



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

AGP: CP/82

**FAO SPECIFICATIONS
FAO PLANT PROTECTION PRODUCTS**

ZINEB
Zinc ethylenebisdithiocarbamate

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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DISCLAIMER¹

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.

¹ This disclaimer applies to all specifications published by FAO.

INTRODUCTION TO FAO SPECIFICATIONS DEVELOPED UNDER THE OLD PROCEDURE

Between 1975 and 2000, FAO published booklets of specifications for technical materials and related formulations of plant protection products. Revisions of, and additions to, already published specifications will be issued when necessary. However, all changes and revisions of FAO specifications are now subject to the new procedure described in the *Manual on the development and use of FAO and WHO Specifications for Plant Protection Products*, FAO Plant Production and Protection Paper No. 173, Rome 2002 (*Revised First Edition* available only on the FAO home page of the Internet at: <http://www.fao.org/pest-and-pesticide-management/en/>)

FAO specifications developed under the old procedure are based on the requirements defined in the Fourth Edition of the *Manual on the development and use of FAO specifications for plant protection products*, Plant Production and Protection Paper No. 128, Rome 1995.

This manual contained detailed definitions and other essential background information on basic procedures and technical principles adopted by the group on Pesticide Specifications of the FAO Panel of Experts on Pesticide Specifications, Registration Requirements, Application Standards and Prior Informed Consent, such as:

3 Categories of Specifications (Section 3.1 of the Manual)

FAO Tentative Specifications (Code 'S/T', formerly 'TS') are those which have been recommended by FAO as preliminary specifications and which are based on minimum requirements. The methods of analysis cited are normally supplied by the manufacturer or may already have been published or be the subject of collaborative work.

FAO Provisional Specifications [Code 'S/P', formerly ('S')] are those for which more evidence of the necessary parameters is available and where some collaborative study of the methods of analysis has been carried out.

FAO (full) Specifications (Code 'S/F', formerly 'S').

Specifications that have all necessary requirements together with CIPAC (full) methods, or other collaboratively studied (proven) methods^{2,3}

Wherever possible, standards for apparatus and common names for pesticides are those approved by the International Organization for Standardization (ISO).

3 Expression of active ingredient content (Section 4.2.5 of the Manual)

3 for solids, liquid technical materials, volatile liquids (of maximum boiling point 50 °C) and viscous liquids (with minimum kinematic viscosity of $1 \times 10^3 \text{ m}^2/\text{s}$ at 20 °C) the FAO Specification shall be based on expression of the content as g/kg;

3 for all other liquids the active ingredient content of the product shall be declared in terms of g/kg *or* g/l at 20 °C. If the customer requires both g/kg *and* g/l at 20 °C, then in case of dispute the analytical results shall be calculated as g/kg.

3 Tolerance on content (Section 4.2.7 of the Manual)

A declared content of active ingredient must be included in all specifications, and one of the problems immediately arising is the level of tolerance acceptable about the nominal figure. The tolerance is influenced by (a) the reproducibility of the method of analysis, (b) the sampling error and (c) the manufacturing variance.

Allowable variations in analytical results (i.e. tolerances in content of active ingredient) with respect to specific pesticide consignments are intended to cover reasonable variations in the contents of active ingredients. For examples of such tolerances, see the table in Section 4.2.7 of the Manual.

3 Containers/packaging

FAO guidelines are in preparation.

Containers shall comply with pertinent national and international transport and safety regulations.

Technical materials, dustable powders and granules

Containers shall be suitable, clean, dry and as specified, and shall not adversely affect, or be affected by, the contents, but shall adequately protect them against external conditions.

Wettable powders

The product shall be packed in suitable, clean, dry containers as specified in the order. The container shall provide all necessary protection against compaction, atmospheric moisture, loss by vaporization and/or contamination to ensure that the product suffers no deterioration under normal transit and storage conditions.

The product shall be protected by an adequate moisture barrier. This may be a suitable bag of polyethylene or alternative means of giving equal or better protection.

Solutions and emulsifiable concentrates

Containers shall be lined, where necessary, with a suitable material, or the interior surfaces shall be treated to prevent corrosion and/or deterioration of the contents.

Additional information should be given in all specifications where particular pesticides present problems in packaging.

3 Biological information

Phytotoxicity

No test can be specified to cover the possible phytotoxicity of a formulation to all crops. When a crop is not mentioned in the instructions for use, purchasers should check with the supplier that the material is suitable, always provided that such a use is not restricted or legally forbidden.

Wetting of crops

The dilute spray should satisfactorily wet the leaves of the specified crops when used in accordance with the instructions. Test method MT 53.2, CIPAC F, p.162, may be useful.

¹ *Should national pesticide specifications developed from these approved FAO specifications deviate from them, the National Authority responsible for making such changes is requested to inform the FAO Plant Protection Service of the nature of, and the reasons for, the modifications.*

² *Methods of analysis and miscellaneous techniques referred to in these specifications have been developed and adopted by CIPAC (Collaborative International Pesticides Analytical Council Ltd.). See CIPAC Handbooks 1 (1970), 1A (1980), 1B (1983), 1C (1985), D (1988), E (1993), F (1995), G (1995), CIPAC Proceedings 1980 and 1981, obtainable from Black Bear Press Limited, King's Hedges Road, Cambridge CB4 2PQ, England. The page numbers of specific methods are given in parentheses in the specifications. Copies of methods not yet published can be obtained from the FAO Plant Protection Service.*

³ *Information on standard waters for laboratory evaluation of pesticidal formulations will be found in CIPAC Monograph 1, Standard Waters and an FAO Survey on Naturally Occurring Waters (1972), Black Bear Press Limited, King's Hedges Road, Cambridge CB4, England.*

ZINEB TECHNICAL
FAO Specification Code 25/1/S/18

.1 DESCRIPTION

The material shall consist of zineb, together with related manufacturing impurities, as a white to cream powder. It shall be free from visible extraneous materials and added modifying agents.

.2 ACTIVE INGREDIENT

.2.1 *Identity tests*

Where the identity of the material is in doubt it shall comply with any of the two following tests:

.2.1.1 *Colorimetric tests* (CIPAC 1A; MT 130)

The sample shall produce similar spots to those produced from a standard zineb.

.2.1.2¹ *Amine* (CIPAC 1C; 25/1/m/1.3.2) – note 1

The majority of the amine produced from the active ingredient shall be ethylenediamine.

.2.1.3¹ *Zinc* (-/m/1.3.3) – note 1

The oxine produced from the sample shall be precipitated at the same pH and have the same colour as that from the standard zineb.

.2.2 *Zineb content*

The zineb content shall be declared (Minimum declared: 86.0%). When the combined carbon disulphide is determined and expressed as zineb (Note 2), the content obtained shall not differ from that declared by more than \pm percentage units.

.2.3 *Zinc* (-/M/1.4)

Minimum: 23.3%

Maximum: 26.0%

} Of the zineb found under .2.2 (note 3)

.3 IMPURITIES (Note 4)

.3.1 *Arsenic* (-/M/1.5)

Maximum: 250 mg/kg.

.3.2 *Water* (-/M/1.6)

Maximum 1.5%

.3.3 *Manganese* (CIPAC 1A; MT 93)

¹ For information

NOTES

Note 1: These tests are for information pending further analytical work.

Note 2: 1.00% carbon disulphide = 1.81 zineb.

Note 3: On a result of 85% zineb the permitted zinc content would be 19.8 to 22.1%

Note 4: In the course of the manufacture of zineb, a small amount of ethylene thiourea (ETU) is also produced. In good manufacturing practice this should not exceed 0.5% of the zineb. During storage more ETU may be formed by decomposition. To minimize decomposition the material should be stored under cool, dry conditions.

Note 5: On a result of 90% zineb the permitted maximum content would be 0.45% of the product. This clause is included to limit cross-contamination with maneb.

ZINEB DUSTS

FAO Specification 25/2/S/18

.1 DESCRIPTION

The product shall consist of a homogeneous mixture containing zineb as the active ingredient, together with suitable carriers and any necessary formulants. It shall be a fine, free flowing, dustable material, free from visible extraneous materials and hard lumps.

It shall be formulated from zineb technical complying with 25/1/S/18.

.2 ACTIVE INGREDIENT

.2.1 *Identity tests*

Where the identity of the material is in doubt it shall comply with any two of the following tests:

.2.1.1 *Colorimetric* (CIPAC 1A; MT 130)

The sample shall produce similar spots to those produced from a standard zineb.

.2.1.2¹ *Amine* (CIPAC 1C; 25/2/m/1.3.2) – note 1

The majority of the amine produced from the active ingredient shall be ethylenediamine.

.2.1.3¹ *Zinc* (-/m/1.3.3) 0- note 1

The oxine produced from the sample shall be precipitated at the same pH and have the same colour as that from the standard zineb.

.2.2 *Zineb* (CIPAC 1; 25/2/M/1.2)

The zineb content shall be declared. When the combined carbon disulphide content is determined and expressed as zineb (note 2), the content obtained shall not be less than that declared by more than $\pm 10\%$ of the declared content.

.2.3 *Zinc* (-/M/1.4)

Minimum: 23.3%
Maximum: 26.0% } Of the zineb found under .2.2 (note 3)

.3 IMPURITIES

.3.1 *Arsenic* (-/M/M/1.5)

Maximum: $2.5x + 20$ mg/kg where x is the percentage zineb declared under .2.2 (note 5).

¹ For information

.3.2 *Water* (-/M/1.6)
Maximum 2.0%

.4 PHYSICAL PROPERTIES

.4.1 *Dry sieve test* (-/M/1.7)
Maximum: 2% retained on a 75 um test sieve.
Not more than (0.06 x x)% of the weight of sample used for the determination shall be present as zineb in the residue on the sieve, where x is the percentage zineb content declared under .2.2 (note 6)

.4.2¹ *Flowability* (CIPAC 1A; MT 44)
Maximum flow number: 12

.5 STORAGE STABILITY

.5.1 *Stability at 54°C* (CIPAC 1; 25/2/M/1.9)
After storage at 54 + 2°C for 14 days the product shall continue to comply with .2.2, (except that the permitted minimum content of zineb shall be 90% of that found under .2.2) and .4.1).

.6 CONTAINERS

They shall be suitable, clean, dry and as specified in the order and shall not affect, or be affected by, the product, but shall adequately protect it from external influences (note 7). They shall comply with pertinent national and international transport safety regulations.

.7 PHYSICAL PROPERTIES

.7.1¹ *Phytotoxicity*
At the present stage of our knowledge, no test can be specified to cover phytotoxicity of formulations to crops. When a crop is not mentioned in the instructions for use, purchasers should check with the supplier that the material is suitable, always provided that such a use is not restricted or legally forbidden.

¹ For information

NOTES

- Note 1: These tests are for information pending further analytical work.
- Note 2: 1.00% carbon disulphide = 1.81% zineb.
- Note 3: On result of 20% zineb the maximum permitted zinc content would be 4.6% to 5.2%.
- Note 4: During the manufacture of zineb technical a small amount of ethylene thiourea (ETU) is also produced. In good manufacturing practice this should not, at the time of manufacture exceed 0.5% of the zineb. During storage more ETU may be formed by decomposition. To minimize decomposition all products containing zineb should be stored under cool, dry conditions.
- Note 5: On a declared zineb content of 5% the maximum permitted arsenic content would be 2.5×5 , plus 20 i.e., 32.5 mg/kg. The 20 mg is the maximum permitted arsenic content of the carriers.
- Note 6: If the dust contains a declared content of 20% zineb and 20 g of sample is used in the test, then the amount of zineb in the residue on the sieve should not exceed 0.24 g i.e:

$$\frac{(0.06 \times x) \text{ weight of sample}}{100} \text{ g}$$

- Note 7: Zineb dusts will deteriorate in the presence of moisture.

ZINEB DISPERSIBLE POWDERS

FAO Specification Code 25/3/S/19

.1 DESCRIPTION

The product shall consist of a homogeneous mixture containing zineb as the active ingredient, together with fillers and any necessary formulants. It shall be a fine powder, free from visible extraneous materials and hard lumps. It shall be formulated by zineb technical complying with 25/1/S/18.

.2 ACTIVE INGREDIENT

.2.1 *Identity tests*

Where the identity of the material is in doubt it shall comply with any two of the following tests:

.2.1.1 *Colorimetric tests* (CIPAC 1A; MT 130)

The sample shall produce similar spots to those produced from a standard zineb.

.2.1.2¹ *Amine* (CIPAC 1C; 25/3/m/1.3.2) – note 1

The majority of the amine produced from the active ingredient shall be ethylenediamine.

.2.1.3¹ *Zinc* (-/m/1.3.3) – note 1

The oxine produced from the sample shall be precipitated at the same pH and have the same colour as that from the standard zineb.

.2.2 *Zineb* (CIPAC 1; 25/3/M/1.3)

The zineb content shall be declared (note 2). When the combined carbon disulphide content is determined, and expressed as zineb (note 3), the content obtained shall not differ from that declared by more than + percentage units.

.2.3 *Zinc* (-/M/1.4)

Minimum: 23.3%

Maximum: 26.0%

} Of the zineb content found under .2.2 (note 4)

.3 IMPURITIES (Note 5)

.3.1 *Arsenic* (-/M/1.5)

Maximum 2.5x mg/kg where x is the percentage zineb declared under .2.2 (note 6.)

.3.2 *Water* (-/M/1.6)

Maximum: 2.0%

¹ For information

.3.3 *Manganese (-/M/1.7)*

Maximum: 0.50% of the zineb content found under .2.2 (note 7).

.4 PHYSICAL PROPERTIES

.4.1 *Wet sieve test (-/M/1.7)*

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

.4.2 *Suspensibility (-/M/1.9).*

A minimum of 70% of the zineb content declared under .2.2 shall be in suspension after 30 min. in CIPAC Standard Water A when determined on the sample as received, and not less than 60% in CIPAC Standard Water C after the Heat Stability test .5.1.

Alternatively, if the buyer requires other CIPAC Standard Waters to be used, then this shall be specified when ordering.

.4.3 *pH range of 1% aqueous dispersion (-/M/1.8)*

5.0 to 9.0.

.4.4 *Wettability of the product (-/M/1.10)*

Shall be completely wetted in 1m in without swirling.

.4.5 *Persistent foam (-/M/1.11)*

Maximum: 25 ml after 1 min.

.5 STORAGE STABILITY

.5.1 *Stability at 54°C (-/M/1.12)*

After storage at 54 + 2°C for 14 days the product shall continue to comply with: .2.2, (except that the minimum permitted zineb content shall be 90% of that found under .2.2) .4.1, .4.2 and .4.4.

.6 CONTAINERS

The product shall be packed in suitable, clean, dry, containers as specified in the order. The container shall provide all necessary protection against compaction, atmospheric moisture, oxidation, loss by evaporation, and/or contamination to ensure that the product suffers no deterioration under normal transit and storage conditions.

The product shall be protected by an adequate moisture barrier. This may be an inner bag of polyethylene (note 8), or alternative means of giving equal or better protection. Containers shall comply with pertinent national and international transport and safety regulations.

.7 BIOLOGICAL PROPERTIES

.7.1¹ *Phytotoxicity*

At the present stage of our knowledge, no test can be specified to cover the phytotoxicity of formulations to crops. When a crop is not mentioned in the instructions for use, purchasers should check with the supplier that the material is suitable, always provided that such a use is not restricted or legally forbidden.

.7.2¹ *Wetting of crops (-M/1.13)*

The dilute spray should satisfactorily wet the leaves of the specified crops when used in accordance with the instructions. The test described may be useful.

¹ For information

NOTES

- Note 1: These tests are for information pending further analytical work.
- Note 2: The zineb content may decrease at the rate of between .04 and 1.0% of the active ingredient per month, e.g. a product containing 80% zineb when manufactured may assay 70.0% at the end of 12 months. In very bad storage conditions e.g. extremes of temperature, or when unsuitable containers have been used, the deterioration is accelerated.
- Note 3: 1.00% carbon disulphide = 1.81% zineb.
- Note 4: On a result of 80% zineb, the permitted zinc content would be 18.96 to 20.0%.
- Note 5: During the manufacture of zineb technical a small amount of ethylene thiourea (ETU) is also produced. In good manufacturing practice this should not, at the time of manufacture, exceed 0.5% of the zineb. During storage more ETU may be formed by decomposition. To minimize decomposition products containing zineb should be stored under cool, dry conditions.
- Note 6: On a declared zineb content of 70% the maximum permitted arsenic content would be 2.5×70 or 175 mg/kg.
- Note 7: On a result of 80% zineb, the maximum permitted manganese content would be 0.40% of the product.
- Note 8: Because of the variation in the nature and size of the container, its destination and other factors, it is not possible to specify the thickness of the polyethylene, but as a guideline for a container with 50 kg of product, the inner light might be for example at least 0.075 mm thick.