Spatial application mosquito repellents —
Specification —
Part 5:
Liquid vaporizers
In order to match with technological development and to keep continuous progress in industries, standards are subject to periodic review. Users shall ascertain that they are in possession of the latest edition.
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Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS 393-5 was prepared by Technical Committee RSB/TC 015, Pharmaceutical Products.

DRS 393 consists of the following parts, under the general title: Spatial application mosquito repellents — Specification:

— Part 1: Coils
— Part 2: Spray
— Part 3: Candles
— Part 4: Papers
— Part 5: Liquid vaporizers
— Part 6: Vaporizing mats
— Part 7: Tablets
— Part 8: Liquid detergents

Committee membership

The following organizations were represented on the Technical Committee on Pharmaceutical Products (RSB/TC 015) in the preparation of this standard.

National Industrial Research and Development Agency (NIRDA)

National Pharmacy Council (NPC)

University of Rwanda/College of Sciences and Technology (UR/CST)

Pharmacie NOVA

Rwanda Development Board (RDB)
AGROPY LTD

IKIREZI NATURAL PRODUCTS

HORIZON/SOPYRWA

Rwanda Social Security Board (RSSB)

Pharmavie

University of Rwanda/College of Medicine and Health Sciences (UR/CMHS)

Rwanda Biomedical Center/ Malaria and Other Parasitic Diseases Division (RBC/MOPDD)

Society for Family Health (SFH) – Rwanda

Rwanda Biomedical Center/Medical Procurement and Production Division (RBC/MPPD)

INES - RUHENGARI

Rwanda Standards Board (RSB) – Secretariat
Introduction

Insecticides are used either for killing or controlling harmful insects. The insecticides which are applied for repelling insects are termed as “Repellents”. Mosquito is one of the most harmful insects for mankind. To destroy them, many preparations are available on the market in various recipes like pest killer spray, soap, oil, powder, repellent etc. Out of these, mosquito repellent is the most popular as it has germicidal and disinfectant properties and is able to repel mosquitoes and is convenient to use.

The mosquito repellent is used for warding off mosquitoes which is the most harmful insect. Nowadays, mosquito repellents are used for controlling mosquito and are complimenting other mosquito destroyers gradually. With the rise in the standard of living, increasing urbanization and population, the demand of mosquito repellent mat is constantly increasing particularly in tropical places. It is a convenient method for protection against mosquito, so it has a tremendous market potential. Thus there is a very good scope for development of such units in the country.

Spatial repellent are chemical products designed to be ‘active’ (requiring heat or electricity) or ‘passive’ (requiring no heat or electricity) and release volatile chemicals into the air within the treated space. Product examples that are currently available include mosquito coils, spray, candles, papers, liquid vaporizers, vaporizing mats, tablets and liquid detergents, among others. However, many more types of spatial repellent products are waiting to be developed.

Spatial repellents elicit ‘spatial repellency’ which refers to a range of insect behaviours induced by airborne chemicals that result in a reduction in human-mosquito contact. These behaviours include movement away from a chemical stimulus, attraction-inhibition and/or and feeding inhibition.
Spatial application mosquito repellents — Specification — Part 5: Liquid vaporizers

1 Scope

This Draft Rwanda Standard prescribes the requirements and test methods for spatial application mosquito repellents formulated and prepared as liquid vaporizers meant for outdoor and indoor use.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

RS 91, Labeling and marking of pharmaceutical products — Specification

RS 191, Refined pyrethrum concentrate — Specification

AOAC 973.12, d-trans-Allethrin in pesticides formulations

CIPAC 741, Determination of transfluthrin content

CIPAC 743, Determination of prallethrin (etoc) content

CIPAC 993, Determination of Metofluthrin (S1264)

CIPAC 742, Determination of d-allethrin

CIPAC 977, Determination of Meperfluthrin

ISO 21149, Cosmetics — Microbiology — Enumeration and detection of aerobic mesophilic bacteria

RS EAS 847-18, Cosmetics — Analytical methods — Part 18: Determination of thermal stability

RS EAS 847-17, Cosmetics — Analytical methods — Part 17: Determination of pH

RS EAS 847-16, Cosmetics — Analytical methods — Part 16: Determination of lead, mercury and arsenic content

3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply
3.1
liquid vaporizer

bottle/catridge filled with a liquid containing an insect repelling substance and meant to be plugged into a heater unit in order to release the repellent

3.2
mosquito

any of numerous arthropod animals of the class mosquito, having an adult stage characterized by three pairs of legs and a body segmented into head, thorax, and abdomen and usually having one or two pairs of wings.

3.3
mosquito repellent

substance applied to skin, clothing, or other surfaces which discourages mosquito (and arthropods in general) from landing or climbing on that surface

3.4
natural repellents/biopesticides

repellents that contain natural, plant-based active ingredients

3.5
synthetic repellents

conventional repellents containing synthetic chemical active ingredients and carrier synthetic chemical compounds as approved by a competent authority.

3.6
Transfluthrin

\[(1R,3S)-3-(2,2-Dichlorovinyl)-2,2-dimethyl-1-cyclopropanecarboxylic acid (2,3,5,6-tetrafluorophenyl)methyl ester\]

3.7
Etoc

Prallethrin. \[(S)-2\text{-methyl-4-oxo-3-prop-2-ynylcyclopent-2-enyl}(1R\text{-cis, trans-2,2-dimethyl-3-(2-methylprop-1-enyl)} cyclopropanecarboxylate\]
3.8

Metofluthrin

C_{18}H_{20}F_{4}O_{3}, 2,3,5,6-Tetrafluoro-4-(methoxymethyl)benzyl 2,2-dimethyl-3-(prop-1-en-1-yl) cyclopropanecarboxylate

3.9

d-Alethrin

(RS)-3-allyl-2-methyl-4-oxocyclopent-2-enyl (1R)-cis, trans-chrysanthemate

3.10

Meperfluthrin

C_{17}H_{16}C_{17}F_{4}O_{3}, [2,3,5,6-tetrafluoro-4-(methoxymethyl)phenyl]methyl (1R,3S)-3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropane-1-carboxylate

4 Requirements

4.1 General requirements

4.1.1 The product shall consist of a liquid mosquito repellent formulation in a cartridge/bottle, designed to fit a suitable heater unit, and the formulation shall be effective as it passes up the heated wick and evaporates at a suitable rate, over the period claimed by the manufacturer.

4.1.2 The cartridge/bottle shall be designed to minimise the risk of accidental ingestion of the contents.

4.1.3 When the product is vaporized, it shall have the benefit of repelling mosquitoes.

4.1.3 The bottle/cartridge shall allow exit of the content with ease when reasonable pressure is applied to the lid.

4.2 Active ingredients

4.2.1 Natural repellents

4.2.1.1 Active ingredients used in natural repellents shall be natural and plant based compounds such as essential oils or any other plant extract approved as mosquito repellents.

4.2.1.3 The manufacturer shall provide adequate data on the repellence/efficacy of such ingredients/product.

4.2.1.4 The manufacturer shall have adequate data justifying the proportion of ingredient(s) for which claims are made, used in the product.
4.2.1.5 The essential oils and plant extracts used in natural repellents shall be, but not limited to:

a) Cedarwood oil;

b) Tea tree oil;

c) Geranium oil;

d) Rosemary oil;

e) Lemongrass oil;

f) Citronella oil;

g) Soybean oil;

h) Eucalyptus oil;

i) Cinnamon oil; and

j) Neem oil.

4.2.1.6 The proportion of single or blended essential oil in natural repellent shall be set by the manufacturer in accordance with specific standard(s) of the essential oil used and records shall be availed.

4.2.1.7 Pyrethrum extracts such as pyrethrins shall be considered in natural repellents. The limits of pyrethrins in natural repellents shall not be less than 0.5 % and the extract used shall meet the requirements of RS 191.

4.2.2 Synthetic repellents

4.2.2.1 Synthetic repellents shall contain synthetic chemical compounds which are able to discourage mosquitoes and send them flying or crawling away.

4.2.2.2 If the synthetic chemical compound is blended with other active ingredient(s), either natural or synthetic, the proportion shall be set by the manufacturer based on scientific research and records shall be availed.

4.2.2.3 Active ingredients and their content in synthetic repellents shall meet the requirements prescribed in table 1.

<table>
<thead>
<tr>
<th>S/N</th>
<th>Active ingredient % w/w</th>
<th>Limits</th>
<th>Identification method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Picaridin</td>
<td>0.2 – 5</td>
<td>CIPAC 740</td>
</tr>
<tr>
<td>2</td>
<td>DEET</td>
<td>5 – 50</td>
<td>Annex B</td>
</tr>
<tr>
<td>3</td>
<td>Permethrin max</td>
<td>13</td>
<td>Annex C</td>
</tr>
<tr>
<td>4</td>
<td>Transfluthrin, max</td>
<td>1</td>
<td>CIPAC 741</td>
</tr>
</tbody>
</table>
5.2.2.4 Synthetic repellents and their active ingredients shall be approved and registered by competent authority before being released to the market.

4.3 Physical requirements

4.3.1 Cartridge/bottle

The cartridge/bottle:

a) shall be made of a suitable heat-resistant material;

b) shall be of a suitable shape and size to fit the heater unit for which it was designed;

c) shall hold the wick firmly, with a stopper preventing spillage in case the cartridge/bottle is inverted with the covering cap; and

d) shall have a child-proof cap.

4.3.2 Wick

The wick:

a) shall be made of a suitably porous heat-resistant material;

b) shall draw up sufficient repellent formulation, when heated at one end, for vaporization to provide a suitable level of protection against mosquitoes; and

c) shall be of material and design such that it can vaporize the total content of the repellent formulation in the bottle/cartridge to which it is attached.

4.3.3 Vaporization rate

The wick and cartridge/bottle shall be designed and constructed such that the repellent formulation vaporizes from the heated end of the wick at a constant, or close to constant, rate to enable a constant rate of active ingredient emission throughout the minimum effective period.

4.3.4 Minimum effective period

The minimum effective period shall be declared and the cartridge/bottle shall hold sufficient formulation to enable the product to function for not less than the minimum effective period declared.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Etoc</td>
<td>0.5 – 1.5</td>
<td>CIPAC 743</td>
</tr>
<tr>
<td>6</td>
<td>Metofluthrin (S1264), max</td>
<td>1.82</td>
<td>CIPAC 993</td>
</tr>
<tr>
<td>7</td>
<td>d-Alethrin (Pynamin Forte), max</td>
<td>0.5</td>
<td>Annex A</td>
</tr>
<tr>
<td>8</td>
<td>Meperfluthrin, max</td>
<td>0.05 – 0.1</td>
<td>CIPAC 977</td>
</tr>
</tbody>
</table>
4.4 Specific requirements for liquid content

The liquid content for the liquid vaporisers shall conform to the requirements as prescribed in table 2.

<table>
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<th>Requirements</th>
<th>Test methods</th>
</tr>
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<tbody>
<tr>
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<td>Thermal stability</td>
<td>To pass test</td>
<td>RS EAS 847-18</td>
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<tr>
<td>ii.</td>
<td>pH</td>
<td>4.0-6.0</td>
<td>RS EAS 847-17</td>
</tr>
<tr>
<td>iii.</td>
<td>Heavy metals, mg/kg, max</td>
<td>Lead (Pb)</td>
<td>RS EAS 847-16</td>
</tr>
<tr>
<td>iv.</td>
<td></td>
<td>Arsenic (As)</td>
<td></td>
</tr>
<tr>
<td>v.</td>
<td></td>
<td>Mercure (Hg)</td>
<td></td>
</tr>
<tr>
<td>vi.</td>
<td>Total viable count, micro-organisms per g, max.</td>
<td>100</td>
<td>RS ISO 21149</td>
</tr>
</tbody>
</table>

4.5 Stability

** Stability at elevated temperature**: After storage at 54°C ±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 and the formulation shall continue to comply with the requirements of the product.

4.6 Biological efficacy

When tested in accordance with DRS 394-2, the product shall repel 100 % of the mosquitoes available in space, within protection time indicated by the manufacturer.

5 Sampling

5.1 General

5.1.1 Samples shall be stored in such a manner that there is no deterioration of the material.

5.1.2 The sampling instrument shall be clean and dry.

5.1.3 Samples shall be protected against contamination.

5.2 Sampling, testing and acceptance

5.2.1 In any consignment, all the master cartons containing liquid vaporizer refill bottles of the same type shall constitute a lot.

5.2.2 Samples shall be drawn from each lot and individually tested to ascertain whether the material complies with the specified requirements.

5.2.3 Any sample failing to comply with the specified requirements shall be termed as “defective”. The acceptance number shall be the maximum number of defective samples permissible for a lot to be accepted.
5.2.4 The number of refill bottles to be drawn from the lot and the acceptance number shall be as shown in the following Table:

<table>
<thead>
<tr>
<th>Total number of containers in lot</th>
<th>Number of containers to be tested</th>
<th>Acceptance number</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 or less</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>301 to 1200</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>1201 to 2000</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>2001 to 7000</td>
<td>21</td>
<td>3</td>
</tr>
<tr>
<td>7001 to 15000</td>
<td>29</td>
<td>4</td>
</tr>
<tr>
<td>15001 to 24000</td>
<td>48</td>
<td>6</td>
</tr>
<tr>
<td>24001 to 41000</td>
<td>84</td>
<td>9</td>
</tr>
<tr>
<td>Over 41000</td>
<td>126</td>
<td>13</td>
</tr>
</tbody>
</table>

5.2.5 Each of the refill bottles to be tested shall be drawn from a different master carton which shall be selected at random. In order to ensure randomness of selection, random number tables shall be used. If such tables are not available, the following procedure may be adopted. Starting from any master carton, count the master cartons as 1, 2, 3...... r in a systematic manner. Every $r^{th}$ carton shall be drawn, r being the integral part of $N/n$, where $N$ is the total number of master cartons in the lot and $n$ the number of master cartons to be selected.

6 Packaging and Labelling

6.1 Packaging

The product shall be packaged in a container which offers protection from breakage and maintains the integrity of the product.

6.2 Labelling

The containers shall be securely closed and in addition to the labelling requirements of RS 91, the following information shall be indelibly and legibly marked on the container:

a) name of the product;

b) name and full address of the manufacture;

c) batch number;

d) date of manufacture and expiry;

e) active ingredient content;

f) net mass of product;

g) directions for use;
h) coverage area for indoor use
i) effect of wind on the repellent use

h) warning and precaution;

i) special population whose exposure is prohibited (children and pregnant women); and

k) storage conditions.
Annex A
(normative)

Determination of allethrin content

A.1 Principle
Allethrin is extracted with a mixture of toluene and formic acid from the coil and then analyze extract using gas chromatography - followed by flame ionization detector (GC-FID).

A.2 Apparatus
A.2.1 Centrifuge with 50 cm tubes
A.2.2 Mechanical shaker
A.2.3 Microlitre syringe 5-10µl capacity

A.3 Reagents
A.3.1 Toluene
A.3.2 Formic acid - 99 % (v/v)
A.3.3 Sodium sulphate - anhydrous
A.3.4 Internal standard - dibutyl phthalate, analytical reagent grade,
A.3.5 Activated charcoal

A.4 Procedure
A.4.1 Extraction
Accurately weigh 10g finely powdered mosquito coil sample in a 250mL Erlenmeyer flask fitted with a glass stopper and add 44mL toluene and 5 mL formic acid. Stopper the flask and shake the contents on a mechanical shaker for 30 min. Add 15 g -20 g anhydrous sodium sulphate and 2 g -3 g activated charcoal and continue shaking for another 10 min. Transfer the contents to a 50-mLcentrifuge tube and centrifuge at 2500 rotations per minute for 10 min.

A.4.2 Preparation of Internal standard Solution
Weigh accurately 1·0 g dibutyl phthalate in a 100-mLvolumetric flask and make up the volume to mark with toluene. This will give a solution containing 10 mg/mL of dibutyl phthalate.
A.4.3 Preparation of Sample Solution

Take 9 mL supernatant solution (A.4.1) into a 10-mL volumetric flask, add 1 mL of internal standard solution and mix the contents thoroughly.
Annex B
(normative)

Determination of DEET content

B.1 General

The sample is dissolved in carbon disulfide and the difference in absorbance at 14.18 µm and at 14.48 µm is determined. The quantity of meta-isomer is obtained from this value by means of a calibration curve prepared by the use of a reference standard.

B.2 Apparatus

F.2.1 Double-beam infrared spectrophotometer. Perkin-Elmer model 21 or equivalent.

F.2.2 Two equivalent infrared absorption cells, with sodium chloride windows and a path length of approximately 0.4 mm.

B.3 Preparation of calibration curve

F.3.1 Weigh (to the nearest 0.1 mg) into four volumetric flasks sufficient amounts of the reference DEET standard of known purity to give concentrations of approximately 20, 40, 60 and 80 g/L when dissolved in carbon disulfide.

F.3.2 Fill the reference cell with carbon disulfide and the sample cell with each of the standard solutions in turn, and record the spectra. The spectrum may be scanned rapidly, except for the region 12 – 15 µm, where a normal speed should be used. Carry out a blank measurement with carbon disulfide to correct for any inequality in the paired cells and to determine whether a cell correction is required.

F.3.3 Measure the absorbance at 14.18 µm and at 14.48 µm and calculate the difference between these values, ΔA, for each of the solutions. Plot the values of ΔA against the concentration (g/l) of the meta-isomer.

F.3.4 If a cell correction is required, the value of ΔA is determined from the formula:

\[ ΔA = (A_{14.18} - A_{14.48})_{\text{ref.}} - (A_{14.48})_{\text{blank}} \]

Where ref. = determination with reference standard
blank = determination on CS\(_2\) blank

B.4 Procedure

Weigh (to the nearest 0.1 mg) about 0.5 g of the sample, transfer quantitatively to a 10 mL volumetric flask, and make up to the mark with carbon disulfide. Measure the infrared absorption at 14.18 µm and 14.48 µm using the same conditions as described in section A.3. Determine the concentration of meta-isomer by comparing this value with the calibration curve. A standard sample should be run each day to check the calibration of the instrument.
B.5 Calculation

\[
\text{DEET content (g/kg)} = \frac{C_1 \times P}{C_2}
\]

Where,

- \(C_1\) = concentration (g/L) of standard DEET found from calibration curve
- \(C_2\) = concentration (g/L) of sample taken
- \(P\) = purity (g/kg) of the reference standard.
Annex C
(normative)

Determination of permethrin

Permethrin as one of the active ingredients in this product may be determined using HPLC by injecting a solution of analyte into a chromatograph, followed by separation and comparison of peak areas of the analyte in the sample with that of an external standard.

C.1 Reagents

Cis – Permethrin, 99%
Trans - Permethrin, 99%
Methanol HPLC grade
Water, HPLC grade

C.2 Apparatus

An HPLC equipped with an autosampler, a variable wavelength detector (or equivalent) and a column (phenomena x, 250 x 4.6mm Luna Phenyl 5μ Reverse phase (or equivalent)

C.3 Operating conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow rate</td>
<td>1.0mL/min</td>
</tr>
<tr>
<td>Solvent composition</td>
<td>60% : 40% (Methanol: Water)</td>
</tr>
<tr>
<td>Elution</td>
<td>Isocratic</td>
</tr>
<tr>
<td>Column temperature</td>
<td>40°C</td>
</tr>
<tr>
<td>Wavelength</td>
<td>240nm</td>
</tr>
<tr>
<td>Injection volume</td>
<td>25 μL</td>
</tr>
<tr>
<td>Stop time</td>
<td>50 minutes</td>
</tr>
<tr>
<td>Post time</td>
<td>2 minutes</td>
</tr>
</tbody>
</table>

C.4 Procedure

G.4.1 Preparation of standard solution

Weigh about 0.001g (to the nearest 0.0001g) Permethrin standard in beaker, use methanol dissolved and transfer them into a separate volumetric flasks (50 ml), dilute to the mark and mix well.

G.4.2 Preparation of Solution
Weigh about 0.02 g (to the nearest 0.0001g) Permethrin test sample into beaker, use methanol dissolved and transfer them into a separate volumetric flasks (50 ml), dilute to the mark and mix well.

G.4.3 Determination

After the chromatograph is stable, make a minimum of three injections of the standard as well as for the sample and average the area counts. The relative standard deviation between injections should be within 2%.

C.5 Calculation

The % of either cis or trans isomers is calculated as follows:

\[
\% \text{ cis or trans permethrin} = \frac{\text{Average sample area} \times \text{ weight of std} \times \text{ purity(in\%)} \times \text{ Average std area}}{\text{ Average std area} \times \text{ weight of sample}}
\]

Report the concentration of permethrin as the total of Cis and Trans.
Bibliography

