

Appendix X

The purpose of this appendix is:

1. not to prescribe a given method, but to specify the reference conditions under which the limit value of formaldehyde released from articles in paragraph 1 of the restriction proposal shall be assessed against;
2. to describe how to use correlation between the conditions of a test method and the reference conditions to demonstrate compliance with paragraph 1;
3. to describe how to measure the formaldehyde concentration in the interior space of road vehicles and aircraft; and
4. to give examples of available test methods for (i) the measurement of formaldehyde released from articles and (ii) for the sampling of test pieces.

1. Reference conditions for the limit value of formaldehyde released from articles in paragraph 1

The limit value of formaldehyde released from articles in paragraph 1 of the restriction entry relates to the formaldehyde concentration measured in the air of a test chamber under the following conditions:

- a. The temperature in the test chamber shall be $(23 \pm 0.5) \text{ }^\circ\text{C}$.
- b. The relative humidity in the test chamber shall be $(45 \pm 3) \%$.
- c. The loading factor, expressed as the ratio of the total surface area of the test piece to the volume of the test chamber, shall be $(1 \pm 0.02) \text{ m}^2/\text{m}^3$.
- d. The air exchange rate in the test chamber shall be $(1 \pm 0.05) \text{ h}^{-1}$.
- e. An appropriate analytical procedure (e.g. acetylacetone method as described in EN 717-1 or DNPH method according to ISO 16000-3) to measure the formaldehyde concentration in the test chamber shall be used.
- f. An appropriate method for sampling of the test pieces shall be used.
- g. The formaldehyde concentration in the air of the test chamber shall be measured at least twice per day throughout the test with a time interval between two consecutive samplings of three hours at a minimum. The measurement shall be repeated until sufficient data are available to determine the steady state concentration.
- h. The duration of the test shall be sufficiently long to allow the determination of the steady state concentration and shall not exceed 28 days.
- i. The steady state concentration of formaldehyde measured in the test chamber shall not exceed the limit value of formaldehyde released from articles in paragraph 1 of the restriction entry.

SEAC box

SEAC supports an amendment of Appendix X to allow more realistic loading factors for testing of small articles that are demonstrably used at very low loading factors. A possible solution could be to allow, in justified cases, the use of the various loading factors related to the European Reference Room as set out in section 4.2.2 of the European Standard EN 16516: 1.0 m²/m³ for walls, 0.4 m²/m³ for floor and ceiling, 0.05 m²/m³ for small surfaces (e.g. door, window, heating system) and 0.007 m²/m³ for very small surfaces (e.g. sealants). SEAC therefore proposes to amend point c above in the following way:

The loading factor, expressed as the ratio of the total surface area of the test piece to the volume of the test chamber, shall be (1 ± 0.02) m²/m³. In cases where such a loading factor would clearly not be realistic under reasonably foreseeable conditions of use, loading factors in accordance with section 4.2.2 of EN 16516 could be used when fully justified.

2. Use of test methods with non-reference conditions to demonstrate compliance

Supply chain actors falling into the scope of the restriction are responsible for ensuring that the formaldehyde released from the articles that they place on the market is compliant with the limit set out in paragraph 1 of the restriction entry and point 1 of this appendix. Compliance will typically be demonstrated by means of testing.

If data from a test method using the reference conditions specified in point 1 are not available, data obtained from a different test method may be used where (i) there is a correlation between the results of the test method used and the reference conditions specified in point 1 and (ii) the results obtained is expressed in terms of the reference conditions specified in point 1.

For example, for certain articles, existing studies¹ have derived correlations between the formaldehyde measurements obtained using different test methods, including test methods that use the reference conditions specified in point 1. Supply chain actors can use existing correlations, where applicable to the specific articles and test methods considered, to calculate the formaldehyde releases under the reference

¹ Non-exhaustive (indicative) list of studies comparing the results of formaldehyde testing under different conditions:

Hemmilä, V., Meyer, B., Larsen, A., Schwab, H., Adamopoulos, S. (2019). Influencing factors, repeatability and correlation of chamber methods in measuring formaldehyde emissions from fiber- and particleboards. *International Journal of Adhesion and Adhesives* 95 (2019) 102420.

Meyer, B., Greubel D., Schwab, H., Marutzky, R. (2014). Formaldehydmissionen aus Spanplatten: Aktualisierung des WKI-Rechenmodells. *Holztechnologie* 55 (6), 20-25.

Wilke, O., Jann, O. (2018). Comparison of Formaldehyde Concentrations in Emission Test Chambers Using EN 717-1 and EN 16516. Available:

https://www.researchgate.net/publication/327208565_Comparison_of_Formaldehyde_Concentrations_in_Emission_Test_Chambers_Using_EN_717-1_and_EN_16516 [Accessed 10 November 2020]

conditions specified in point 1 in order to demonstrate compliance with paragraph 1 of the restriction.

If relevant correlation data are not available, they can be generated on a case-by-case basis. One possible scenario for generating correlation data would be to perform measurements of formaldehyde released from articles (or samples of articles) using a method with non-reference conditions and, in parallel, to measure the formaldehyde released from samples of the same articles under the reference conditions in point 1. Sufficient repeat testing should be conducted to ensure the reliability of the derived correlation. Where a correlation is evident, it would only be necessary to undertake subsequent testing (e.g. process/quality control testing) using the method with non-reference conditions. Parallel measurements would only need to be repeated in case of variations in the characteristics of the article (e.g. material, size, production process etc.) that may foreseeably impact the release of formaldehyde. Where correlation data are used to demonstrate compliance, these should be available for enforcement authorities on request.

Compliance with paragraph 1 of the restriction entry may also be demonstrated if the limit value of formaldehyde released from articles in paragraph 1 is not exceeded when tests are performed in a test chamber under conditions that are more stringent than those specified in point 1 (i.e. lower air exchange rate and/or higher temperature and/or higher relative humidity and/or higher loading factor).

Examples on how to correlate test results obtained with different test methods can be found in the following standards:

- EN 326-2: Wood-based panels – Sampling, cutting and inspection – Part 2: Initial type testing and factory production control
- California Environmental Protection Agency, Air Resources Board, Guideline No. CWP-10-001: Establishing a Correlation With an Acceptable Correlation Coefficient (“r” Value)

3. Measurement of formaldehyde concentration in the interior space of road vehicles for the transportation of people and passenger aircraft

The interior space of a road vehicle (e.g. car, truck, van, bus and motor-home) for the transportation of people or a passenger aircraft is the space where people are present under normal and reasonably foreseeable conditions and potentially exposed to formaldehyde via inhalation. To demonstrate compliance with the restriction entry, the formaldehyde concentration in the interior space of road vehicles and passenger aircraft shall not exceed the value set out in paragraph 1 of the restriction entry.

For road vehicles, the formaldehyde concentration shall be measured according to the conditions specified in ISO 12219-1² or an equivalent method and the value set out in paragraph 1 of the restriction entry shall not be exceeded when measured in ambient mode according to ISO 12219-1.

² ISO 12219-1: Interior air of road vehicles – Part 1: Whole vehicle test chamber – Specification and method for the determination of volatile organic compounds in cabin interiors

For passenger aircraft the formaldehyde concentration shall be measured using ISO 16000-3³ or an equivalent method and the value set out in paragraph 1 of the restriction entry shall not be exceeded at any time when the aircraft is occupied by passengers.

RAC box

RAC concluded that passenger risk in aircraft is adequately controlled and therefore proposes that a concentration limit for aircraft is not applied.

SEAC box

With regard to aircraft, SEAC takes note of RAC's assessment that passenger risk is adequately controlled and agrees with RAC's conclusion that a concentration limit for aircraft is not applied.

4. Examples of standardised methods for the measurement of formaldehyde released from articles and for the sampling of test pieces

Standardised test methods for the measurement of formaldehyde released from articles based on test chambers are available including, but not limited to:

- EN 717-1: Wood-based panels – Determination of formaldehyde release – Part 1: Formaldehyde emission by the chamber method. This method is based on the conditions indicated in point 1 of this appendix.
- ISO 16000-9: Indoor air – Part 9: Determination of the emission of volatile organic compounds from building products and furnishing – Emission test chamber method
- EN 16516: Construction products – Assessment of release of dangerous substances – Determination of emissions into indoor air
- ASTM E 1333: Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber
- ASTM D 6007: Standard Test Method for Determining Formaldehyde Concentrations in Air from Wood Products Using a Small-Scale Chamber
- ISO 12460-1: Wood-based panels – Determination of formaldehyde release – Part 1: Formaldehyde emission by the 1-cubic-metre chamber method
- ISO 12219-3: Interior air of road vehicles – Part 3: Screening method for the determination of the emissions of volatile organic compounds from vehicle interior parts and materials – Micro-scale chamber method

³ ISO 16000-3: Indoor air – Part 3: Determination of formaldehyde and other carbonyl compounds in indoor air and test chamber air – Active sampling method

- ISO 12219-4: Interior air of road vehicles – Part 4: Method for the determination of the emissions of volatile organic compounds from vehicle interior parts and materials – Small chamber method

Standardised test methods for the measurement of formaldehyde released from articles not based on test chambers are available including, but not limited to:

- ISO 12460-3: Wood-based panels – Determination of formaldehyde release – Part 3: Gas analysis method
- ISO 12460-4: Wood-based panels – Determination of formaldehyde release – Part 4: Desiccator method
- ISO 12460-5: Wood-based panels – Determination of formaldehyde release – Part 5: Extraction method (called the perforator method)
- EN 717-3: Wood-based panels – Determination of formaldehyde release – Part 3: Formaldehyde release by the flask method
- ISO 12219-2: Interior air of road vehicles – Part 2: Screening method for the determination of the emissions of volatile organic compounds from vehicle interior parts and materials – Bag method
- VDA 275: Formaldehyde release by modified flask/UV Vis Spec method

Standardised methods are available for the sampling of test pieces including, but not limited to:

- EN 326-1: Wood-based panels – Sampling, cutting and inspection – Part 1: Sampling and cutting of test pieces and expression of test results
- EN 326-2: Wood-based panels – Sampling, cutting and inspection – Part 2: Initial type testing and factory production control
- EN 326-3: Wood-based panels – Sampling, cutting and inspection – Part 3: Inspection of an isolated lot of panels
- ISO 16000-11: Indoor air – Part 11: Determination of the emission of volatile organic compounds from building products and furnishing - Sampling, storage of samples and preparation of test specimens
- EN 16516: Construction products – Assessment of release of dangerous substances – Determination of emissions into indoor air – Section 5: Product sampling and transport to the laboratory

Although some of the methods in these lists are designed for specific categories of articles, they may also be used for other articles.