

# **M1 Emission Classification of Building Materials: Protocol for Chemical and Sensory Testing of Building Materials**



Version 5.7.2017

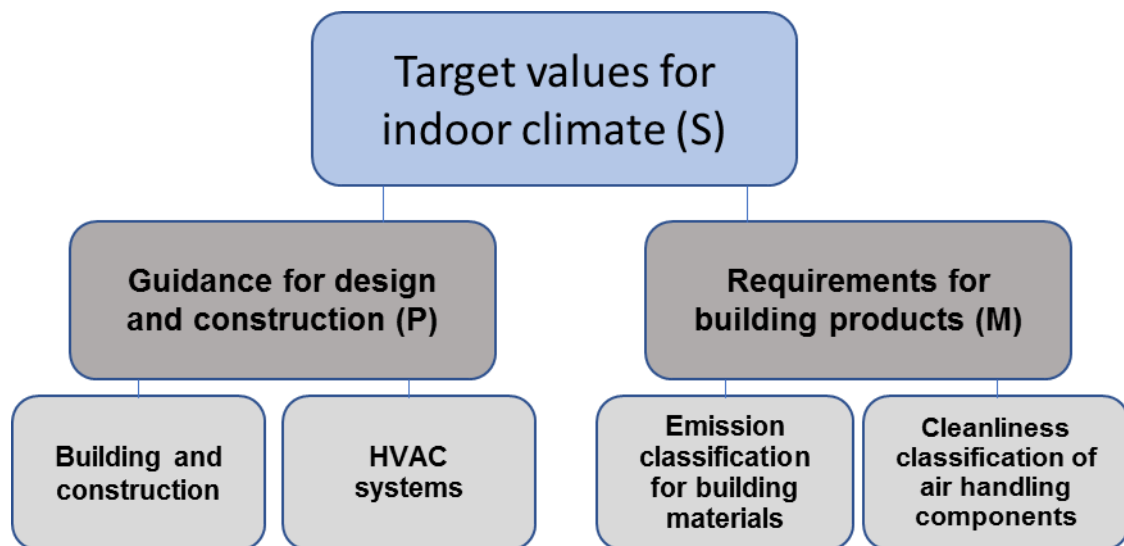
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# 1 INTRODUCTION

M1 classification is part of the Finnish voluntary indoor climate classification system published by the The Finnish Society of Indoor Air and Climate (FiSIAQ). The indoor climate classification was first introduced in 1995. The latest version is from year 2008 and called Classification of Indoor Climate 2008. The classification is intended to be used by the construction and building design sector and in associated contracting, as well as by the building material industry, when building healthier and more comfortable buildings. The classification consists of three parts, Target values for indoor environment, Guidance for design and construction, and Requirements for building products, Figure 1. The requirements for building products consist of emission classification system for building materials and air handling components. The requirements for building products enhance the development and use of low-emitting materials and clean air-handling equipment for better indoor air environment.



Picture 1 The construction of the Classification of Indoor Climate 2008.

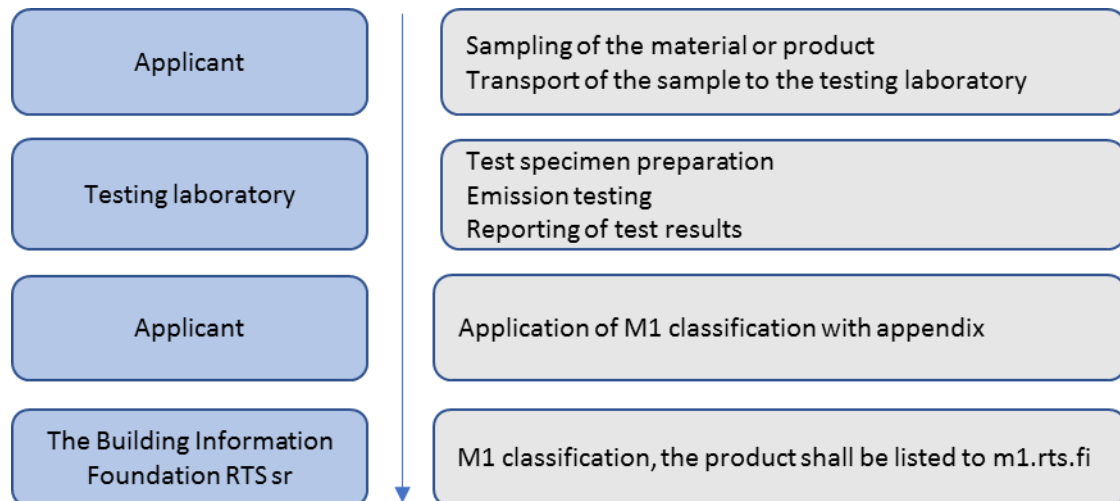
## 2 Scope

The voluntary Finnish emission classification of building materials, M1 classification, covers fixture, furniture and all building materials and products. M1 classification includes requirements for

- TVOC emission
- Emission of EU carc. 1A and 1B carcinogens (CMR)
- Agreed EU-LCI-values [https://ec.europa.eu/growth/sectors/construction/eu-lci/values\\_en](https://ec.europa.eu/growth/sectors/construction/eu-lci/values_en)
- Formaldehyde emission
- Ammonia emission
- Sensory acceptability of emissions

In this testing protocol requirements for M1 classification emission testing procedure are presented. Only emission tests performed in an approved testing laboratory are accepted for M1 classification. List of approved testing laboratories is published on [m1.rts.fi](http://m1.rts.fi).

The M1 classification procedure is illustrated in the following flow chart:



Picture 2 Flow chart of the M1 classification procedure

### 3 Definitions

For the purposes of this testing protocol, terms and definitions given in ISO 16000-6:2011, EN ISO 16000-9:2006 and CEN/TS 16516:2013 with following specifications apply:

**testing age**, the age of the test specimen at the point of testing is  $28 \pm 2$  days for building materials, fixture and furniture without coverings. Testing age for upholstered chairs is 3 days.

**TVOC, total volatile organic compounds**, the sum of the individual concentrations of the identified and unidentified volatile organic compounds and eluting between and including C<sub>6</sub> – C<sub>16</sub> (n-hexane and n-hexadecane) on a gas chromatographic capillary column coated with 5% phenyl/95% methyl-polysiloxane and having a concentration (corresponding to model room loading) of  $\geq 5 \mu\text{g}/\text{m}^3$  calculated as toluene equivalent.

### 4 References

CEN/TS 16516:2013 Construction products - Assessment of release of dangerous substances - Determination of emissions into indoor air.

EN ISO 16000-9:2006 Indoor air Part 9: Determination of the emission of volatile organic compounds from building products and furnishing – Emission test chamber method

EN ISO 16000-11:2006 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 717-1:2004 Wood-based panels. Determination of formaldehyde release. Part 1: Formaldehyde emission by the chamber method.

ISO 16000-3:2011 Indoor air Part 3: Determination of formaldehyde and other carbonyl compounds in indoor air and test chamber air – Active sampling method

ISO 16000-6:2011 Indoor air Part 6: Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, thermal desorption and gas chromatography using MS or MS-FID

ISO 16000-28:2012 Indoor air Part 28: Determination of odour emissions from building products using test chambers

Nordtest method NT Build 482 (1998), Building Materials: Emissions testing using the CLIMPAQ

EN 16402:2013 Paints and varnishes – Assessment of emissions of substances from coatings into indoor air – Sampling, conditioning and testing

## **5 Material sampling, sample packing and delivery to the testing laboratory**

Collection of material sample of the building product is an important step in emission testing procedure for obtaining a representative material sample for testing. The responsibility of sample collection is on the party applying for M1 classification. The sample is collected according to the instructions given in this document. If these instructions cannot be applied, further instructions shall be consulted from the Building Information Foundation RTS sr, [m1.rts.fi](http://m1.rts.fi).

### **5.1 Sampling location**

Material sample shall be collected at the production line or production storage after normal manufacturing process as soon as the material is ready for delivery. If sampling at the production site is not possible, material sample may be collected at delivery phase within 8 weeks from production, provided the material has been stored airtight under normal climate conditions.

Exception: canned and tightly packed products (e.g. package of dry mortar mixture) best before date shall be valid over the whole testing period (age of sample can be >12 weeks).

### **5.2 Packing of material sample**

Material sample shall be packed in an airtight emission free package immediately after sampling to protect the sample from contamination and to restore the sample during transportation. Products delivered in impermeable retail packages, e.g. cans, may be delivered as such.

Different material samples shall be packed separately to avoid cross-contamination.

### **5.3 Maximum age of material sample**

Material sample delivered to testing laboratory shall always be as recently produced as possible. Maximum allowed age of material sample at the point of initiating the testing period is 8+4 weeks provided that the material sample has been collected according to this document and stored in an inert, airtight package.

Exception: canned products best before date shall be valid over the whole testing period (age of sample can be >12 weeks).

### **5.4 Sample transportation to the testing laboratory**

The sample shall be transported to the testing laboratory without delay. The sample shall not be exposed to excessive temperature fluctuations (freezing or overheating) during the transportation.

## 5.5 Material sample information

A sampling report shall be delivered to the testing laboratory together with the sample.

In the sampling report the following information shall be given:

- product name
- date of production, batch number
- date of assembly (furniture)
- sampling location (production line, storage, etc.)
- date of sampling
- storage of material before sampling (where, package, environmental conditions)
- description of the applied sampling procedure, how has the sample been taken
- amount of sample
- person responsible for sampling

An example of a sampling form is given in Appendix E of CEN/TS 16516:2013. Finnish version of the Appendix may be loaded at M1 homepage [m1.rts.fi](http://m1.rts.fi).

## 5.6 Sampling instructions for different materials

Instructions how to collect a material sample from different kind of products are presented in the following chapters. The list may not be comprehensive and in unclear situations RTS shall be consulted.

### 5.6.1 Resilient materials, rolled products

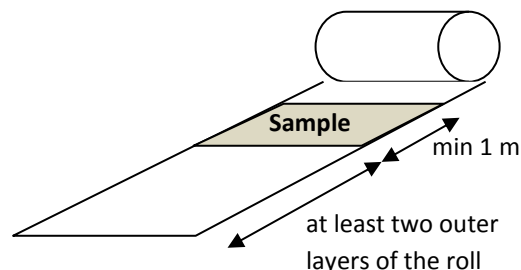
Product examples include, e.g.:

- resilient floor and wall coverings
- building membranes
- wallpapers
- soft thermal insulation product in roll

a) An unopened retail package/packages are sampled for testing whenever appropriate.

b) Sub-sampling from large and heavy product rolls, e.g. PVC-flooring:

- discard at least two outer layers of the roll
- cut at least 1 m sample of full roll width
- immediately roll the sample tightly and wrap in an airtight and inert wrapping
- describe the sub-sampling procedure in the sampling report



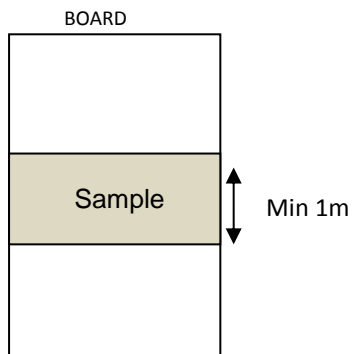
Picture 3 sub-sampling roll

### 5.6.2 Rigid products, boards, planks, tiles, blocks, bricks

Product examples include, e.g.:

- parquets, laminates, floor boards and tiles
- wall boards, ceiling boards
- building boards

- thermal insulation boards
  - building blocks, bricks and tiles
- a) An unopened retail package or packages are sampled for testing whenever appropriate
  - b) Building blocks, bricks, tiles and corresponding piece products are sampled as full pieces at production line
  - c) Storage sampling of boards delivered in large pallets shall be directed to boards in the middle of the pallet
  - d) Sub-sampling from large size building boards:
    - cut at least 1 m sample of full board width from the middle of the board
    - describe the sub-sampling procedure in the sampling report
  - e) Sample shall be packed in an inert airtight package



Picture 4 Sub-sampling board

### 5.6.3 Liquid products and powders, concrete

Product examples include, e.g.:

- paints, varnishes and other liquid applied surface materials
- adhesives
- levelling agents and screeds
- ready-mixed concrete

- a) An unopened retail package or packages are sampled for testing whenever appropriate
- b) From products delivered only in large bulk units a representative sample for laboratory testing may be taken in a clean, inert, airtight and closable container.
- c) Concrete is delivered to the testing laboratory as pre-mixed by the producer or test specimens are prepared at the mixing site.

### 5.6.4 Doors, windows, partition walls and other building components and elements made in a factory

Building components, e.g. doors, windows and partitions are sampled as whole pieces at the manufacturing site as soon after production and ready for customer delivery. The sample shall be packed in an airtight inert package. For testing purposes the size of the product may need scaling. If scaling is needed the proportions of the product shall be maintained.

## 6 Emission testing

Emission tests are performed using a ventilated test chamber according to ISO 16000-9:2006 together with sampling and analysis of volatile organic compounds according to ISO 16000-6:2011, sampling and analysis of formaldehyde according to ISO 16000-3:2006 (or applying EN 717-1 for formaldehyde sampling and analysis method), sampling and analysis of ammonia using a suitable validated method, and determining the acceptability of the emissions in sensory terms according to ISO 16000-28:2012 or using CLIMPAQ. Test specimen preparation is based on harmonized product standards when available. ISO 16000-11 shall be used when the product standards are not available.

Emission test chamber volume shall be at least 0.02 m<sup>3</sup>. Chamber size in relation to the inhomogeneity of tested materials shall be recognized and the chamber size selected accordingly.

### 6.1 Time schedule of emission determination

Emission testing is performed at 28 days ± 2 days. Emissions measurements (chemical and sensory) performed during 3 d – 28 d may be accepted provided the test results fulfill the M1 classification requirements also at 28 d. Upholstered chair emission testing is performed at the day 3, sensory evaluation at the day 3+1.

The age of the test specimen is the time elapsed between finishing the test specimen preparation and the emission sampling. If the test specimen is aged outside the test chamber, it shall be placed into the chamber at least two days before emission sampling.

NOTE: A shorter testing period than 28 d can be used if it can be ascertained that no processes leading to increasing emissions with time cannot take place in the material.

### 6.2 Loading factors

The loading factors and area specific air flow rates given in Table 1 are used in M1 emission testing. The values are based on a reference room having total volume of 30 m<sup>3</sup> (3 m x 4 m, height 2.5 m) and air change rate of 0.5 h<sup>-1</sup>. When testing low emitting sealants or other very small area products, higher loading factor in chemical testing may be used to increase the reliability of the test results. The product is tested in its main intended use category applying the largest surface and loading factor of the possible surfaces, e.g. leveling agent applicable for both walls and ceiling are tested using wall loading.

In Table 1 examples of test specimen areas for sensory testing using a CLIMPAQ –type chamber with outlet air flow rates and air change rate of 2 h<sup>-1</sup> in the model room are also given.



Table 1 Chamber loading factors based on a reference room of 30 m<sup>3</sup>.

		<b>Chemical emissions Sensory assessment according to ISO 16000-28:2012</b> air change 0.5 h <sup>-1</sup>		<b>Sensory assessment using CLIMPAQ according to NT Build 482</b> air change 2 h <sup>-1</sup>		
Material / surface	Surface area, m <sup>2</sup>	Loading factor m <sup>2</sup> /m <sup>3</sup>	Area specific air flow rate m <sup>3</sup> /(m <sup>2</sup> h)	Area specific air flow rate m <sup>3</sup> /(m <sup>2</sup> h)(q)	Examples of test specimen area m <sup>2</sup>	
					Outlet air flow	
					0.6 l/s	0.9 l/s
Floor / Ceiling	12	0.4	1.25	5	0.43	0.65
Wall	31.4	1	0.48	1.9	1.1	1.7
Small areas	ca 1.6	0.05	9.4	36	0.06	0.09
Very small areas	0.2	0.007	71	324	0.01	0.01

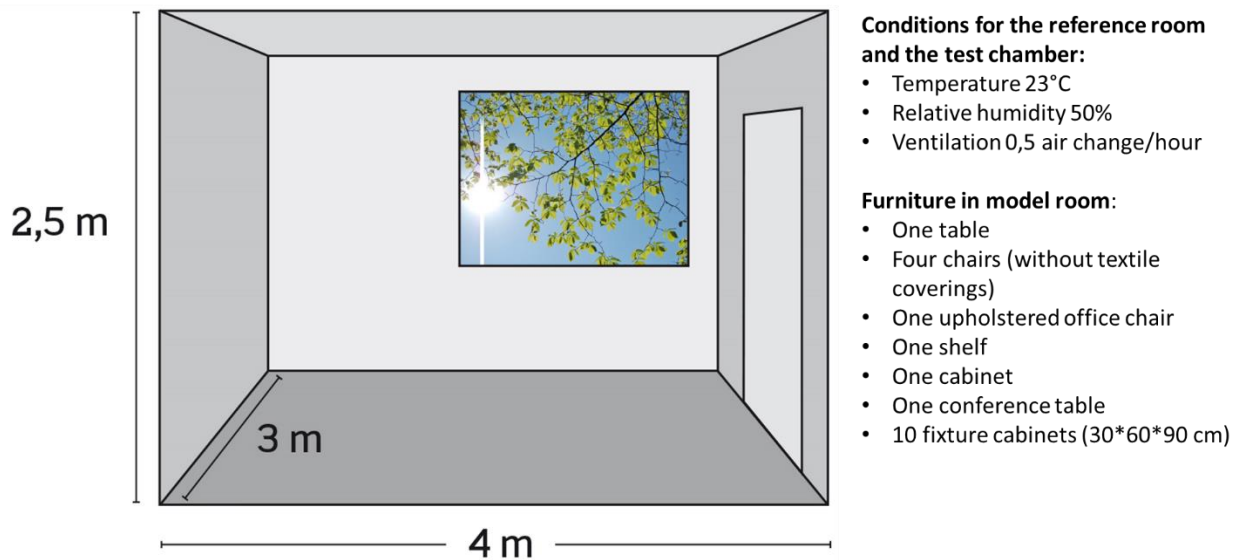
### 6.2.1 Number of furniture in the reference room

The number of furniture placed in the reference room is presented in the following table.

Table 2 Number of furniture

Item	Number of units in reference room
table (80 x 140 cm) /desk / conference table	1
shelf (80cm x 40cm x 120cm)/ cabinet	1
drawer (40 x 60 x 50cm) /chest of drawer	1
chair (without upholstering or padding)	4
upholstered office chair	1
fixture cabinet (30 x 60 x 90 cm)	10
fixture doors (60 x 90 cm)	10
fixture countertop (300 x 60 cm)	1

## European reference room: conditions and amount of placed furniture



Picture 5 European reference room

### 6.3 Test specimen preparation

Test specimens are prepared by the testing laboratory. The manufacturer may prepare the test specimen according to the instructions from the testing laboratory if the test specimen preparation requires special equipment, special instrumentation or special conditioning or curing methods (e.g. UV-curing, 2-part mixing equipment for glues) that cannot be required being a part of equipment in a material emission testing laboratory. The test specimens prepared outside the testing laboratory shall be transported to the testing laboratory without any unnecessary delay and the preparation shall be documented corresponding to preparation in a testing laboratory.

#### Handling of product samples in the laboratory

The material sample is stored in its original unopened delivery package at normal room temperature (20 – 25 °C) in a laboratory. Emission testing period shall be initiated within 8 + 4 weeks after manufacturing date, see also chapter 5.3. Canned products best before date shall be valid over the whole testing period.

#### Materials used in test specimen preparation

Materials used in test specimen preparation shall be inert and non-emitting:

- edge and back side sealing: aluminum foil, low-emitting aluminum tape, inert metal frame
- support for liquid applied products: glass, stainless steel or polyester film of sufficient rigidity

NOTE 1: Liquid applied products that undergo curing reactions with its support shall be tested on an appropriate support, selection of which is made in agreement with RTS.

NOTE 2: If the drying process of a liquid applied product is severely affected when applied on a non-absorbing surface (e.g. severely extended drying time, poor adhesion causing accumulation and uneven

film thickness), a product specific support may be used. The unsuitability of the non-absorbing support for the product shall be demonstrated before using an alternative support.

### **Ageing of test specimen**

Test specimen is transferred to the conditioning unit as soon after preparation as possible.

Environmental conditions during ageing shall be identical to those during the emission testing. Accepted ageing units are:

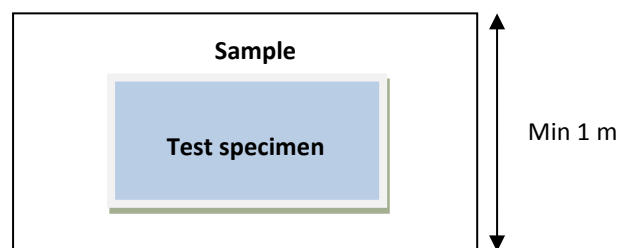
- test chamber
- separate conditioning chamber.

### **6.3.1 Resilient materials, rolled materials**

This product group includes, e.g.:

- resilient floor coverings
- resilient wall coverings, wallpaper
- building membranes

Test specimen is taken symmetrically from the middle of the material sample excluding minimum 10 cm from factory-finished edges. From a full roll test specimen is taken accordingly discarding at least the two outer layers of the roll. Cut edges and reverse side of the test specimen are covered.



*Picture 6 Test specimen cutting*

### **6.3.2 Rigid materials**

This product group includes:

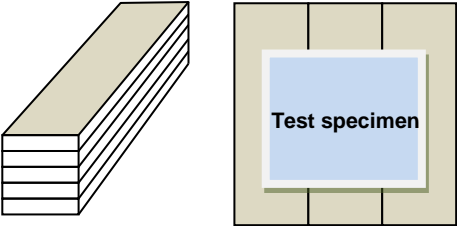
- parquets, laminates, vinyl tiles, planks and other floor boards
- wall boards and panels
- ceiling boards and panels
- building boards
- building blocks, bricks and masonry products

From stacked pieces always discard the top and bottom piece from test specimen preparation.

Building boards: cut the test specimen from the middle of the sample, excluding minimum 10 cm from all sides.

Test specimen preparation and sealing of edges is performed according to *Table 3*.

Table 3 Rigid materials: test specimen preparation.

Product	Test specimen preparation
<b>Building boards and beams</b>	
<ul style="list-style-type: none"> <li>• Building boards for building construction</li> </ul>	<ul style="list-style-type: none"> <li>- cutting: exclude minimum 10 cm of the sample sides</li> <li>- reverse side and cut edges are covered</li> </ul>
<ul style="list-style-type: none"> <li>• Boards used for furniture manufacturing (e.g. melamine faced chipboard)</li> <li>• HPL, thickness &gt;2 mm</li> </ul>	<ul style="list-style-type: none"> <li>- cutting: exclude minimum 10 cm of the sample sides</li> <li>- both faces are left unsealed</li> <li>- cut edges are partly sealed as described in standard EN 717-1: the ratio of open (unsealed) edges <math>U</math> and the surface area of the test specimen <math>A</math> shall be <math>U/A=1.5 \text{ m/m}^2</math></li> </ul>
<ul style="list-style-type: none"> <li>• Building beams</li> <li>• LVL</li> </ul>	<ul style="list-style-type: none"> <li>- cutting: exclude minimum 10 cm of the sample ends</li> <li>- cut ends of the test specimen are covered</li> </ul>
<b>Ceiling tiles and boards</b>	
<ul style="list-style-type: none"> <li>• Ceiling tiles not applicable as suspended ceiling</li> </ul>	<ul style="list-style-type: none"> <li>- cut to appropriate size, test specimen shall contain one factory made edge</li> <li>- reverse side and laboratory cut edges of the board are covered, factory made edges are left unsealed</li> </ul>
<ul style="list-style-type: none"> <li>• Ceiling tiles, applicable as suspended ceiling</li> </ul>	<ul style="list-style-type: none"> <li>- cut to appropriate size, test specimen shall contain one factory made edge</li> <li>- both faces and factory made edges are left unsealed, laboratory cut edges are sealed</li> </ul> <p>NOTE: The area specific emission factor is calculated using only the primary surface of the test specimen.</p>
<b>Surface materials including mechanically fastened joints</b>	
<ul style="list-style-type: none"> <li>• Parquets, panels</li> <li>• Laminate floorings</li> <li>• Vinyl planks and tiles</li> <li>• Other corresponding interior surface materials composed of several pieces with mechanically fastened joints</li> </ul>	<ul style="list-style-type: none"> <li>- test specimen shall include mechanically fastened joints</li> <li>- the length of joint per area unit in test specimen shall reflect the average in real use and it shall be reported in the test report.</li> <li>- reverse side and cut edges are sealed</li> </ul> <div style="text-align: center;">  </div>

### 6.3.3 Thermal insulations, on-site applied acoustic insulations

Test specimen preparation is specified in *Table 4*.

*Table 4 Thermal insulations and acoustic insulations, test specimen preparation.*

Product type	Test specimen preparation
<ul style="list-style-type: none"> <li>• Insulations without facing</li> <li>• Insulations with permeable facing</li> <li>• Boards and rigid foam insulations</li> </ul>	<ul style="list-style-type: none"> <li>-cutting from rolls: from the middle of the roll width, excluding at least the outer layer of the roll and 10 cm of factory made sides</li> <li>-cutting from boards: from the middle of the board, excluding at least 10 cm of all sides</li> <li>-cut edges and reverse side covered</li> </ul>
<ul style="list-style-type: none"> <li>• Insulations with impermeable facing</li> </ul>	<ul style="list-style-type: none"> <li>-cutting, see above</li> <li>-tested with a joint (boards) or cut edge partly sealed with U/A 1.5 m/m<sup>2</sup>, reverse side covered</li> </ul>
<ul style="list-style-type: none"> <li>• Loose fill products, blowing wools</li> </ul>	<ul style="list-style-type: none"> <li>-test specimen preparation: machine blowing in an inert mould, thickness according to the product specific installation instructions to fulfill U (walls) 0.17 W/(m<sup>2</sup> K), U (roof) 0.09 W/(m<sup>2</sup> K) or at least 20 cm.</li> </ul>
<ul style="list-style-type: none"> <li>• Spray applied acoustic insulations</li> </ul>	<ul style="list-style-type: none"> <li>-test specimen preparation: sprayed on inert support, thickness according to the product specific installation instructions.</li> </ul>

### 6.3.4 Liquid products

#### 6.3.4.1 On-site applied decorative coatings, surface treatment oils and waxes, primers, moisture barriers

##### Testing substrates

- Primary substrates: glass, stainless steel or polyester of sufficient rigidity.
- Products undergoing curing reactions with the substrate: product specific substrate. Test results shall be evaluated taking into account the emissions from the used, untreated substrate. Possible secondary emissions from the substrate cannot be excluded.
- Products not suitable for non-absorbing surfaces due to effects on the drying process or film thickness homogeneity: product specific substrate may be used if the unsuitability of the non-absorbing surface has been demonstrated. Test results shall be evaluated taking into account the emissions from the used, untreated substrate. Possible secondary emissions from the substrate cannot be excluded.

##### Application

- Test specimen thickness is based on the maximum application thickness of the product specified in the manufacturer's technical instructions or according to *Table 5* if relevant technical information is not available.

- The product is applied as a single layer if multiple layer application is not mandatory according to the technical information. Multilayer test specimens are prepared according to manufacturer's instructions.
- Material layer on the substrate shall be even, examples of suitable application tools: applicator, brush, spray pistol, roll and drawdown bar
- The substrate shall be weighed before and after application of the product
- The applied amount as g/m<sup>2</sup> of material shall be reported in the test report.

*Table 5 Decorative coatings: wet consumption.*

<b>Product</b>	<b>Wet consumption</b>
Interior paints	<b>Highest application amount</b> = amount corresponding to the lowest coverage (m <sup>2</sup> /L) given by the manufacturer Or at least 150 g/m <sup>2</sup>
Lacquers, varnishes, oils, wood stains, waxes	<b>Highest application amount</b> = amount corresponding to the lowest coverage (m <sup>2</sup> /L) given by the manufacturer Or at least 80 g/m <sup>2</sup>

#### **6.3.4.2 Liquid applied floor coatings and coating systems, liquid applied waterproofing materials**

##### **Testing substrates**

- Primary substrates: glass, stainless steel or polyester of sufficient rigidity.

##### **Application**

- Test specimen is prepared using material amounts given in *Table 6*
- In preparation manufacturer's technical instructions shall be followed concerning e.g. number of applications and drying times between applications
- The substrate shall be weighed before and after application of the product
- The applied amount as g/m<sup>2</sup> of material shall be reported in the test report.

*Table 6 Liquid applied floor coatings: wet consumption.*

<b>Application</b>	<b>Test specimen preparation wet consumption / wet layer thickness</b>
Products used as top coating only, final film thickness < 1 mm	Maximum consumption (kg/m <sup>2</sup> ) given in the technical instructions.
Mass coatings, layer thickness ≥ 1 mm	Maximum consumption of coating when applied without filler or sand. Note: Test specimen is prepared without filler or sand.
Coating systems	According to manufacturer's instructions containing all coating system components and using maximum wet consumption of each system component.

### 6.3.4.3 Waterproofing membranes and waterproofing systems

Waterproofing membrane is tested on glass substrate.

Waterproofing systems including primer, liquid applied waterproofing membrane and tile adhesive are tested on gypsum board with tiling as described in *Table 7*.

*Table 7 Waterproofing membranes and systems: test specimen preparation.*

<b>Waterproofing membrane</b>	Glass substrate Application according to manufacturer's instructions concerning wet consumption per application, drying times and number of applications
<b>Waterproofing system:</b>	
Testing substrate	Gypsum board
Primer	According to manufacturer's installation instructions
Waterproofing membrane	According to manufacturer's installation instructions
Drying times	Minimum drying times given in installation instructions are followed at all stages.
Tiling	Tile adhesive is applied using 6 mm x 6 mm notched spatula Tiles: glazed wall tiles with water absorption <15 %, size 10 cm x 10 cm Joint width: 3 mm
Tile grout	Not used
Sides and reverse side	Sides and reverse side of the test specimen are covered

### 6.3.5 Adhesives

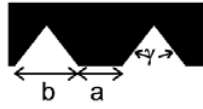
#### Testing substrates

- Primary substrates: glass, stainless steel or polyester of sufficient rigidity

#### Application

- Amount of adhesive on test specimen is determined by the consumption specified in manufacturer's instructions
- Adhesive is applied using a notched trowel specified in Table 8
- Adhesives delivered in powder form are mixed with water according to the manufacturer's instructions using the average of given water amount per kg of powder
- The applied wet amount as g/m<sup>2</sup> and used trowel size shall be reported.
- The test specimen preparation of adhesives requiring special application techniques and instrumentation shall be consulted RTS.

Table 8 Adhesives: test specimen preparation.

Adhesive	Consumption specified in manufacturer's instructions	TKB Notch size <sup>1)</sup>			
			b, mm	a, mm	$\gamma$ , °
Adhesives, e.g. floor and wall coverings, (not tile adhesives)	<500 g/m <sup>2</sup>	TKB B1	2.40	2.60	55
	>500 – 1100 g/m <sup>2</sup>	TKB B3	3.70	3.30	55
	>1100 g/m <sup>2</sup>	TKB B12	5.10	4.90	50
Assembly adhesives		TKB B5 <sup>2)</sup>	5.70	14.30	55
Tile adhesives		TKB C2	6.00	6.00	Rectangular

<sup>1)</sup> TKB, Technische Kommission Bauklebstoffe, [http://www.klebstoffe.com/07\\_publication/pdf/TKB\\_6-Spachtelzahnung.pdf](http://www.klebstoffe.com/07_publication/pdf/TKB_6-Spachtelzahnung.pdf)

<sup>2)</sup> resulting. 500 g/m<sup>2</sup>

### 6.3.6 Sealants

Sealants are tested in an inert profile with depth of 3 mm and width of 10 mm.

### 6.3.7 Sealing foams

Sealing foams are tested in an inert profile with depth of 40 mm and width at least 15 mm. The surface of the foam is cut to the profile level as soon as the foam has hardened.

### 6.3.8 Levelling compounds, screeds, plasters, tile grouts and cast concrete

- Powders are mixed according to the manufacturer's instructions using the average of given water amount per kg of powder
- Concrete is delivered as ready-mixed by the manufacturer.
- Support: glass or stainless steel
- Test specimen thickness is based on the maximum application thickness of the product specified in the manufacturer's technical instructions or according to *Table 9*.

Table 9 Test specimen wet layer thickness of levelling compounds, screeds, renders, plasters, tile grouts and concrete.

Product	Application thickness of the product specified in manufacturer's instructions	Test specimen wet layer thickness
Wall and ceiling plasters, renders and putties, levelling compounds, screeds	≤ 2 – 30 mm	3 mm
	maximum > 30 mm	50 mm
Tile grouts		3 mm
Concrete cast on site		Minimum 50 mm



### **6.3.9 Building bricks and blocks**

Bricks and building blocks are tested as whole pieces. Test specimen preparation depends on the product:

- insulated and non-insulated building blocks: test specimen shall contain at least one horizontal and one vertical seam between blocks. No jointing materials are used. The outer border of the test specimen is sealed
- homogeneous solid products may be tested as whole, uncovered pieces.

### **6.3.10 Building components, elements, factory made combined products**

Building components, elements and factory made combined products (e.g. partition walls) shall be tested as whole products. In case the regular product is too large for inserting into the test chamber a smaller sample with identical proportions is prepared for testing. From a homogeneous product a representative sample may be prepared by cutting and sealing all cut surfaces.

#### **Doors**

- Internal door is tested as whole unit, all sides uncovered
- External door is tested by sealing all other parts but those facing indoors after installation in building
- If the doorframe is an integral part of the delivery system the whole system shall be tested. In that case the parts of the doorframe not directly in contact with indoor air are sealed.

#### **Windows**

- Window is tested by sealing all other parts but those facing indoors after installation in building
- The test specimen area used in calculating the specific emission rate is the total area facing the chamber air, i.e. including the glass.

### **6.3.11 Fixture**

#### **Doors**

- Fixture door is tested as whole unit, all sides uncovered, the joint hinges fastened
- The doors are grouped by the surface treatment material (door area 0,54m<sup>2</sup>)
- Emission results are calculated for the surface area open in the test chamber and then calculated for the reference room (5,4 m<sup>2</sup>)

#### **Cabinets**

- Fixture cabinet is tested as whole unit with shelves, all sides uncovered
- The cabinets are grouped by the carcass material, e.g. moisture resistant and regular materials are grouped in different groups
- Products based on the same material are grouped in the same group despite of the thickness
- 60cm x 30cm x 90cm cabin is tested (or cabin with equivalent door area 0,54m<sup>2</sup>)
- Emission results are calculated for the surface area open in the test chamber and then calculated for the reference room (5,4 m<sup>2</sup>)

### **Countertop**

- The countertops are grouped by the surface treatment material
- A 60x 60 cm sample is prepared for testing. From a homogeneous product a representative sample may be prepared by cutting and sealing all cut surfaces. Both sides uncovered.
- Emission results are calculated for the whole product (300 cm x 60 cm)

## **6.3.12 Furniture without textile coverings or padding**

### **Cabinets/Open shelves**

- Furniture cabinet is tested as whole unit with shelves, all sides uncovered
- The cabinets are grouped by the carcass material, e.g. moisture resistant and regular materials are grouped in different groups
- Products based on the same material are grouped in the same group despite of the thickness
- The best seller cabin or 80cm x 40cm x 120cm open shelve is tested
- Emission results are calculated for the surface area of the door face (0,96m<sup>2</sup>)

### **Table/ Conference table/ Working desk**

- *Alternative 1*
- The tables are grouped by the surface treatment material
- The whole table (80 x 140 cm) or e.g. a school desk shall be tested.
- Emission results are calculated for the whole product
- *Alternative 2*
- The countertops are grouped by the surface treatment material
- A 60\*60 cm sample is prepared for testing. A representative sample shall be prepared by cutting and sealing all cut surfaces. Both sides uncovered.
- The real usage situation in all cases is prepared by drilling 4 times Ø3mm, 75% deep hole in the surface or by installing table leg fastener to the surface. There should be two drilling holes/m<sup>2</sup>/ whole product.
- Emission results are calculated for the whole product

### **Chair**

- Office chairs are grouped by the surface treatment material
- The chair is tested as a one whole unit, all sides uncovered, parts will not be removed
- Emission results are calculated for the whole product

### **Drawers and chest of drawers**

- Office drawers and chest of drawers are grouped by the surface treatment material
- The product is tested as a one whole unit (40 x 60 x 50cm) or best seller, all sides uncovered, boxes in an original position, closed
- Emission results are calculated for the whole product

## **6.3.13 Upholstered chairs**

### **Chairs with textile coverings and paddings**

- Chairs are grouped by the surface treatment material
- The chair is tested as a one whole unit, all sides uncovered, parts will not be removed
- Chair parts shall be directly from the production, production date shall be mentioned

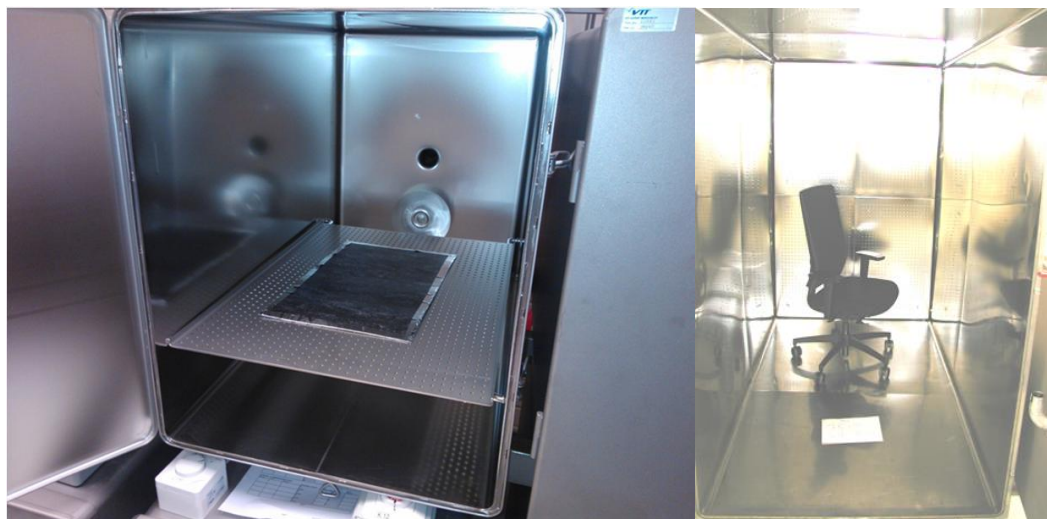
- Emission results are calculated for the whole product, one product in the model room

## 6.4 Test chamber conditions

Test chamber conditions given in *Table 10* shall be used in testing. Loading factors, see *Table 1*. Examples of the tests specimen placed in the emission test chambers can be observed in the *Picture 7*, unobstructed air flow shall be confirmed. The preferable test chamber size is 1 m<sup>3</sup>, if a smaller chamber is used it should be ascertained that the test subject does not fill more than 30 % of total chamber volume.

*Table 10 Test chamber conditions.*

Parameter	Value
Temperature	23°C ± 1°C
Relative humidity	50% ± 5%
Air velocity at the specimen surface	0.1 – 0.3 m/s
Air change rate	0.5 h <sup>-1</sup> ± 3%
Air flow rate, sensory testing with CLIMPAQ –type chamber	(0.6 – 0.9) l/s ± 10%



*Picture 7 Emission measurement samples in chambers*

## 6.5 Chemical measurements

Chemical measurements for M1 classification include the determination of TVOC emission value, single VOC compounds, detection of EU carc. 1A and carc. 1B compounds, formaldehyde emission and ammonia emission.

### 6.5.1 Determination of volatile organic compounds in test chamber air

VOCs present in the chamber air are sampled on Tenax TA adsorbent and subsequently analysed using gas chromatograph equipped with at least mass selective detector. Sampling and analysis shall be performed applying standard EN ISO 16000-6:2011 with deviations and additional requirements specified in CEN/TS 16516:2013.

TVOC is determined as in CEN/TS 16516:2013, i.e. summing the individual concentrations of identified and unidentified compounds eluting from a gas chromatographic column between and including acetic acid, 2,2,4 Tri Methyl 1,3 Pentanediol di-isobutyrate, n-hexane and n-hexadecane inclusively, at a concentration above 5 µg/m<sup>3</sup>, all calculated as toluene equivalent. Detected very volatile organic compounds and semi-volatile organic compounds shall be reported at least as toluene equivalents. LCI-compounds shall be quantified by compound specific response factor.

[https://ec.europa.eu/growth/sectors/construction/eu-lci/values\\_en](https://ec.europa.eu/growth/sectors/construction/eu-lci/values_en).

### **6.5.2 CMR-substances**

Carcinogenic, mutagenic and reprotoxic (CMR) substances, detectable by the used VOC sampling and analysis method and classified as carc. 1A or 1B in Annex VI to Regulation (EC) No 1272/2008 shall be considered. CMR compounds shall be analysed using compound specific response factor. Quantitative reporting limit for carcinogenic compounds is 1 µg/m<sup>3</sup> (model room concentration), as far as feasible.

### **6.5.3 Formaldehyde**

Formaldehyde sampling and analysis is performed using DNPH-method according to EN ISO 16000-3:2011 or applying sampling and analysis method based on acetylacetone –method as described e.g. in EN 717-1.

### **6.5.4 Ammonia**

For sampling and analysis of ammonia a validated in-house method is used. The method shall be sensitive enough to be used for M1 emission measurements. As an example, ammonia may be sampled in dilute Sulphur acid using technique or acid treated sorbent tube or filter, and analyzed using ammonia specific electrode or spectrophotometric method.

### **6.5.5 Reporting of test results**

The chemical emission test results are reported as area specific emission rate, SER, and model room concentration. Calculation formulas and presented e.g. in CEN/TS 16516:2013.

## **6.6 Sensory evaluation**

Sensory evaluation is performed using the acceptability scale and untrained panel according to standard ISO 16000-28:2012. The area specific air flow rates given in the informative Annex H of ISO 16000-28:2012 shall be replaced with Table 1 of this protocol.

For the time being sensory evaluation performed using CLIMPAQ –type chamber according to NT Build 482 is also accepted.

### **6.6.1 Chamber techniques in sensory assessment**

Chemical emission test chambers as described in ISO 16000-28:2012 and loading factors/area specific air flow rates given in Table 1 may be used for direct sensory evaluation with diffuser if the outlet airflow rate is in the range of 0.6 – 0.9 l/s. If the chamber outlet airflow is smaller, sensory evaluation may be performed at the chamber outlet using a sniffing mask or representing the chamber air to panelists via sampling container as described in ISO 16000-28. Sniffing mask method, if used, shall be validated

against the diffuser method. Increasing the loading factor and air change rate to increase the outlet air flow rate shall be maintained in the limits specified in CEN/TS 16516:2013 chapter 7.

If the sensory evaluation is performed using CLIMPAQ –type chamber airflow rate of 0.6 – 0.9 l/s through the diffuser and the corresponding test specimen area shall be calculated. Examples of test specimen areas at the endpoints of the range are given in Table 1.

The requirements of ISO 16000-28 for the acceptability of the test room air and empty test chamber air apply.

### **6.6.2 Panel size and instructions for the panel**

The panel size of 15 (+15) as described in ISO 16000-28:2012 for acceptability assessment shall be used.

The instructions for panelists given in ISO 16000-28:2012 apply.

### **6.6.3 Odour assessment procedure and calculation of odour acceptability**

The odour assessment and odour acceptability calculation procedures described in ISO 16000-28:2012 chapter 10.2 shall be used. In addition to the arithmetic mean of the assessments the standard deviation and the 90 % confidence interval of the mean value shall be calculated and reported.

## **7 Quality assurance**

Emission measurements for M1 classification may only be performed by an approved testing laboratory.

An approved testing laboratory shall fulfill the following criteria:

- the laboratory shall have an accredited quality assurance system according to EN 17025
- the accreditation shall cover the chemical testing of material emissions including chamber technique and analysis according to ISO 16000 –series standards
- the laboratory shall participate and prove acceptable performance in international material emission round robin tests covering chamber technique and analysis

## **8 Test report**

The test report shall include the following information:

- a) testing laboratory
  - name and address of the laboratory
  - name of the responsible person
- b) sample description and identification, sampling report
  - product type
  - product name
  - batch number or other product marking
  - sample description: details specifying the tested sample, e.g. sample thickness or other relevant remarks on the sample
  - production date
  - sending date
  - date the sample was received at the testing laboratory
  - note on the sample packaging
  - material sample sampling report as appendix

c) test specimen preparation

- description and characterization of the tested material
- date of test specimen preparation
- detailed description of the test specimen and test specimen preparation, e.g., sealing of edges and backside, used substrate, application method, applied amount per unit area and/or applied thickness, all other test specimen related details and remarks which may influence the test results
- conditions during ageing

d) experimental conditions in chemical measurements and sensory evaluation

- chamber volume, m<sup>3</sup>
- air change rate, h<sup>-1</sup>
- temperature, °C
- relative humidity, RH %
- test specimen area, m<sup>2</sup>, or loading factor, m<sup>2</sup>/m<sup>3</sup>

e) emission sampling and analytical methods

- description of sampling and analysis methods
- detection limits of the methods
- chamber air sampling volumes
- sensory evaluation panel size

f) test results of chemical emissions given as SER, specific emission rate, mg/(m<sup>2</sup> h), and model room concentrations, used surface area( m<sup>2</sup>) in calculations and results compared to M-criteria

- TVOC emission
- EU-LCI VOC-compound emission [https://ec.europa.eu/growth/sectors/construction/eu-lci/values\\_en](https://ec.europa.eu/growth/sectors/construction/eu-lci/values_en)
- Emission of EU carc. 1A and 1B carcinogens (CMR)
- Formaldehyde emission
- Ammonia emission
- Sensory acceptability of emissions

g) test result of sensory evaluation

- individual results of each panelist
- arithmetic mean of acceptability
- standard deviation
- 90 % confidence interval of arithmetic mean

h) measurement uncertainty of chemical test methods

i) VOC chromatogram

j) a photo of the test specimen

# Appendix 1: Evaluation form for sensory assessment of building materials for M1 classification

## SENSORY ASSESSMENT OF BUILDING MATERIALS FOR M1 CLASSIFICATION

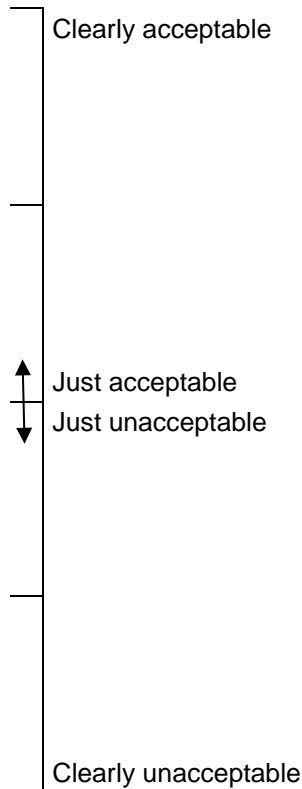
Sample: \_\_\_\_\_

Date: \_\_\_\_\_

Panellist: \_\_\_\_\_

Imagine that you would daily for several hours be exposed to the air from the test chamber.

How acceptable is the air quality?



Comments:

## Appendix 2: Example of a sampling report

<b>Sampler</b> (Name, company, contact info)	<b>Manufacturer of the product</b>
<b>Name of the product</b>	<b>Type of the product</b>
<b>Manufacturing date</b>	<b>Batch no</b>
<b>Date of assembly (office chairs and furniture)</b>	
<b>Date of sampling</b>	<b>Amount of material sampled</b>
<b>Date of assembly</b> (upholstered office chairs)	
<b>Sample is taken from</b> production line <input type="checkbox"/> stock / storage <input type="checkbox"/> miscellaneous <input type="checkbox"/> -where, specify:	<b>How was the product stored before sampling?</b>
<b>If a sub-sample was collected from a larger material amount, describe how the sub-sample was taken</b>	
<b>Observations and remarks</b>	
<b>Confirmation</b> I hereby confirm that the sample was selected, taken and packed in accordance with M1 testing protocol.	
<b>Date</b>	<b>Signature</b>



## 9 Additional information

Rakennustietosäätiö RTS sr

The Building Information Foundation RTS sr

Malminkatu 16 A

00100 Helsinki

email: [firstname.lastname@rakennustieto.fi](mailto:firstname.lastname@rakennustieto.fi)

Homepage: <http://m1.rts.fi>