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## Guidelines for SINTEF Technical Approval for

# Radon Membranes

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### 1. General information about SINTEF Technical Approval

General information about SINTEF Technical Approval procedures is available at <http://www.sintefcertification.no/en-us/PortalPage.aspx?pageid=180>

### 2. Properties to be included in the approval and how the properties are determined

#### User groups

Membranes for protection against radon can be used in several types of structures. Figure 1 shows the alternative placements of radon membranes in the so-called user groups.

#### User group A

The membrane has to be installed in the construction hole on an even underlay with flatness and stability at least as compressed sandy soil. The membrane shall be installed with an air-tight connection towards the sole foundation or the base plate. Installation in user group A requires that the sole foundation is designed as an air-tight construction, and also that any pipe penetrations through the sole foundation is airtight.

The filling compound must have documented low radon content, see SINTEF Byggforsk Design Sheet No. 520.706.

For use group A1 the filling under and above the membrane shall not have scales larger than 16-32 mm. For use group A2 the filling under and above the membrane shall not have scales larger than 8-16 mm.

#### User group B

The membrane has to be installed on a pre-leveled surface of insulation. The membrane then has to be protected with insulation also at the top side, and the insulation finally has to be protected with a plastic film, another type of protection film or an antifriction layer at the top. At least two thirds of the insulation thickness should be installed at the underside of the membrane. The membrane has to be installed continuous over the top of the sole foundation to ensure air tight connections between the sole foundation and the floor.

#### User group C

The membrane has to be installed on leveled concrete slab or similar with clamped glued (sealed) connections towards all construction parts and penetrations. The need to protect the membrane must be considered in each case.

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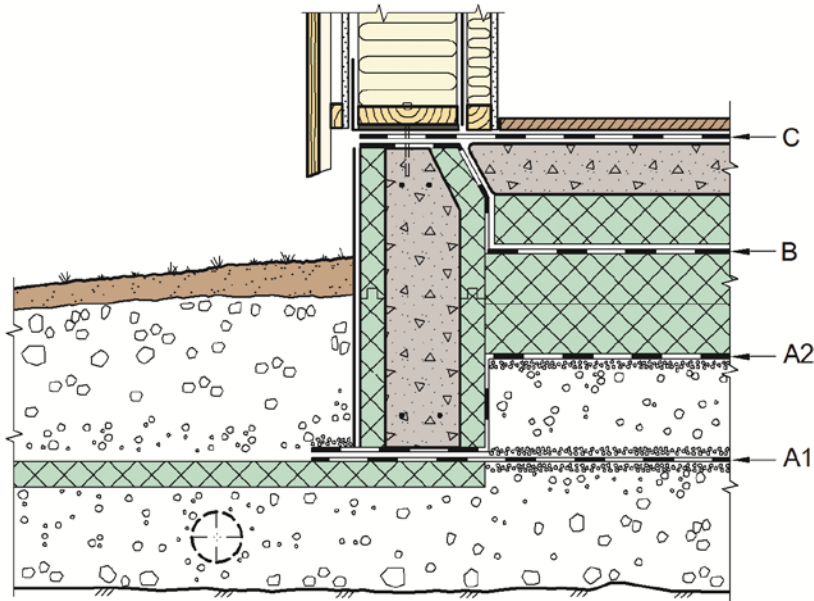


Fig. 1  
Example of positioning radon barrier in user group A, B and C.

There are different requirements to the radon membrane depending on how it is used.

- In Group A1 the membrane is placed on a compressed, but rough underlay, the filling under and above the membrane shall not have scales larger than 16-32 mm. The membrane will be subject to strain and deformations in the building period. Therefore the requirements must be high, especially for elongation, tensile strength and puncturing. In Group A2 the membrane is placed on compressed filling with maximum scale 16-32 mm. The membrane will be subject to less strain and deformations in the building period than in A1, but some more strain and deformations in the building period than in B and C. Therefore the requirements for elongation, tensile strength, puncturing and strength of joint is some higher in A1 than in B and C. Teiped joints in A1 and A2 must be performed as to two step, for example a two sided tape in the joint and a one sided tape as a overlap tape. One step jointing can be approved after a sepcial assessment that includes assessment of the technich of mounting the system and the air tightness over time.
- In Group B the membrane must be placed on an even underlay of insulation, in a way so that it is not locked in place and not subject to tearing caused by small movements.
- In Group C the membrane must be placed on a stable and even underlay, for example concrete, and it must not be locked in place. It might be natural to lay the membrane after the raw building is completed, since it gives better control with the underlay and the climate. Radon membranes in this group will normally be covered. If they are not, the case has to be considered specially.

The requirements in group A are stricter than for Group B and C. This means that radon membranes approved for user group A will normally be approved for also user group B and C, and membranes approved for user group B will normally be approved for user group C. Membranes approved for user group A1 will be approved for user group A2. Note that documentation of emission in user group C, and leaching in user group A, is required.

## Water in the construction hole

For solutions where the insulation is placed above the radon membrane there will be danger for accumulation of water during the construction period. It's therefore important to take actions to prevent such incidents for membranes approved in user group A and B. Any drainage solutions have to be closed when the construction period is over to ensure air- and radon tightness.

## Testing and requirements for the fresh product

The approval guidelines for the membranes in all three user groups are given in Table 2. The performance requirement to air tightness is applicable to all groups.

The product is the complete, installed radon barrier, which means that the joints and all details around holes, pipes and corners must satisfy the requirements. Loose overlap joints, for example, can not be accepted. The details around holes, pipes and corners must be described in the suppliers installation directions, and the approval must be based on an evaluation of the complete system.

## Testing of durability

Radon membranes will usually be in contact with moistened concrete, for example under the sole foundation in user group A, or concrete floors in wet rooms user group C. The durability has therefore to be tested in alkaline environment according to NT POLY 161. It is assumed that the product is packaged and stored in such a way that it will not be degraded from UV-radiation before use. Current testing after aging is visual control, Water vapour resistance and tensile properties. For the joint usually Resistance to shear of joints is tested.

Table 1. Ageing methods for radon membranes – Group A, B and C

User group	Property	Method	Comment
A, B and C	Resistance to ageing in alkaline environment	NT POLY 161	24 weeks
Joint and joint material	Climate carousel and heat ageing	NT Build 495 and EN 1296	2 weeks + 24 weeks
Bitumen products in user group A and B	Resistance to heat ageing	NS-EN 1296	12 weeks

The changes in the material properties after ageing for 24 weeks are subject to the following requirements:

- a) The properties must not change more than 35 % in relation to the tested fresh product.
- b) If the change is between 35 % and 50 % of the properties for the fresh material, the properties must be within 25 % of the *requirements* for the fresh product.
- c) If the change is larger than 50 % the properties must be better than or as good as the requirements for the fresh product.
- d) Changes larger than 60 % will not be accepted.

The changes in the material properties after heat ageing for 12 weeks are subject to the following requirements:

- e) The properties must not change more than 20 % in relation to the tested fresh product.
- f) If the change is between 20 % and 30 % of the properties for the fresh material, the properties must be within 15 % of the *requirements* for the fresh product.
- g) If the change is larger than 30 % the properties must be better than or as good as the requirements for the fresh product.
- h) Changes larger than 35 % will not be accepted.

**Fire technical properties**

There are no fire technical requirements for radon membranes.

**Performance test / test of air tightness**

The radon gas transportation due to air flow has to be known. The air tightness of the radon membrane (including joints) has therefore always to be tested. Test method and requirements are given in Table 2.

**Material properties**

The material properties for newly produced product (fresh material) are tested according to the given methods, and must satisfy the requirements given in Table 2 for the relevant field of application.

**Durability**

Durability assessment shall always be performed. It will normally be carried out as accelerated laboratory ageing, as given in Table 1, where a limited number of properties are tested after ageing, as given in Table 2.

**FTIR material characterization**

FTIR material characterization shall be tested for fresh material as a part of the type testing. The FTIR material characterization is carried out applying an attenuated total reflectance (ATR) accessory (single reflection) with a diamond crystal, in the wavelength range  $4000\text{ cm}^{-1}$  ( $2.5\text{ }\mu\text{m}$ ) to  $400\text{ cm}^{-1}$  ( $25\text{ }\mu\text{m}$ ), in an atmosphere with minimized  $\text{CO}_2$  and  $\text{H}_2\text{O}$  content through purging.

**Environmental characteristics**

Requirements concerning material and product properties related to impact on the environment is available at;

<http://www.sintefcertification.no/en-us/PortalPage.aspx?pageid=180>

For radon membranes in user group A, a leaching test is required, while an emission test is required for membranes in user group C.

**3. Description of the manufacturer's factory production control**

As a basis for the approval SINTEF must receive a copy of the description of the manufacturer's control plan for the product. This may be the relevant part of the manufacturer's quality control system for the product, or other documentation describing the manufacturer's factory production control. The person responsible for the factory production control shall be identified.

The control plan shall as a minimum describe the controls performed for:

- Incoming materials
- The production process
- Finished product
- Marking and storage

including the control frequency, how the controls are performed and by whom.

The factory production control description shall also include what measures are taken when faults are observed in the production or in the product.

#### 4. Supervisory production control

The production shall be subject to a supervisory product and production control performed by an independent body. General description of how the supervisory product and production control are performed is available at;

<http://www.sintefcertification.no/en-us/PortalPage.aspx?pageid=180>

Supervisory product and production control is annual production control and annual control testing of some properties.

*Table 2. Example of annual control testing*

Property	Method	Frequensy
Ageing in alkaline environment <sup>1) 2)</sup>	NT Poly 161	Each 5 <sup>th</sup> year
Heat ageing of joints <sup>1)</sup>	EN 1296	Each 5 <sup>th</sup> year
Radontransmisjon	SP-method	Each 5 <sup>th</sup> year
Thickness	EN 1849-1	Each year
Density / Area weight	EN 1849-1	Each year
Flexibility at low temperature	EN 495-5	Each year
Dimensional stability	EN 1107-2	<sup>3)</sup>
Resistance to tearing	EN 12310-2	<sup>3)</sup>
Tensile strength/Elongation	EN 12311-2	Each year
Resistance to shear of joints	EN 12317-2	Each 5 <sup>th</sup> year with heat ageing if joints
Puncturing - Static load - Impact - Impact	EN 12730 EN 12691:2006 EN 12691:2001	<sup>3)</sup> <sup>3)</sup> <sup>3)</sup>
Vanndampmotstand, S <sub>d</sub> -verdi	EN ISO 12572	Each 5 <sup>th</sup> year with ageing in alkaline environment

<sup>1)</sup> Ageing in alkaline environment and heat ageing of is not performed the same year

<sup>2)</sup> The year when ageing in alkaline environment is performed only tensile strengt/elongation is performed on fresh material (ion addition to tensile strengt/elongation + water vapour resistance on aged material)

<sup>3)</sup> In addition to thickness, area weight, flexibility at low temperature and tensile strength/elongation wich is tested every year, a selection of 0-2 of the other proeptries marked with <sup>3)</sup> is tested each

If the manufacturer has a quality system certified according to ISO 9001, the audit control in connection to the certificate, can be sufficient to cover the requirements to supervisory factory production control.

Prerequisites for such an arrangement is that the above mentioned audits are carried out sufficient detailed in relation to the production of the product which shall be approved. Likewise, supervisory control related to existing agreements with a body of national approvals or product certifications in other countries are used in many cases.

SINTEF Building and Infrastructure must have a copy of contracts for independent production and product control where they will meet the need also for SINTEF Technical Approval. If the manufacturer does not have a satisfactory agreement for the existing independent production and product control must be established an agreement with SINTEF, or another independent control body SINTEF accepts. Normally requires an initial inspection of SINTEF Building and Infrastructure on the production site before an approval is completed.

## **5. Application for SINTEF Technical Approval and project management**

Information regarding application and project management for SINTEF Technical Approval is available at;

<http://www.sintefcertification.no/en-us/PortalPage.aspx?pageid=180>

## **6. More information**

Further information about SINTEF Technical Approval can be found on [www.sintefcertification.no](http://www.sintefcertification.no).

Table 3. Properties, methods and requirements for radon membranes – Field of application User group A, B and C.

	Method	A		B	C	Unit	Comment
		A1	A2				
<b>Product identification:</b>							
Density / Area weight	EN 1849-1 or -2						Typical values with tolerance is usually given here.  (Given by the supplier/tested by SINTEF)
Thickness	EN 1849-1 or -2						
Length	EN 1848-1 or -2						
Width	EN 1848-1 or -2						
Visible defects	EN 1850-1 or -2					–	
<b>Product properties:</b>							
Radon transmittance <sup>1)</sup>	SP-method 3873	< 2·10 <sup>-8</sup>	< 2·10 <sup>-8</sup>	< 2·10 <sup>-8</sup>	< 2·10 <sup>-8</sup>	m/s	If the radon content in the ground is high, further actions, in addition to radon membrane, may be necessary
Radon resistance		≥ 5·10 <sup>7</sup>	≥ 5·10 <sup>7</sup>	≥ 5·10 <sup>7</sup>	≥ 5·10 <sup>7</sup>	s/m	
Water vapour resistance <sup>2)</sup>	EN ISO 12572	≥ 50·10 <sup>9</sup>	≥ 50·10 <sup>9</sup>	≥ 50·10 <sup>9</sup>	≥ 50·10 <sup>9</sup>	m <sup>2</sup> ·s·Pa/kg	Tested before and after ageing in alkaline environment
Equivalent air layer thickness		≥ 10	≥ 10	≥ 10	≥ 10	m	
Dimensional stability	EN 1107-1or -2	≤ 1,0	≤ 1,0	≤ 1,0	≤ 1,0	%	
Flexibility at low temperature	EN 1109 / EN 495-5	-10 / -30	-10 / -30	-10 / -30	---	°C	In use group C the membrane is indoors
Resistance to tearing	EN 12310-1 or 2	100	80	60	40	N	
Tensile strength	EN 12311-1 or -2	≥ 400	≥ 200	≥ 50	≥ 50	N/50 mm	Tested before and after ageing in alkaline environment <sup>3)</sup>
Elongation	EN 12311-1 or -2	≥ 30	≥ 15	≥ 15	≥ 15	%	Tested before and after ageing in alkaline environment <sup>3)</sup>
Resistance to shear of joints	EN 12317-1 or -2	≥ 400	≥ 200	≥ 50	≥ 50	N/50 mm	Tested before and after climate and heat ageing <sup>4)</sup>
Resistance to impact	EN 12691:2006 (A) EN 12691:2001	≥ 700 ≤ 15	≥ 700 ≤ 15	≥ 600 ≤ 30	≥ 600 ≤ 30	Mm height mm diam.	Primary requirement Secondary requirement if primary requirement is not sufficient
Resistance to static loading	EN 12730 (A or B)	≥ 15	≥ 15	≥ 5	≥ 5	kg	
FTIR material characterization							FTIR material characterization have to be determined on fresh material in connection to type testing
<b>Performance test:</b>							
Air tightness - construction	NBI-method 167/01	< 5	< 5	< 5	< 5	l/min	Differential pressure: 30 Pa
<b>Environmental characteristics</b>							
Emission test	ISO 16000-series				Necessary		Necessary in user group C
Leaching test	CEN/TC 351 - Tanktest	Necessary	Necessary				Necessary in user group A

<sup>1)</sup> Welded radon membranes will empirically have better airtightness than adhesive applications. A radon transmission value of 2.5·10<sup>-8</sup> m / s (corresponding to a radon resistance of 4·10<sup>7</sup> s / m) can therefore be approved for these products.

<sup>2)</sup> This material property is not necessary to determine for bitumen products because the water vapour resistance is so high that the method is not accurate enough.

<sup>3)</sup> Bituminous membrane shall only be aged in heat at 70 °C (based on experience, bituminous membranes has good alkalieresistent properties, but can't handle temperature of 90 °C)

<sup>4)</sup> For welded products this can be skipped (welded joints are based on experience as strong as the product)