_4$ .

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\* Specifications may be revised and/or additional evaluations may be undertaken. Ensure the use of current versions by checking at: <http://www.fao.org/pest-and-pesticide-management/en/>

## 5 Storage stability

### 5.1 Stability at 0°C (MT 39.3, CIPAC Handbook J, p.126, 2000)

After storage at  $0 \pm 2^\circ\text{C}$  for 7 days, the volume of solid and/or liquid which separate shall not be more than 0.3 ml.

### 5.2 Stability at elevated temperature (MT 46.3, CIPAC Handbook J, p.128, 2000)

After storage at  $54 \pm 2^\circ\text{C}$  for 14 days, the determined average active ingredient content must not be lower than 95% relative to the determined average content found before storage (Note 4) and the formulation shall continue to comply with the clause for:

- acidity (4.1).

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Note 1 Extension of methods for the identification and determination of fenthion content, to UL, was adopted by CIPAC in 2006 but the details are not yet published in a Handbook. Prior to publication of the Handbook, copies of the methods may be obtained through the CIPAC website, <http://www.cipac.org>.

Note 2 If the buyer requires both g/kg and g/l at  $20^\circ\text{C}$ , then in case of dispute, the analytical results shall be calculated as g/kg.

Note 3 There are no relevant impurities to be controlled in products of the manufacturer identified in evaluation report 79/2004. However, if O,O,O',O'-tetramethyl dithiopyrophosphate (sulfo-TMPP) could occur at  $\geq 1$  g/kg of the fenthion content in products of other manufacturers, it would be designated as a relevant impurity and a clause would be required to limit its concentration.

Note 4 Samples of the formulation taken before and after the storage stability test should be analyzed concurrently after the test in order to reduce the analytical error.

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## FENTHION EMULSIFIABLE CONCENTRATE

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### FAO specification 79/EC (December 2006\*)

*This specification, which is PART ONE of this publication, is based on an evaluation of data submitted by the manufacturer whose name is listed in the evaluation reports (79/2004). It should be applicable to relevant products of this manufacturer, and those of any other formulators who use only TC from the evaluated source. The specification is not an endorsement of those products, nor a guarantee that they comply with the specification. The specification may not be appropriate for the products of other manufacturers who use TC from other sources. The evaluation reports (79/2004), as PART TWO, form an integral part of this publication.*

## 1 Description

The material shall consist of technical fenthion complying with the requirements of FAO specification 79/TC (December 2006), dissolved in suitable solvent(s), together with any other necessary formulants. It shall be in the form of a clear brown or blue, stable and homogeneous liquid, free from visible suspended matter and sediment, to be applied as an emulsion after dilution in water.

## 2 Active ingredient

### 2.1 Identity tests (79/EC/M/2, CIPAC Handbook L, p.81, 2006)

The active ingredient shall comply with an identity test and, where the identity remains in doubt, shall comply with at least one additional test.

### 2.2 Fenthion content (79/EC/M/3, CIPAC Handbook L, p.81, 2006)

The fenthion content shall be declared (g/kg or g/l at 20 ± 2°C, Note 1) and, when determined, the average content measured shall not differ from that declared by more than the following tolerances.

Declared content in g/kg or g/l at 20 ± 2°C	Tolerance
above 250 up to 500	± 5% of the declared content
above 500	± 25 g/kg or g/l
Note: the upper limit is included in each range	

## 3 Relevant impurities (Note 2)

### 3.2 Water (MT 30.5, CIPAC Handbook J, p.120, 2000)

Maximum: 2 g/kg.

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\* Specifications may be revised and/or additional evaluations may be undertaken. Ensure the use of current versions by checking at: <http://www.fao.org/pest-and-pesticide-management/en/>

#### 4 Physical properties

##### 4.1 Acidity (MT 31, CIPAC Handbook F, p.96, 1995)

Maximum acidity: 1 g/kg calculated as H<sub>2</sub>SO<sub>4</sub>.

##### 4.2 Emulsion stability and re-emulsification (MT 36.1.1, CIPAC Handbook F, p.108, 1995 or MT 36.3, CIPAC Handbook K, p.137, 2003) (Note 3)

The formulation, when diluted at 30 ± 2°C with CIPAC standard waters A and D, shall comply with the following:

Time after dilution	Limits of stability, MT 36.1, MT 36.3
0 h	Initial emulsification complete
0.5 h	"Cream", maximum: 1 ml
2.0 h	"Cream", maximum: 2 ml "Free oil", none
24 h	Re-emulsification complete
24.5 h	"Cream", maximum: 1 ml "Free oil", none
Note: in applying MT 36.1 or 36.3, tests after 24 h are required only where results at 2 h are in doubt	

##### 4.3 Persistent foam (MT 47.2, CIPAC Handbook F, p.152, 1995) (Note 4)

Maximum: 20 ml after 1 min.

#### 5 Storage stability

##### 5.1 Stability at 0°C (MT 39.3, CIPAC Handbook J, p.126, 2000)

After storage at 0 ± 2°C for 7 days, the volume of solid and/or liquid which separate shall not be more than 0.3 ml.

##### 5.2 Stability at elevated temperature (MT 46.3, CIPAC Handbook J, p.128, 2000)

After storage at 54 ± 2°C for 14 days, the determined average active ingredient content must not be lower than 95% relative to the determined average content found before storage (Note 5) and the formulation shall continue to comply with the clauses for:

- acidity (4.1),
- emulsion stability and re-emulsification (4.2).

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**Note 1** If the buyer requires both g/kg and g/l at 20°C, then in case of dispute the analytical results shall be calculated as g/kg.

**Note 2** There are no relevant impurities to be controlled in products of the manufacturer identified in evaluation report 79/2004. However, if O,O,O',O'-tetramethyl dithiopyrophosphate (sulfo-TMPP) could occur at ≥1 g/kg of the fenthion content in products of other manufacturers, it

would be designated as a relevant impurity and a clause would be required to limit its concentration.

Note 3 This test will normally only be carried out after the heat stability test, 5.2. The criteria given in the table for MT 36.1 and MT 36.3 are appropriate for tests carried out at 5% concentration.

Note 4 The test should be carried out at the highest application concentration. The test is to be conducted in CIPAC standard water D.

Note 5 Samples of the formulation taken before and after the storage stability test should be analyzed concurrently after the test in order to reduce the analytical error.



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## FENTHION EMULSION, OIL IN WATER

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### FAO specification 79/EW (December 2006\*)

*This specification, which is PART ONE of this publication, is based on an evaluation of data submitted by the manufacturer whose name is listed in the evaluation reports (79/2004). It should be applicable to relevant products of this manufacturer, and those of any other formulators who use only TC from the evaluated source. The specification is not an endorsement of those products, nor a guarantee that they comply with the specification. The specification may not be appropriate for the products of other manufacturers who use TC from other sources. The evaluation reports (79/2004), as PART TWO, form an integral part of this publication.*

## 1 Description

The formulation shall consist of an emulsion of technical fenthion, complying with the requirements of FAO specification 79/TC (December 2006), in an aqueous phase together with suitable formulants. After gentle agitation, the formulation shall be homogeneous (Note 1) and suitable for dilution in water.

## 2 Active ingredient

### 2.1 Identity tests (79/EW/M/2, CIPAC Handbook L, p.81, 2006)

The active ingredient shall comply with an identity test and, where the identity remains in doubt, shall comply with at least one additional test.

### 2.2 Fenthion content (79/EW/M/3, CIPAC Handbook L, p.81, 2006)

The fenthion content shall be declared (g/kg or g/l at  $20 \pm 2^\circ\text{C}$ , Note 2) and, when determined, the average content measured shall not differ from that declared by more than the following tolerances:

Declared content in g/kg or g/l at $20 \pm 2^\circ\text{C}$	Tolerance
above 25 up to 100	$\pm 10\%$ of the declared content
Note: the upper limit is included in the range	

## 3 Relevant impurities (Note 3)

## 4 Physical properties

### 4.1 Acidity (MT 31, CIPAC Handbook F, p.96, 1995)

Maximum acidity: 1 g/kg calculated as  $\text{H}_2\text{SO}_4$ .

### 4.2 Pourability (MT 148.1, CIPAC Handbook F, p.348, 1995)

Maximum "residue": 3%.

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\* Specifications may be revised and/or additional evaluations may be undertaken. Ensure the use of current versions by checking at: <http://www.fao.org/pest-and-pesticide-management/en/>

**4.3 Emulsion stability and re-emulsification** (MT 36.1.1, CIPAC Handbook F, p.108, 1995 or MT 36.3, CIPAC Handbook K, p.137, 2003) (Notes 4 & 5)

The formulation, when diluted at  $30 \pm 2^\circ\text{C}$  with CIPAC standard waters A and D, shall comply with the following:

Time after dilution	Limits of stability, MT 36.1, 36.3
0 h	Initial emulsification complete
0.5 h	"Cream", maximum: 0.5 ml
2.0 h	"Cream", maximum: 2 ml "Free oil", none
24 h	Re-emulsification complete
24.5 h	"Cream", maximum: 0.5 ml "Free oil", none
Note: in applying MT 36.1 or 36.3, tests after 24 h are required only where results at 2 h are in doubt	

**4.4 Persistent foam** (MT 47.2, CIPAC Handbook F, p.152, 1995) (Note 6)

Maximum: 5 ml after 1 min.

**5 Storage stability**

**5.1 Stability at  $0^\circ\text{C}$**  (MT 39.3, CIPAC Handbook J, p.126, 2000)

After storage at  $0 \pm 2^\circ\text{C}$  for 7 days, no separation of particulate or oily matter shall be visible after gentle agitation.

**5.2 Stability at elevated temperature** (MT 46.3, CIPAC Handbook J, p.128, 2000)

After storage  $54 \pm 2^\circ\text{C}$  for 14 days, the determined average active ingredient content must not be lower than 95% relative to the determined average content found before storage (Note 7) and the formulation shall continue to comply with the clauses for:

- acidity (4.1),
- emulsion stability and re-emulsification (4.3).

**Note 1** All physical and chemical tests listed in this specification are to be performed with a laboratory sample taken after the recommended homogenisation procedure.

Before sampling to verify the formulation quality, the commercial container must be inspected carefully. On standing, emulsions may develop a concentration gradient which could even result in the appearance of a clear liquid on the top (sedimentation of the emulsion) or on the bottom (creaming up of the emulsion). Therefore, before sampling, the formulation must be homogenised according to the instructions given by the manufacturer or, in the absence of such instructions, by gentle shaking of the commercial container (for example, by inverting the closed container several times). Large containers must be opened and stirred adequately.

**Note 2** If the buyer requires both g/kg and g/l at  $20^\circ\text{C}$ , then in case of dispute the analytical results shall be calculated as g/kg.

- Note 3 There are no relevant impurities to be controlled in products of the manufacturer identified in evaluation report 79/2004. However, if O,O,O',O'-tetramethyl dithiopyrophosphate (sulfo-TMPP) could occur at  $\geq 1$  g/kg of the fenthion content in products of other manufacturers, it would be designated as a relevant impurity and a clause would be required to limit its concentration.
- Note 4 This test will normally be carried out only after the stability at elevated temperature test (5.2). The criteria given in the table for MT 36.1 and MT 36.3 are appropriate for tests carried out at 5% concentration.
- Note 5 The formulation should be tested at the highest and lowest rates of use recommended by the supplier.
- Note 6 The test should be carried out at the highest application concentration. The test is to be conducted in CIPAC standard water D.
- Note 7 Samples of the formulation taken before and after the storage stability test should be analyzed concurrently after the test in order to reduce the analytical error.

## PART TWO

### EVALUATION REPORTS

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#### FENTHION

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## FENTHION

### FAO/WHO EVALUATION REPORT 79/2004

#### Recommendations

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The Meeting recommended the following.

- (i) Existing FAO specifications for fenthion TC, DP, WP, OL and EC should be withdrawn.
- (ii) Existing WHO specifications for fenthion TC, WP and EC should be withdrawn.
- (iii) The specifications for fenthion TC, WP and EC, proposed by Bayer CropScience and as amended, should be adopted by WHO.
- (iv) The specifications for fenthion TC, DP, WP, UL, EC and EW, proposed by Bayer CropScience and as amended, should be adopted by FAO.
- (v) The specification for fenthion GR, proposed by Bayer CropScience and as amended, should be adopted by FAO subject to validation and adoption by CIPAC of the method for analysis of this formulation, with provisional/full method status.

#### Appraisal

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The Meeting considered data on fenthion, submitted by Bayer CropScience AG (BCS), for the review of existing FAO specifications for TC, DP, WP, OL and EC (FAO 1989) and existing WHO specifications for TC, WP and EC (WHO 1999). The data submitted were in accordance with the requirements of the manual (FAO/WHO 2002). Proposed FAO specifications were submitted for fenthion TC, DP, GR, WP, UL, EC and EW. Proposed WHO specifications were submitted for fenthion TC, WP and EC.

Fenthion is no longer under patent.

The draft specifications and the supporting data were provided by Bayer CropScience AG in 2003.

Fenthion is an organophosphorus insecticide. It is a liquid of rather low vapour pressure, only slightly soluble in water but readily soluble in organic solvents. Fenthion is slowly hydrolyzed in water at pH 5 and somewhat more rapidly at pH 7 and 9 but it is subject to rapid photolysis and is readily degraded biologically. It has no acidic or basic properties.

The Meeting was provided with commercially confidential information on the manufacturing process and two series of 5 batch analysis data on all impurities present at or above 1g/kg. Mass balances were >980 g/kg and no unknowns above 1 g/kg were reported. One of the two series of 5-batch data, and the corresponding manufacturing specification, proved to be similar to the data submitted for registration in Greece (EU rapporteur member state for fenthion). This manufacturing specification supported a minimum content of fenthion in the TC of 930 g/kg (946 g/kg average), which was similar to that adopted by the EU. The second series of 5-batch data and manufacturing specification supported a minimum fenthion content of 940 g/kg (948 g/kg average) in the TC (BCS 2004). The second series of data represented current production by the manufacturer at a new site. As

the newer data were within the envelope of the earlier manufacturing specification, a formal determination of equivalence was unnecessary. As the earlier manufacturing specification was correlated with the toxicology and ecotoxicology data, the Meeting agreed that the first manufacturing specification should be used as the reference profile of purity and impurities.

The manufacturer identified no relevant impurities but, in considering this issue, the Meeting requested more information on two impurities.

By analogy with some other organophosphorus pesticides, an S-alkyl impurity, referred to in this evaluation as “*iso-fenthion*” (O,S-dimethyl O-[3-methyl-4-(methylthio)phenyl] phosphorothioate), could increase in storage and could be more toxic than fenthion. The proposed lower-than-standard limits for fenthion after the storage stability test for the solid formulations (80% for DP, 90% for GR and WP) could have been due to conversion to this compound but no information was available on the degradation products (BCS 2004). The manufacturer stated that “*iso-fenthion*” is not expected to be a more potent cholinesterase inhibitor than fenthion itself and is therefore not relevant (BCS 2004). The company also noted that the new manufacturing specification for this impurity was lower ( $\frac{2}{3}$ ) than the previous specification (BCS 2004). The Meeting agreed that, in the absence of evidence to indicate that “*iso-fenthion*” is substantially more toxic than fenthion, it should be considered non-relevant.

In addition, and also by analogy with other organophosphorus compounds, the Meeting requested information on the relative toxicity of O,O,O',O'-tetramethyl dithiopyrophosphate (sulfo-TMPP). The manufacturer stated that its acute oral LD<sub>50</sub> in mice is 25 mg/kg bw and, noting that the new manufacturing specification is <0.5 g/kg, expressed the opinion that the impurity is not relevant (M-255350-01-1). WHO/PCS observed that, with a TC minimum purity of 940 g/kg, in a theoretical worst case, the impurity could increase the overall hazard by up to 64% (i.e. exceeding the limit of 10% increase normally adopted by JMPS) and thus, in principle, the impurity could be designated as relevant (PCS 2006). WHO/PCS estimated that a maximum acceptable limit would be 10 g/kg. However, the manufacturing specification of <0.5 g/kg is below the 1 g/kg cut-off value adopted by the JMPS for decisions on the relevance of impurities (other than impurities associated with exceptional hazards). The Meeting therefore agreed with a PCS conclusion (PCS 2006) that sulfo-TMPP could be designated as non-relevant in the proposer's fenthion, subject to inclusion of a cautionary note in the specifications to the effect that sulfo-TMPP may be considered a relevant impurity in the products of other manufacturers, if such products could contain the impurity at  $\geq 1$  g/kg of active ingredient.

The Meeting considered the proposed specifications.

TC. The existing FAO and WHO specifications were similar (though expressed differently). In considering the proposed specification, the Meeting welcomed an increase in minimum content of fenthion from 920 to 940 g/kg and noted that the maximum limits had been lowered from 2 to 1 g/kg for water and from 4 to 3 g/kg for acidity. No limits were proposed for alkalinity or acetone insolubles (previously 0.5 g/kg and 5 g/kg respectively). The Meeting accepted the proposed specification.

DP. The proposed specification differed in some respects from the existing FAO specification (a WHO specification did not exist and was not proposed). The existing

clause for active ingredient content did not specify ranges but the tolerance (-10 to +20%) indicated an overage to compensate for possible loss of active ingredient. In the existing specification, the clause for storage stability allowed a minimum of 85% fenthion after 2 weeks at 54°C, whereas the proposed specification allowed a minimum of 80%. The manufacturer stated that the proposed 80% limit was based on long experience. Because the supporting studies were conducted prior to the requirements of EU Directive 91/414/EEC, no information was available on the nature of the degradation products following storage (BCS 2004). The existing specification included clauses for acidity and alkalinity whereas the proposed specification included only a clause to limit water content. The manufacturer explained that autocatalytic hydrolysis of fenthion occurs if the water content is not adequately controlled<sup>1</sup> and that the proposed limit guarantees a 2-year shelf-life (Bayer 2004). The Meeting welcomed the proposed limit for dry sieve testing, which was more stringent than that of the existing specification.

WP. The existing FAO and WHO specifications were broadly similar, though with differences in the limits for persistent foam, storage stability and in the ranges given for fenthion content. As in the case of DP, the existing clause for fenthion content indicated an overage but the proposed minimum of 90% remaining after the storage stability was in accordance with the existing FAO specification. The existing specifications included no clause for water content but included clauses for acidity and alkalinity. The proposed specification included limits for water and acidity, both supported by the same justification as in the DP (Bayer 2004), and no clause for alkalinity. The Meeting questioned the limit of 2 minutes proposed for wettability, which was similar to that of the existing specifications. The manufacturer stated that no complaints had ever been received regarding wettability in practice (BCS 2004). The Meeting considered the proposed specification to be acceptable.

EC. The existing FAO and WHO specifications were broadly similar but with differences in the limits for persistent foam (no limit in that of FAO), storage stability and emulsion stability. As in the case of DP and WP, the existing clauses for fenthion content indicated an overage but the proposed minimum of 95% remaining after the storage stability was in accordance with the existing FAO specification. The existing and proposed specifications included the same limit (2 g/kg) for water content but the limit for acidity was reduced from 6 to 1 g/kg in the proposed specification. The proposed specification included more stringent limits for emulsion stability than those of the existing specifications. The Meeting accepted the proposed specification.

EW. There were no existing specifications for EW and only an FAO specification was proposed. Noting that, if acidity is controlled, fenthion is evidently stable to hydrolysis at 54°C for 2 weeks in the presence of the water phase (minimum 95% remaining), the Meeting considered the proposed specification to be acceptable.

UL. There were no existing specifications for UL and only an FAO specification was proposed. The Meeting considered the proposed specification to be acceptable.

GR. There were no existing specifications for GR and only an FAO specification was proposed. Noting that the limit for fenthion content after 2 weeks at 54°C was only

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<sup>1</sup> Note: initiation of autocatalytic hydrolysis in the EW is avoided by limiting the acidity.

90% (see also DP and WP), the Meeting considered the proposed specification to be acceptable.

The GC-FID analytical method for determination of fenthion in TC, WP, EC and EW became a full CIPAC method in 2005. Extensions of the full CIPAC method to analysis of DP and UL were adopted by CIPAC in 2006, with provisional status. The method for determination of fenthion in GR is a tentative CIPAC method, which is not an appropriate status for support of WHO and FAO specifications.



**SUPPORTING INFORMATION  
FOR  
EVALUATION REPORT 79/2004**

**Uses**

Fenthion is an insecticide with contact and stomach action and broad-spectrum activity against sucking and biting pests. It has been used in agriculture on numerous crops in many countries since 1957, for the control of mining and boring insects, leafhoppers and fruit flies (e.g. *Ceratitis capitata*, *Dacus oleae*). Fenthion also has uses in veterinary applications and in public health programmes for vector control.

**Identity**

*ISO common name*

fenthion (E-ISO, (m) F-ISO, BSI, ESA, BAN)

*Synonyms*

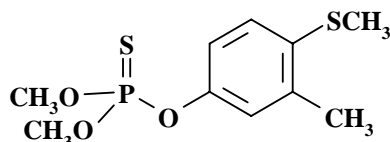
MPP (JMAF)

*Chemical names*

*IUPAC* O,O-dimethyl O-4-methylthio-*m*-tolyl phosphorothioate

*CA* O,O-dimethyl O-[3-methyl-4-(methylthio)phenyl] phosphorothioate

*Structural formula*



*Empirical formula*

C<sub>10</sub>H<sub>15</sub>O<sub>3</sub>PS<sub>2</sub>

*Relative molecular mass*

278.3

*CAS Registry number*

55-38-9

*CIPAC number*

79

*Identity tests*

RP-HPLC retention time (UV detection), capillary GC retention time

## Physical and chemical properties

**Table 1. Physico-chemical properties of pure fenthion**

Parameter	Value(s) and conditions	Purity %	Method	Reference
Vapour pressure	7.4 x 10 <sup>-4</sup> Pa at 20°C (extrapolated) 1.4 x 10 <sup>-3</sup> Pa at 25°C (extrapolated)	99.7	OECD 104, by extrapolation	M-024084-02-1
Melting point, boiling point and/or temperature of decomposition	Melting point: below -80°C	99.7	EEC A.1	M-024075-01-2
	Boiling point: 90°C at 0.01 hPa 117-120°C at 0.1 hPa 284-310°C at 1013 hPa	99.7	By calculation	M-024077-01-1
	Fenthion is thermally stable at room temperature.	99.7	OECD 113	M-024119-01-1
Solubility in water	4.2 mg/l at 20°C	99.7	EEC A6, OECD 105	M-024102-01-1
Partition coefficient	log P <sub>ow</sub> = 4.84 at 20°C	99.8	EEC A8 OECD 107	M-024113-01-2
Hydrolysis characteristics	Half-life: pH 5: 56 days at 25°C pH 7: 41 days at 25°C pH 9: 32 days at 25°C	99.9	EPA 161-1	M-088741-01-1
	pH 4: 223 days at 22°C pH 7: 200 days at 22°C pH 9: 151 days at 22°C	99.9	OECD 111	M-089034-01-1
Photolysis characteristics	DT <sub>50</sub> = 28.8 minutes at 23°C A bank of height lamps comprised of alternating FS-20 sunlamps (Westinghouse) and F20T12-BL black lights (Westinghouse) provided an artificial light source. The spectral distribution of light emitted by these lamps closely approximates that of natural sunlight.	98.7	EPA 161-2	M-088743-01-1
Dissociation characteristics	Fenthion has no acidic or alkaline properties in water.	99.0	OECD 112	M-024091-01-2

**Table 2. Chemical composition and properties of fenthion technical material (TC)**

Manufacturing process, maximum limits for impurities ≥ 1 g/kg, 5 batch analysis data	Confidential information supplied and held on file by FAO. Mass balances were 980 to 991 g/kg, with no unknowns at or above 1 g/kg
Declared minimum fenthion content	940 g/kg
Relevant impurities ≥ 1 g/kg and maximum limits for them	None
Relevant impurities < 1 g/kg and maximum limits for them:	None
Stabilisers or other additives and maximum limits for them:	None
Melting temperature range of the TC	below -80°C

## Hazard summary

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The FAO/WHO JMPR evaluated fenthion toxicology in 1971, 1975, 1979, 1980, 1995 and 1997 and fenthion residues in 1971, 1975, 1977, 1978, 1983, 1995 and 2000. The 1995 JMPR established an ADI of 0-0.007 mg/kg bw/d (JMPR 1995) and the 1997 JMPR established an acute RfD of 0.01 mg/kg bw (JMPR 1997).

The U.S. EPA concluded that fenthion spraying, especially when repeated at frequent intervals, may cause mortality in a variety of bird species, including raptors feeding on exposed birds (EPA 2001).

The Canadian Pest Management Regulatory Agency concluded that the use of fenthion on beef cattle or non-lactating cattle does not entail an unacceptable risk to human health and the environment after implementation of adequate product labelling (Health Canada 2003).

The European Commission (EU 2004) concluded that fenthion cannot be included in Annex I to Directive 91/414/CE, based on possible risks to birds. Generally, EU uses of fenthion were withdrawn in 2005 although, in the absence of efficient alternatives for certain uses in citrus, peaches and olives, the registrations may continue in four member states until 2007.

The EU hazard classification of fenthion is as follows:

R 21/22	harmful in contact with skin and if swallowed;
R 23	toxic by inhalation;
R 68	possible risks of irreversible effects;
R 48/25	toxic: danger of serious damage to health by prolonged exposure if swallowed;
R 50/53	very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment;
Classification	T toxic;
	N dangerous for the environment.

The WHO hazard classification of fenthion is class II, moderately hazardous (WHO 2002).

## Formulations

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Fenthion is sold under various trade names such as Baytex, Lebaycid and Queletox. The most important formulation types and countries where they are registered and sold are as follows:

- EC: Algeria, Armenia, Australia, Bosnia-Herzegovina, Brazil, Bulgaria, Colombia, Croatia, Cuba, Egypt, India, Iran, Israel, Japan, Jordan, Lebanon, Mauritius, Moldavia, Morocco, Namibia, Philippines, Saudi Arabia, South Africa, Spain, Sudan, Turkey, Uganda, United Arab Emirates (UAE), Uzbekistan.
- DP: Argentina, Bolivia.
- GR: Japan.
- UL: Cameroon, Ethiopia, Nigeria, Sudan, South Africa.
- WP: France, Spain.
- EW: Italy.

## **Methods of analysis and testing**

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Fenthion is determined by capillary GC-FID, using di-(2-ethylhexyl)-phthalate as internal standard. This method was adopted as a provisional CIPAC method in 2004 for the analysis of TC, WP, EC and EW but was accorded only tentative method status for the analysis of GR. The provisional method was promoted to full CIPAC method status in 2005 but the status of the method for analysis of GR remained tentative. Extension of the method to analysis of DP and UL was adopted by CIPAC, with provisional status, in 2006. Validation data and details of the method for determination of impurities were provided to FAO and WHO.

Test methods for determination of physico-chemical properties of the technical active ingredient were OECD, EPA, EC, while those for the formulations were for example, CIPAC, as indicated in the specifications.

## **Physical properties**

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The physical properties, the methods for testing them and the limits proposed for the DP, EC, GR, WP, UL formulations, comply with the requirements of the manual (FAO/WHO 2002).

## **Containers and packaging**

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No special requirements for containers and packaging have been identified.

## **Expression of the active ingredient**

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The active ingredient is expressed as fenthion.

## **ANNEX 1**

### **HAZARD SUMMARY PROVIDED BY THE PROPOSER**

Note: Bayer CropScience (BCS) provided written confirmation that the toxicological and ecotoxicological data included in the following summary were derived from fenthion having impurity profiles similar to those referred to in Table 2, above.

**Table A. Toxicology profile of fenthion technical material, based on acute toxicity, irritation and sensitization.**

Species	Test	Duration, conditions, guideline adopted, purity	Result	Reference
Rat	oral	single application; OECD 401 Purity not specified	LD <sub>50</sub> = ca. 250 mg/kg bw	M-107745-01-1
Rat	dermal	single application, 24 h; OECD 402 98.2%	LD <sub>50</sub> : ca. 586 males ca. 800 females mg/kg bw	M-107875-01-1
Rat	inhalation	dust, 4 h exposure; OECD 403 96.9%	LC <sub>50</sub> : ca. 507 males mg/m <sup>3</sup> ca. 454 females mg/m <sup>3</sup>	M-106131-01-1
Rabbit	skin irritation	OECD 404 96.9 & 98.5%	Non-irritant	M-107247-01-1, M-106113-01-1
Rabbit	eye irritation	OECD 405 96.9 - 98.5%	Non-irritant	M-107247-01-1
Guinea pig	skin sensitization	Maximization test 98.5%	Non-sensitizing	M-108752-01-1

**Table B. Toxicology profile of fenthion technical material based on repeated administration (sub-acute to chronic)**

Species	Test	Duration, conditions, guideline adopted, purity	Result	Reference
Rhesus monkeys	chronic oral	Special study, 23 months. Purity not specified	NOAEL = 0.2 mg/kg bw/day*	M-078555-02-1
Dog	chronic feeding	OECD 452, 52 weeks. 97.1%	NOAEL = 0.05 mg/kg bw/day	M-113317-03-1
Rat	chronic feeding	OECD 453, 24 months. 97.9% - 97.5%	NOAEL = 0.15 mg/kg bw/day No evidence of carcinogenicity	M-113359-01-1, M-109054-02-1
Mouse	oncogenicity feeding	OECD 451, 24 months. 98.2% - 98.7%	NOAEL = 5.0 ppm (2.0 mg/kg bw/day)** No evidence of carcinogenicity	M-111398-03-1
Rat	2-generation reproduction toxicity	OECD 416. 96.9%	NOAEL = 0.16 mg/kg bw/day	M-108899-02-1
Rat	developmental	OECD 414. 96.5% Administration: day 6-15	Developmental: NOAEL = 4.2 mg/kg bw/day Maternal: NOAEL = 4.2 mg/kg bw/day No evidence of teratogenicity or primary developmental toxicity	M-106147-01-1

**Table B. Toxicology profile of fenthion technical material based on repeated administration (sub-acute to chronic)**

Species	Test	Duration, conditions, guideline adopted, purity	Result	Reference
Rabbit	developmental	OECD 414. 96.5% Administration. Day 6-18	Developmental: NOAEL = 2.75 mg/kg bw/day Maternal: NOAEL = 1 mg/kg bw/day No evidence of teratogenicity or primary developmental toxicity	M-108942-01-1
Hen	acute delayed neurotoxicity	OECD 418. Purity: 95.3 -95.5% Single administration - under atropine protection	No evidence for organophosphate-induced delayed neuropathy	M-028301-01-1
Hen	sub-chronic delayed neurotoxicity	FIFRA 82-5 Purity: 96.5 Daily applications over 3 months	No evidence for organophosphate-induced delayed neuropathy	M-108868-01-1

\* The NOAEL quoted is based on the lack of erythrocyte cholinesterase inhibition at this dose level

\*\* The NOAEL quoted is in agreement with the WHO evaluation of this study and is based on the lack of brain and erythrocyte cholinesterase inhibition at this dose level.

**Table C. Mutagenicity profile of fenthion technical material based on *in vitro* and *in vivo* tests**

Species	Test system	Guideline, purity	Result	Reference
<i>in vitro</i> studies				
<i>Salmonella typhimurium</i> (TA 100, TA 98,TA 1535,TA 1537)	microsome test	OECD 471, 93.3%	Negative	M-108823-01-1
<i>Salmonella typhimurium</i> (TA 100, TA 98,TA 1535,A 1537)	microsome test	OECD 471, 98.3- 98.5%	Negative	M-106280-01-1
Chinese hamster ovary (CHO-K1-BH <sub>4</sub> ) cells	HGPRT test	OECD 476, 98.5%	Negative	M-106286-01-1
Chinese hamster ovary (CHO-K <sub>1</sub> ) cells	chromosome aberration assay	FIFRA § 84-3, 97.1%	Negative	M-106286-01-1
Chinese hamster fibroblasts (CHL)	chromosome aberration assay	FIFRA § 84-3, 98.6%	Negative	M-108011-01-1
Human lymphocytes	chromosome aberration assay	FIFRA § 84-3, 98%	Positive (1)	M-067896-01-1
Human lymphocytes	sister chromatid exchange assay	OECD 473, 98%	Positive (2)	M-067896-01-1
Human lymphocytes	sister chromatid exchange assay	OECD 473, purity not specified	Negative	M-278386-01-1
Chinese hamster ovary (CHO) cells	sister chromatid exchange assay	OECD 473, purity not specified	Positive (3a, 3b)	M-073310-01-1
Chinese hamster ovary (CHO) cells	sister chromatid exchange assay	OECD 473, purity not specified	Positive (3a)	M-073310-01-1

**Table C. Mutagenicity profile of fenthion technical material based on *in vitro* and *in vivo* tests**

Species	Test system	Guideline, purity	Result	Reference
male Sprague-Dawley rat primary liver cells	unscheduled DNA synthesis test	OECD 482, 98.3-98.5%	Positive	M-106320-01-1
<i>in vivo</i> studies				
Male and female NMRI-mice bone marrow cells	micronucleus test	OECD 475, 98.3%	Positive (4)	M-030214-01-1
Male NMRI-mice bone marrow cells	micronucleus-Test	OECD 475, 95.7%	Positive (4)	M-031864-01-1
Male NMRI-mice	dominant lethal test	No guideline, 98.1%	Negative	M-108348-01-1
Wistar rats	sister chromatid exchange assay	OPPTS 8705915, purity not specified	Negative	M-066630-01-1
Rat primary hepatocytes	unscheduled DNA synthesis test	OECD 486, 95.3-95.5%	Negative	M-021722-01-1

(1) Predominantly gaps and breaks, no second assay for confirmation.

(2) No second assay for confirmation.

(3a) Weak clastogenic effect at 40 and 80 µg/ml, no second assay for confirmation.

(3b) Delay of first cell cycle at 20 µg/ml and above.

(4) Weak clastogenic effect.

**Table D. Ecotoxicology profile of fenthion technical material**

Species	Test	Duration and conditions, purity	Result	Reference
<i>Leuciscus idus melanotus</i> (golden orfe)	acute	96h, 21°C, ca. 98%	LC <sub>50</sub> = 2.7 mg a.i./l	M-050292-01-2
<i>Oncorhynchus mykiss</i> (rainbow trout)	acute	96h, 12°C, 97.2%	LC <sub>50</sub> = 0.83 mg a.i./l	M-050315-02-1
<i>Daphnia magna</i> (water flea)	acute	48h, 20°C static, 93%	EC <sub>50</sub> = 5.7 µg/l	M-050213-02-1
<i>Daphnia magna</i> (water flea)	chronic	21 d, 20°C static renewal, 97.9%	EC <sub>50</sub> : 0.059 µg/l NOEC: 0.042 µg/l	M-050242-01-1
<i>Scenedesmus subspicatus</i> (green alga)	chronic	72h, 23°C, 93.6%	ErC <sub>50</sub> = 1.79 mg/l	M-051435-02-1
Earthworm	acute toxicity	14d, 22°C, 50.3% (formulation EC <sub>50</sub> )	LC <sub>50</sub> = 750 mg/kg dry soil	M-052505-01-1
<i>Apis mellifera</i> (honey bee)	acute contact toxicity	48h, 96.1%	0.16 ng/bee	M-106208-01-1
Bobwhite quail	acute toxicity	14d, single dose, 96.9%	LD <sub>50</sub> = 7.2 mg/kg bw	M-051816-01-1
Bobwhite quail	sub-acute toxicity	5 d, 96.9%	LC <sub>50</sub> = 60 ppm feed	M-051799-01-1
Mallard duck	sub-acute toxicity	5 d, 96.9%	LC <sub>50</sub> >1259 ppm feed	M-052231-01-1



## ANNEX 2. REFERENCES

BCS document number or other reference	Year and title of report or publication details
EPA 2001	U.S. EPA, Interim Re-registration Eligibility Decision for Fenthion. IRED, EPA 738-R-00-013, January 2001. Available at <a href="http://www.epa.gov/oppsrrd1/op/fenthion.htm">http://www.epa.gov/oppsrrd1/op/fenthion.htm</a> .
EU 2004	<i>Official Journal of the European Union</i> . European Commission Decision, 11 February 2004, 2004/140/EC. 17 February 2004.
FAO 1989	FAO specifications AGP: CP/234. 79/TC/S (1989); 79/DP/S (1989); 79/WP/S (1989); 79/OL/S (1989); 79/EC/S (1989).
FAO/WHO 2002	Manual on development and use of FAO and WHO specifications for pesticides, 1 <sup>st</sup> edition. FAO plant production and protection paper 173. FAO & WHO, Rome, 2002.
Health Canada 2003	Re-evaluation of Fenthion. PACR 2003-05, Health Canada, 2003.
JMPR 1995	FAO/WHO Joint Meeting on Pesticide Residues. Pesticide residues in food – 1995 evaluations. Part II. Toxicological and Environmental. World Health Organization. WHO/PCS/96.48. 1996.
JMPR 1997	FAO/WHO Joint Meeting on Pesticide Residues. Pesticide residues in food – 1997 evaluations. Part II. Toxicological and Environmental. World Health Organization. WHO/PCS/98.6. 1998.
M-021722-01-1	2000. E 1752 Unscheduled DNA synthesis test with rat liver cells in vivo.
M-024075-01-2	1994. Solidification point of Fenthion (European registration).
M-024077-01-1	1996. Boiling point of fenthion.
M-024084-02-1	1996. Vapour pressure curve of fenthion.
M-024091-01-2	1989. Dissociation constant of fenthion.
M-024102-01-1	1987. Water solubility of fenthion at 20°C.
M-024113-01-2	1983. Partition coefficient of Fenthion.
M-024119-01-1	1986. Thermal stability of the agrochemical active ingredient Fenthion.
M-028301-01-1	2000. E 1752 (c.n. fenthion) Study for delayed neurotoxicity following acute oral administration to hens.
M-030214-01-1	1990. E 1752 Micronucleus test on the mouse.
M-031864-01-1	2001. E 1752 Micronucleus test on the male mouse.
M-050213-02-1	1985. Acute toxicity of fenthion (technical) to water fleas.
M-050242-01-1	1988. Chronic toxicity of 14C-Baytex to <i>Daphnia magna</i> under flow-through test conditions.
M-050292-01-1	1979. Fischtoxizität Fenthion = S 1752, Goldorfe. Bayer AG.
M-050315-02-1	1986. Acute flow-through toxicity of Baytex to rainbow trout ( <i>Salmo gairdneri</i> ).
M-051435-02-1	1985. Growth inhibition of green algae ( <i>Scenedesmus subspicatus</i> ) by fenthion (technical).
M-051799-01-1	1987. Baytex technical: subacute dietary LC50 to Bobwhite quail.
M-051816-01-1	1987. Baytex (technical grade) – Acute LD50 to Bobwhite quail.
M-052231-01-1	1987. Baytex technical: subacute dietary LC50 to Mallard duck.
M-052505-01-1	1989. Toxicity of “Lebaycid” to earthworms.
M-066630-01-1	Bai Chenglong, Qiao Cibing, Zhang Weidong, Chen Yuliand Qu Zhuxin, 1990. A study of the pesticide fenthion: toxicity, mutagenicity and influence on tissue enzymes. <i>Biomed. Environ. Sci.</i> <b>3</b> , 262-275.
M-067896-01-1	1991. In vitro effect of fenthion on human lymphocytes.
M-070600-01-1	1989. Baytex technical - Chromosome aberrations in Chinese hamster ovary (CHO) cells.
M-073310-01-1	H.H. Chen, S.R. Sirianni and C.C. Huang, 1982. Sister chromatid exchanges in Chinese hamster cells treated with seventeen organophosphorus compounds in the presence of a metabolic activation system. <i>Environmental Mutagenesis</i> <b>4</b> : 621-624.

BCS document number or other reference	Year and title of report or publication details
M-078555-02-1	1996. A safety evaluation of fenthion (S 1752) in rhesus monkeys ( <i>Macaca mulata</i> ).
M-088741-01-1	1976. Stability of Baytex in sterile aqueous buffer solutions.
M-088743-01-1	1987. Aqueous photolysis of Baytex in sterile buffered solution.
M-089034-01-2	1983. E1752; Water.
M-106113-01-1	1987. Primary dermal irritation of Baytex technical in Albino rabbits.
M-106131-01-1	1987. Acute inhalation toxicity study with Baytex technical in rats.
M-106147-01-1	1987. A teratology study with fenthion (Baytex technical) in the rat.
M-106208-01-1	1977/1980. Bee toxicity of pesticides.
M-106280-01-1	1990. E 1752 Salmonella/microsome test.
M-106286-01-1	1990. E 1752 (c.n. fenthion) Mutagenicity study for the detection of induced forward mutations in the CHO-HGPRT assay in vitro.
M-106320-01-1	1990. E 1752 (c.n. fenthion) Mutagenicity test on unscheduled DNA synthesis in rat liver primary cell cultures in vitro.
M-107247-01-1	1985. E 1752 (technical) (c.n. fenthion) Study for irritant / corrosive effect on skin and eye (rabbit).
M-107745-01-1	1987. Lebaycid active ingredient 1625 MO: a) storage at room temperature / 0-days value, b) storage at 54°C / 8-week sample, Comparative study on acute oral toxicity in rats.
M-107875-01-1	1991. E 1752 (c.n.: Fenthion). Study for acute dermal toxicity in the rat.
M-108011-01-1	1989. Chromosomal aberration test of fenthion using cultured mammalian CHL cells
M-108348-01-1	1978. S 1752 (fenthion; Lebaycid active ingredient) Dominant lethal study on male mice to test for mutagenic effects.
M-108752-01-1	1987. E 1752 (c.n. fenthion) Study for skin-sensitizing effect on guinea pigs.
M-108823-01-1	1987. E 1752 (c.n. fenthion) Salmonella/microsome test point-mutagenic effect.
M-108868-01-1	1988. Subchronic delayed neurotoxicity study of fenthion technical (Baytex) with hens.
M-108899-02-1	1989. A two generation reproduction study with fenthion (Baytex) in the rat.
M-108942-01-1	1987. A teratology study in the rabbit with fenthion (Baytex technical).
M-109054-02-1	1990. Combined chronic toxicity/oncogenicity study of fenthion technical (Baytex) with rats.
M-111398-03-1	1990. E 1752 (fenthion): oncogenicity study on B6C3FA mice (feeding study for periods up to 24 months).
M-113317-03-1	1990. Chronic feeding toxicity study of fenthion technical (Baytex) with dogs.
M-113359-01-1	1977. BAY 29 493. Chronic toxicity study on rats (two-year feeding experiment).
M-265598-01-1	E-mail from Bayer CropScience to WHO, dated 25 October 2004. Antwort: Bayer, Minutes of the Closed Session of the 3rd JMPS Meeting, Brno, Czech Republic 3-8 June 2004 – FENTHION.
M-278386-01-1	Sobti R.C., Krishan A. and Pfaffenberger C.D., 1982. Cytokinetic and cytogenetic effects of some agricultural chemicals on human lymphoid cells in vitro: organophosphates. <i>Mut. Res.</i> <b>102</b> , 89-102.
PCS 2006	2006. JMPS enquiry on fenthion. Fenthion.pdf.
WHO 1999	WHO specifications: TC, WHO/SIT/15.R4 (1999); WP, WHO/SIF/38.R2 (1999); EC, WHO/SIF/28.R5 (1999).
WHO 2002	The WHO recommended classification of pesticides by hazard and guidelines to classification 2000-2002. WHO, Geneva, 2002.