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**Committee of Experts on the Transport of Dangerous Goods
and on the Globally Harmonized System of Classification
and Labelling of Chemicals**

**Sub-Committee of Experts on the Transport of Dangerous Goods**

**Sixty-fifth session**

Geneva, 25 November-3 December 2024

Item 3 of the provisional agenda

**Listing, classification and packing**

 Listing of Artemisinin and derivatives in 2.5.3.2.4

 Transmitted by the expert from China, and the European Chemical Industry Council (Cefic)[[1]](#footnote-2)\*

 I. Introduction

1. At the sixty-fourth session of the Sub-Committee of Experts, the expert from China, and the European Chemical Industry Council (Cefic) presented an informal document that proposed to amend the entry "([3R-(3R, 5aS, 6S, 8aS, 9R, 10R, 12S, 12aR\*\*)]-DECAHYDRO-10-METHOXY-3,6,9-TRIMETHYL-3,12-EPOXY-12H-PYRANO[4,3-j]-1,2-BENZODIOXEPIN)" to "ARTEMISININ or ARTEMISININ DERIVATIVES" in the list in paragraph 2.5.3.2.4 of the *Model Regulations* based on the inaccuracy of the original entry name (see INF.40, sixty-fourth session).[[2]](#footnote-3) During the discussion of the document within the Explosives Working Group (EWG), this proposal received general support. However, there was a concern about including all derivatives in the list and it was suggested to list by name only the relevant ones instead of having them referred to in a note.

2. Artemisinin is a natural product with a peroxide bridge structure extracted from the plant of *artemisia annua*, which is one of the most effective drugs for the treatment of malaria. A series of derivatives produced by deep processing of artemisinin are also often used in the treatment of malaria. Common artemisinin derivatives include arteether, artemether, artesunate, dihydroartemisinin, etc. with a subset of stereoisomers thereof (see figure ). The specific chemical structure can be determined through the generic names.

# **Artemisinin and common derivatives (including stereoisomers)**



3. Artemisinin and artemisinin derivatives (including stereoisomers) have similar molecular structures, all containing a single peroxide bridge, and having the properties of organic peroxides. Some institutions such as the “Nanjing University of Science & Technology” (NJUST), the “Netherlands Organisation for Applied Scientific Research” (TNO) and the “Federal Institute for Materials Research and Testing” (BAM) have carried out classification tests on artemether, artemisinin and dihydroartemisinin, and some competent authorities have also provided classification results for artemether. Artemether as currently given in 2.5.3.2.4 was classified as organic peroxide type D (UN 3106). Artemisinin was classified as either organic peroxide type D (UN 3106) or organic peroxide type E (UN 3108), and according to the conservative classification, organic peroxide type D (UN 3106) is recommended. Dihydroartemisinin was classified as organic peroxide type D (see table ).

# **Classification result of artemether, artemisinin and dihydroartemisinin**

|  |  |  |  |
| --- | --- | --- | --- |
| **Generic name** | **Chemical name** | **Organic peroxide type** | **Institution/Competent authority** |
| artemether | (3R,5aS,6R,8aS,9R,10S,12R,12aR)-decahydro-10-methoxy-3,6,9-trimethyl-3,12-epoxy-12H-pyrano [4.3-j]-1,2-benzodioxepin | type D | TNO |
| artemether | ([3R-(3R, 5aS, 6S, 8aS, 9R, 10R, 12S, 12aR\*\*)]-Decahydro-10-methoxy-3,6,9-trimethyl-3,12-epoxy-12H-pyrano[4,3-j]-1,2-benzodioxepin)(may be inaccurate) | type D | Swiss Federal Inspectorate of Dangerous Goods, Cert. No. 4’205’570 |
| artemether | Not provided in the original document | type D | U.S. Department of Transportation, CA2006080015 (3rd Rev.) |
| artemisinin | molecular formula: C15H22O5 | type D | NJUST, 2011 |
| artemisinin | (3R,5aS,6R,8aS,9R,12S,12aR)-Octahydro-3,6,9-trimethyl-3,12-epoxy-12H-pyrano[4,3-j]-1,2-benzodioxepin-10(3H)-one | type D | BAM |
| artemisinin | 3,12-epoxy-12H-pyranol(4,3-j)-1,2-benzodioxepin-10(3H)-one, octahydro-3,6,9-trimethyl-, (3α,5aβ,6β,8aβ,9α,12β,12aR\*)-(+)- | type E | TNO, 2012 |
| dihydro-artemisinin | 3,12-epoxy-12H-pyranol(4,3-j)-1,2-benzodioxepin-10-ol, decahydro-3,6,9-trimethyl-, (3R-(3α,5aβ,6β,8aβ,9α,10α,12β,12aR\*))- | type D | TNO |

4. For stereoisomers of artemether or dihydroartemisinin, the molecular structure is almost identical to that of artemether or dihydroartemisinin, and it is inferred that the degree of danger of organic peroxide is the same as that of artemether or dihydroartemisinin. For arteether, artesunate and their stereoisomers, they have similar molecular structures to artemether and dihydroartemisinin, while having a larger molecular weight and lower available oxygen content, and it is inferred that their degrees of danger of organic peroxides do not exceed artemether and dihydroartemisinin. In order to facilitate the transport of these substances, it is recommended to refer to artemether and dihydroartemisinin, classifying them as organic peroxide type D (UN 3106) in accordance with the conservative estimates, with the packaging method OP7 assigned.

 II. Proposal

5. Amend the list in 2.5.3.2.4 as follows:

Delete the following entry:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ORGANIC PEROXIDE** | **Concen-tration (%)** | **Diluent type A (%)** | **Diluent type B (%)** | **Inert solid (%)** | **Water** | **Packing Method** | **Control tempe-rature (°C)** | **Emergency temperature (°C)** | **Number (Generic entry)** | **Sub-sidiary hazards and remarks** |
| ([3R-(3R, 5aS, 6S, 8aS, 9R, 10R, 12S, 12aR\*\*)]-DECAHYDRO-10-METHOXY-3,6,9-TRIMETHYL-3,12-EPOXY-12H-PYRANO[4,3-j]-1,2-BENZODIOXEPIN) | ≤  100 |  |  |  |  | OP7 |  |  | 3106 |  |

Add the following entries:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ORGANIC PEROXIDE** | **Concen-tration (%)** | **Diluent type A (%)** | **Diluent type B (%)** | **Inert solid (%)** | **Water** | **Packing Method** | **Control tempe-rature (°C)** | **Emergency temperature (°C)** | **Number (Generic entry)** | **Sub-sidiary hazards and remarks** |
| ARTEETHER (Including stereoisomers) | ≤ 100 |  |  |  |  | OP7 |  |  | 3106 |  |
| ARTEMETHER (Including stereoisomers) | ≤  100 |  |  |  |  | OP7 |  |  | 3106 |  |
| ARTEMISININ | ≤  100 |  |  |  |  | OP7 |  |  | 3106 |  |
| ARTESUNATE (Including stereoisomers) | ≤  100 |  |  |  |  | OP7 |  |  | 3106 |  |
| DIHYDROARTEMISININ (Including stereoisomers) | ≤  100 |  |  |  |  | OP7 |  |  | 3106 |  |

1. \* A/78/6 (Sect. 20), table 20.5. [↑](#footnote-ref-2)
2. <https://unece.org/sites/default/files/2024-06/UN-SCETDG-64-INF40e.pdf> [↑](#footnote-ref-3)